Transport
for NSW

HW29 Spring Creek Bridge Replacement

Review of Environmental Factors

12 May 2023

NSW GOVERNMENT

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Acknowledgement of Country

Transport for NSW acknowledges the Kamilaroi people, the traditional custodians of the land on which the Spring Creek Bridge Replacement is proposed.

We pay our respects to their Elders past and present and celebrate the diversity of Aboriginal people and their ongoing cultures and connections to the lands and waters of NSW.

Many of the transport routes we use today – from rail lines, to roads, to water crossings – follow the traditional Songlines, trade routes and ceremonial paths in Country that our nation's First Peoples followed for tens of thousands of years.

Transport for NSW is committed to honouring Aboriginal peoples' cultural and spiritual connections to the land, waters and seas and their rich contribution to society.

Approval and authorisation

Title	Senior Project Manager
Accepted on behalf of Transport for NSW by:	Peter Hamilton
Signed	
Date:	30 May 2023

Document review tracking

Draft No.	Date	Name	Comments
1	6 October 2022	Catherine Brady	Draft Ch 1-5 only
2	25 November 2022	Catherine Brady	Full Draft
3	21 December 2022	Catherine Brady	Final

Executive summary

The proposal

Transport for NSW (Transport) proposes to replace the existing bridge sized culvert at Spring Creek (B3858) (the proposal) on the Kamilaroi Highway (HW29) located 9.5 kilometres west of Narrabri, NSW (the proposal area). Spring Creek Bridge provides two lanes of travel along the Kamilaroi Highway between Narrabri and Wee Waa.

Continued deterioration of the existing culvert poses a safety hazard for road users and requires ongoing monitoring and maintenance to ensure that the structure is fit for use. The existing structure does not meet the current and future road network requirements. Transport proposes to remove the existing bridge sized culvert and replace with a new bridge on the existing alignment.

Key features of the proposal include:

- Installation of creek bed and perimeter sediment controls
- Switching of traffic from the Kamilaroi Highway (HW29) on to the previously approved and constructed side-track (assessed separately under a MWREF)
- Removal of culvert scuppers and any other contaminated material prior to demolition
- Installation of temporary gravel access tracks to the waterway area downstream of the existing structure to allow construction vehicles to enter and leave the waterway area in one direction
- Construction of rock platforms within the waterway upstream and downstream of the existing structure, including installation of temporary steel pipes within the platforms/waterway upstream and downstream of the culvert to maintain channel flow
- Adjustment of rock working platforms and temporary steel pipes, as required to suit demolition and bridge construction staging to maintain channel flow
- Clearing of vegetation and tree removal adjacent to the existing culvert abutments
- Demolition of the existing bridge sized culvert, including excavation of the base slab and culvert abutment areas to widen the waterway opening and accommodate the new bridge
- Adjustment of the rock working platforms within the bridge footprint and waterway to suit piling and crane access for bridge construction
- Construction of a new reinforced concrete bridge with driven steel tubular piles, reinforced concrete columns and headstocks with precast prestressed planks on the existing alignment, including preliminary earthworks on the road approaches as required
- Removal of all temporary working platforms and rock platforms from the waterway
- Installation of rock scour protection for the new bridge
- Reinstatement and revegetation of disturbed areas
- Road works to tie into the new bridge
- Removal of the side track on completion.

Construction is expected to commence in early 2024 and would take up to 18 months to complete.

Need for the proposal

Continued deterioration of the existing culvert structure poses a safety hazard for road users and requires ongoing monitoring and maintenance to ensure that the bridge is fit for use. The existing structure does not meet the current and future road network requirements. Transport proposes to remove the existing bridge sized culvert and replace with a new bridge on the existing alignment.

Proposal objectives

The objectives of the proposal include:

- Provide a new, wider bridge that is compliant with current Australian design and safety standards
- Provide a new bridge capable of accommodating HML loading
- Provide a new bridge which suits hydrology requirements of the area and has no adverse hydraulic impacts on the locality
- Provide a road alignment that complies with a design traffic speed that meets or exceeds existing conditions
- Minimise environmental disturbance during construction of the new bridge and removal of the existing bridge through the requirement for minimal road approach works and riparian vegetation removal
- Improve bridge and road user safety
- Minimise future maintenance costs.

Options considered

The options considered for the proposal include:

- Option 1: Do Nothing. This option would not result in any construction related environmental impacts, however this option would not meet the objectives of the proposal.
- Option 2: Strengthen the existing culvert structure over Spring Creek. This option would involve works to strengthen and repair the existing structure to achieve the remainder of its design life. This option was not considered feasible as the existing structure has reached the end of its service life and it is not considered viable to rehabilitate from both a technical and financial perspective.
- Option 3: Full replacement of the existing structure with a new bridge on the existing alignment. This option would involve switching all traffic on to the pre-approved side-track to maintain traffic flow during construction and provides a long-term solution to safety risks posed by the existing bridge. This option is cost effective and reliable with the majority of works confined within the existing disturbed road corridor.
- Option 4: Full replacement of the existing structure with a new bridge upstream or downstream of the existing structure. This option would involve the construction of a new bridge off-line while traffic flow is maintained on the existing alignment. The existing structure would be demolished once the new bridge is constructed and commissioned. This option would require significant earthworks to construct the road approaches to the new bridge which would result in additional costs for the proposal. This option was not considered feasible due to rapid deterioration of the existing structure and proposal area constraints including length of timeframes associated with potential property acquisition requirements.

Option 3 was selected as the preferred option as it best met all of the proposal objectives, involves lower environmental impacts and could be built at a reduced cost.

Statutory and planning framework

Clause 2.108 of the *State Environmental Planning Policy (Transport and Infrastructure) 2021* permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

The proposal is for a bridge replacement and is to be carried out by Transport and can therefore be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979 (NSW)*. Development consent from council is not required.

Community and stakeholder consultation

Transport engaged with community and stakeholders to inform and identify potential issues associated with the proposal. Consultation letters inviting feedback and comments on the proposal were sent to Narrabri Shire Council, NSW Department of Primary Industries (Fisheries), NSW State Emergency Services, National Resource Access Regular (NRAR), NSW Department of Planning and Environment (DPE) - Water and Water NSW.

Consultation with the community and key stakeholders would continue during construction of the proposal, including notification of temporary changes to traffic conditions and detours during the construction period.

Environmental impacts

The main environmental impacts of the proposal are summarised below:

Biodiversity

The proposal would require the removal of 4.3 hectares of native and exotic grassed vegetation. Plant community type (PCT) 39 and PCT 78 were mapped as being potentially present within the proposal area, however neither of these PCTs were identified within the proposal area during the site inspection.

The proposal would remove two *Eucalyptus camaldulensis* which may reduce the nesting and roosting habitat for this species. Given the presence of larger stands upstream and the minimal vegetation removal required, the impact of this is not expected to be significant.

Spring Creek is identified as Key Fish Habitat and is classed 'Type 2 - Moderately Sensitive Key Fish Habitat' as well as 'Class 2 - Moderate Key Fish Habitat'. Construction of the proposal would require instream works for demolition and construction works. With the implementation of suggested safeguards, fish passage would be maintained, and impacts to other aquatic life would be minimised.

Surface water, Ground water and soils

During construction, works would be required within and immediately adjacent to the waterway. These works would involve disturbance to the riverbed and riparian area, potentially generating sediment discharge into the waterway. Construction and demolition activities also pose a risk whereby pollutants could potentially enter the waterway and impact on water quality. Implementation of an Erosion and Sediment Control Plan, along with implementation of appropriate safeguards would limit potential water quality impacts.

Traffic

Spring Creek Bridge would remain closed for the duration of construction, and all traffic would be diverted onto a side-track which is to be constructed on the upstream side of the existing structure (approved in July 2022 under a separate environmental approval). Due to the large upstream catchment area and to minimise adverse afflux on surrounding properties, the side-track has been designed to have a low flood immunity (< 1 in 2 Average Recurrent Interval) and would therefore overtop in significant flood events. The side-track would be built prior to the commencement of bridge demolition and construction. Traffic impacts would arise from the changed traffic conditions along the Kamilaroi Highway during the construction period, including reduced speed zones. In addition, impacts may arise should the side-track be inundated during flood events and a detour put in place requiring additional travel time for motorists and heavy vehicles. These impacts would be considered and managed with the implementation of a Traffic Management Plan (TMP).

Landscape and visual impacts

The proposal would involve minor visual impacts as road users would observe construction plant in operation, along with construction ancillary facilities set up throughout demolition and construction works. The visual impact would be minor and temporary, occurring only through the construction phase of the proposal and within a limited viewshed, impacting mainly local road users. The final reinstatement of the site would include a planting strategy which would use native species to reinstate vegetation over the proposal batters.

Cumulative impacts

The proposal would likely be undertaken throughout a time during which other proposals are being constructed in Narrabri or Wee Waa. Cumulative impacts may arise from increased construction traffic and increased travel times on roads nearby these proposals. Safeguards proposed within this Review of Environment Factors (REF) would likely limit the potential cumulative impact of the proposal.

Justification and conclusion

The proposal is subject to assessment under Division 5.1 of the EP&A Act. This REF has examined and considered all matters affecting or likely to affect the environment by reason of the proposed activity.

The proposal is considered to be consistent with strategic planning at Commonwealth, State and regional levels as it would lead to improved efficiency and safety of the road network. While there would be some environmental impacts as a consequence of the proposal, these impacts have been avoided, minimised or offset wherever possible through design and site-specific safeguards.

This REF has concluded that the adverse impacts and risks of the proposal would be outweighed by the longer-term benefits of providing improved structural standards and safeguarded heavy vehicle access for an important local and regional creek crossing, as well as improved safety for all road users. On balance, the proposal is considered to be justified.

This REF has also concluded the proposal is not likely to significantly affect the environment and therefore an environmental impact statement and assessment under Division 5.2 of the EP&A Act is not required. Furthermore, there would be no significant impacts to matters of national environmental significance or to the environment of Commonwealth land, and as such, the proposal was not referred to the Australian Government Minster for the Environment.

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Figures

1. Introduction

This chapter introduces the proposal and provides context for the environmental assessment. In introducing the proposal, the objectives and proposal development history are detailed, and the purpose of the report provided.

1.1 Proposal identification

Transport for NSW (Transport) proposes to replace the existing bridge sized culvert at Spring Creek (B3858) (the proposal) on the Kamilaroi Highway (HW29) located 9.5 kilometres west of Narrabri, NSW (the proposal area). The Kamilaroi Highway is a state road and the main connecting road from Willow Tree in the south-east to Narrabri, Walgett and Bourke in the north-west. The highway is used by local traffic, agricultural transit vehicles and freight.

The existing culvert structure is an eight cell cast in-situ reinforced concrete box culvert which was built in 1968. The culvert was constructed as two four cell modules with a total length of about 39 metres and has a reinforced concrete base slab with no piled foundations. The ground conditions throughout the waterway present as clay soil and alluvium with little to no rock.

In June 2021, following heavy rainfall, flood water penetrated beneath the base slab of the culvert and scoured beneath the structure. The water flowing under the base slab created a large void which caused one of the four cell modules to settle relative to the other and resulted in about a 250 millimetre step in the deck. The displacement in the deck of the culvert structure was rectified by placing asphalt pavement over the affected area. To support the additional loading from the asphalt pavement, temporary steel propping was installed in cells 3 and 4 of the structure. The void under the culvert was filled with mass concrete to try and prevent further settlement.

A 15 tonne load limit was implemented on the bridge at the end of May 2022 following an inspection by Transport where further movement and cracking was identified in the structure. This resulted in the installation of additional temporary propping in cells 1 and 2 of the culvert, as well as Abutment A, which was completed by the end of July 2022. The additional temporary propping has allowed the 15 tonne load limit to be removed from the culvert but provides only a short term solution for the structure which is in poor condition and remains vulnerable to further deterioration from future flood events. As a result, full replacement of the existing culvert is proposed as this is the most viable cost-effective long-term solution for the site. This would involve demolition of the existing structure and construction of a new bridge at the site (bridge number B12489) on the existing highway alignment.

A temporary side-track has been assessed and approved under a separate Minor Works Review of Environmental Factors (MWREF) and is proposed to be constructed on the upstream side of the existing structure. The side-track would maintain safe two-lane traffic flow on the Kamilaroi Highway during both the development phase and construction of the bridge replacement proposal (refer to Figure 1-2).

Key features of the proposal would include:

- Installation of creek bed and perimeter sediment controls
- Switching of traffic from the Kamilaroi Highway (HW29) on to the previously approved and constructed side-track (assessed separately under a MWREF)
- Removal of culvert scuppers and any other contaminated material prior to demolition
- Installation of temporary gravel access tracks to the waterway area downstream of the existing structure to allow construction vehicles to enter and leave the area in one direction
- Construction of rock platforms within the waterway upstream and downstream of the existing structure, including installation of temporary steel pipes within the platforms/waterway upstream and downstream of the culvert to maintain channel flow
- Adjustment of rock working platforms and temporary steel pipes, as required to suit demolition and bridge construction staging to maintain channel flow
- Clearing of vegetation and tree removal adjacent to the existing culvert abutments
- Demolition of the existing bridge sized culvert, including excavation of the base slab and culvert abutment areas to widen the waterway opening and accommodate the new bridge

- Adjustment of the rock working platforms within the bridge footprint and waterway to suit piling and crane access for bridge construction
- Construction of a new reinforced concrete bridge with driven steel tubular piles, reinforced concrete columns and headstocks supporting precast planks on the existing alignment, including preliminary earthworks on the road approaches as required
- Removal of all temporary working platforms and rock platforms from the waterway
- Installation of rock scour protection for the new bridge
- Reinstatement and revegetation of disturbed areas
- Road works to tie into the new bridge
- Removal of the side track on completion.

The location of the proposal is shown in Figure 1-1 and an overview of the proposal is provided in Figure 1-2. Chapter 3 describes the proposal in more detail.

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FIGURE 1-1:
LOCATION OF THE PROPOSAL

Legend

- Proposal area
- Road
- Watecourse

Source: Esri, USGS, Esri, Garmin, FAO, NOAA, USGS

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FIGURE 1-2:
THE PROPOSAL

Legend

- Proposal area
- Existing bridge
- Approved (MWREF) side-track
- Road
- Watercourse

Source: Maxar

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1.2 Purpose of the report

This review of environmental factors (REF) has been prepared by AECOM Pty Ltd on behalf of Transport. For the purposes of these works, Transport is the proponent and determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979 (NSW)* (EP&A Act).

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail mitigation and management measures to be implemented.

The description of the proposed work and assessment of associated environmental impacts has been undertaken in the context of Section 171 of the Environmental Planning and Assessment Regulation 2021, the factors in *Guidelines for Division 5.1 assessments, (DPE 2022)*, *Roads and Related Facilities EIS Guideline* (DUAP 1996), the *Biodiversity Conservation Act, 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)* (EPBC Act).

In doing so, the REF helps to fulfil the requirements of:

- Section 5.5 of the EP&A Act including that Transport examines and takes into account, to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval sought from the Minister for Planning under Division 5.2 of the EP&A Act
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report
- The significance of any impact on nationally-listed biodiversity matters under the https://www.awe.gov.au/environment/epbcEPBC Act, including whether there is a real possibility that the activity may threaten long-term survival of these matters, and if offsets are required and able to be secured.

The potential for the proposal to significantly impact any other matters of national environmental significance or Commonwealth land and the need, subject to the EPBC Act strategic assessment approval, to make a referral to the Australian Department of Climate Change, Energy, the Environment and Water for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

1.3 Key terms used in this report

Table 1-1: outlines key terms and their definitions used within this report.

Table 1-1: Key terms used in the REF

Term	Definition
Proposal	The removal of the existing bridge sized culvert and construction of a new bridge over Spring Creek, including all ancillary activities.
Proposal area	The disturbance area which would contain all construction activities, stockpile sites, compound areas, access tracks, working platforms and side-track.
Side-track	A temporary side-track which has been assessed and approved under a separate Minor Works Review of Environmental Factors (MWREF) located on the upstream side of the structure. Traffic would be diverted on to this side-track during construction.
Access track	A temporary access track which would be constructed from the Kamilaroi Highway on the southern approach, downstream of the bridge, through the waterway connecting back up with the Kamilaroi Highway on the northern approach.
Compound area	Area for ancillary facilities such as site amenities, offices, parking and material storage including bridge planks.
Stockpile site	A site used for material and spoil storage.

2. Need and options considered

This chapter describes the need for the proposal in terms of its strategic setting and operational need. It identifies the various options considered and the selection of the preferred option for the proposal.

2.1 Strategic need for the proposal

The proposal would address the following NSW and Australian strategic documents and plans:

- Future Transport Strategy 2056 (Transport, 2018a)
- Regional NSW Services and Infrastructure Plan (Transport, 2018b)
- NSW Freight and Ports Plan 2018-2023 (NSW Government, 2018)
- National Road Safety Strategy 2021-2030 (Office of Road Safety, 2021)
- NSW Infrastructure Strategy 2018-2038: Building Momentum. (Infrastructure NSW, 2018).

2.1.1 Future Transport Strategy 2056

The *Future Transport Strategy 2056* is the NSW Government's vision for the next 40 years of transport in NSW. The purpose of the strategy is to guide integrated transport and land use planning across regional NSW and Greater Sydney.

A key priority and direction under the *Future Transport Strategy 2056* relates to movement and place, balancing the efficient movement of people and goods with the liveability of places on the transport network. The proposed new bridge would provide a reliable and safe transport route for the local community and freight transport to regional centres along the Kamilaroi Highway.

2.1.2 Regional NSW Services and Infrastructure Plan

The *Regional NSW Services and Infrastructure Plan* is a sub-plan of the *Future Transport Strategy 2056* which sets out the NSW Government's blueprint for transport in regional NSW. The plan focuses on improving connectivity between regional cities and centres as well as locally. The proposed new bridge would ensure the Kamilaroi Highway remains a viable transport route for traffic, freight, and would ensure the bridge is compliant with current design and safety standards.

2.1.3 NSW Freight and Ports Plan 2018-2023

The *NSW Freight and Ports Plan 2018-2023* (NSW Government, 2018) is a supporting plan to the *Future Transport Strategy 2056* and aligns with other key NSW Government plans, including the *State Infrastructure Strategy* and NSW Regional Plans. The purpose of the plan is for government and industry to set clear initiatives and targets to improve the safety and efficiency of the NSW freight task. The proposed new bridge would ensure the safety of road users through compliance with current design and safety standards.

2.1.4 National Road Safety Strategy 2021-2030

The *National Road Safety Strategy 2021–2030* aims to reduce death and serious injury on Australian roads. A target of this strategy is to reduce per capita fatalities on roads by at least 50 percent and serious injury by 30 percent by 2030.

The proposed new bridge would provide for a safer road through compliance with design and safety standards (*AS 5100 Bridge Design*), and a wider flow area for Spring Creek to improve the bridges' flood resilience.

2.1.5 NSW Infrastructure Strategy 2018-2038: Building Momentum

The *NSW Infrastructure Strategy 2018 – 2038: Building Momentum* (Infrastructure NSW, 2018) is a strategy to plan and fund infrastructure that the NSW Government delivers. The plan identifies the role of infrastructure as a response to the growth of Regional NSW by supporting regional hubs in serving their surrounding regional populations and developing local freight and service networks. The proposal would align with the objectives of this strategy by providing a new bridge which is safe and reliable for use by the local community or for freight use.

2.2 Limitations of existing infrastructure

2.2.1 Bridge infrastructure

Spring Creek Bridge (Bridge number B3858) is a two-lane reinforced concrete culvert structure which was built over Spring Creek in 1968. The existing structure is an eight cell cast in-situ reinforced concrete box culvert which was built as two four cell modules. The culvert is 8.4 metres wide, 39.4 metres long and is founded on a reinforced concrete base slab with no pier supports (refer to Figure 2-1). The ground conditions below the slab and within the waterway are clay soil and alluvium with little to no rock.

The condition of the existing culvert structure is progressively deteriorating. The route on which the bridge is located is approved for Higher Mass Limits (HML) loading, however the carriageway width over the culvert is narrow at 7.3 metres and the barrier rail does not comply with current Australian Standards. Shortly after construction the wing walls and abutments of the structure developed small cracks which were filled with epoxy resin. Following this, a 1978 inspection identified major cracks on the deck and wing walls.

During heavy rainfall in June 2021, flood water penetrated beneath the base slab of the culvert which created a large void beneath the structure. This caused one of the four cell modules to settle relative to the other (refer to Figure 2-2) and resulted in about a 250 millimetre step in the deck at the corresponding joint. Emergency works were undertaken to stabilise the structure which included filling the void under the culvert with mass concrete to try and prevent further settlement. A reinforced concrete cut off wall (1500 millimetres deep by 300 millimetres wide) was also installed across the inlet side of the culvert to prevent further water flowing under the base slab, and rock was placed across the outlet side to provide scour protection. To rectify the displacement in the deck, asphalt pavement was placed over the affected area and temporary steel propping (refer to Figure 2-3) was installed in cells three and four to support the additional dead load of the asphalt.

Following the initial emergency repairs, the existing bridge structure has been monitored for further movement and deterioration which may impact on road safety or HML load capacity.

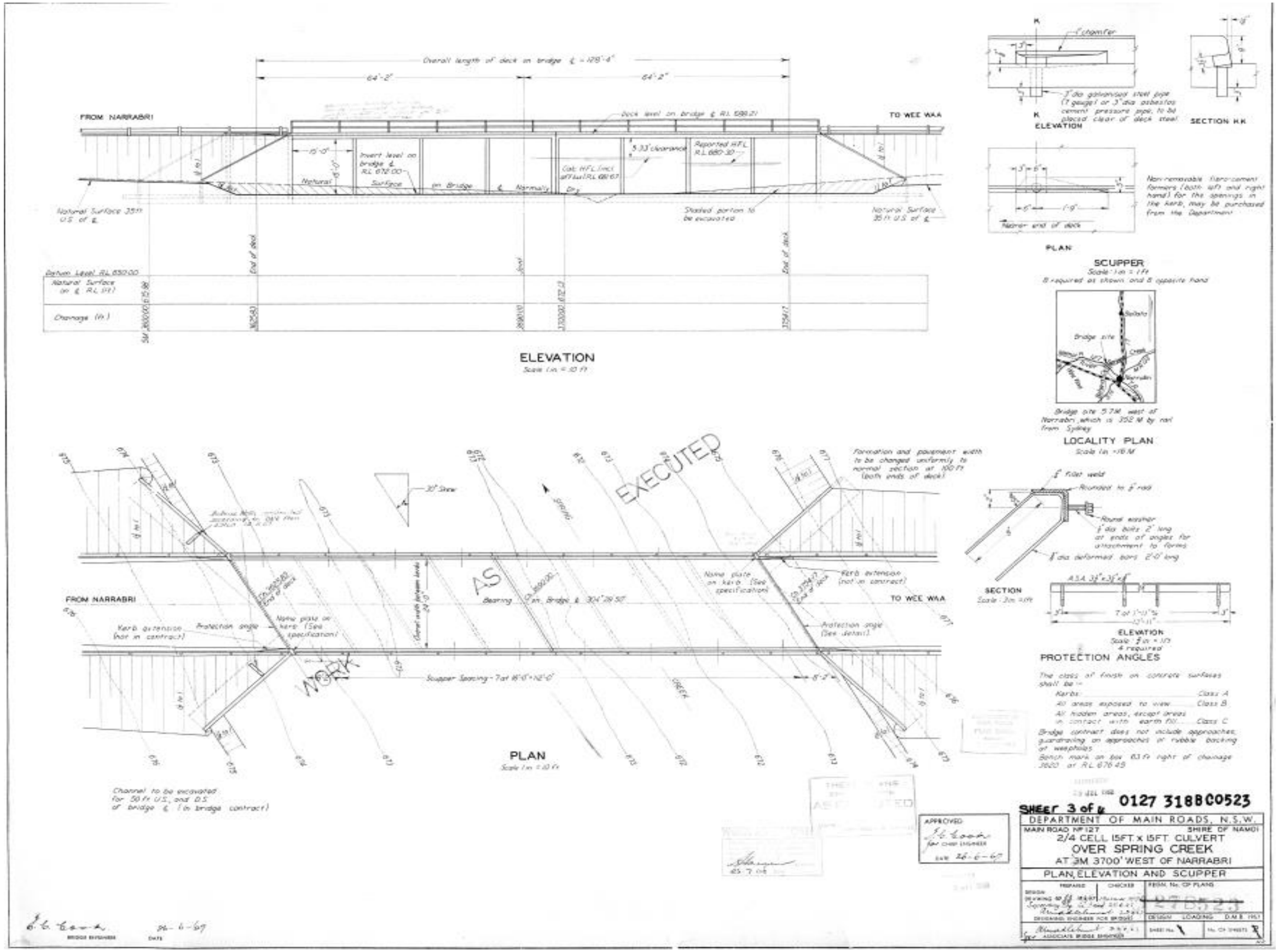

Figure 2-1: Extract from the existing bridge sized culvert (B3858) design drawings (Transport)

Figure 2-2: Water penetrating underneath the concrete base slab of the Spring Creek culvert structure (June 2021) (Transport)

Figure 2-3: Temporary steel propping in cells 3 and 4 of the Spring Creek culvert structure (Transport)

2.2.2 Pedestrian and cyclist facilities

There are no pedestrian or dedicated cyclist facilities on the bridge. Cyclists can continue to use the existing traffic lanes.

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The objectives of the proposal include:

- Provide a new, wider bridge that is compliant with current Australian design and safety standards
- Provide a new bridge capable of accommodating HML loading
- Provide a new bridge which suits hydrology requirements of the area and has no adverse hydraulic impacts on the locality
- Provide a road alignment that complies with a design traffic speed that meets or exceeds existing conditions
- Minimise environmental disturbance during construction of the new bridge and removal of the existing bridge through the requirement for minimal road approach works and riparian vegetation removal
- Improve bridge and road user safety
- Minimise future maintenance costs.

2.3.2 Development criteria

The development criteria for the proposal include:

- The new bridge is to have a two-lane, two-way carriageway with 3.5-metre-wide lanes and 1.5 metre shoulders to allow for future provision of a 1.0 metre wide centreline
- The deck level and bridge length of the new structure is to be designed to suit flood modelling and hydrology requirements
- The new bridge is to be capable of accommodating HML loading
- The design traffic speed is to match or exceed existing conditions.

2.3.3 Urban design objectives

Urban design objectives for the proposal include:

- Create a new bridge structure that is neat, with modern simple lines to suit its rural setting
- Design for low maintenance and a long lifespan.

2.4 Alternatives and options considered

2.4.1 Methodology for selection of preferred option

Transport has investigated multiple options to replace the bridge at Spring Creek which would address the existing structural, safety, and ongoing scour issues. This is supported by the Transport Level 3 Inspection and Structural Assessment in 2020, and previously a Level 3 Inspection and Assessment completed in 2004.

Several components of the existing culvert structure were assessed to be in poor condition including cracks in the deck, walls of Cell 5, concrete base, mid joint, and the deck level difference. The traffic barrier railing was also noted as not complying with current Australian Design Standards.

Three design options involving strengthening the existing structure and full replacement were considered against the proposal objectives. The “Do Nothing option” was also considered for the proposal. The options considered as part of the proposal are described below and an options analysis is provided in Section 2.4.3.

2.4.2 Identified options

Four options were considered as part of the bridge replacement proposal. These options include:

- Option 1: “Do nothing”

- Option 2: Strengthen existing structure
- Option 3: Full replacement of the existing structure with a new bridge on the existing alignment
- Option 4: Full replacement of the existing structure with a new bridge upstream or downstream of the existing structure.

The four options are described below and analysis of the options against the proposal objectives is provided in Table 2-1.

Option 1: "Do nothing"

This option would involve retaining the existing bridge sized culvert structure, continuing to monitor for structural integrity and performing maintenance and repair activities as required. The current condition of the culvert is poor and has reached the end of its service life. The existing structure has non-compliant traffic barriers, temporary propping in four cells, significant cracking in the cell walls and deck and long-term durability issues which would not be addressed by this option. Continuing deterioration presents an ongoing safety risk with potentially severe consequences.

Option 1 would not generate environmental impacts, however Option 1 would not meet the objectives of the proposal. This option does not assist in preventing a potential failure of the culvert in the future.

Option 2: Strengthen existing structure

This option would involve strengthening the existing culvert structure to achieve its remaining design life. Required site investigations and studies would need to be undertaken to determine appropriate methods for strengthening and retaining the existing structure.

This option would likely generate minor environmental impacts from construction works required to strengthen and repair the existing structure. This option was not considered feasible as the existing structure has reached the end of its service life and it is not considered viable to rehabilitate from both a technical and financial perspective. This option would also not meet the objectives of the proposal, as strengthening the existing structure would not allow for compliance with current Australian safety and design features and would require ongoing costs for monitoring and maintenance.

Option 3: Full replacement of the existing structure with a new bridge on the existing alignment

This option would involve a full bridge replacement on the same alignment as the existing bridge with a side-track utilised during demolition and construction to maintain traffic flow on the Kamilaroi Highway. This option would provide for a safe, reliable, and cost-effective solution for the site. This option provides a long-term solution to the safety risks posed by the existing culvert structure and confines the majority of works to within the existing disturbed road corridor. This option does not require any property acquisition.

Although there would be minor environmental impacts from site establishment, vegetation clearing, compound areas and demolition and construction works, this option would meet all the proposal objectives. Benefits would arise from minimal disruption to traffic during construction and demolition phases of the proposal.

Option 4: Full replacement of the existing structure with a new bridge upstream or downstream of the existing structure

This option would involve construction of a new bridge upstream or downstream of the existing structure, with the existing bridge utilised for traffic flow for the duration of construction. The existing culvert structure would be demolished following completion and commissioning of the new bridge.

This option would generate environmental impacts for site establishment, vegetation clearing and compound areas, as well as permanently disturb the area required for the new bridge alignment. Significant earthworks would be required for construction of the road approaches to the new structure as they would need to be designed to tie-in to the existing road alignment in a way where design traffic speed requirements are met. The additional earthworks would involve significant additional costs to the proposal.

Benefits would arise from minimal disruption to traffic during the construction and demolition phases of the proposal, however this option was not considered viable due to the continuing rapid deterioration of the existing structure and site constraints including lengthy timeframes associated with potential property acquisition requirements.

2.4.3 Analysis of options

A summary of the options evaluation against the proposal objectives outlined in Section 2.3.1 is provided in Table 2-1 below.

Table 2-1: Analysis of the options against the proposal objectives

Proposal objectives	Options considered			
	Option 1: "Do nothing"	**Option 2: Strengthen existing structure**	**Option 3: Full bridge replacement on existing alignment**	**Option 4: Full bridge replacement upstream or downstream of existing alignment**
Provide a new, wider bridge that is compliant with current Australian design and safety standards	Objective not met Option 1 would retain the existing structure which does not meet current Australian design and safety standards	Objective not met Option 2 would attempt to strengthen and retain the existing structure which does not meet current Australian design and safety standards	Objective met Option 3 would result in construction of a new, wider bridge which meets current Australian design and safety standards	Objective met Option 4 would result in construction of a new, wider bridge which meets current Australian design and safety standards
Provide a new bridge capable of taking HML loading	Objective not met Option 1 would retain the existing structure which may not be able to sustain HML loading for the remainder of its design life	Objective not met Option 2 would attempt to strength and retain the existing structure to achieve its remaining design life and sustain HML loading. This is not considered feasible from both a technical and financial perspective	Objective met Option 3 would result in a new, wider bridge capable of sustaining HML loading for the entirety of its design life	Objective met Option 4 would result in a new, wider bridge capable of sustaining HML loading for the entirety of its design life
Provide a new bridge which suits hydrology requirements of the area and has no adverse hydraulic impacts on the locality	Objective not met Option 1 would retain the existing structure which is in poor condition and vulnerable to further deterioration from future flood events. Scour issues at the site are potentially exacerbated due to the length of the existing structure which constricts the waterway at this location and results in higher water velocities through the area	Objective not met Option 2 would attempt to strength and retain the existing structure which is in poor condition and vulnerable to further deterioration from future flood events. Scour issues at the site are potentially exacerbated due to the length of the existing structure which constricts the waterway at this location and results in higher water velocities through the area	Objective met Option 3 would result in construction of a new, wider bridge that has no adverse effects on current flood behaviour or surrounding properties. The new bridge would be constructed longer than existing which would increase the waterway opening and remove the flow constraint at this location	Objective partially met Option 4 would result in construction of a new, wider and longer bridge which would increase the waterway opening and remove the flow constraint at this location. However, this option would require substantial excavation and significant earthworks to construct the new bridge alignment, which may result in adverse hydraulic impacts on the locality

Provide a road alignment that complies with a design traffic speed that meets or exceeds existing conditions	Objective met Option 1 would maintain the existing road alignment	Objective met Option 2 would maintain the existing road alignment	Objective met Option 3 would maintain the existing road alignment	Objective met Option 4 would be designed to provide a road alignment that complies with a design traffic speed that meets or exceeds existing conditions
Minimise environmental disturbance during construction of the new bridge and removal of the existing bridge through the requirement for minimal road approach works and riparian vegetation removal	Objective met Option 1 would not generate environmental impacts from construction	Objective met Option 2 would likely generate minor environmental impacts from construction works required to strength and repair the existing structure	Objective met Option 3 would generate minor environmental impacts from construction, however this would be mitigated as outlined in Section 7.2	Objective not met Option 4 would generate moderate environmental impacts as a result of significant earthworks and disturbance that would be required for construction of the road approaches to the new bridge alignment; however, this would be mitigated as outlined in Section 7.2
Improve bridge and road user safety	Objective not met Option 1 would retain the existing structure which is in poor condition and has reached the end of its service life. The existing structure has long-term durability issues with continuing deterioration posing safety risks with potentially severe consequences	Objective not met Option 2 would not improve road user safety as the non-compliant traffic barriers on the existing structure would not be replaced. The existing structure has long-term durability issues with continuing deterioration posing safety risks with potentially severe consequences	Objective met Option 3 would result in construction of a new, wider bridge that meets current design and safety standards. This option would improve bridge and road user safety at the site by providing a long-term solution to the safety risks posed by the existing culvert structure	Objective met Option 4 would result in construction of a new, wider bridge that meets current design and safety standards. This option would improve bridge and road user safety at the site by providing a long-term solution to the safety risks posed by the existing culvert structure
Minimise future maintenance costs	Objective not met Option 1 would retain the existing structure which is rapidly deteriorating, requires ongoing monitoring for structural integrity and would require ongoing maintenance and repair	Objective not met Option 2 would attempt to strengthen and retain the existing structure which would require ongoing monitoring and maintenance	Objective met Option 3 would result in construction of a new, wider bridge which would have a 100-year design life. Standard routine maintenance costs would be required	Objective met Option 4 would result in construction of a new, wider bridge which would have a 100-year design life. Standard routine maintenance costs would be required

2.5 Preferred option

The “do nothing” option would not result in any construction related environmental impacts. However, this option would not meet the objectives of the proposal.

Option 2 would theoretically meet some of the proposal objectives through strengthening of the existing infrastructure. This includes minimised environmental disturbance and maintaining the existing alignment and therefore existing traffic conditions. However, the existing structure has reached the end of its serviceable life and it is not considered viable to rehabilitate it from both a technical and financial perspective. The ongoing capability of the existing structure to carry HML loading would be unlikely and current Australian design and safety standards would not be met.

Option 3 (the preferred option) would provide for a full bridge replacement within the alignment of the existing bridge, utilising a side-track constructed previously to enable through traffic movement. This option would meet all proposal objectives, including minimal environmental disturbance.

Option 4 would provide a full bridge replacement on the upstream or downstream side of the existing bridge. This option would meet most of the proposal objectives, however would result in additional environmental impacts and construction cost compared to option 3.

3. Description of the proposal

This chapter describes the proposal and provides descriptions of existing conditions, the design parameters including major design features, the construction method and associated infrastructure and activities.

3.1 The proposal

Transport proposes to replace the existing bridge sized culvert at Spring Creek (B3858) on the Kamilaroi Highway, located 9.5 kilometres west of Narrabri, NSW. The proposal would account for the provision of temporary access tracks on the downstream side of the bridge, removal of the existing culvert structure and construction of a new bridge and road approach works on the existing alignment. The new bridge would provide for one lane travel in both directions with 1.5-metre-wide shoulders.

The proposal is shown in Figure 1-2 and Figure 3-1.

Key features of the proposal would include:

- Installation of creek bed and perimeter sediment controls
- Switching of traffic from the Kamilaroi Highway (HW29) on to the previously approved and constructed side-track (assessed separately under a MWREF)
- Removal of culvert scuppers and any other contaminated material prior to demolition
- Installation of temporary gravel access tracks to the waterway area downstream of the existing structure to allow construction vehicles to enter and leave the area in one direction
- Construction of rock platforms within the waterway upstream and downstream of the existing structure, including installation of temporary steel pipes within the platforms/waterway upstream and downstream of the culvert to maintain channel flow
- Adjustment of rock working platforms and temporary steel pipes, as required to suit demolition and bridge construction staging to maintain channel flow
- Clearing of vegetation and tree removal adjacent to the existing culvert abutments
- Demolition of the existing bridge sized culvert, including excavation of the base slab and culvert abutment areas to widen the waterway opening and accommodate the new bridge
- Adjustment of the rock working platforms within the bridge footprint and waterway to suit piling and crane access for bridge construction
- Construction of a new reinforced concrete bridge with driven steel tubular piles, reinforced concrete columns and headstocks supporting precast planks on the existing alignment, including preliminary earthworks on the road approaches as required
- Removal of all temporary working platforms and rock platforms from the waterway
- Installation of rock scour protection for the new bridge
- Reinstatement and revegetation of disturbed areas
- Road works to tie into the new bridge
- Removal of the side track on completion.

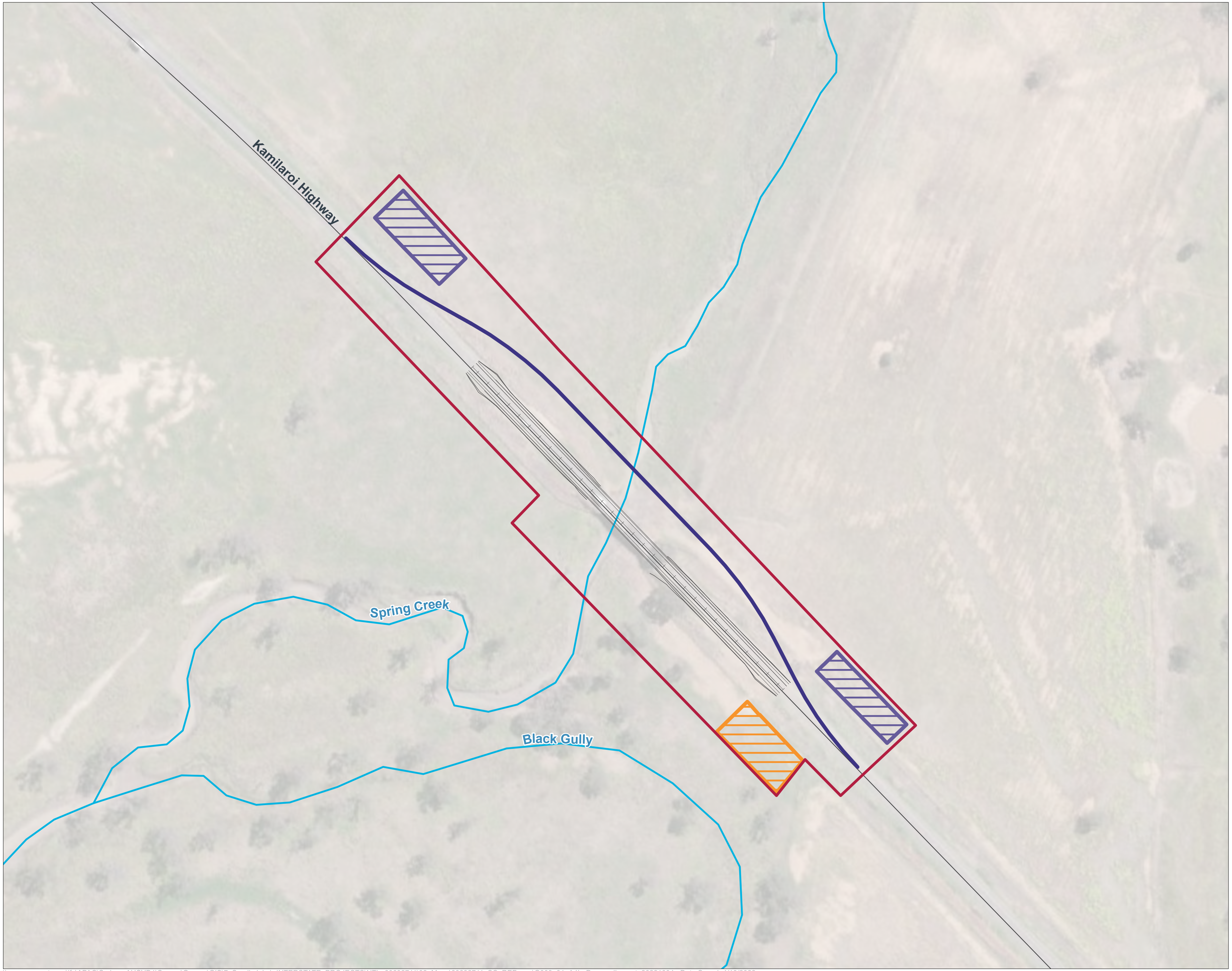

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FIGURE 3-1:
KEY FEATURES OF THE PROPOSAL

Legend

- Proposal area
- Compound
- Stockpile
- Proposed design
- Approved (MWREF) side-track
- Road
- Watecourse

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3.2 Design

3.2.1 Design criteria

The design criteria considered the site constraints, such as topographical constraints, existing utilities, civil design standards and existing transport routes. The design criteria for the proposal are outlined in Table 3-1. The 50% detailed design is attached in Appendix A, and a typical cross section for the new bridge is shown in Figure 3-2 and long section in Figure 3-3.

Table 3-1: Design criteria for the proposal

Requirement	Design criteria
Civil	• Design loading in accordance with Australian Standard (AS) 5100 Bridge Design • Traffic loading in accordance with Stationary Load 1600 (SM1600) and Heavy Load Platform (HLP400) Standards • Design in accordance with Transport bridge design specifications • Deck level and bridge length to be set to suit hydrology requirements
Environmental	• Placement on existing bridge alignment to minimise approach works and associated environmental impacts
Design Speed	• Speed limit at location (100 km / hour) + 10 km / hour
Lane width	• Two lane single carriageway • 3.5 metre lanes • 1.5 metre shoulders (to allow for future 1.0m wide centre line)
Economic	• Design to consider all asset lifecycle costs and activities

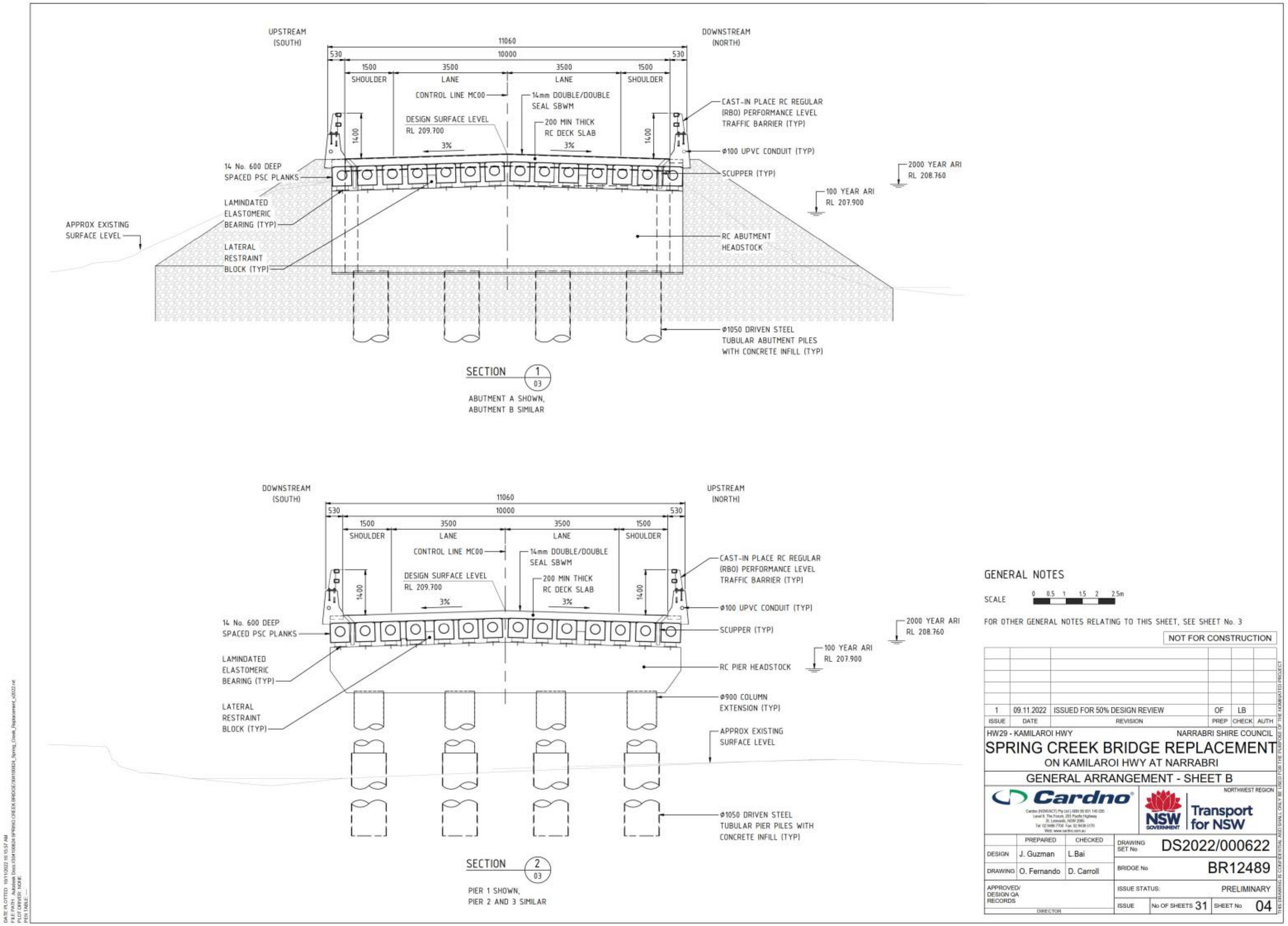


Figure 3-2: Typical cross section of the new bridge design (Transport 50% Detailed Design)

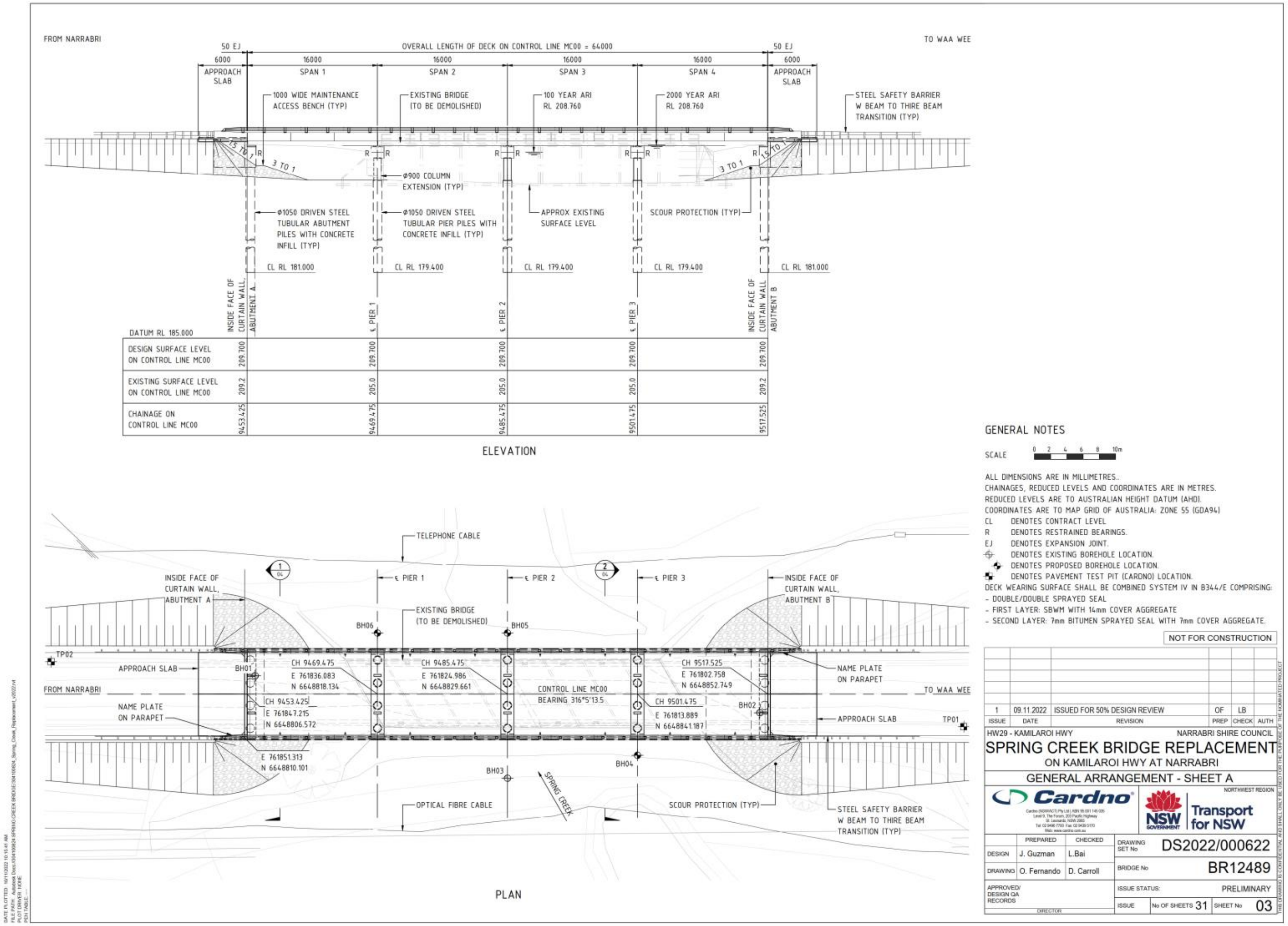


Figure 3-3: Long section of the new bridge (Transport 50% Detailed Design)

3.2.2 Engineering constraints

For the construction and operational phases of the proposal, a number of engineering constraints were identified during development of the concept design. These constraints included:

- Cells 1 to 4 have temporary steel propping which cannot be removed safely unless the cells are strengthened prior
- A cut off wall (1500 millimetre deep and 300 millimetres wide) has been installed on the upstream side of the structure to prevent water flow underneath the base slab
- Hydraulic performance of the bridge during major flood events
- Constructability issues associated with building a new bridge within the waterway of Spring Creek.
- Management of traffic on a low flood immunity side-track during construction.

3.2.3 Major design features

Major design features of the proposal include demolition of the existing culvert structure, and construction of the new bridge over Spring Creek and the new bridge approaches.

Existing culvert demolition

The existing structure over Spring Creek would be demolished prior to construction of the new bridge along the current alignment of the Kamilaroi Highway. Demolition would require vegetation clearance and tree removal, earthworks, construction of temporary access tracks downstream of the existing culvert and construction of temporary rock working platforms within the waterway. Depending on the environmental conditions present at the time of demolition, the bridge may be demolished in wet or dry conditions (refer to Section 3.3.2). Following demolition, earthworks would begin for the new bridge and approaches.

New bridge

The new bridge would be located on the same alignment as the existing structure, as shown in Figure 3-1. The new bridge would be 64 metres long with 3.5-metre-wide lanes and 1.5 metre shoulders. There would be three sets of piers within the waterway, and one set at each abutment location of the new bridge. The new bridge would meet current Australian design and safety standards and have a flood immunity corresponding to approximately the 1 in 100 to 1 in 2000 year Average Recurrence Interval (ARI) which matches the immunity of the highway at this location. The new bridge is supported by pile/column piers without pile caps which helps reduce environmental disturbance within the waterway.

Bridge approaches

The new road approaches to the bridge would improve road user safety by providing a wider, smoother geometry with slight improvements on the existing vertical alignment.

3.3 Construction activities

Construction activities would be guided by a Construction Environmental Management Plan (CEMP) which would be prepared in accordance with the requirements of the Transport QA Specification G36 Environmental Protection (Management System). Works would be undertaken within the work area specified within the CEMP and completed to incorporate all safeguards as described in this REF and any other relevant Transport environmental specifications.

As part of the proposal, a Traffic Management Plan (TMP) and Erosion and Sediment Control Plan (ESCP) would be prepared, implemented, and referred to for all stages of construction and demolition works

3.3.1 Work methodology

The proposal would involve the following work methodology and staging:

Stage 1: Advance works

Prior to establishing works, environmental controls within the creek bed and around the site perimeter would be implemented as per the ESCP. Traffic on the existing bridge would be diverted to the upstream side-track installed prior and would be maintained and managed as outlined in the TMP.

Asbestos culvert scuppers and all other contaminated material would be removed from the bridge and disposed of at an appropriately licensed waste facility prior to demolition.

Stage 2: Access tracks, working platform and vegetation clearing

Temporary gravel access tracks would be installed traversing from the compound site on the downstream side of the existing structure to the waterway, through to the Kamilaroi Highway on the other side of the downstream waterway. This would form a full access track that would serve as construction access and removal of demolition debris by truck, allowing for construction vehicles to safely enter and leave the proposal area in one direction (refer to Figure 3-1).

Temporary steel pipes would be installed within the waterway upstream and downstream of the existing culvert to allow for fish and water passage under the rock working platform. A top up of the rock working platform would be undertaken for use during demolition and construction of the new bridge.

Vegetation and tree clearing would occur adjacent to the existing culvert abutments. Topsoil would be stockpiled for reuse during site rehabilitation following the completion of works. Impacts of clearance are detailed in the Biodiversity Assessment Report (Appendix C) and discussed in Section 6.1.

Stage 3: Culvert demolition

Prior to commencing works associated with culvert demolition, environmental controls would be implemented as per the ESCP. Traffic would be switched over to the temporary side-track and managed as outlined in the TMP. Two options have been considered for culvert demolition depending on environmental conditions at the time of demolition, as detailed in Section 3.3.2 and Appendix B. The demolition methodology is indicative only and is subject to change based on final engineering assessment and weather conditions leading up to the proposed works. General removal of the existing culvert structure would include:

- Staged demolition of the bridge sized culvert using conventional construction equipment including hydraulic breaker/shears mounted on a 32-tonne excavator. The existing culvert base slab would be removed to 0.5 metres below existing creek bed level
- Concrete would be broken up on site using a pulveriser/jaw attachment on a 32-tonne excavator
- Temporary steel reinforcement would be recovered and recycled. Broken up concrete would be disposed of at a licensed waste facility
- A 12 metre excavation of the existing culvert abutments would accommodate the length of the new bridge and provide a widened waterway area. Spoil would be stockpiled on site and used to rehabilitate the land used for the access side-track on completion of the bridge.

The two options provided for demolition depend on whether Spring Creek is flowing with water or is dry. The key differences in the demolition methodology are summarised within Section 3.3.2 and are detailed in Appendix B.

Stage 4: Bridge construction

The rock working platform would be adjusted within the bridge footprint and waterway area on completion of demolition to allow for piling and crane access for bridge construction. This working platform may be used as final scour protection on completion of the bridge. Adjustment of erosion and sedimentation controls would occur prior to the construction of the new bridge. A temporary working platform would be constructed at each abutment and pier location.

The water and abutment piles would be constructed using a driven steel tubular casing (1050 mm diameter) with reinforced concrete infills. The pile casing would be driven up to 25 metres below existing surface level with a pile driving hammer and piling rig. Reinforced concrete columns, headstocks and abutments would be constructed in situ with backfilling behind abutments using granular fill or stabilised sand. Rock would be installed in front of the bridge abutments to provide scour protection.

Installation of planks for Spans 1 to 4 of the bridge deck would be undertaken by cranes (50 to 250 tonne) located on crane working platforms sited on either bank of the river or behind bridge abutments. Following the installation of spaced planks, deck slabs and parapets would be constructed in situ and approach slabs constructed behind bridge abutments. Steel traffic rails would then be installed on top of the concrete parapets.

Rock working platforms would be removed following construction. Rock would be taken to a Transport stockpile site for reuse or recycling. Final shaping of the upstream and downstream waterway, and installation of final rock scour protection for the new bridge would then occur. Vegetation on the riverbanks would be planted following rehabilitation with stored topsoil.

Stage 5: Final Roadworks construction

The final road approach earthworks would involve shaping of batter slopes to final design profile and construction of stormwater drainage. Batter slopes and exposed earthworks would then be rehabilitated and revegetated.

Final roadworks for the bridge approaches would include:

- Placing final select material layers for approach roadworks
- Placing pavement layers, trim and applying bituminous primer seal. Pavement gravel would be sourced from a commercial quarry in Narrabri and/or surrounds
- Installing guardrail on approaches to bridge
- Installing bituminous final seal on bridge and road approaches
- Installing signs and line marking
- Switching traffic from the side-track onto the new bridge
- Removing the side-track concrete culvert pipes from the waterway
- Removing the side-track and storing pavement material (for future maintenance) within the stockpile site
- Reinstating creek banks using stockpiled material from bridge and side-track construction
- Removing side-track fencing and tidying up site and stockpile areas
- Demobilisation from site.

Upon completion of final roadworks and tie-ins, the new bridge would be opened to traffic. The changeover of traffic on the Kamilaroi Highway would then take place from the temporary side-track to the new bridge. The management of this change over would be implemented as outlined in the TMP. Traffic along the new bridge would then be managed as per the TMP for the duration of the demobilisation and rehabilitation as required.

Perimeter sediment control measures and traffic control would then be removed, and all equipment would be demobilised from site.

3.3.2 Demolition activities

The existing structure over Spring Creek would be demolished prior to construction of the new bridge. An indicative demolition methodology is detailed within the Demolition Report provided in Appendix B, however demolition of the culvert may also be undertaken from ground level using large excavation equipment located upstream or downstream of the existing structure. The demolition methodology for the structure will be finalised with the successful tenderer and may change subject to final engineering assessment and weather conditions at the time of the proposed works.

It is anticipated that the following basic staging would be undertaken:

1. Stage 1: Superstructure – Remove crown slabs, traffic barrier, kerb, and superimposed dead loads.
2. Stage 2: Substructure – Remove substructure down to ground/creek level.
3. Stage 3: Foundations – Remove base slab and tidy site.

Stages 1 to 3 would be completed for each 'segment' of the existing structure, starting with the segment comprising cells 1 to 4 and then repeated for cells 5 to 8.

The demolition plan outlines two possible methods depending on the state of Spring Creek at the time of demolition, this includes conditions when Spring Creek is full and when Spring Creek has no flowing water. A summary of this is outlined below.

Wet site - Spring Creek is full

Where Spring Creek is full of flowing water, flow would be constricted through one segment of the culvert structure using diversions banks, steel sheet piles or temporary instream structures lined with pinned geofabric or clean rock upstream and downstream of the culvert. This would allow room for staged demolition of one segment of the culvert whilst channel flow is maintained in the other. The pinned geofabric (or similar) would be in addition to general conventional silt barriers and environmental management measures.

The first segment to be demolished comprises cells 1 to 4. This would allow channel flow to be maintained through cells 5 to 8 whilst the adjacent cells are demolished. Following demolition of the first segment, channel flow would be redirected through cells 1 to 4 whilst the second segment is demolished.

Dry site - Spring Creek has no flowing water

Where Spring Creek has no flowing water, a similar methodology to a wet site would be used. As there would be no water flow through the culvert, the area surrounding the segment being demolished would require conventional silt barriers and environmental management measures to ensure the waterway is protected from demolition debris and runoff.

3.3.3 Construction workforce

The construction workforce required for each stage of construction is listed in Table 3-2.

Table 3-2: Construction workforce for each stage

Stage	Workforce required
1. Advance Works	• Up to four construction workers with traffic control
2. Access tracks, working platform, and vegetation clearing	• Ten to twelve construction workers
3. Bridge Demolition	• Ten to sixteen construction workers
4. Bridge Construction	• Temporary construction platforms and crane pads – up to eight construction workers • Waterway and abutment piles – up to eight construction workers • Construction of concrete piers – up to eight construction workers • Spaced planks installation – up to eight construction workers • Construction of deck slabs, approach slabs and parapets – ten to sixteen construction workers
5. Final Roadworks Construction	• Ten to twelve construction workers

3.3.4 Construction hours and duration

The anticipated construction duration for the proposal is expected to be up to 18 months, with works commencing in early 2024.

The works would generally be carried out during the following working hours:

- Monday to Friday: 7:00 am to 6:00 pm
- Saturday: 8:00 am to 5:00 pm
- Sunday and public holidays: no work.

3.3.5 Plant and equipment

The plant and equipment required for each of the proposed stages of construction are listed in Table 3-3.

Table 3-3: Proposed plant and equipment for each stage of the proposal.

Stage	Proposed Equipment	
1. Advance Works	• Bobcat with attachments • Up to 20 tonne excavator • Medium rigid trucks • Small trucks	• Wood chipper • Boom lift • Chainsaws • Light vehicles
2. Access tracks, working platform, and vegetation clearing	• 20-30 tonne Excavator • Heavy Rigid or Semi-Trailer Tippers • Rigid Trucks • 300-500 HP soil stabiliser • Stabilising agent spreader truck	• 12' Grader • Heavy Rigid Watercart • Light vehicles • Hand tools and equipment • Road broom

Stage	Proposed Equipment	
	• 16-21 tonne rubber tyre roller/ padfoot roller/ smooth drum roller	• Aggregate trucks
3. Bridge Demolition	• Excavator 12-32 tonne • Hydraulic breaker/shears (excavator mounted) • Concrete road saw • Concrete wall saw • Air powered hand jack hammer 75-90 pound size • Demolition saw (handheld)	• Cranes 50-300 tonne • Crane 25-50 tonne • Oxy cutting equipment • Tippers • Heavy haulage trucks • Aggregate trucks • Heavy rigid trucks
4. Bridge Construction	• Excavator 12-32 tonne • Excavator 12-20 tonne • Heavy haulage equipment • Pile driving rig 50-80 tonne • Crane 50-300 tonne • Hydraulic vibrating hammer 4-5 tonne (crane mounted) • Hydraulic impact hammer 5-9 tonne crane or rig mounted • Portable welding equipment	• Electric power tools (grinders etc.) • Concrete pump • Concrete agitators (trucks) • Concrete vibrators x 2 • Water pump flex drive x 2 • Air powered jack hammer • Air powered jack hammer • Air compressor to clean out formwork • Air powered scabbler • Motorised vibration screed • Water pump standard 2"
5. Final Roadworks Construction	• Heavy Rigid or Semi-Trailer Tippers • 20-30 tonne Excavator • Rigid Trucks • 12' Grader • Heavy Rigid Watercart x 2 • 16-21 tonne rubber tyre roller/ padfoot roller/ smooth drum roller • 300-500 HP soil stabiliser	• Stabilising agent spreader truck • Franna crane • Concrete trucks • Concrete vibrators and front-end loader • Bitumen truck used for sealing works • Aggregate trucks • Tractor with broom attachment • Rubber tyre rollers x 2

3.3.6 Earthworks

The construction of the access tracks, compound area and new bridge would require moderate earthworks as described In Section 3.3.1. Earthworks would include removal of grass and topsoil which would be stockpiled and used for land rehabilitation, as well as the removal of up to three trees. Specifically, earthworks would involve:

- Excavation and widening of downstream access track to access the waterway and through to the other bank of the waterway to reconnect with the Kamilaroi Highway
- Excavation and installation of rock scour protection in front of bridge abutments
- Excavation of the existing bridge abutments
- Excavation of bridge approaches finished to select material level
- Excavation and fill to accommodate crane pads supporting up to 300 tonne cranes on creek banks and in the waterway

Quantities of fill material required for earthworks are about 2,000 m^3 for the bridge approach embankments and access track. Material excavated to build the side-track (approved in a separate MWREF) and the proposal would be stored in stockpiles on site and reused for fill material. The anticipated material quantity required has been considered and two stockpile sites have been proposed to adequately and safely accommodate this material (see Section 3.1). These were established as part of the approved MWREF and would be reused for the proposal.

3.3.7 Source and quantity of materials

The source and quantity of materials would consider the requirements of the *NSW Sustainable Design Guidelines – Version 3.0*. Materials for final roadworks construction would be sourced from an appropriately licenced quarry or facility. In the event an approved B80 concrete mix cannot be sourced locally, a mobile batching plant would be situated within either of the two designated stockpile areas or compound area for use during construction of the proposal.

Key materials to be imported into the site include:

- Reinforcing steel and steel casing
- Road aggregate
- Clean rock
- In-situ concrete
- Prestressed precast concrete bridge planks
- Pavement gravel.

The proposal would require water for activities such as the compaction of earthworks and pavement layers and for dust suppression. Water needed for the works would be obtained from a Narrabri Council Standpipe or Spring Creek during periods of water flow.

3.3.8 Traffic management and access

The Kamilaroi Highway would remain open throughout construction. Traffic would be diverted from the existing alignment onto the approved temporary side-track for the duration of construction and demolition works. Traffic movement at the proposal area would be managed through a TMP. The posted speed on the temporary side-track would be 60 km/hr. Spring Creek is not a navigable waterway and would not require closure notification.

The side-track has been constructed to allow overtopping in a two-year ARI event. Should this occur during construction of the bridge, the side-track would be closed and local light traffic diverted via Culgoora Rd. This road is partially unsealed and is not suitable for long term heavy vehicle diversion. Heavy vehicles would be detoured via Moree, Collarenebri and Walgett. The impacts of this are discussed in Section 6.5.

Construction vehicles would access the proposal area via the Kamilaroi Highway from both the northern and southern approaches. From the Kamilaroi Highway, access to the downstream side of the existing structure and waterway area would be facilitated via new or reworked access tracks. A new access track would be constructed downstream of the existing bridge on the northern approach. This access track would connect both sides of the Kamilaroi Highway and enable safe passage across Spring creek for construction vehicles accessing the proposal area, the compound site and stockpile sites.

3.4 Ancillary facilities

An existing compound site with an area of about 1595 m^2 would be utilized at the southern approach, on the downstream side of the Kamilaroi Highway within the proposal area. Access to this compound site would be from the Kamilaroi Highway. Upon completion of construction and demolition, standard rehabilitation work would be undertaken for the compound site.

The compound site would include:

- Site office and amenities
- Light and heavy vehicle parking, including machinery storage
- Fuel and chemical storage.

There are two existing stockpile sites which were established for use during the construction of the approved side-track. One is located at the southern approach and one on the northern approach, both on the upstream side of the Kamilaroi Highway, within the proposal area. The stockpile sites contain regrowth groundcover and gravel. The stockpile sites are approximately 1292m^2 (southern) and 1674 m^2 (northern). Both stockpile areas would be accessed from the Kamilaroi Highway. The stockpile sites could also be used to establish a mobile batching plant to supply concrete for the project.

Transport would gain access to private property via lease and/or entry agreement to enable access to these existing sites.

Ancillary facilities are shown in Figure 3-1.

3.5 Public utility adjustment

No public utility adjustments would be required for the proposal.

3.6 Property acquisition

No property acquisition would be required for the proposal as the new bridge would be built on the existing alignment. Transport would obtain a lease, entry agreement or gain temporary access to land required for ancillary facilities under a Section 175 notice issued under the *Roads Act 1993.* Land temporarily required for the proposal would be used for stockpile and compound sites, temporary access tracks and working platforms. The affected areas would be rehabilitated to pre-existing condition upon completion of the proposal. Details of consultation with property owners are outlined in Section 5.2.

4. Statutory and planning framework

This chapter provides the statutory and planning framework for the proposal and considers the provisions of relevant state environmental planning policies, local environmental plans and other legislation.

4.1 Environmental Planning and Assessment Act 1979

The NSW EP&A Act and its associated regulations provide the framework for assessing environmental impacts and determining planning approvals for developments and activities in NSW. The EP&A Act also establishes State Environmental Planning Policies (SEPPs) and Local Environmental Plans (LEPs) which may include provisions relevant to the proposal.

This REF has been prepared under Division 5.1 of the EP&A Act and describes the level of impact that the proposed activity may have. It aims to address Transports duty with respect to considering the environmental impact of the proposed activity under Section 5.5 of the EP&A Act and clause 171 of the *Environmental Planning and Assessment Regulation 2021*.

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Transport and Infrastructure) 2021

State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP (Transport and Infrastructure)) aims to facilitate the effective delivery of infrastructure across the State.

Section 2.108 of SEPP (Transport and Infrastructure) permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposal is for road infrastructure facilities and is to be carried out by Transport, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (NSW). Development consent from council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not require development consent or approval under:

- State Environmental Planning Policy (Resilience and Hazards) 2021
- State Environmental Planning Policy (Planning Systems) 2021
- State Environmental Planning Policy (Precincts – Central River City)
- State Environmental Planning Policy (Precincts – Eastern Harbour City)
- State Environmental Planning Policy (Precincts – Regional) 2021
- State Environmental Planning Policy (Precincts – Western Parkland City) 2021.

Section 2.10 to 2.15 of SEPP (Transport and Infrastructure) contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Consultation, including consultation as required by SEPP (Transport and Infrastructure) (where applicable), is discussed in chapter 5 of this REF.

4.1.2 Local Environmental Plans

Narrabri Shire Council Local Environmental Plan (2012)

The proposal area is located within the Narrabri Shire Council Local Government Area (LGA) with land use planning governed by the *Narrabri LEP 2012*. The proposal is located within the road corridor and private land, both of which are zoned as RU1 - Primary Production.

The objectives of RU1 Primary Production are detailed in Table 4-1 with comparison to the proposal objectives.

Table 4-1: Comparison of the proposal consistency with zoning objectives of Narrabri LEP 2012

Zoning and objectives	Proposal consistency with objectives

RU1 Primary Production • *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.* • *To encourage diversity in primary industry enterprises and systems appropriate for the area.* • *To minimise the fragmentation and alienation of resource lands.* • *To minimise conflict between land uses within this zone and land uses within adjoining zones.* • *To allow for non-agricultural land uses that will not restrict the use of other land for agricultural purposes.*	The proposal is for a *non-agricultural land use (a bridge) which would not restrict the use of other land for agricultural purposes.* The provisions of SEPP (Transport and Infrastructure) override development consent requirements of the relevant LEPs and development consent from Narrabri Shire Council is not required.

4.2 Other relevant NSW legislation

4.2.1 Biodiversity Conservation Act 2016

The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community consistent with the principles of ecologically sustainable development.

Under the BC Act it is an offence to harm animals and plants, damage areas of outstanding biodiversity value and damage habitat of threatened species or ecological communities. Under Part 2, Division 2 of the Act, it is a defence if the harm or damage was necessary for the carrying out of a Division 5.1 EP&A Act activity undertaken in compliance with the determination, or undertaken consistent with a State significant infrastructure approval under Division 5.2 of the EP&A Act.

The BC Act establishes a test to establish whether a proposal or activity is “likely to significantly affect threatened species.” If an activity under Division 5.1 is likely to significantly affect threatened species, a Species Impact Assessment must be prepared.

A Biodiversity Assessment Report was prepared by AECOM (2022) which involved the relevant database searches, and a detailed field survey was undertaken in September 2022. The findings of this report are discussed in Section 6.1 and in Appendix C.

Significance assessments carried out indicated that there would be no significant impacts to any threatened species, populations or communities, and that a species impact statement is not required for the proposal.

4.2.2 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) covers all biosecurity risks, including pest animals, plant diseases and noxious weeds. The Biosecurity Act provides the regulatory controls and powers to manage noxious weeds in NSW and introduces the legally enforceable concept of a General Biosecurity Duty. This means that any person dealing with plant matter must take measures to prevent, minimise or eliminate the biosecurity risk (as far as reasonably practicable).

The proposal is located within the North West Local Land Services (LLS) region of NSW. The *North West Regional Strategic Weed Management Plan* (2017-2022) provides the framework for weed management within this region.

During construction of the proposal, disturbed areas, such as those in which earthworks are to be carried out, would be particularly susceptible to weed establishment. Mitigation measures to control weeds during construction of the proposal are detailed in Section 6.1.5 and 6.4.4.

4.2.3 Contaminated Lands Management Act 1997

The object of the *Contaminated Lands Management Act 1997* (CLM Act) is to establish a process for investigating and remediating land where required. The CLM Act allows the NSW Environment Protection Authority (EPA) to declare land as significantly contaminated land. The EPA may order a public authority to carry out actions or prepare a plan of management for significantly contaminated land.

A search was undertaken of the NSW EPA’s contaminated land register on 4 October 2022. No NSW EPA contaminated land records have been identified within the proposal area or the immediate surrounds.

4.2.4 Fisheries Management Act 1994

The objectives of the FM Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. The FM Act includes provisions for threatened fish and marine vegetation and associated threatening processes and is administered by the NSW Department of Primary Industries (DPI).

The FM Act applies to all waters within the limits of the State, except where Commonwealth legislation applies. Part 7A Division 4 of the FM Act prohibits, without a licence, activities that damage habitats or harm threatened species, populations or ecological communities. Activities which may require a permit under the FM Act include, but are not limited to, dredging works, reclamation work and works that would block fish passage.

Under clause 198A Definitions, the construction of temporary in stream structures during construction may be considered as reclamation being:

> *(a) using any material (such as sand, soil, silt, gravel, concrete, oyster shells, tyres, timber or rocks) to fill in or reclaim water land, or*
>
> *(b) depositing any such material on water land for the purpose of constructing anything over water land (such as a bridge)*

Under clause 199 of the Act, a public authority must provide the Minister with 21 days written notice of the proposal.

Clause 219 of the FM Act makes it an offence to obstruct fish passage without a permit issued under clause 200 of the Act. In-stream structures, such as rock platforms or sheet piling, may obstruct fish passage subject to the extent of works.

A review of the DPI (Fisheries) Fisheries Spatial Data Portal was undertaken by AECOM as part of the Biodiversity Assessment Report (see Appendix C). Spring Creek is an identified Key Fish Habitat.

DPI Fisheries has been consulted by Transport as part of the proposal (refer to Section 5.5).

4.2.5 Water Management Act 2000

The *Water Management Act 2000* (WM Act) provides for the sustainable and integrated management of the State's water for the benefit of both present and future generations. The Act controls the extraction and use of water and any activity that is in or near water sources in NSW. It provides for the implementation of water sharing plans that establish rules for sharing a water resource while taking into account the environmental need of the resource.

Section 56 of the WM Act establishes access licences for the take of water within a particular water management area. Under Schedule 4 Part 1 (2) of the Water Management (General) Regulation 2018, Transport as a roads authority is exempt from the need to obtain an access licence in relation to water required for road construction and road maintenance.

A search was undertaken on 5 October 2022 of licensed groundwater and surface water bores in or adjacent to the proposal area. This search identified the groundwater province as Great Artesian and the Bioregion as Darling Riverine Plains. The detailed results of these searches are discussed in Section 6.4.2.

4.2.6 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) provides for the conservation of buildings, work, relics and places that are of historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance to the State. Matters protected under the Act include items subject to an Interim Heritage Order and items listed on the State Heritage Register, the heritage schedules of local council LEPs, and the heritage and conservation registers established under Section 170 of the Act by State government agencies (Section 170 Registers). The Act also provides for the protection of archaeological 'relics', being any deposit, object or material evidence that relates to the non-Aboriginal settlement of NSW and is of State or local heritage significance.

The existing bridge is not listed on the Section 170 Register, therefore a Statement of Heritage Impact (SoHI) is not required, and a delisting package from Heritage NSW is not required to demolish the bridge.

4.2.7 Protection of the Environment and Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) aims to protect, restore and enhance the environments of NSW and reduce potential risks to human health and the environment.

The management of environmental impacts in relation to air, noise and water quality fall under the provisions of the POEO Act. The POEO Act identifies a number of pollution offences, including offences relating to:

- Wilful or negligent disposal of waste in a manner that is likely to harm the environment
- Wilful or negligent causing of a substance to leak, spill or otherwise escape in a manner that harms or is likely to harm the environment
- The pollution of water.

Under the provisions of the POEO Act, Transport is required to notify the EPA if a 'pollution incident' occurs that causes or threatens 'material harm' to the environment.

Environmental Protection Licences (EPL) are issued under Section 122 of the POEO Act for various scheduled development and activities. The proposal does not involve undertaking any scheduled activities as listed under Schedule 1 of the POEO Act, therefore an EPL is not required.

4.2.8 Roads Act 1993

The Roads Act 1993 (Roads Act) regulates the carrying out of certain activities on public roads, provides classification of roads and establishes procedures for opening and closing public roads. Under Section 138 of the Roads Act, it is an offence on a public road to erect a structure or carry out a work; dig up or disturb the surface; remove or interfere with a structure, work or tree; pump water into a road from adjoining land; and connect a road to a classified road without consent. As the proposal would involve work on Kamilaroi Highway, consent from Transport in the form of a Road Occupancy Licence and Speed Zone Authorisation under the Roads Act is required.

4.2.9 National Parks and Wildlife Act 1974

Section 86 of the *National Parks and Wildlife Act 1974* (NP&W Act) identifies offences relating to Aboriginal objects, including disturbing land to discover an artefact. Section 87(1) of the NP&W Act requires a permit to be obtained to remove any artefacts, while section 90(2) requires consent from the Minister for Planning to knowingly destroy, deface or damage a relic or Aboriginal place.

A search of the Aboriginal Heritage Information Management System (AHIMS) was undertaken on 5 October 2022 for the Proposal area. No known Aboriginal heritage items were identified in the search. As such, an Aboriginal Heritage Impact Permit is not required.

Stage 1 of the Roads and Maritime Services' Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) has been undertaken for the Proposal and concluded that the Proposal is unlikely to have an impact on Aboriginal cultural heritage (Appendix E).

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act, a referral is required to the Australian Government for proposed actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land. These are considered in Appendix D and Section 6.

A referral is not required for proposed road activities that may affect nationally-listed threatened species, endangered ecological communities and migratory species. This is because requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted under the EPBC Act by the Australian Government in September 2015.

Potential impacts to these biodiversity matters are also considered as part of Section 6 of the REF and Appendix C.

Findings - matters of national environmental significance

The assessment of the proposal's impact, on matters of national environmental significance and the environment of Commonwealth land, found that there is unlikely to be a significant impact on relevant matters of national environmental significance or on Commonwealth land. Accordingly, the proposal has not been referred to the Australian Department of Climate Change, Energy, the Environment and Water under the EPBC Act.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of road infrastructure facilities and is being carried out by or on behalf of a public authority. Under section 108 of SEPP (Transport and Infrastructure) the proposal is permissible without consent. The proposal is not State significant infrastructure or State significant development. The proposal can be assessed under Division 5.1 of the EP&A Act.

Transport is the determining authority for the proposal. This REF fulfils Transport's obligation under section 5.5 of the EP&A Act including to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

5. Consultation

This chapter discusses the consultation undertaken to date for the proposal and the consultation proposed for the future.

5.1 Consultation strategy

Consultation has occurred with the following key stakeholders

- The local landholders
- Narrabri Shire Council
- NSW State Emergency Service (SES)
- DPI (Fisheries)
- DPE (Water)
- Water NSW
- Natural Resources Access Regulator (NRAR).

Further consultation would continue through the lifetime of the proposal.

5.2 Community involvement

A Community Engagement Plan (CEP) will be prepared for the proposal to provide timely and accurate information to the community during construction. The CEP will include:

- Mechanisms to provide details and timing of proposed activities to affected residents including changed traffic conditions, contact name and a number for complaints
- Information for road users on changed conditions and timeframes. Consultation would be undertaken with potentially affected residents prior to commencement of, and during the proposed work in accordance with the Roads and Maritime Community Involvement and Communications Resource Manual. Communication would include letter box drops or newsletters containing information on the proposed works, working hours, anticipated duration, and contact name and number for complaints
- Liaison initiatives including:
  - Compilation of a community stakeholder list
  - Provision of media releases and traffic alerts
  - Notification / consultation letters
  - Development and management of a complaints register
  - Direct consultation with community stakeholders.

Extensive consultation with the landholder and property manager of 87 Bald Hill Road, Narrabri has been undertaken. Transport has formalised a lease/entry agreement with the landowner of the agricultural property required for the construction access side-track and siting of stockpiles and the compound area as part of the existing MWREF approval. The affected area would be rehabilitated to pre-existing condition upon completion of the proposal. In addition, Transport would assist with fencing requirements north of the proposal area as compensation for use of the land for the extent of the proposal.

5.3 Aboriginal community involvement

Involvement of the Aboriginal community in Transport proposals is carried out following the provisions of the Transport Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime, 2011). The PACHCI provides for consistent and effective consultation with Aboriginal stakeholders where a Transport activity may impact upon

Aboriginal cultural heritage values. A summary of the stages and assessment involved with the PACHCI is available in Table 5-1 below.

The PACHCI is generally consistent with the Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (Department of Environment, Climate Change and Water, 2010).

A Stage 1 PACHCI assessment was conducted for the proposal and involved a site walk over of the proposal area by a Transport Aboriginal Cultural Heritage Officer on 19 September 2022. The findings of the desktop assessment and site walkover are discussed further in Section 6.8.

Table 5-1: Summary of Transport's Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Stage	Description
Stage 1	Initial assessment by Transport.
Stage 2	Site survey and further assessment.
Stage 3	Formal consultation and preparation of a cultural heritage assessment report.
Stage 4	Implement environmental impact assessment recommendations.

5.4 SEPP (Transport and Infrastructure) consultation

Narrabri Shire Council was consulted regarding the proposal as per the requirements of Section 2.12 of the SEPP (Transport and Infrastructure). A consultation letter was issued to Narrabri Shire Council on 26 October 2022. A response was received on 31 October 2022 which noted that the current bridge design has incorporated the outputs of hydraulic modelling to ensure there are no adverse effects to current flood behaviour.

NSW SES was consulted as per requirements of Section 2.13 of the SEPP (Transport and Infrastructure). A consultation letter was issued to NSW SES on 26 October 2022. A response was received on 23 November 2022 which noted that the proposal appears to have a minimal impact to the NSW SES response operations, however, considerations to reduce any flood risk will benefit the community.

Appendix F contains a SEPP (Transport and Infrastructure) consultation checklist that documents how SEPP (Transport and Infrastructure) consultation requirements have been considered. The consultation letters and responses are also provided in Appendix G.

Issues raised from this consultation are outlined in Table 5-2 below.

Table 5-2: Issues raised through SEPP (Transport and Infrastructure) consultation

Group	Issue/ item raised	Response / where addressed in REF
Narrabri Shire Council	No adverse afflux should be created in respect to nearby council-managed infrastructure assets or residential properties.	Refer to Section 6.5.3 and Appendix H.
	An aboriginal cultural heritage assessment should be undertaken as part of the REF.	Refer to Section 6.8 and Appendix E.
SES	Consider the impact of flooding on the infrastructure, up to and including the Probable Maximum Flood Level.	Refer to Section 6.5 and Appendix H.
	If relevant, pursue site design and stormwater management that minimises risk to the community	Refer to Section 6.4.
	Ensure workers and people using the site during and after the upgrades are aware of the flood risk	Refer to Section 7.2

5.5 Government agency and stakeholder involvement

DPI (Fisheries), DPE Water, Water NSW and NRAR were invited to comment on the proposal on 26 October 2022. Issues that have been raised as a result of these invitations are summarised below in Table 5-3, and verbatim is provided in Appendix G.

Table 5-3: Issues or items raised through stakeholder consultation

Agency	Issues/ Items raised	Response / where addressed in REF
DPI (Fisheries)	Temporary blockages to fish passage through waterway works	Refer to Section 3.3.1 and 6.1 for Transport's standard measures.
	Maintenance or improvement to the cross-sectional area of the waterway	Refer to Sections 3.3.1 and 6.4.3 for Transport's standard measures.
	Damage to riparian vegetation	Refer to Sections 6.1 and 6.4.3 for Transport's standard measures.
	Bank stabilisation and rehabilitation	Refer to Sections 3.3, 4.2.4 and 6.1.
	Removal and realignment of snags	Refer to Section 6.1 for Transport's standard measures.
	Threatened species, populations and ecological communities	Refer to Section 6.1 for Transport's standard measures.
Water NSW	Gully erosion should be accounted for in the design and construction methodology	Refer to Section 6.5.3 for scour protection considerations.
	Adequate mitigation measures must be included in the REF to address impacts to water quality and flooding risk. The works must be carried out in a manner that would prevent or minimise impacts on water quality, environmental damage and fire. • Appropriate and adequate dust suppression measures must be undertaken to prevent dust and windblown debris leaving the proposal site. • Effective erosion and sediment controls, designed, installed and maintained in accordance with *Landcom's 2004 'Blue Book'*, must be installed prior to construction and be regularly maintained and retained until works have been completed and the ground surface stabilised or groundcover re-established.	Refer to Section 6.5.4 and Section 6.4.4.
	Potential biosecurity risks must be appropriately addressed and mitigation measure included	Refer to Section 6.1.5 for Transport's standard and additional measures.

	Rehabilitation of the proposal area should occur following the completion of construction.	The proposal area would be rehabilitated following the completion of construction, as outlined In Section 3.3.1.
	An unexpected cultural heritage finds protocol must be in place for the duration for construction.	Refer to Section 6.8.4 for Transport's standard measures.
	An unexpected contaminated or hazardous material finds encountered protocol must be in place for the duration of construction.	Refer to Section 6.12.3 for Transport's standard measures.
	Spills must be managed in accordance with the measures outlined within a CEMP or as otherwise stated within the REF	Refer to Section 6.3.4 for Transport's standard measures.
	All waste generated from the works must be removed off site and disposed of at a licenced waste facility.	Refer to Section 6.12.3 Transport's standard measures.
	All spill or contamination incidents that affect or could affect WaterNSW lands shall be reported to EPA	Refer to Section 6.3.4 for Transport's standard mitigations.
NRAR	No response	-
DPIE (Water)	No Response	-

5.6 Ongoing or future consultation

Transport would continue to inform residents and stakeholders of the ongoing development of the proposal. This would be carried out using methods such as the distribution of community updates, emails to the stakeholder database, social media posts and updates on the proposal website.

Transport would advise residents and road users of the start of construction and potential delays to motorists with the use of temporary electronic Variable Message Signs (VMS) that would be placed along the Kamilaroi Highway (HW29). The work would also be added to the Transport Live Traffic Website as 'scheduled road work' to provide advance notice to motorists of the potential delays and to allow for travel time adjustment where possible. A stakeholder database and issues register would also be managed by Transport. Meetings and briefings would be arranged for ongoing consultation as needed.

Construction is anticipated to commence in early 2024, with the proposal to be operational in early to mid-2025. Transport would inform the community of the construction period dates prior to commencement and would continue to inform the community throughout construction.

Targeted consultation during both the pre-construction and construction phases of the proposal would be carried out with:

- Narrabri Shire Council
- NSW SES
- DPI (Fisheries)
- Water NSW
- Businesses, agricultural operations, stake holders in the locality and freight companies.

6. Environmental assessment

This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment, potentially impacted upon by the proposal, are considered. This includes consideration of:

- Potential impacts on matters of national environmental significance under the EPBC Act.
- The factors specified in the Guideline for Division 5.1 assessments (DPE 2022) and as required under section 171 of the Environmental Planning and Assessment Regulation 2021 and the Roads and Related Facilities EIS Guideline (DUAP 1996). The factors specified in section 171 of the Environmental Planning and Assessment Regulation 2021 are considered in Appendix D.
- Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

6.1 Biodiversity

A Biodiversity Assessment Report (2023) was prepared by AECOM following a field survey undertaken on 19 September 2022, by a qualified ecologist.

For the purposes of the biodiversity assessment, a desktop search area of up to 10 kilometres was used to understand the ecological context of the proposal area. A field survey was undertaken assessing the biodiversity values associated with land that is likely to be affected by the construction of the proposal and the operational footprint of the new bridge.

6.1.1 Methodology

Desktop Review

Database searches were conducted to collect and review information on the presence or likelihood of occurrence of threatened biota within the proposal area. The following databases were reviewed:

- Bureau of Meteorology Atlas of Groundwater Dependent Ecosystems (GDE)
- DPE Spatial Layer of HEVAE Vegetation Groundwater Dependent Ecosystems Value in NSW
- NSW DPE BioNet Database within a five kilometre radius of the proposal area
- NSW DPE Vegetation Types Database and Threatened Species Profile Database
- Protected Matters Report that documents all Matters of National Environmental Significance (MNES) within a five kilometre radius of the proposal area
- NSW DPI – Fisheries spatial data portal
- NSW Department of Primary Industries WeedWise Priority Weeds List
- NSW Department of Primary Industries database for threatened species and aquatic TECs.

The results of the database searches are listed in Section 6.1.2.

Field Survey

A field inspection was undertaken on 19 September 2022 of the proposal area and immediate surrounds. The survey included an assessment of vegetation present and opportunistic fauna sightings. No detailed fauna survey was undertaken, though an assessment of fauna habitat within the proposal area was carried out. No instream aquatic survey was undertaken, although aquatic conditions were noted from the riverbank. As no threatened species were recorded or considered likely to occur within the proposal area, targeted threatened fauna or flora surveys were not conducted.

Vegetation mapping

Native vegetation was reviewed for the proposal area using the NSW State Vegetation Type Map. The presence of native vegetation and plant community types was verified by the field survey.

6.1.2 Existing environment

The proposal area is located within, and adjacent to, the riparian zone of Spring Creek. Both eastern and western riparian areas are characterised by gentle slopes from the bank towards the water line. It is noted that the stream in this general region meanders, suggesting that there is a risk of ongoing channel migration.

The landscape surrounding the proposal area is predominantly characterised by agricultural production, scattered rural residences and native vegetation. The private land adjacent to the Kamilaroi Highway consists of cleared agricultural land including access tracks and areas of isolated trees.

The broader area around the proposal area is generally agricultural, comprised of cropping and grazing, with substantial areas along the nearby Namoi River subject to irrigation. These areas also include farmhouses, sheds and other infrastructure such as grain storage.

Native vegetation

NSW State Vegetation Type Mapping indicates the potential presence of two plant community types (PCTs), including PCT 39 and PCT 78 within and around the proposal area (refer to Figure 6-1). These consist of:

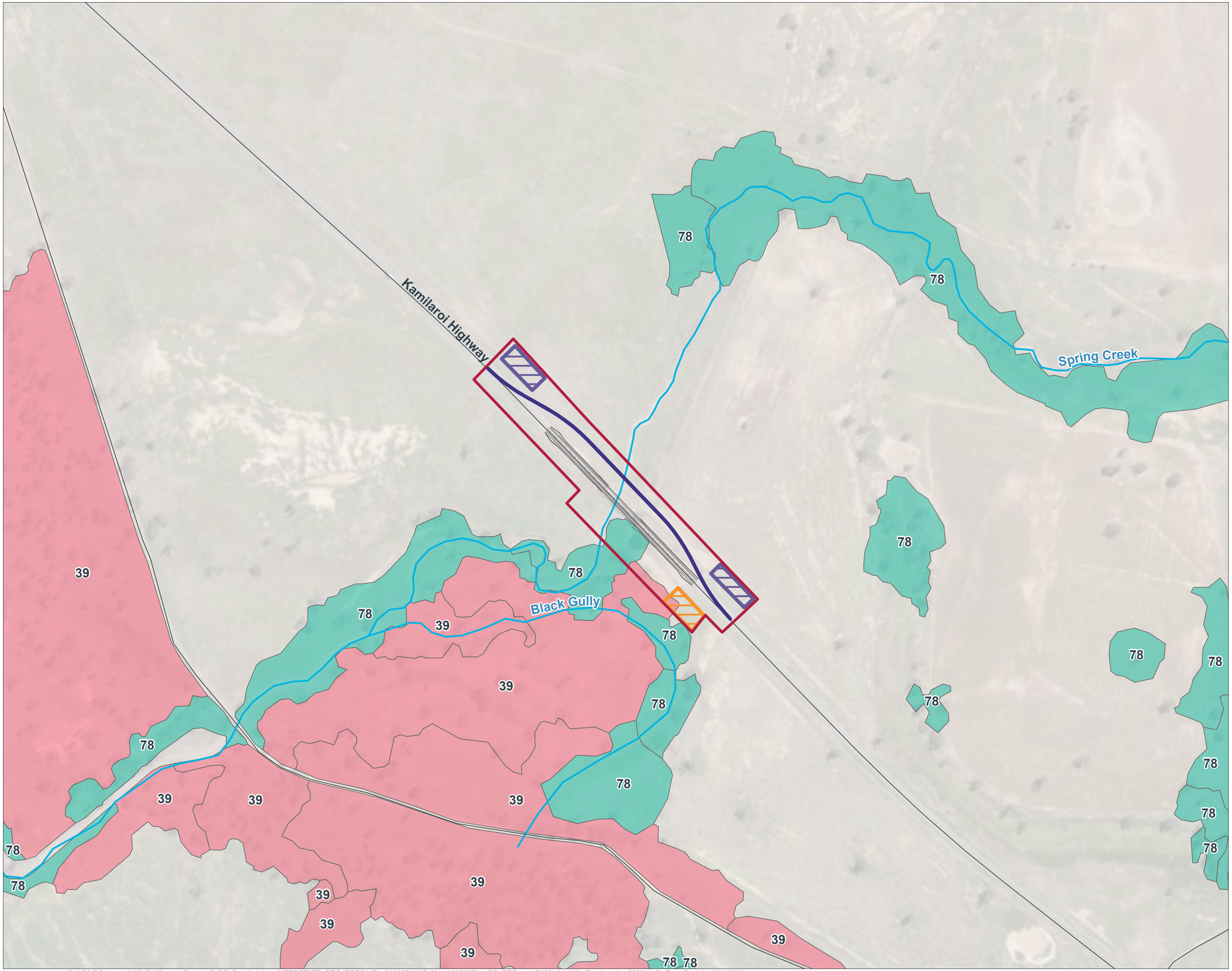
- PCT 39 - Coolibah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion
- PCT 78 - River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion.

From the field inspection, the vegetation within the proposal area was not identified as an accurate representation of the mapped PCTs, and as such were not identified to be present within the proposal area (as shown in Table 6-1). The proposal area also contains some areas of non-native vegetation due to the agricultural land use of the surrounding area and historic invasion by exotic species.

Table 6-1: Plant community types within the proposal area

PCT	Community name	Potential Threatened Ecological Community (TEC) based on desktop searches	Total previously mapped within the proposal area (hectares)	Total within the proposal area based on inspection (hectares)
PCT 39	Coolibah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	BC Act: Artesian Springs Ecological Community in the Great Artesian Basin, Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions, Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	0.13	0
PCT 78	River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	Nil	0.27	0
Total			0.4	0

FIGURE 6-1:
PROPOSAL AREA AND MAPPED PCT



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0 100 200

Legend

- Proposal area
- Compound
- Stockpile
- Proposed design
- Approved (MWREF) side-track
- Road
- Watercourse

Plant Community Types

- (Forested Wetlands) River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion
- (Semi-arid Woodlands (Grassy sub-formation)) Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion

Source: Maxar

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Fauna habitat

Fauna habitat within the proposal area is minimal, with the majority of the area being cultivated or grazed regularly. Fauna habitat features within the proposal area include:

- Four mature *Eucalyptus camuldulensis* on the eastern bank of the creek
- Two dead standing trees (located on the western bank either side of the Kamilaroi Highway)
- Logs and woody debris on the eastern bank north of the Kamilaroi Highway
- Native and exotic pasture grasses and weeds within the roadside reserve
- No logs or branches observed within the creek on the day of inspection

In an area about 1.5 kilometres beyond the proposal area, fauna habitat was categorised from available vegetation mapping as:

- Small stands of *Eucalyptus camaldulensis* among both native and exotic pastures, three of which housed hollows about 5-10 cm in diameter
- Cleared agricultural land with isolated paddock trees
- Sparse open woodland mapped as PCT 39 and which is suspected to contain a mix of *E. coolabah, E. camuldulensis and E. largiflorens*
- Riparian vegetation
- Farm dams with up to 1000 metre areas.

Priority weeds

There were no eradication priority weeds identified within the proposal area. The exotic species African boxthorn (*Lycium ferocissimum*) was found within the proposal area. This species is listed as 'manage' under the *Biosecurity Act 2015*.

Threatened Ecological Communities

A search of the NSW Bionet Atlas and the Commonwealth Protected Matters Search Tool identified four Threatened Ecological Communities (TECs) present within a five-kilometre search area. Three of these were associated with PCTs mapped for the area, including:

- Artesian Springs Ecological Community in the Great Artesian Basin (Listed BC Act, Critically Endangered)
- Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions (Listed BC Act, Endangered and EPBC Act, Endangered)
- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Listed BC Act, Endangered).

As the PCTs associated with these TECs were not considered present within the proposal area following the survey, no TECs were considered present within the proposal area.

Groundwater Dependant Ecosystems

A review of the Groundwater Dependant Ecosystems Atlas (Bureau of Meteorology 2022) identified the majority of the proposal area has low potential for GDE. No known low, medium or high potential aquatic GDEs are within the vicinity of the proposal. One medium probability aquatic GDE is mapped along Bohena Creek about 1.65 kilometres west of the proposal.

Threatened species

A search of the NSW Bionet Atlas and the Commonwealth MNES tool indicated potential for 25 threatened and nine migratory species to be present within a five kilometre radius of the proposal area. There are several records within the surrounding area (refer to Figure 6-2) including Regent Honeyeater, Corben's Long-eared Bat and Grey-headed Flying-fox, as well as less mobile species such as Five-clawed Worm-skink and Pink-tailed Worm-lizard. Threatened plants in the area include Five-finger Panic Grass, Bluegrass and Spiny Pepper-cress. While none were recorded as present during the inspection of the proposal area, there remains potential for threatened species to be present within the proposal area.

During the field inspection four Dusky Woodswallows (*Artamus cyanopterus cyanopterus*) were observed foraging within the proposal area. The Dusky Woodswallow are listed as vulnerable under the BC Act.

Figure 6-2: Bionet Atlas threatened species

Aquatic environment

Spring Creek Bridge crosses Spring Creek, which is a fourth order stream part of the Lower Namoi River Catchment. Spring Creek is listed as Key Fish Habitat by DPI Fisheries. Review of threatened fish habitat mapping (DPI 2022) indicated the potential for the following species to be present within Spring Creek:

- Eel Tailed Catfish (*Tandanus tandanus*)
- Purple Spotted Gudgeon (*Mogurnda adspera*).

A search of the NSW DPI Fisheries Spatial Data Portal identified the creek through this area as "Fair" freshwater fish community status. As outlined previously, the water within Spring Creek was observed as heavily sediment-laden, with no branches or logs observed within the creek.

Areas of outstanding biodiversity value

There are no records of land of outstanding biodiversity value within or surrounding the proposal area.

Wildlife connectivity corridors

The proposal is largely surrounded by agricultural lands, and as such wildlife connectivity is patchy as there are large areas of land cleared or nearly completely cleared of native vegetation. Remaining native vegetation is limited to riparian vegetation and scattered paddock trees.

6.1.3 Avoidance and minimisation

A key part of Transport's management of biodiversity for this proposal is the application of the 'avoid, minimise, mitigate and offset' hierarchy as follows:

- Avoid and minimise impacts
- Mitigate impacts
- Offset impacts in accordance with Transport's guidelines.

Key actions taken to avoid and minimise ecological impacts are outlined in Table 6-2 below:

Table 6-2: Avoidance and minimisation measures undertaken by Transport

Avoid	Minimise
• The overall footprint of the proposal has been selected to minimise the amount of clearing required. This has included the avoidance of existing riparian vegetation along Spring Creek adjacent to the proposal area • The location of the new bridge has been selected to be on the same alignment as the existing bridge to avoid new permanent impacts on habitat upstream or downstream of the alignment • The proposed ancillary facilities are to be located within areas already cleared of vegetation • The design of the new bridge has been selected to enable the removal of the existing box culvert structure. This includes the removal of the base slabs and the return of the creek bed to a more natural state	• The extent of vegetation clearing has been reduced to the minimum to enable the proposal to be constructed safely and efficiently • The amount of rock platform within the creek bed has been minimised as far as practical in order to allow the project to be constructed safely • The extent of piers and footings within the channel of Spring Creek have been minimised as far as possible to reduce the degree of potential blocking of fish passage.

6.1.4 Potential impacts

Construction

Removal of vegetation

The proposal would impact upon 4.3 hectares of native and exotic pasture grasses within the road reserve, and two *Eucalyptus camaldulensis.* No PCTs were determined as present within the proposal area and no vegetation to be removed were identified to form part of a TEC.

Based on the degree of vegetation removal required, the context of the surrounding lands, and the safeguards proposed, the overall impact associated with vegetation loss within and around the bridge would be minor and is not considered to be significant.

Removal of threatened fauna habitat

The proposal would include the removal of a mix of native and non-native vegetation in the form of native and exotic pasture grasses, and the removal of two *Eucalyptus camaldulensis*. The removal of this species may potentially reduce nesting and roosting habitat for Dusky Woodswallows (*Artamus cyanopterus cyanopterus*). However, given the presence of larger stands of *Eucalyptus camaldulensis* both upstream and downstream of the proposal and the minimal vegetation clearance required, this impact is not expected to be significant. Additionally, a dead standing tree on the northern side of Spring Creek bridge would require removal for construction of the proposal.

Woody debris would be removed for the proposal on the northern side of Spring Creek bridge which has the potential to provide habitat for small native fauna. Removal of this debris would unlikely cause significant impacts on the availability of fauna habitat in the area. Roadside vegetation along the Kamilaroi Highway consists primarily of disturbed native and non-native grasses and removal of this vegetation would not likely result in a significant impact to fauna.

Given the surrounding landscape character and the presence of no hollow bearing trees within the proposal area, to ameliorate the impacts, recommended safeguards would be implemented.

Construction of the proposal would require demolition of the existing bridge, a potential microbat habitat. However, the existing bridge was inspected and does not provide habitat for microbats. Demolition of the bridge would not likely significantly impact threatened or non-threatened microbat habitat. Following completion of the proposal it would be likely that the new bridge structure would provide potential microbat habitat.

Construction impacts which may arise from the use of machinery and equipment include:

- Increased risk of accidental spills of fuels, lubricants or paints
- Dispersal of weeds (terrestrial and aquatic).

Threatened species and ecological communities

No threatened fauna species were recorded in the proposal area during the site inspection, and no potential habitat for threatened species was present.

While no threatened aquatic species were recorded in the proposal area during the site inspection, suitable habitat was identified from the side of the creek, for the following species:

- Eel Tailed Catfish (*Tandanus tandanus*) – slow-flowing areas with cobble and gravel beds. It is often found around undercut banks
- Purple-Spotted Gudgeon (*Mogurnda adspersa*) – slow-flowing waters with overhanging bank vegetation and snags.

Tests of significance (ToS) concluded the proposal would not have a significant impact on these species as the proposal would unlikely place a local occurrence of these species at risk of extinction.

Although no threatened fauna species were recorded in the proposal area, suitable potential habitat for the following species was present:

- Grey Falcon (Falco hypoleucos) – Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey.

- Black-Necked Stork (Ephippiorhynchus asiaticus) - Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.

ToS concluded the proposal would not have a significant impact on these species, as the proposal would unlikely place a local occurrence of these species at risk of extinction.

Aquatic impacts

Construction of the proposal would require several activities that have the potential to result in impacts upon the aquatic environment of Spring Creek, including:

- Construction of the temporary rock platforms: there is potential to temporarily restrict water flow and fish passage through the proposal area. Temporary steel pipes would be installed to reduce this risk.
- Permanent bridge piers: the proposed bridge piers would be placed within the waterway in a manner which would generally improve fish passage compared to the existing structure.
- Increased sediment loads within the waterway: Spring Creek was noted to have an existing high level of sediment load prior to construction. While the proposal has the potential to result in increased sedimentation risks to the waterway this would be managed through the implementation of standard soil and water safeguards.
- Spills: during construction there is the potential for substances associated with the works such as oil, petrol, paint, solvents and other materials to be spilled and enter the waterway. The risk of such events would be managed through the implementation of standard safeguards.
- Underwater noise: the noise of piling in the creek bed is likely to result in direct disturbance of aquatic fauna, particularly fish. Given the energy of the piling hammer this has the potential to result in temporary or permanent disturbance for fish or even mortality for those in close proximity. In order to manage this risk, it is proposed that all piling commence with a ‘soft start’ approach so as to provide an opportunity for fish to disperse.

In addition to the impact above, the consequences of aquatic impacts have been considered as per NSW DPI’s *Policy and guidelines for fish habitat conservation and management* (the fish habitat guideline). Based on the criteria outlined in this document, Spring Creek is considered to be 'Type 2 - Moderately Sensitive Key Fish Habitat' as well as 'Class 2 - Moderate Key Fish Habitat'. Refer to Appendix C for the full assessment.

As the installation of temporary steel pipes within the waterway would provide water flow and fish passage that would otherwise be obstructed by construction of the new bridge structure, it is not necessary to obtain a permit for the obstruction of fish passage from the Minister for Primary industries in order to operate the proposal as per section 219 of the *Fisheries Management Act 1994.* Transport must also undertake the works in accordance with the Code of Practice for Minor Works in NSW Waterways, or alternatively, provide notification to the Minister 21 days prior to carrying out dredging or reclamation work within the river.

Injury and mortality

During construction, potential injury and mortality impacts on fauna may arise from the movement of plant and machinery and removal of mature vegetation to facilitate the proposal. Although the existing road already poses a threat to native fauna for injury, mortality and displacement, it is likely the risk would be higher during construction, particularly during vegetation or habitat feature clearing. This would be somewhat mitigated by the generally slower speed of construction vehicles and machinery, as well as general traffic, and through the implementation of mitigation measures as outlined in Section 6.1.5.

Groundwater dependant ecosystems

The new bridge requires three sets of piers within the waterway and one set at each abutment of the new bridge. The piers would be constructed by driving steel tubular piles into the creek bed, which would then be filled with concrete. This may involve pump out of infiltrating groundwater in order to set the concrete which would have a negligible impact on the groundwater and associated GDEs.

Edge effects on adjacent native vegetation and habitat

Edge effects are likely to arise from construction activities including earthworks and movement of soil. The proposal area currently contains invasive forbs such as Buchan Weed, Sweet Clover, Sow Thistle, Patterson's Curse and Black Nightshade, all of which have the potential to migrate into newly cleared areas. Given the safeguards and mitigation measures proposed, this impact is not anticipated to be significant.

Invasion and spread of weeds

The movement of vehicles and personnel into and throughout the proposal area has the potential to facilitate the spread of weeds. Weeds are easily transported as seeds and propagules on machinery brought to the proposal area and can be spread around the proposal area during construction. With the implementation of management measures, the potential spread of weeds during the construction phase of this proposal is considered to be minimal.

Invasion of pests and pathogens

The proposal area is likely to be utilised by a range of vertebrate pest species. Impacts from pest species are likely to include ongoing grazing and predation on small to medium native fauna. The proposal is unlikely to alter the occurrence of pest species in and around the proposal area, either positively or negatively, due to the localised nature of the works. As such the overall impact in this regard is considered to be neutral with respect to the baseline scenario.

The proposal has the potential to spread pathogens into the proposal area through the movement of machinery and personnel, including myrtle rust and phytophthora fungus, or animal disease such as chytrid fungus, which affects amphibians. The inspection undertaken within the proposal area did not identify any of these pathogens or dieback to be present, and assuming this to be true, suitable hygiene measures would likely reduce the risk of introduction of such pathogens to low.

Changes to hydrology

The construction of the proposal would involve the installation of temporary instream rock working platforms and access tracks. These structures would be placed in the waterway with pipe culverts ensuring surface water flow and providing some level of flood resistance. These structures can potentially detain water, increasing inundation. However, given the morphology of the waterway channel, it is unlikely they would greatly alter water flow in the event of flooding. Refer to Section 6.5.3 for more information regarding hydrology impacts.

Noise, light, dust and vibration

During construction, noise, light, dust and vibration impacts may arise from:

- Movement and use of machinery and personnel
- Driving of tubular steel piles in the waterway
- Demolition of the bridge.

The installation of the piles is likely to result in increased noise, which may result in direct disturbance to some fauna, particularly aquatic fauna within the waterway. This impact is not likely to be substantial however given that piling would include a soft start procedure and would not be a continuous process during the work shift.

Given construction would only be carried out between 7am and 6pm at the latest, the potential for disruption to nocturnal species would be reduced. Despite this, measures should be implemented to reduce the potential for adversely affecting these individuals. However, no additional safeguards have been recommended for noise, light dust and vibration as there are no significant impacts likely during operation of the proposal.

Wildlife connectivity and habitat fragmentation

The proposal would result in the clearing of up to 4.3 hectares of vegetation consisting of a mix of native and exotic pasture grasses, to provide sufficient room for key features of the proposal.

Canopy vegetation in this location is largely restricted to four *Eucalyptus camaldulensis* located on the eastern bank of the creek. Removal of only two of these *Eucalyptus camaldulensis* individuals are required for the proposal. In the east of the proposal area and south of the Kamilaroi Highway, construction of the widened approaches to the new bridge would require clearing of areas found to be mostly consisting of a mix of low condition native and exotic grasses.

Removal of the *Eucalyptus camaldulensis* would expand the gap in riparian vegetation by approximately 60 metres. Whilst this corridor is already interrupted by the existing bridge and approximately 350 metres of cleared riparian areas north of the proposal, this gap would be expanded to facilitate construction and demolition access, as well as ongoing maintenance. In the context of the broader regional landscape which has been subject to significant historic clearing for agriculture, the riparian corridor takes on an increased importance for fauna movement. Whilst the degree of disruption to this corridor is not expected to fragment local populations or threatened species, measures are recommended to mitigate this impact in the long term. These include the absolute minimisation of vegetation removal to facilitate construction, as well the revegetation of this corridor post-construction to close this gap.

Operation

Injury and mortality

The widened approaches to the new bridge would increase the distance of travel for fauna crossing the highway. This increased distance would increase the time spent crossing and would increase the chances of vehicle strike, particularly for ground-dwelling species. However, given the limited extent of existing vegetation in the road reserve and the absence of connectivity north of the highway to the river, the desire for such crossing is expected to be minimal. On this basis, the increased likelihood of injury or mortality is not expected to result in any significant impact.

Invasion and spread of weeds

The operation of the proposal would likely not present any additional or ongoing risk in terms of the spread of weeds. The rehabilitation of disturbed areas after the completion of construction activities would limit the establishment and spread of weed species during operation.

Invasion of pests and pathogens

The operation of the proposal would not present any additional or ongoing risk in terms of the spread of pests or pathogens in line with existing operations.

Changes to hydrology

Operation of the proposal would provide a widened waterway opening compared to existing, with a 64-metre-wide channel as abutments would be set back to accommodate the longer deck length. The bridge deck would be approximately 0.5 metres above the level of the existing bridge in its current state.

Noise, light, dust and vibration

Operational noise is expected to be the same as existing conditions, given there are no changes to traffic speed limit or traffic volume.

Conclusion on significance of impacts

The proposal is not likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the *BC Act, 2016* or *FM Act 1994* and therefore a SIS or BDAR is not required.

The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the EPBC Act.

6.1.5 Safeguards and management measures

Table 6-3: Biodiversity safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible.	Transport, Contractor	Detailed design / pre-construction
Aquatic Impacts	Sediment and erosion controls for in-stream works will be used to avoid impacts on water quality and fish passage, e.g. erosion fencing, stockpile covers and silt curtains.	Contractor	Construction
Aquatic Impacts	Work will be undertaken in accordance with the Code of Practice for Minor Works in NSW Waterways (Roads and Maritime Services, 2014).	Contractor	Construction
Aquatic impacts	Restrict substructure works to periods of normal flow (i.e. no work during flood periods).	Contractor	Construction
Aquatic impacts	Place stockpiles in designated stockpile locations such that they are not subject to a 1 in 10 year flood event i.e. at top of banks.	Contractor	Construction

Aquatic impacts	Replace/add snags into the waterway post-construction where practicable so as to replicate the pre-construction condition.	Contractor	Post- construction
Aquatic impacts	Rehabilitation of vegetation within the riparian zone upon completion of construction including revegetation with local native species, e.g. *E. camaldulensis and C. glauca.*	Contractor	Post- construction
Aquatic impacts	Aquatic habitat will be protected in accordance with *Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 Standard precautions and mitigation measures of the *Policy and guidelines for fish habitat conservation and management Update 2013* (DPI 2013).	Contractor	Construction
Vegetation removal	All vegetation removal will be limited to the minimum extent necessary to construct the bridge and approaches, and demolition and removal of the temporary diversion track.	Contractor	Construction
Vegetation removal	Prior to the commencement of any works, a physical clearing boundary is to be demarcated and implemented. The demarcation of the exclusion zone will be in accordance with *Biodiversity Guidelines – Protecting and Managing Biodiversity on RTA Projects: Guide 2: exclusion zones* (RTA 2011).	Contractor	Construction
Vegetation removal	A 'Clearing and Grubbing Plan' will be developed in accordance with Guide 4 (clearing of vegetation) of the *Transport for NSW Biodiversity Guidelines* (RTA 2011). This will include best practice methods for the removal of woody vegetation and non-woody vegetation.	Transport, Contractor	Pre-construction, Construction
Vegetation removal	As mature trees with a DBH >40 cm diameter are proposed to be cleared, an ecologist or Transport Environment Officer must be on site to undertake a pre-clearance survey prior to and whilst the tree/s are being removed (*see Biodiversity Guidelines – Protecting and Managing Biodiversity on RTA Projects: Guide 1 Pre-clearing Process and Guide 4 Clearing of vegetation and removal of bushrock* (RTA 2011).	Transport, Contractor	Pre-construction, Construction
Vegetation removal	Within the riparian area, the sections of felled trees including hollows should be placed on the ground to provide habitat for ground-dwelling fauna, where practicable.	Contractor	Construction
Protection of native flora	If unexpected, threatened flora species are discovered, stop works immediately and follow the *Biodiversity Guidelines – Protecting and Managing Biodiversity on RTA Projects: Guide 1 (Pre-clearing process)* (RTA 2011).	Contractor	Construction
Protection of fauna and habitat	Construction of the new bridge should include the rehabilitation of the temporary side track upon removal. This should include removal of the existing pavement and tilling to allow the regeneration of native plants.	Contractor	Pre-construction, construction, post-construction
Protection of fauna and habitat	Transport will contribute to the Transport Conservation Fund in accordance with the Tree and Hollow Replacement Guidelines (Transport for NSW, 2022). Fund contributions are detailed in Table 2-2 of the Guidelines.	Transport	Pre-construction, construction, post-construction

Protection of fauna and habitat	If unexpected, threatened fauna species are discovered, stop works immediately and follow the *Biodiversity Guidelines – Protecting and Managing Biodiversity on RTA Projects: Guide 1 (Pre-clearing process)* (RTA 2011)	Contractor	Construction
Protection of fauna and habitat	WIRES should be consulted if any injured fauna are encountered.	Contractor	Construction
Protection of fauna and habitat	If it is perceived that significant impacts are occurring to aquatic environments within the vicinity of the work area (e.g. spill of any chemicals), works at that location should cease and Transport environment branch should be contacted for further advice.	Contractor	Construction
Protection of fauna and habitat	To minimise the risk of injury or mortality to fauna and their young the following measures are recommended: • All clearing is to follow the RTA biodiversity guidelines with respect to the pre-clearing process, including the capture and relocation (by licenced wildlife carers or ecologists) of fauna that have the potential to be disturbed as a result of clearing activities • Vegetation removal is to be undertaken as per guide 4 of the RTA biodiversity Guidelines, including the implementation of staged clearing.	Contractor	Construction
Protection of fauna and habitat	Routine corridor maintenance should be carried out to manage mid-storey vegetation on road batters to reduce congregation of wildlife and improve sight lines for motorists during operation.	Transport	Operation
Weeds and disease	Weeds will be managed in accordance with Transport's standard weed management measures.	Transport, Contractor	Pre-construction, construction
Offsite impacts	Reduce the potential for off-site impacts arising from sedimentation, dust, and noise through the implementation of a CEMP. The CEMP should seek to retain any native vegetation present within and around the proposal area wherever possible. The CEMP should include erosion and sediment controls in accordance with *Managing urban stormwater: soils and construction* (the Blue Book).	Transport, Contractor	Pre-construction, construction
Waste	All waste material and rubbish associated with the proposal, particularly chemicals, are to be removed from site and properly disposed of.	Contractor	Construction, post-construction

6.2 Noise and vibration

A Noise and Vibration Impact Assessment (NVIA) was prepared by AECOM in September 2022. A copy of the assessment is provided in Appendix I, with a summary provided in the sections below.

6.2.1 Methodology

A quantitative assessment of construction noise and vibration has been carried out, with the following documents considered applicable to the proposal:

- *RMS Construction Noise Estimator Tool*, Roads and Maritime Services, 2016
- *Construction Noise and Vibration Guideline* (CNVG), Transport, 2016.

Existing noise environment

The existing noise environment surrounding the proposal area was assessed using the RMS Construction Noise Estimator Tool. The predicted background noise levels for the site and surrounds were used to assess potential noise and vibration impacts for the proposal. Predicted background noise levels are detailed in Section 6.2.2.

Construction noise assessment

The RMS Construction Noise Estimator Tool was used to predict the 'worst case scenario' noise impacts during construction of the new bridge. The 'distance based (scenario)' assessment was selected as it considers a number of plant operating together during a certain construction activity. In this case, 'Bulk earthworks' was selected as the noisiest activity.

Vibration Assessment

The assessment of vibration was undertaken using relevant standards and guidelines, with consideration of the highest vibration inducing construction plant. However, no Australian Standards exist for the assessment of building damage caused by vibration. Conservative criteria for vibration are subsequently adopted.

6.2.2 Existing environment

Sensitive receivers in this area are predominantly isolated residential properties. Table 6-4 outlines the sensitive receivers which were identified in the vicinity of the proposal. Due to the lack of a solid barrier, residences are considered to have line of sight to the construction works.

Table 6-4: Sensitive receivers nearby the proposal

Receiver	Distance (metres)
20281 Kamilaroi Highway, Narrabri	580
87 Bald Hill Road, Narrabri	890
'Dunraven' 20576 Kamilaroi Highway, Narrabri	1140

6.2.3 Criteria

The RMS construction noise estimator tool was used to assess the impacts during construction. The noise area category has been selected as R0 due to proximity to the Kamilaroi Highway and the isolated nature of residences.

Table 6-5 provides the background noise levels (also referred to as Rating Background Level (RBL)) and noise management levels or the noise area category R0 within line of sight to the receiver.

Table 6-5: Background noise levels and noise management levels

Noise Area Category		R0
RBL or L_{A90}[1] Background level (dB(A))	Day	35[3]
	Evening	30
	Night	30
$L_{Aeq(15minute)}$ Noise Management Level[2] (dB(A))	Day	45
	Day (OOHW)	40
	Evening	35
	Night	35

Notes:

1. *LA90 = Background noise level*
2. *Noise Management Level for works during standard hours = Background level plus 10dB(A)*

   Noise Management Level (NML) for out of hours works = Background level plus 5dB(A)
3. *Daytime RBL adjusted to be minimum 35 dB(A) in line with current EPA recommendations.*

6.2.4 Potential impacts

Construction

Construction noise (standard hours)

The noise estimator tool produced predicted noise levels at different locations for various receivers. To assist with the assessment, common residential receivers were grouped into noise catchment areas (NCAs) for construction noise assessment. For NCA1, affected distances are inclusive of where noise levels are expected to exceed the NML by up to 10 dB (as per the EPA Interim Construction Noise Guideline). This is recorded in Table 6-6 below together with the predicted noise levels. The results of the construction noise assessment are summarised in Table 6-6 and Figure 6-3.

From this assessment, no noise sensitive receivers are located within 490 metres of the proposal area, and therefore noise impacts resulting from the construction of the proposal are unlikely. Additional mitigations would not be required.

Table 6-6: Predicted noise levels

Catchment distances	Day (OOHW)		
	NML, dB(A)	Predicted noise levels, dB(A)	Recommended additional mitigation measures
Bulk earthworks			
NCA1 (490 metres) – in line of sight	40	50	N
NCA2 (700 metres) – in line of sight	40	45	-

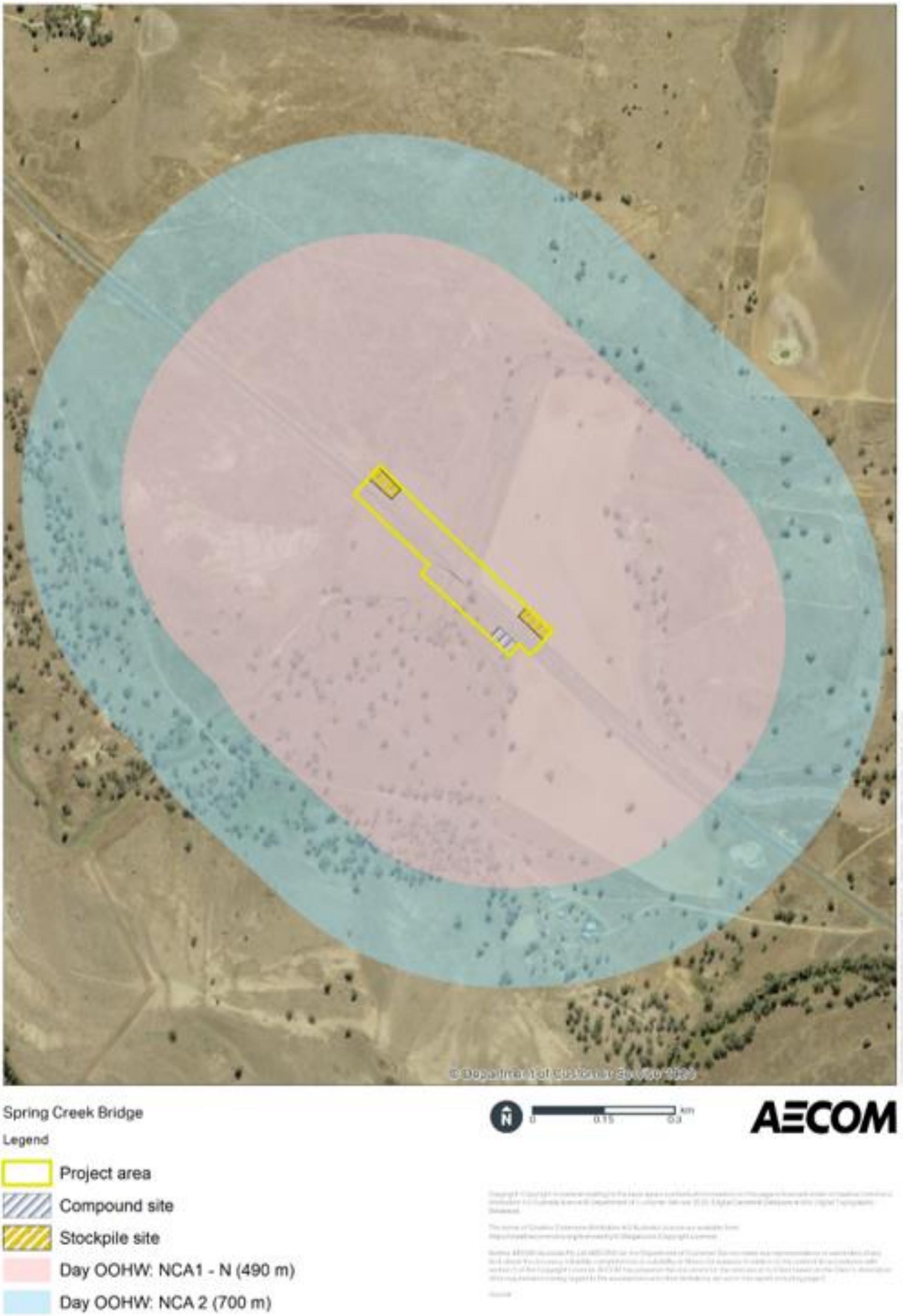

Figure 6-3: Noise catchment areas for construction noise assessment

Vibration

Vibration intensive works may take place as part of the bridge replacement works. The works may include the use of impact pile driving equipment. Impact piling has a minimum working distance of 50 metres to prevent cosmetic damage, according to '*BS 7385: Evaluation and measurement for vibration in buildings*'. There are no buildings or receivers within 50 metres, therefore no further considerations have been given.

Vibration impacts resulting from the proposal would be unlikely. No additional safeguards were recommended by the assessment for standard hours work.

Operation

The proposal is not likely to significantly increase the volumes of traffic, traffic composition, traffic behaviour, or change the alignment of the current road. Significant change to the current operating noise environment is not anticipated.

6.2.5 Safeguards and management measures

Table 6-7: Noise and vibration safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Noise and vibration	A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in *the Interim Construction Noise Guideline (ICNG) (DECC, 2009*) and identify: • All potential significant noise and vibration generating activities associated with the activity • Feasible and reasonable mitigation measures to be implemented, taking into account *Beyond the Pavement: urban design policy, process and principles* (Transport, 2014). • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.	Contractor	Pre-construction
Noise and vibration	All sensitive receivers (e.g., schools and local residents) likely to be affected will be notified at least 5 days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • The proposal • The construction period and construction hours • Contact information for proposal management staff • Complaint and incident reporting • How to obtain further information.	Contractor	Pre-construction

Other safeguards and management measures to address noise and vibration impacts are identified in Section 6.11.4

6.3 Hazardous materials

6.3.1 Methodology

AECOM undertook a hazardous materials survey at Spring Creek bridge on 19 September 2022. The objective of the survey was to as far as practicable, identify and evaluate the presence, condition and extent of hazardous materials at the bridge, and to provide bridge removal specific recommendations.

For the purpose of this report, hazardous materials include the following:

- Asbestos containing materials (ACM)
- Lead in paint
- Synthetic mineral fibre (SMF)
- Polychlorinated biphenyls (PCB).

The methodology for the survey included the following:

- A review of the existing plans and proposal area documentation pertaining to the bridge
- A survey of the accessible areas at the proposal area to identify and locate hazardous material
  - The survey was conducted by a combination of 'destructive' and 'semi-intrusive' techniques where practicable
- Suspected ACM and lead in paint were sampled. Samples were forwarded to a National Association of Testing Authorities (NATA) accredited laboratory for analysis and issue of NATA endorsed report
- Where sampling was not possible (i.e. lack of accessibility or risk of causing contamination), a reasonable assumption was made as to the presence or absence of a hazardous materials (ACM or lead in paint taking into account factors such as age, physical appearance, and fixing method). Where possible, non-sampled materials were cross referenced to similarly sampled items:
  - SMF materials were visually identified or as a result of asbestos identification analysis
- Suspected hazardous materials were photographed where possible
- Delivery of a hazardous materials register outlining the location, type, extent, condition, and recommendation of the identified hazardous materials.

For more detailed information on the hazardous materials and methodologies used in the hazardous material register, refer to Appendix J.

6.3.2 Existing environment

A search was undertaken of the NSW EPA's contaminated land register on 4 October 2022. No NSW EPA contaminated land records have been identified within the proposal area or the immediate surrounds. A site inspection was also conducted on 19 September 2022 to identify visible sources of contamination.

The existing bridge and approaches are part of an operational road corridor surrounded by land used primarily for agricultural purposes, such as grazing and cropping.

The existing bridge is likely to contain hazardous materials due to the bridge's age and era of construction. The survey identified two detected or assumed hazardous materials including:

- Lead Paint
- ACM.

6.3.3 Potential impacts

Construction

Given the potential for the existing bridge structure to contain two contaminants, hazardous material risk management strategies should be implemented when undertaking demolition works on the existing bridge. These are detailed in the safeguards below, refer to Section 6.3.4.

The construction plant, equipment and general demolition and construction work would require the use of a variety of substances, such as hydrocarbon fuel, lubricants, solvents and paints. There is potential for accidental spills of these substances to occur and result in contamination impacts to both terrestrial, aquatic and groundwater environments. The activities where there is a potential for accidental spills to occur include but are not limited to the use of plant and equipment on the in-stream structure, refuelling and maintenance of plant and equipment and the use of paints on the proposed bridge.

Safeguards as outlined below (Section 6.3.4) would be used to reduce the chance of accidental spills occurring and would assist in mitigating the impacts of a spill, should it occur. Restrictions would be placed on potentially contaminating activities and incident management plans would be prepared to prevent the risk of contamination of surface, groundwater or soils during construction (Section 6.4.4).

It is unlikely that unknown contamination would be encountered during the construction of the proposal. If contamination is encountered, a procedure would be employed to appropriately contain, handle and dispose of contaminated material as outlined in Section 6.12.3.

Operation

The design of the proposed bridge allows for the bridge deck to be drained using open scuppers (an opening for the purpose of draining water). The scuppers would drain surface water from the deck and direct it into Spring Creek. Should oil or hydrocarbon fuels which have leaked from traffic be present on the bridge, there is potential that surface water could mobilise these contaminants and release them into the river. This is consistent with the existing bridge drainage system.

6.3.4 Safeguards and management measures

Table 6-8: Hazardous materials safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Hazards and risk management	Hazard and Risk will be managed as part of the CEMP. The CEMP will include, but not be limited to: • Details of hazards and risks associated with the activity • Measures to be implemented during construction to minimise these risks • Record keeping arrangements, including information on the materials present on the proposal area, material safety data sheets, and personnel trained and authorised to use such materials • A monitoring program to assess performance in managing the identified risks • Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations. The CEMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or Office of Environment and Heritage publications	Contractor	Construction
Bridge removal – ACM	**Mitigation method includes**: Non-friable ACM with fair condition that has a low to moderate risk of exposure can be mitigated with a combination of engineering and administrative controls. Mitigation control measures may include the ACM being enclosed, encapsulated or sealed as described below.	Contractor	Construction

	• Enclose - Placing a fixed physical barrier between the ACM and the surrounding area reducing the risk of exposure to airborne asbestos fibres from general interaction with the material (suitable for non-friable ACM where removal is not reasonably practicable and where the ACM is at risk of damage from work activities).
	• Encapsulate– ACM is encapsulated in a resilient matrix (e.g. reinforced plastic, vinyls, resins, mastics, bitumen, flexible plaster or cement) to prevent the release of asbestos fibres into the air (applicable if the ACM cannot be removed or enclosed).
	• Seal – Covering the surface of the ACM with a protective coating (paint) to reduce fibre release and/or bind the fibres together (sealing is inappropriate where the process of sealing or applying paint will disturb or damage the ACM).
	Mitigation control measures are interim in nature and should be supported through regular inspections by a competent person to evaluate the ongoing effectiveness of the applied controls. Removal should be considered when the applied controls are no longer effective and degradation and damage of the applied controls is observed.
	The process of encapsulating and sealing ACM is considered as 'asbestos-related works' due to the direct interaction with the ACM. As such, the following should be considered when these mitigation control measures are implemented:
	• Engage an appropriately licensed asbestos contractor (Class A or Class B) to undertake the works.
	• The licensed asbestos contactor is to ensure they have conducted and implemented the following:
	  – Notified the regulator of the licensed asbestos work.
	  – Prepared a Safe Work Method Statement and Safety Management Plan.
	  – Limited access to the asbestos work area (e.g. barricading, signage).
	  – Provided suitable decontamination facilities or processes.
	• Engage a hygienist or competent person to undertake air monitoring where asbestos-related work is being carried out, particularly if there is uncertainty as to whether the exposure standard is likely to be exceeded.
	
	Removal method:
	ACM must be removed prior to any demolition or construction works that are likely to result in the disturbance of ACM.
	Any work involving the removal of ACM must be undertaken under controlled conditions following obtaining all necessary licences.
	• The following licence requires much be following with regards to asbestos removal works:
	  – Class A Licence - For any amount of friable ACM, asbestos containing dust and non-friable asbestos.
	  – Class B Licence - For greater than 10 m2 of non-friable ACM and asbestos containing dust associated with the removal of non-friable ACM.		

	– No licence required – For up to 10 m2 of non-friable ACM and asbestos containing dust associated with the removal of less than 10 m^2 of non-friable ACM. • The licensed asbestos contractor (where used as per licence requirements) is to ensure they have conducted and implemented the following: – Notified the regulator of the licensed asbestos removal work. – Prepared a Safe Work Method Statement and an Asbestos Removal Control Plan. – Limited access to the asbestos work area (e.g. barricading, signage). – Provided decontamination facilities appropriate for the type of asbestos removal works. • For Class A licensed asbestos removal works: – Ensure an independent Licensed Asbestos Assessor is engaged to conduct airborne asbestos monitoring prior to, during and following any works. o Airborne asbestos analysis should be undertaken by a NATA Accredited laboratory. – Ensure an independent Licensed Asbestos Assessor conducts a clearance inspection following the Class A licensed asbestos removal works. This is undertaken to assess the adequacy of the removal works and to validate that asbestos has been removed to a satisfactory standard and that the affected areas are safe for reoccupation. This must include clearance airborne asbestos monitoring and may include soil validation sampling depending of the asbestos removal work. • For Class B licensed asbestos removal works: – Consider engaging an independent Licensed Asbestos Assessor or competent person to conduct airborne asbestos monitoring (e.g. at, or near sensitive locations such as public areas, a school or a hospital). o Airborne asbestos analysis should be undertaken by a NATA Accredited laboratory. – Ensure an independent Licensed Asbestos Assessor or competent person conducts a clearance inspection following the Class B licensed asbestos removal works. This is undertaken to assess the adequacy of the removal works and to validate that asbestos has been removed to a satisfactory standard and that the affected areas are safe for reoccupation. This may include clearance airborne asbestos monitoring and / or soil validation sampling depending of the asbestos removal work. • Clause 79 of the NSW *Protection of the Environment Operations (waste) Regulation 2014* requires asbestos waste transporters (transporting a minimum of 100 kilograms of asbestos waste, or 10 m^2 of asbestos waste that is asbestos sheeting, in any single load) to provide tracking information to the EPA via the WasteLocate online tool. ACM must also be disposed of at a suitably		

	approved waste collection facility. All tipping dockets must be retained.		
Bridge removal – Lead Paint	Lead paint management during demolition should be conducted under controlled conditions in accordance with applicable legislation outlined in Appendix J. The following recommendations are provided when undertaking lead paint removal works. **Removal methods include:** • Removal of lead-painted products in its entirety – Material/structures covered in lead paint may be removed in its entirety (with lead paint in-situ) and replaced with new materials that do not contain lead paint. • Removal of lead paint from the structural surface – This process involves the removal of lead paint from a structure surface only. Lead paint removal may be conducted using the following methods: – Wet scraping and wet sanding – On site chemical stripping – Removal by heat gun and scraper. The removal of lead paint from structural surfaces may be defined as a lead process or lead risk work based on WHS Regulation 2017, clauses 392 and 394. As such, the following should be considered: • Seek approval from the regulator regarding the nature of the removal works with respect to lead processes and lead risk work • Where removal works are deemed a lead process or lead risk work, address relevant WHS Regulation clauses associated with lead processes. The WHS Regulation (Chapter 7) outlines specific requirements relating to lead risk work that need to be conducted by a person conducting a business or undertaking (or the contractor engaged to do the work), including: • Ensuring information is provided to workers about the risks and health effects when working with lead • Ensuring health monitoring is provided to workers before lead risk works starts and one month after starting • Ensuring a lead risk work notification form is submitted at least seven (7) days before lead works commences. **Other considerations include:** • Preparation of a Safe Work Method Statement for the selected methodology • Limiting access to the lead paint work area (e.g. barricading, signage) • Providing suitable decontamination facilities and processes • Managing lead related waste in accordance with the requirements detailed in *Protection of the Environment Operations (Waste) Regulation 2014*. • Schedule 1 of the NSW *Protection of the Environment Operations (waste) Regulation 2014* requires lead waste transporters to provide tracking information to the EPA via the WasteLocate online tool. Lead related waste	Contractor	Construction

	must be disposed at a suitably approved waste collection facility. All tipping dockets must be retained.		
Hazardous materials – Unexpected finds	When suspected hazardous materials are encountered, the following procedure protocol should be followed: • Cease work and restricted access by isolating the area with a barrier and warning signage. • Engage a hazardous materials consultant or equivalent specialist (e.g. licensed asbestos assessor or competent person) to undertake an assessment of the unexpected find. • Hazardous material removal may require the engagement of a licensed contractor and implementation of specific controls which may include air monitoring. • If the unexpected find is deemed to be emergency asbestos removal work, a SafeWork NSW notification is not required, however the engaged asbestos removal contractor must advise SafeWork NSW within 24 hours of being advised and/or undertaking the emergency works. • Following the removal of the hazardous material a clearance inspection may be required by a hazardous materials consultant or equivalent (e.g. licensed asbestos assessor or competent person). • Following successful hazardous material removal works and clearance certificate (where required) remove barriers and recommence demolition and redevelopment works under normal conditions.	Contractor	Construction
Accidental spill	A site-specific emergency spill plan will be developed and include spill management measures in accordance with the Transport *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport and EPA officers)	Contractor	Pre-construction
Chemical handling	The storage of chemicals and hazardous materials would be conducted in accordance with the relevant Material Safety Data Sheets and in accordance with requirements of *the Environmentally Hazardous Chemicals Act 1985*	Contractor	Construction

Other safeguards and management measures to address contamination impacts are identified in Sections 6.4.4 and 6.12.3

6.4 Surface water, ground water and soils

6.4.1 Methodology

The assessment of surface water, groundwater and soils was based on a desktop analysis of publicly available information on 7-11 October 2022. The databases and resources that were searched include:

- NSW Department of Planning E-Spatial Planner
- Environmental Protect Authority Contaminated Lands Register
- Narrabri Shire LEP 2012
- Groundwater Dependant Ecosystems Atlas (GDE Atlas)

- ESPADE Spatial Viewer
- Water NSW Water register
- Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2016
- NSW Fisheries Spatial Viewer.

6.4.2 Existing environment

Surface water

The proposal area is located over Spring Creek, which is a fourth order stream part of the Lower Namoi River Catchment. Spring Creek traverses the proposal area north to south, intersecting with Black Gully which discharges into the Namoi River about 1.9 kilometres southwest of the proposal area. Spring creek is 5 to 10 metres wide, meandering and turbid, with ephemeral flows. Spring Creek is considered Key Fish Habitat, fair condition Freshwater Fish community and Freshwater Fish Threatened Species habitat (NSW Fisheries, 2022).

The proposal area and Spring Creek is lined with patches of native and exotic pasture grasses.

Surface Water Entitlements

A search of the Water NSW Water Register on 11 October 2022 identified that there are nine Water Access Licences (WAL) for the water usage from the Lower Namoi River Catchment for the 2022/23 financial year.

Table 6-9: WAL's for water usage from the Lower Namoi River Catchment for the 2022/23 financial year

Access Licence Category	Number of WAL(s)	Total Share Component (ML)
Domestic and Stock	3	21.5
Domestic and Stock [Stock]	1	4.5
Unregulated River	4	2646
Unregulated River [Special Additional High Flow]	1	729
Total	9	3401

Groundwater

The use of groundwater in the proposal area is currently governed by the Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2016. No groundwater would be used as part of the proposal.

The Groundwater Dependant Ecosystems Atlas (GDE Atlas) identified the proposal area to be located in the Darling Riverine Plains bioregion, and within the Castlereagh-Barwon subregion. The area is typical of semi-arid climatic conditions, and topographical features include extensive plains with low angle alluvial fans (NSW Government, 2003).

A search of the Water NSW Groundwater bore data on 11 October 2022 found no groundwater bores within 500 metres of the proposal, the closest being over 900 m southeast of the proposal area.

Soils

Sediments found at the proposal area are derived from the Jurassic sandstone and basalts. The soils present within the proposal area are characteristic of past sedimentation patterns and present-day flooding regimes. Soils are mainly grey and brown clays found on flood plains and brown loamy sands, pale yellow or red sands with texture contrast soils on low rises, levees and channels (NSW Government, 2003).

The two soil profiles north and south of the proposal area are identified as red-brown earth and alluvial sediment (ESpade 2022). Under the Narrabri Shire LEP 2012, there are no maps indicating the presence of acid sulfate soils (ASS). A review of NSW Government E-Spatial Planning ASS mapping on 7 October 2022 indicates the locality has no acid soils present.

A search was undertaken of the NSW EPA's contaminated land register on 4 October 2022. No NSW EPA contaminated land records have been identified within the proposal area or the immediate surrounds.

6.4.3 Potential impacts

The potential impacts to surface water, groundwater and soils are broken down into each construction work stage, as previously described in Section 3.3.1.

Construction

Construction water use would be managed within the sustainable limits of the area and catchment. It may be necessary to reduce or limit water extraction and some construction activities if water supply is heavily constrained. The Transport Regional Environmental Manager would be contacted if water supply becomes an issue and direction would be provided. All dirty and wastewater created within the proposal area would be managed and disposed of as part of an ESCP to prevent mixing with clean water and discharge into Spring Creek.

Stage 1 - Advance works

Appropriate erosion and sedimentation controls would be implemented to reduce impacts on downstream water quality by managing sediments entering Spring Creek.

Stage 2 - Access Track, working platform and vegetation clearing

Prior to construction, up to 4.3 hectares of vegetation, including native and exotic vegetation from the riparian area of Spring Creek may be removed. Topsoil in the construction areas would be stripped including in the waterway and riparian area. Removal of vegetation and ground surface disturbance would have the potential to result in erosion and sedimentation.

Construction of the access track would involve ground disturbance within the waterway and riparian area. These activities would involve earthworks, operation of heavy machinery and the placing of rock and steel pipes within the waterway. These activities have the potential to result in direct impacts to the waterway through construction materials entering the waterway and migrating downstream. As such, appropriate erosion and sediment controls, including silt curtains, erosion fencing, diverting of clean water and management of construction activities would be employed to prevent significant impact to the waterway.

Excavated spoil from the establishment of access tracks would be placed in stockpiles and at the compound site. If not managed, disturbance, such as wind or rain could release materials from stockpiles into Spring Creek and the surrounding environment, adversely affecting water quality. A such, appropriate erosion and sediment controls would be in place to prevent migration of materials off-site.

Stage 3 - Bridge Demolition

Crane platforms would be constructed on the banks of the creek or above the abutments. This has the potential to result in sediments being released into the creek. This impact would be mitigated by the construction of crane pads to reduce risk of destabilisation. Silt curtains, or similar, would also be used to contain sediments and mitigate impacts to the waterway.

The cells and abutments of the existing structure would be removed using conventional excavation machinery, including saw cutting and a hydraulic breaker. The existing culvert would be removed up to 0.5 m below the existing creek bed level. Sedimentation may occur where earthworks are completed for movement of the abutments to widen the waterway. Impacts would be managed by implementation of standard erosion and sediment safeguards, including in stream sediment controls such as silt curtains. There is potential for erosion and sediment controls to be overtopped during extreme wet weather events which would cause a greater risk of waterway contamination as a large area of the site may be inundated with water that is not easily controlled. Measures would be included in the ESCP to ensure this risk is managed effectively.

Particulates, fine materials and slurries may be generated from activities such as sawing, cutting, grinding and jack hammering undertaken as part of the bridge removal. Protective sheets, channels and temporary bunding can be used to prevent material falling into Spring Creek during the removal processes.

The use of construction plant and equipment and the use of chemical substances during removal could result in accidental spills and leaks into Spring Creek. Additionally, contaminants from the existing bridge could be released through the removal process. Potential sources of contamination and appropriate mitigation measures to reduce impacts as a result of accidental spills and identified hazardous materials have previously been discussed in Section 6.3.

Generally, works in and around the waterway may disturb sediments and result in increased turbidity levels in Spring Creek. As the creek is ephemeral, construction of working platforms and bridge works would take place during periods of both minimal flow and high flow. This would be manageable with the implementation of the controls described below.

Stage 4 - Bridge Construction

Working platforms would be used to construct the new bridge. Erosion and sedimentation measures established in Stages 1 and 2 would continue to be used. Sedimentation may occur during earthworks associated with the movement of the abutments to widen the channel.

There is potential that during the installation of the piles of the new bridge, groundwater may be intercepted, and the piles could interfere with aquifers present underneath Spring Creek. As piles would be constructed using driven steel tubular casing with concrete infills, up to a depth of 25 metres, no excavation would be undertaken below the creek bed and dewatering of groundwater is not expected to be required. As such, the potential impact on groundwater or aquifers in the locality would be negligible.

The use of construction plant and equipment to construct the new bridge poses the potential for substances, such as hydrocarbon fuels and other chemicals, to be spilled or to accidentally leak into Spring Creek. An emergency spill plan would be developed and would include measures to appropriately contain the spill and reduce impacts to the receiving environment.

Stage 5 - Final Earthworks Construction

Roadworks would take place on the extent of the bridge approaches to the bridge abutments. This would include activities that may disturb the ground such as shaping batters and constructing the road. These activities could mobilise sediment which could discharge into the creek, potentially increasing turbidity. Erosion and sediment impacts would be managed by erosion and sediment controls at the area of works and installing silt curtains (or similar) in Spring Creek in the event of the waterway flowing during construction.

Operation

Open scuppers are a feature of the bridge design to allow surface water to drain from the bridge deck into the Spring Creek. This has the potential to allow the movement of hydrocarbon fuels or oil leaks that may be present on the bridge into Spring Creek during a rain event. This is consistent with the existing bridge drainage arrangement.

Subsurface water flow, including groundwater movement into the river, could be affected by the placement of barriers to subsurface water flow. This would mainly apply to the abutment piles. However, due to the minimal displacement and spacing of the piles, the potential for the new bridge to interfere with any groundwater–surface water interactions would be negligible.

6.4.4 Safeguards and management measures

Table 6-10: Surface water safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Soil and water	An Erosion and Sediment Control Plan (ESCP) will be prepared and implemented as part of the CEMP for the main construction works (bridge removal, construction, side track, in stream works and landscape works). The ESCP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction	Contractor	Pre-construction
Soil and water	An incident management plan is to be developed as a component of the CEMP and/or ESCP. The incident management plan is to include: • Locations for spill kits and floating booms to contain spills • Adopting the Transport Environmental Incident Classification and Reporting Procedure and notification of the Transport Project Manager as soon as practicable • Contact details for the Transport Project and Environment Managers for incident notification purposes under the POEO Act including Narrabri Shire Council, local EPA, EPA pollution line, NSW Health, SafeWork NSW, Water NSW and Fire and Rescue NSW	Contractor	Pre-construction
Soil and water	Water quality control measures are to be used to prevent any materials (e.g. concrete, grout, sediment, etc) entering drain inlets or waterways	Contractor	Pre-construction

Soil and water	The ESCP would include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather	Contractor	Pre-construction
Soil and water	Erosion and sediment control measures are to be implemented and maintained to: • Prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets • Reduce water velocity and capture sediment on site • Minimise the amount of material transported from site to surrounding pavement surfaces • Divert clean water around the site (Erosion and sediment control measures will be in accordance with the *Landcom/Department of Housing Managing Urban Stormwater, Soils and Construction Guidelines (the Blue Book))*	Contractor	Construction
Soil and water	Erosion and sedimentation controls are to be checked and maintained on a regular basis (including clearing of sediment from behind barriers) and records kept and provided on request	Contractor	Construction
Soil and water	Erosion and sediment control measures are not to be removed until the works are complete and areas are stabilised	Contractor	Construction
Soil and water	Work areas are to be stabilised progressively during the works	Contractor	Construction
Soil and water	The maintenance of established stockpile sites is to be in accordance with the *Roads and Maritime Services Stockpile Site Management Guideline* (EMS-TG-10)	Contractor	Construction
Soil and water	An emergency spill kit is to be kept on site at all times and maintained throughout the construction work. The spill kit must be appropriately sized for the volume of substances at the work site. The spill kit must be readily accessible on the bridge and temporary instream work structures	Contractor	Construction
Soil and water	Emergency contacts will be kept in an easily accessible location on vehicles, plant and site office. All workers will be advised of these contact details and procedures	Contractor	Construction
Soil and water	All workers will be advised of the location of the spill kit and trained in its use	Contractor	Construction
Soil and water	Exposed areas on the creek banks (such as abutments) are to be covered with geofabric when exposed for prolonged periods	Contractor	Construction
Water quality	Construction water is to be managed within the sustainable limits of the area and catchment. The Regional Environmental Manager would be contacted if water supply becomes an issue and direction would be provided	Contractor	Construction
Water quality	There is to be no release of dirty water into drainage lines and/or waterways	Contractor	Construction

Water quality	Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) is to be carried out on a regular basis to identify any potential spills or erosion and sediment controls	Transport Project Manager/ Contractor	Construction
Water Quality	Control measures to minimise the risk of water pollution are to be implemented including: • All fuels, chemicals, and liquids will be stored at least 50 metres away from the existing stormwater drainage system and stored in an impervious bunded area within the compound site • Plant and maintenance machinery is to be refuelled in impervious bunded areas in the designated compound area • Vehicle wash downs and/or concrete truck washouts are to be carried out within a designated bunded area of an impervious surface or carried out off-site.	Contractor	Construction
Water quality	Geofabric or clean rock is to be used for diversion banks or instream temporary structures to prevent sediment transport	Contractor	Construction
Water quality	Sediment and erosion controls are to be used for in-stream works to avoid impacts on water quality and fish passage, e.g. erosion fencing, stockpile covers and silt curtains	Contractor	Construction
Water quality	Silt curtains and erosion and sediment controls are to be installed, monitored and maintained as needed to contain any sediment runoff into Spring Creek.	Contractor	Construction

Other safeguards and management measures to address surface water impacts are identified in Sections 6.5.4 and 6.12.3.

6.5 Hydrology and flooding

An initial bridge hydraulics investigation was undertaken by Stantec (Cardno) in September 2022. The assessment is provided in Appendix H, with a summary provided below.

6.5.1 Methodology

Existing environment

The existing environment of the proposal area was investigated through desktop analysis of available online information.

Hydraulic investigation

2D flood modelling was developed to investigate the likely flood and hydrology characteristics for the proposal area. The Narrabri Creek Flood Study was reviewed to inform background flood characteristics for Spring Creek.

6.5.2 Existing environment

Spring Creek forms part of the Namoi Catchment, more specifically the lower Namoi Catchment. The catchment has a total land area of 42,000 km^2. The Namoi Valley experienced extreme drought conditions between 2017 and 2020, where river and creek conditions within the catchment included ceased flows and dry refuge pools. Since 2020, elevated rainfall has resulted in increased flows and augmented storage whilst also giving rise to areas of flooding (DCCEEW, 2022). Refer to Section 6.4 for further information regarding surface water.

Flooding within the catchment, and at Spring Creek, is common during high rainfall events. Floods within the floodplain within this catchment historically recede slowly due to the small carrying capacities of the major flood channels and slow rates of rise and fall of floods. Slow moving floodwaters on flat slopes often lead to long duration flooding (NSW Government, 2020).

Along the road, the Australian Height Datum (AHD) is 209 metres, and the creek bed is ~204 metres AHD At present, Spring Creek has a confined outlet at the bridge which opens up to a larger floodplain of the adjacent Narrabri Creek. Downstream of Spring Creek bridge is very flat with significant floodplain storage available. Additional characteristics of the surrounding area identified within Appendix H include:

- A steep gradient across the area (1 in 60) within the main channel
- An upstream storage and low-lying area that results in ponding behind the roadway
- An existing 40 metre opening between abutments
- A more defined channel downstream and evidence of scour within the main channel from culvert outflows
- An upstream flow constraint 1.7 kilometres upstream
- Flow appears to be skewed at 20 degrees to the main bridge.

Existing data suggests that the classification of material within Spring Creek is generally sandy silty clay, clay and sand, which suggests a high erodibility within the creek bed.

Predicted flood levels

Historically, the existing bridge over Spring creek would retain flood immunity for the one per cent Annual Exceedance Probability (AEP), where the water level was set at 207 metres AHD.

The predicted base flood levels for the existing catchment area include a one per cent AEP peak flow rate at the crossing location of 488m^3/s and 0.05% (1 in 2000) peak flow rate of 770m^3/s.

Hydraulics

Flood modelling was developed to estimate flow velocity including peak flow velocity and potential for scour about the new bridge area. A summary of the results is presented in Table 6-11 and Table 6-12. A major consideration for flood modelling is the potential for the downstream Narrabri Creek backwater to impact the conveyance of the existing bridge. An initial assessment with a water level set at 207m AHD, in line with the regional Narrabri Creek Flood Study, shows the bridge retains flood immunity for the one per cent AEP event.

Table 6-11: Flood model summary

	Flow Gap (mm)	Flow Velocity (m/s)		Flood level (mRL)	
		1% AEP	0.05% AEP	1% AEP	0.05% AEP
New bridge Design	400	3.3	4.0	207.4	207.81

2D flood modelling was used to define the expected afflux about the area compared to the existing arrangement. It found that with the new bridge, there would be up to 700 millimetres reduction in the upstream water level for the one per cent AEP event. There also appears to be limited downstream afflux due to the ponded nature of flows in this location.

Scour protection

An initial 1D scour assessment based on material classification from existing boreholes was used to determine the scour performance for the one per cent and 0.05 per cent AEP events as shown in Table 6-12.

Table 6-12: Scour assessment

Scour type	1% AEP Scour Depth (m)	0.05% AEP Scour Depth
Contraction	3.25	0.5
Pier		
Abutment	Left 0.00 Right 0.75	Left 0.00 Right 0.75

A detailed 2D hydraulic sediment model was also developed to confirm the appropriateness of these values. The results were generally consistent with the 1D assessment and indicate the need for abutment scour protection and pier design that considers potential scour depth.

6.5.3 Potential impacts

Construction

The proposal would involve the installation of temporary instream structures, such as temporary construction working platforms and temporary access tracks for construction and demolition. These structures would be placed in the waterway with pipe culverts ensuring surface water flow and providing some level of flood resistance. These structures can potentially detain water, increasing inundation. However, given the morphology of the waterway channel, it is unlikely they would greatly alter water flow in the event of flooding.

Flooding may result in temporary inundation of work areas. A flood contingency management plan would be prepared to manage potential water quality and flooding. This would include long term rainfall forecasting to effectively program high risk works that may be more susceptible to flooding, such as instream works, to be undertaken during forecast dry periods.

Operation

The new bridge would result in a 64-metre-wide channel as abutments would be set back to accommodate a longer deck length, resulting in an increased lateral extent of available waterway under the bridge. The deck would be approximately 0.5 metres above the level of the existing bridge in its current state.

It is anticipated that material within Spring Creek would accumulate in areas of slow-moving water and scour in areas of faster moving water between the piers. With the implementation of mitigation measures, the risk of this occurring would be adequately managed.

6.5.4 Safeguards and management measures

Table 6-13: Hydrology safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Flooding	A Flood Contingency Management Plan is to be prepared for the work site, compound site and ancillary areas. The plan is to: • Ensure workers and road users are aware of the flood risks • Monitor long term rainfall forecasts and schedule high risk work activities around these forecasts • Have contingency locations for the temporary flood storage of equipment and materials outside of potential inundation areas • Have contingency measures to secure and stabilise work areas and compound sites prior to flooding.	Contractor	Pre-construction
Flooding	Any major changes to the bridge geometry are to be investigated for potential changes to flood characteristics. This includes changes to upstream and downstream water levels, velocities and direction	Transport Project Manager	Detailed design
Flooding	Temporary instream structures are to avoid fully impeding the flow of Spring Creek.	Contractor	Construction
Aquatic impacts	Works are to be restricted to periods of normal flow (i.e. no substructure work during major flood events).	Contractor	Construction
Aquatic impacts	Stockpiles are to be placed in designated stockpile locations such that they are not subject to a one in 10 year flood event i.e. at top of banks.	Contractor	Construction
Scour protection	Scour protection on the abutments would need to be undertaken and assessed on the basis of the proposed 1.5:1 slope. This would be part of the new permanent bridge design and would likely consist of larger rocks or rock mattresses.	Transport	Pre-construction, Construction, Post construction

Other safeguards and management measures to address hydrology and flooding impacts are identified in Section 6.4.4.

6.6 Traffic and transport

6.6.1 Methodology

Traffic information was supplied by Transport including traffic counts and high mass vehicle movements on the existing Spring Creek bridge.

6.6.2 Existing environment

The existing bridge has one westbound and one eastbound lane which forms part of the Kamilaroi Highway and connects Narrabri to Wee Waa. The bridge currently has a posted speed limit of 100 km/hr and no dedicated pedestrian or bicycle paths.

A Transport traffic survey in 2016 showed the area of the Kamilaroi Highway near the proposal area accommodated approximately 1625 vehicles per day, with around 250 of those heavy vehicles.

A side-track would be established (approved under an existing MWREF) on the upstream side of the existing culvert structure at Spring Creek. This side-track would facilitate safe two-lane traffic flow on the Kamilaroi Highway during both the development and construction phases of the proposal.

There are a few public bus routes which use the Kamilaroi Highway. These are summarised in below.

Table 6-14: Public transport routes utilising the Kamilaroi Highway

Route Number	Route	Frequency
329	Narrabri Station to Rose Street (Wee Waa) to Alma Street Barren Junction	Once per Week
330	Alma Street Barren Junction to Rose Street (Wee Waa) to Narrabri Station	Once per Week
331	Narrabri Station to Rose Street (Wee Waa)	Once per Week
333	Narrabri Station to Rose Street (Wee Waa)	Once per Week
334	Rose Street (Wee Waa) to Narrabri Station	Once per Week
335	Narrabri Station to Rose Street (Wee Waa) to Alma Street Barren Junction	Once per Week
336	Alma Street Barren Junction to Rose Street (Wee Waa) to Narrabri Station	Once per Week

6.6.3 Potential impacts

Construction

There is a potential for traffic impacts, such as queuing, and minor delays associated with reduced speed limits for diversion onto the side-track. Traffic would be moved across to the side-track from the existing alignment for the entirety of bridge demolition and construction activities. Traffic would be reinstated onto the highway alignment upon completion and commissioning of the new bridge and roadwork tie-ins.

The approved MWREF side-track has been designed to have a low flood immunity (less than 1 in 2 ARI) to avoid upstream afflux effects and would therefore be inundated in flood events. During these events the side-track would be closed and a detour put in place until such time as flood waters recede and the side-track is again deemed safe for use.

There are two proposed detour routes that would be implemented during side-track closures to allow for travel between Narrabri and Wee Waa: via Culgoora Road and/or via Moree, Collarenebri, and Walgett. The implementation of the detour from Narrabri to Wee Waa via Culgoora Road would be subject to approval by Narrabri Shire Council as Culgoora Road is classified as a local road. Culgoora Road is also partially unsealed and is not suitable for long term vehicle diversion. The detour via Moree, Collarenebri and Walgett is along the state highway network, however distance and time impacts are significantly greater for travel between Narrabri to Wee Waa. The distance and time impacts for each detour route are detailed in

Table 6-15 and depicted in Figure 6-4. It should be noted that the impacts shown for detour via Moree, Collarenebri and Walgett are conservative as through traffic travelling along the Kamilaroi Highway would be diverted at Walgett or Narrabri. Local traffic would likely utilise Culgoora Road to travel between Narrabri and Wee Waa even if this route is not advertised as the official detour. During major flood events, which would force closure of the side-track, Culgoora Road would also be impacted by flood waters and be closed to traffic. Construction traffic would maintain use of the Kamilaroi Highway for the duration of construction.

Additional cumulative traffic impacts may arise should other project proposals within the surrounding area utilise the Kamilaroi Highway as a main haulage route. Refer to Section 6.14 for further assessment.

Table 6-15: Possible detour timings and distance (as detailed from Google maps)

Road (Narrabri to Wee Waa)	Approximate Distance (km)	Approximate time
Kamilaroi Highway (from Newell Highway, Narrabri to Rose Street, Wee Waa)	37.8	25 minutes
Local road vehicle detour route – via Culgoora Road (from the intersection of Kamilaroi Highway/Newell Highway to Charles Street, Wee Waa)	39.4	33 minutes
State highway vehicle detour route - Newell Highway, Narrabri to Rose Steet, Wee Waa via Moree, Collarenebri, and Walgett	448	5 hours

FIGURE 6-4:
PROPOSED ROUTES

AECOM

N

0 5 10 km

Legend

- Proposal area
- Original route
- State Highway detour route
- Local Road detour route
- Watecourse

Source: Earthstar Geographics

It is expected that background traffic volumes are likely to remain the same during the construction period. Construction vehicle traffic volumes would increase due to the movement of up to 16 construction and service vehicles accessing the site for the haulage of construction materials and employee access.

Other than a few minor roads connecting with the Kamilaroi Highway, the closest intersection to Spring Creek bridge is with the Newell Highway, 7.8 kilometres southeast of the proposal area. The majority of traffic flow through this intersection continues north or south along the Newell Highway. It is anticipated that impacts to traffic at the intersection of Kamilaroi Highway and the Newell Highway would not likely be significant given there would only be a minor increase to the existing low traffic volume from construction traffic along the Kamilaroi Highway. Use of Culgoora Road and the Newell Highway (towards Moree) in the event of a closure of the side-track would also direct heavy vehicles away from this intersection.

As such, quantitative analysis of this intersection was not undertaken.

Operation

The proposal would allow for the safe use of Spring Creek Bridge, with long term HML capacity. The route would be safeguarded against higher level flood events and would become a more reliable route for freight and provide safe travel for the local community. An increase of vehicles using the bridge is not anticipated, and a significant traffic impact on the surrounding road network would be unlikely.

6.6.4 Safeguards and management measures

Table 6-16: Traffic and transport safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Traffic and transport	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the requirements of the current Transport *Traffic Control at Work Sites Manual* and *QA Specification G10 Traffic Management*. The TMP will include: • Confirmation of haulage routes • Site specific traffic control measures (including signage) to manage and regulate traffic movement • Requirements and methods to consult and inform the local community (including local public transport routes, freight companies and heavy vehicle owners) of impacts on the local road network • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads. • A response plan for any construction traffic incident • Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • Response plan in the case of the side-track being affected by rising water within the waterway or potential flood events • Monitoring, review and amendment mechanisms.	Contractor	Pre-construction
Traffic and transport	The TMP will also include measures relating to the operation of the proposed sidetrack including: • Provision of traffic control and additional signage for side-track usage • Potential detour routes if the side-track becomes inundated • Notification to local agricultural businesses and stakeholders of closure of the bridge/ use of the side-track.	Transport	Construction

6.7 Non-Aboriginal heritage

6.7.1 Methodology

Searches of statutory and non-statutory local, State and Commonwealth registers were undertaken on 12 October 2022 as part of the non-Aboriginal heritage investigations. The results of the database searches are provided in Table 6-17.

Table 6-17: Statutory and non-statutory listings

Heritage Listing	Status
Australian Heritage Database	Not listed
Australia's National Heritage List	Not listed
State Heritage Inventory (LGOV)	Not listed
Heritage Act – State Heritage Register	Not listed
Heritage Act – s.170 NSW State agency heritage register	Not listed
Narrabri LEP 2012	Not listed

6.7.2 Existing environment

Spring Creek Bridge is located about 9.5 kilometres northwest of Narrabri and was built in 1968. This bridge is not heritage listed. The proposal would occur within the road corridor and surrounding agricultural land which has been subject to previous disturbance.

The closest heritage listed item is Narrabri's Cemetery, about nine kilometres from the proposal area. This item is listed on both the State Heritage Inventory and Narrabri LEP.

6.7.3 Potential impacts

Construction

The construction of the proposal would occur within a highly disturbed landscape. The nearest heritage item is about nine kilometres from the proposal area. It would be unlikely that previously unidentified non-Aboriginal heritage items would be discovered during construction, and it would be unlikely that the proposal would impact on listed heritage items within the Narrabri LGA.

Operation

The proposal involves demolishing and replacing the existing culvert with a modern concrete bridge in the same location as the existing structure. The new bridge would have a load capacity and traffic barriers meeting current safety and design standards which would enable the bridge to continue as a significant connection for local agricultural businesses and the community by supporting HML vehicles.

The operation of the proposal would likely have negligible impacts on local non-Aboriginal heritage.

6.7.4 Safeguards and management measures

Table 6-18: Non-Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Non-Aboriginal heritage	• The *Standard Management Procedure - Unexpected Heritage Items* (Transport, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of non-Aboriginal origin are encountered. • Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Detailed design / Pre-construction

6.8 Aboriginal cultural heritage

6.8.1 Methodology

Aboriginal heritage within the surrounding area was investigated by desktop analysis and proposal area walk over by a Transport Aboriginal Cultural Heritage Advisor. A clearance letter was provided with the findings of the proposal area walk over (refer to Appendix E). This is consistent with Stage 1 of the PACHCI process.

6.8.2 Existing environment

An Aboriginal Heritage Information Management System (AHIMS) search was undertaken on 19 October 2022 which identified three Aboriginal Heritage items within a study area shown in Appendix E, however these were not located within the proposal area. This finding was further supported by the clearance letter which identified:

- The proposal is unlikely to harm known Aboriginal objects or places.
- The AHIMS search did not indicate moderate to high concentrations of Aboriginal objects or places in the study area.
- The study area does not contain landscape features that indicate the presence of Aboriginal objects, based on the Office of Environment and Heritage's *Due diligence Code of Practice for the Protection of Aboriginal objects in NSW* and the Transport's procedure.
- The cultural heritage potential of the study area appears to be reduced due to past disturbance.

6.8.3 Potential impacts

Construction

Construction of the proposal would involve establishing working platforms within the waterway and excavation works to create room for the new location of the embankments and abutments. The proposal would be limited to the operating road corridor, adjacent road reserve and agricultural land which has generally been subject to previous disturbance. No previously recorded items or places of Aboriginal heritage have been identified within the proposal area, and the proposal area has been identified to have no indication of potential unidentified Aboriginal heritage items.

Based on the findings within the clearance letter, and the previous disturbance of the proposal area, it is unlikely that the proposal would impact on items of Aboriginal heritage.

Operation

Operation of the proposal would align with the existing Spring Creek bridge operation. The area of disturbance would be limited to the existing road corridor and road reserve. It is unlikely the proposal would impact on items of Aboriginal heritage.

6.8.4 Safeguards and management measures

Table 6-19: Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Aboriginal heritage	If any suspected Aboriginal heritage items are uncovered during the works, all works in the vicinity of the find must cease and the Transport Aboriginal Cultural Heritage Officer and Environment Manager be contacted immediately. Steps in the Transport *Unexpected Heritage Items Procedure* (2022) must be followed.	Contractor	Construction
Aboriginal heritage	If suspected human remains are located during any stage of the proposal, activities must be stopped immediately, and the NSW police and Transport Environment Manager must be notified.	Contractor	Construction

6.9 Landscape character and visual impacts

6.9.1 Methodology

The landscape character and visual impacts were assessed using Transports *Guideline for Landscape Character and Visual Impact Assessment: Environmental Impact Assessment Practice note EIA-N04*.

6.9.2 Existing environment

Landscape character

The landscape surrounding the proposal area is predominantly characterised by agricultural production, scattered rural residences and native vegetation. Spring Creek and associated riparian vegetation are features of the surrounding landscape. The Kamilaroi Highway is also a prominent feature of the landscape with both light and heavy vehicles regularly travelling through the area.

The existing culvert structure over Spring Creek is not a prominent feature within the landscape, although contributes to landscape character of Spring Creek within the locality.

Visual character

The visual catchment of the proposal is defined by the area within which the construction and operation of the proposal is visible. This is influenced by landscape position, obstructions such as vegetation and spatial arrangement of the landscape. Spring Creek Bridge is located on a straight section of the Kamilaroi Highway, and from the road the bridge's defining feature are the guard rails and steel railings which are closer to the edges of the road (refer to Figure 6-5), compared to the other parts of the Kamilaroi Highway which have no barriers. The visual catchment of the existing Spring creek bridge and Spring Creek is limited to 200 metres either side of the bridge.

Views of the existing bridge and the proposal area are seen in Figure 6-5, Figure 6-6 and Figure 6-7.

Figure 6-5: Upstream Spring Creek, view from Spring Creek bridge

Figure 6-6: Downstream Spring Creek, view from Spring Creek bridge

Figure 6-7: Existing Spring Creek bridge, viewed from southern bank downstream

6.9.3 Potential impacts

Construction

During construction, visual impacts would arise through the demolition and replacement of Spring Creek Bridge. This would include instream structures, hydrocarbon booms, and heavy machinery. Light vehicle movements facilitating the movement of materials and construction personnel around the proposal area would also be visible. The visual impacts would be temporary.

An existing temporary compound site would be utilised for placement of site amenities, construction personnel parking, equipment and machinery, and for chemical storage. This would be located on the downstream side of the road from the southern approach along the Kamilaroi Highway. Two existing stockpile sites are located at the southern approach and one on the northern approach, both on the upstream side of the Kamilaroi Highway, within the proposal area. The stockpile sites would be used for storing excavated material and endemic species. As the compound and stockpile sites are already established, the landscape character and visual amenity would incur a minor change once in use.

The proposal requires the removal of 4.3 hectares of native and exotic grassed vegetation from the surrounding riparian zone of Spring Creek and within the road corridor, and two mature trees. The final landscaping design would include a planting strategy which would include using native vegetation species to reinstate the vegetation over the proposal batters.

Elements of construction would be visible to receivers travelling on the Kamilaroi Highway. Residential receivers would likely experience impacts from the view of construction activities, plant and signage. Although this would likely be minor given the nearest dwelling is located ~ 580 metres south of the proposal area and there is scattered natural vegetation screening.

The landscape character and visual impacts associated with construction are anticipated to be low as summarised in Table 6-20.

Table 6-20: Landscape character and visual impacts during construction

Viewpoint	Magnitude	Sensitivity	Rating
Rural residences about 580 to 890 metres south of the proposal	Low	Low	Low
Rural residences about 1140 metres north of the proposal	Low	Low	Low
Passing motorists on the Kamilaroi Highway	Low	Low	Low

Operation

The new concrete bridge would replace dated and deteriorating infrastructure with a bridge which is built for current and future demands of the roadway. It would introduce a new landscape character consistent with the evolving demands of agriculture and other operations in the surrounding and wider area The design of the new bridge is consistent with key components of the bridge Aesthetics Design Guideline (Transport, 2019) while remaining compliant with design constraints, such as hydraulics and constructability. The proposal would include rehabilitation of disturbed riparian areas with endemic vegetation presenting a minimal impact to the landscape character of the locality The visual impact of the operation of the new bridge and approaches would be largely consistent with the current roadway, with improvements in visual appeal with the removal of the temporary steel propping and bridge barriers. Although the new bridge would be longer with a wider waterway area, and roadside reserve vegetation would be removed, the new bridge would be seen in the similar context as the existing structure as vegetation would be reinstated within the reserve following completion of the proposal.

The landscape character and visual impact of the operational phase of the proposal are both anticipated to be negligible as detailed in Table 6-21 .

Table 6-21: Landscape character and visual impacts during operation

Viewpoint	Magnitude	Sensitivity	Rating
Rural residences north of the proposal	Negligible	Low	Negligible
Rural residences south of the proposal	Negligible	Low	Negligible
Passing motorists on the Kamilaroi Highway	Negligible	Low	Negligible

6.9.4 Safeguards and management measures

No additional landscape character and visual impact environmental safeguards and management measures are proposed in addition to the 'designed in' measures to avoid such impacts (e.g. reduction in overall height, symmetry, material selection, etc). Other safeguards and management measures to address landscape character and visual impacts are identified in Section 6.11.4.

6.10 Property and land use

6.10.1 Methodology

The proposal area is located within the Narrabri Shire LGA in northern NSW. The land use surrounding the proposal area was determined using the Narrabri LEP 2012 and satellite imagery.

6.10.2 Existing environment

The proposal area is surrounded by agricultural and broadacre properties. The land surrounding Spring Creek bridge is zoned RU1 Primary Production. Narrabri, located approximately 9.5 km southeast of the proposal area, is a small rural town providing employment, industry, retail, health services and education. Wee Waa, located approximately 28 kilometres northwest of the proposal area, a smaller town than Narrabri, supplying similar services on a smaller scale.

The proposal is located primarily in the road corridor and some areas of the surrounding private agricultural properties. This includes:

- 2/DP579381 (Water NSW land (temporary occupation through S175 notice under the Roads Act)
- 2/DP719220.

Transport would obtain a lease and/or entry agreement with the respective landowners for use of the private properties for the compound and stockpile sites, and temporary access tracks. The cadastral boundaries around the proposal area are shown in Figure 6-8.

FIGURE 6-8:
CADASTRAL BOUNDARIES AND LAND USE

0 100 200 m

Legend

- Proposal area
- Road
- Watercourse
- Cadastre

Land Use Zone

- RU1 Primary Production

Source: Maxar

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6.10.3 Potential impacts

Construction

Use of the approved side-side track for diverting traffic within private agricultural property has been approved through an existing entry agreement Transport acquired for the establishment of the side-track under the approved MWREF.

For the agricultural property listed above, Transport would obtain an entry agreement for use of areas of private property required for the proposal. Access to these areas by the landowners would be prohibited for the duration of the proposal. These areas would be rehabilitated, and landowners would resume the ability to access these areas following the completion of construction.

Operation

The proposal would continue to operate within the existing road corridor with no operational impact to surrounding land uses.

6.10.4 Safeguards and management measures

Table 6-22: Property and land use safeguards and land use

Impact	Environmental safeguards	Responsibility	Timing
Property lease	Property owners would be consulted and an entry agreement arranged for the use of agricultural property required prior to construction.	Transport Project Manager	Pre-construction and construction

6.11 Socio-economic

6.11.1 Methodology

The proposal is located in the Narrabri Shire LGA in northern NSW. The socio-economic data for Narrabri and Wee Waa was collected from the Bureau of Statistics Census Database (ABS, 2021)

6.11.2 Existing environment

The proposal area encompasses road infrastructure, native vegetation and a waterway with no commercial or industrial uses. Kamilaroi Highway is the fastest travel route connecting the towns of Narrabri and Wee Waa.

The population of Narrabri and Wee Waa is collectively 9361, with the working age population employed in a professional capacity or as machinery operators, labourers and trades workers. The top industries for employment include coal mining and cotton growing. Over 70% of the workforce in the area drive to work every day, utilising local roads (including the Kamilaroi Highway) to get to their place of employment.

Spring Creek is not used for recreational activities by the community but may be used by the private landowners in areas which would be used for the proposal.

6.11.3 Potential impacts

Construction

Given the location of the proposal along a major regional roadway, impacts would likely be primarily associated with commuters undertaking longer distance travel between rural centres or freight and agriculture transport. Traffic impacts are discussed in Section 6.6.3, and mitigation measures have been provided to mitigate these impacts.

Redirecting traffic to the approved side-track would likely result in a minor increase in travel time. The side-track speed limit would be 60km/hr compared to the current 100km/hr. Given the small area affected by the reduced speed limit for the proposal, this impact would not likely be significant.

Private landowners would have restricted access to areas within the proposal area. However, the areas of land which would be used by the proposal are still over 500 metres from dwellings on the properties and the proposal would not restrict access to these dwellings The proposal would likely result in a minor socio-economic impact.

Operation

Once operational, the upgraded bridge would provide improved and safe access for heavy vehicles, including agricultural machinery, facilitating connectivity locally and within the region. Additionally, the safety improvements afforded by the new bridge (including wider shoulders and improved location of approaches for increased flood immunity) would benefit residents.

The new bridge is designed to require minimal ongoing maintenance. The proposal would remove the need for the existing makeshift steel propping and improve safety along the Kamilaroi Highway during heavy rainfall and flood events.

6.11.4 Safeguards and management measures

Table 6-23: Socio economic safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
General notification	All businesses, residential properties and other key stakeholders (e.g. local councils and businesses) affected by the activity will be notified at least five working days prior to commencement of the activity. The notification will include: • Details of the proposal • Construction period and construction hours • Contact information for proposal management staff • Complaint and incident reporting and how to obtain further information	Transport Project Manager & Contractor	Pre-construction

Other safeguards and management measures to address socio-economic impacts are identified in Section 6.6.4 and 6.10.4.

6.12 Waste and resources

6.12.1 Policy setting

The waste regulatory framework is administered under the POEO Act and the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act). The purpose of these policies is to prevent degradation of the environment, eliminate harmful wastes, reduce the amount of waste generated and establish priorities for waste reuse, recovery and recycling. The WARR Act establishes a waste hierarchy, which comprises the following principles:

- Avoidance of waste, such as unnecessary resource consumption
- Resource recovery, such as the reuse, reprocessing and recycling of waste products generated during construction
- Disposal of waste, where resources cannot be recovered.

By adopting the WARR Act principles, Transport encourages the most efficient use of resources and reduces cost and environmental harm in accordance with the principles of ecologically sustainable development.

6.12.2 Potential impacts

As outlined in Section 3.3.1, the main activities to be carried out as part of the proposal are:

- Advance works
- Access track, working platform and vegetation clearing
- Bridge removal
- Bridge construction
- Final roadworks construction.

The waste streams which would likely be generated during each activity are presented in Table 6-24.

Table 6-24: Main proposal activities and likely waste streams to be generated

Stage	Likely wastes
1. Advance works	• Green waste
2. Access track, working platform and vegetation clearing	• Green waste • Spoil from excavations • General wastes from construction personnel • Gravel for access tracks • Temporary in-stream working platform (rock)
3. Bridge demolition	• Identified hazardous materials including ACM and lead paint • Existing bridge components including concrete culverts and walls • Steel propping • Temporary in-stream working platform (rock) • Road pavement and bitumen • Removed sediment and erosion controls, such as silt fence
4. Bridge construction	• Spoil material from excavations • Waste from construction activities • General wastes from construction personnel • Packaging materials, such as pallets, plastic bags • Temporary in-stream working platform (rock)
5. Final roadworks construction.	• Waste from construction activities • General wastes from construction personnel • Excess stockpiled materials, such as spoil • Road pavement, bitumen, fill and materials from side-track

Stage	Likely wastes
	• Waste from proposal area demobilisation

The tree trimming and vegetation removal during Stage 2 activities would likely produce a small amount of green waste. Where possible, this green waste would be re-used as mulch during the rehabilitation phase of the proposal.

The construction activity likely to generate the largest quantity of waste is the removal of the existing bridge. The existing bridge is mostly made of concrete and steel and contains hazardous materials such as ACM and lead paint. Waste classification would be undertaken to ensure various waste streams containing hazardous material would be disposed of at an appropriate licenced waste facility. Narrabri Waste Management Centre would be used to dispose of demolition concrete including culverts, excess road pavement and bitumen.

Rock from in-stream structures and crane pads would be stored at an appropriate Transport stockpile site for future reuse or recycling. Excavated waste may also be installed as scour protection for the new bridge abutments.

Following removal of the access tracks and working platforms, pavement materials and steel piping would likely be reused by Narrabri Shire Council for future patching and pavement activities within the road corridor.

Excess spoil or stockpiled materials remaining following the completion of the final roadworks phase of the proposal would be disposed of in accordance with the NSW EPA Waste Classification Guidelines (EPA, 2014). These materials would be removed by a licensed contractor to an appropriately licenced waste facility.

6.12.3 Safeguards and management measures

Table 6-25: Waste and resource safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Waste	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to: • Measures to avoid and minimise waste associated with the proposal • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • Lead related waste is to be managed in accordance with the requirements detailed in *Protection of the Environment Operations (Waste) Regulation 2014* • Schedule 1 of the NSW *Protection of the Environment Operations (waste) Regulation 2014* requires lead waste transporters to provide tracking information to the EPA via the WasteLocate online tool. Lead related waste must be disposed at a suitably approved waste collection facility. All tipping dockets must be retained • Specify the measures to be implemented for the removal and disposal of asbestos containing material if found. The removal and disposal of asbestos would be carried out in accordance with the requirements of the *Code of Practice How to Safely Remove Asbestos* (Safe Work Australia, 2016) • Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal • Monitoring, record keeping and reporting The WMP will be prepared taking into account the *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime, 2014) and relevant transport Waste Fact Sheets.	Contractor	Pre-construction

Hazardous waste	As part of the WMP, measures will be implemented in relation to disposal of identified hazardous materials as outlined in Section 6.3.	Contractor	Construction, post- construction
Resource use	A far as reasonably practicable, construction materials would be sourced within the local region so as to reduce transport costs and fuel usage.	Contractor	Pre-construction / construction

Other safeguards and management measures to address waste impacts are identified in Section 6.3.4 and 6.4.4.

6.13 Air quality and climate change

6.13.1 Methodology

The Department of Climate Chance, Energy, the Environment and Water National Pollutant Inventory (NPI) was searched on 14 October 2022 to identify facilities with a licence to produce air emissions near the proposal area. The NSW Department of Planning and Environment Air Quality Data Service was accessed on 14 October 2022 to provide baseline air quality for the proposal area.

6.13.2 Existing environment

Air quality

The proposal area is located within a rural area. The existing air quality within and surrounding the proposal is likely to be influenced by local agricultural operations and from vehicle emissions on the Kamilaroi Highway.

The search of the NPI indicated that there are four facilities with a licence to produce emissions in the Narrabri LGA. However, these facilities are located over nine kilometres from the proposal area and are unlikely to influence air quality in the vicinity of the proposal.

The closest air quality data is obtained from the Narrabri monitoring station about nine kilometres south of the proposal. Available data, which was restricted to particulate matter PM_{10} and $PM_{2.5}$ for these areas over the period between 1 January 2021 and 1 January 2022, is shown in Table 6-26. Particulate matter air quality readings were within the maximum concentrations per year as identified in the *National Environmental Protection Measure for Ambient Air* (AIR NEPM).

Table 6-26: Air quality measurements for Narrabri

Location	Measure	Maximum concentration per year (μg/m³)	Annual average (24hr) (μg/m³)	Monthly Averages (24hr) (μg/m³)
Narrabri	PM_{10}	25	7.0	6.97
	$PM_{2.5}$	8	3.1	3.81

The land surrounding the proposal area is partly cleared and cultivated for cropping and grazing. Air quality impacts due to large areas of bare ground and agricultural operations agitating the surface and emitting dust into the air. Impacts from this source can vary with long dry periods emitting significant amounts of dust into the air while wet periods supress dust emission.

There are two residential receivers within one kilometre of the proposal area, including:

- 20281 Kamilaroi Highway, located about 580 metres southeast of the proposal area
- 87 Bald Hill Road, located about 890 metres east of the proposal area.

These residences are located in close proximity to cultivated agricultural fields and would be subject to dust from operations in these areas.

Greenhouse gas and Climate Change

Existing sources of greenhouse gas emissions within proximity of the proposal area are likely to arise mainly from vehicle emissions from the road network and agricultural operations. These include heavy vehicles travelling along the Kamilaroi Highway and agricultural machinery used in the surrounding fields.

6.13.3 Potential impacts

Construction

Earthworks would be carried out for constructing the temporary access tracks, working platforms and excavating bridge abutments. These activities could give rise to emissions of dust from ground disturbance and exposed earth surfaces. The loading and movement of fill around the proposal area and the transport of equipment and machinery may also mobilise dust into the air. Dust impacts may be exacerbated in prolonged dry conditions.

The potential sources of greenhouse gas emissions during the construction phase would be exhaust emissions from construction plant and equipment, as well as exhaust emissions from light and heavy vehicles. Given the extent of works associated with the proposal, the volume of emissions would likely be minor.

Safeguards and management measures as outlined in Section 6.13.4 would be utilised to reduce and minimise air emissions and consequent impacts.

Operation

The proposal would not likely increase emissions or affect air quality more generally during operation.

6.13.4 Safeguards and management measures

Table 6-27: Air quality and climate change safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Air quality	Air Quality will be managed as part of the CEMP. The CEMP will include, but not be limited to: • Information on potential sources of air pollution • Mitigation and suppression measures to be implemented • Methods to manage work during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces.	Contractor	Pre-construction
Air quality	Vehicles transporting waste or other materials that may produce dust are to be covered during transportation.	Contractor	Construction
Air quality	Measures (including watering or covering exposed areas) are to be used to minimise or prevent air pollution and dust.	Contractor	Construction
Greenhouse gas and emissions	Construction vehicles, plant and equipment are to be maintained in accordance with manufacturer instructions and vehicles and equipment are to be monitored for 'dirty' exhaust fumes.	Contractor	Construction

Other safeguards and management measures to address air quality impacts are identified in Section 6.4.4.

6.14 Cumulative impacts

There is a requirement under clause 171(2) of the EP&A Regulations to consider any cumulative environmental impacts of the proposal with other existing or planned future activities. Cumulative impacts have the potential to arise from the interaction of individual components within the proposed area and the effects of the proposal alongside other proposals.

6.14.1 Study area

The cumulative impact assessment has considered other proposals or developments around Narrabri and Wee Waa.

6.14.2 Other proposals and developments

A search was carried out on the Narrabri Shire Council website for Development Applications (DAs) submitted in locations near the proposal area between July 2021 and June 2022. The search results identified that there was no large DAs submitted to Narrabri Shire Council within this time that would be likely to interact with the proposal and result in significant cumulative impacts.

The Department of Planning and Environment's Major Proposal register was also searched on 18 October 2022 and identified three major proposals approved since 2018 near Narrabri and Wee Waa. These are shown in Table 6-28 below.

Table 6-28: Summary of major proposals nearby the proposal area

Proposal	Determination	Construction timeframe	Approximate distance to proposal area (km)
Silverleaf Solar Farm	Approved 21/04/22	12 months planned commencement early 2020 (however was determined in early 2022)	5
New Wee Waa Highschool	Approved 12/10/22	Six months planned commencement March 2022	27
Narrabri South Solar Farm	Approved 21/12/2018	Six to 12 months planned commencement not stated	19

It is likely that the Silverleaf solar farm and Wee Waa Highschool major proposals would be constructed at a similar time to the proposal given each proposal was determined within 2022, and the proposal is planned to begin construction in early 2023.

6.14.3 Potential impacts

The proposal is not part of a broader program of works and therefore would unlikely result in cumulative traffic impacts in this respect.

However, cumulative impacts may arise where road users may experience increased construction traffic and traffic condition/route changes from enforced traffic management plans. Further impacts may arise should the Kamilaroi Highway be a key travel route for construction workers or construction equipment, plant and material haulages for these major proposals, where the community would likely experience potential increased travel time due to road works. Following the completion of the proposal, these cumulative potential impacts would be resolved, hence they would be considered as minor and temporary.

There would be potential for minor cumulative impacts in the event unforeseen or emergency roadworks take place along the Kamilaroi Highway.

6.14.4 Safeguards and management measures

Table 6-29: Cumulative safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Cumulative impacts	Potential cumulative impacts from surrounding development activities would be reviewed as part of the development of the CEMP.	Transport Project Manager/ Contractor	Construction

Other safeguards and management measures to address cumulative impacts are identified in Section 6.6.4.

7. Environmental management

This chapter describes how the proposal will be managed to reduce potential environmental impacts during detailed design, construction and operation. A framework for managing potential impacts is provided. A summary of site-specific environmental safeguards is provided and the licence and/or approval requirements required prior to construction are listed.

7.1 Environmental management plans (or system)

Safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A CEMP will be prepared to describe the safeguards and management measures identified. The CEMP would provide a framework for establishing how these measures would be implemented and who would be responsible for their implementation.

The CEMP will be prepared prior to construction of the proposal and must be reviewed and certified by the relevant Transport Environment Officer, Western Region, prior to the commencement of any on-site works. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP would be developed in accordance with the requirements set out in the relevant Transport QA Specifications including *QA Specification G36 - Environmental Protection (Management System)*, *QA Specification G38 - Soil and Water Management (Soil and Water Plan)*, *QA Specification G40 - Clearing and Grubbing,* and *QA Specification G10 - Traffic Management*.

7.2 Summary of safeguards and management measures

Environmental safeguards and management measures outlined in this REF would be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards and management measures would minimise any potential adverse impacts arising from the proposal on the surrounding environment. The safeguards and management measures are summarised in Table 7-1.

Table 7-1: Summary of safeguards and management measures

No.	Impact	Environmental safeguards	Responsibility	Timing
G1	General	A CEMP will be prepared and submitted for review and endorsement by the Transport Environment Officer prior to commencement of the activity. As a minimum, the CEMP will address the following: • Any requirements associated with statutory approvals • Details of how the project will implement the identified safeguards outlined in the REF • Issue-specific environmental management plans • Roles and responsibilities • Communication requirements • Induction and training requirements • Procedures for monitoring and evaluating environmental performance, and for corrective action • Reporting requirements and record-keeping • Procedures for emergency and incident management • Procedures for audit and review. The endorsed CEMP will be implemented during the undertaking of the activity	Transport Project Manager / Contractor	Preconstruction, construction
G2	General	All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular "toolbox" style briefings Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include: • Location of spill kits and the use of spill kits • Awareness of potential flood levels and flood risks.	Transport Project Manager / Contractor	Preconstruction, construction
G3	General	Works and ancillary areas are to be clearly delineated and marked. Vehicles and plant/equipment are to be kept away from environmentally sensitive areas and outside the dripline of trees.	Transport Project Manager / Contractor	Preconstruction, construction
B1	Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible.	Transport, Contractor	Detailed design / pre-construction
B2	Aquatic Impacts	Sediment and erosion controls for in-stream works will be used to avoid impacts on water quality and fish passage, e.g. erosion fencing, stockpile covers and silt curtains	Contractor	Construction

B3	Aquatic Impacts	Work will be undertaken in accordance with the Code of Practice for Minor Works in NSW Waterways (Roads and Maritime Services, 2014)	Contractor	Construction
B5	Aquatic impacts	Restrict substructure works to periods of normal flow (i.e. no work during flood periods).	Contractor	Construction
B6	Aquatic impacts	Place stockpiles in designated stockpile locations such that they are not subject to a 1 in 10 year flood event, i.e. at top of banks.	Contractor	Construction
B7	Aquatic impacts	Replace/add snags into the waterway post-construction where practicable so as to replicate the pre-construction condition.	Contractor	Post-construction
B8	Aquatic impacts	Rehabilitate vegetation within the riparian zone upon completion of construction including revegetation with local native species, e.g. *E. camaldulensis and C. glauca.*	Contractor	Post-construction
B9	Aquatic impacts	Aquatic habitat shall be protected in accordance with *Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 Standard precautions and mitigation measures of the *Policy and guidelines for fish habitat conservation and management Update 2013* (DPI 2013).	Contractor	Construction
B10	Vegetation removal	All vegetation removal would be limited to the minimum extent necessary to construct the bridge and approaches, and demolition and removal of the temporary diversion track	Contractor	Construction
B11	Vegetation removal	Prior to the commencement of any works, a physical clearing boundary is to be demarcated and implemented. The demarcation of the exclusion zone will be in accordance with *Biodiversity Guidelines – Protecting and Managing Biodiversity on RTA Projects: Guide 2: exclusion zones* (RTA 2011).	Contractor	Construction
B12	Vegetation removal	A 'Clearing and Grubbing Plan' would be developed in accordance with Guide 4 (clearing of vegetation) of the *Transport for NSW Biodiversity Guidelines* (RTA 2011). This will include best practice methods for the removal of woody vegetation and non-woody vegetation.	Transport, Contractor	Pre-construction, Construction
B13	Vegetation removal	As mature trees with a DBH >40 cm diameter are proposed to be cleared, an ecologist or Transport Environmental Officer must be onsite to undertake a pre-clearance survey prior to and whilst the tree/s are being removed (*see Biodiversity Guidelines – Protecting and Managing Biodiversity on RTA Projects: Guide 1 Pre-clearing Process and Guide 4 Clearing of vegetation and removal of bushrock* (RTA 2011).	Transport, Contractor	Pre-construction, Construction
B14	Vegetation removal	Within the riparian area, the sections of felled trees including hollows should be placed on the ground to provide habitat for ground-dwelling fauna, where practicable.	Contractor	Construction
	Protection of native flora	If unexpected, threatened flora species are discovered, stop works immediately and follow the *Biodiversity Guidelines – Protecting and Managing Biodiversity on RTA Projects: Guide 1 (Pre-clearing process)* (RTA 2011).	Contractor	Construction
B15	Protection of fauna and habitat	Construction of the new bridge should include the rehabilitation of the temporary side track upon removal. This should include removal of the existing pavement and tilling to allow the regeneration of native plants.	Contractor	Pre-construction, construction, post-construction
B16	Protection of fauna and habitat	Transport should contribute to the Transport Conservation Fund in accordance with the Tree and Hollow Replacement Guidelines (Transport for NSW, 2022). Fund contributions are detailed in Table 2-2 of the Guidelines.	Transport	Pre-construction, construction,

				post-construction
B18	Protection of fauna and habitat	If unexpected, threatened fauna species are discovered, stop works immediately and follow the *Biodiversity Guidelines – Protecting and Managing Biodiversity on RTA Projects: Guide 1 (Pre-clearing process)* (RTA 2011)	Contractor	Construction
B19	Protection of fauna and habitat	WIRES should be consulted if any injured fauna are encountered.	Contractor	Construction
B21	Protection of fauna and habitat	If it is perceived that significant impacts are occurring to aquatic environments within the vicinity of the work area (e.g. spill of any chemicals), works at that location should cease and Transport environment branch should be contacted for further advice.	Contractor	Construction
B22	Protection of fauna and habitat	To minimise the risk of injury or mortality to fauna and their young the following measures are recommended: • All clearing is to follow the RTA biodiversity guidelines with respect to the pre-clearing process, including the capture and relocation (by licenced wildlife carers or ecologists) of fauna that have the potential to be disturbed as a result of clearing activities • Vegetation removal is to be undertaken as per guide 4 of the RTA biodiversity Guidelines, including the implementation of staged clearing.	Contractor	Construction
B23	Protection of fauna and habitat	Routine corridor maintenance should be carried out to manage mid-storey vegetation on road batters to reduce congregation of wildlife and improve sight lines for motorists during operation.	Transport	Operation
B24	Weeds and disease	Weeds will be managed in accordance with the Transport's standard weed management measures.	Transport, Contractor	Pre-construction, construction
B25	Offsite impacts	Reduce the potential for off-site impacts arising from sedimentation, dust, and noise through the implementation of a CEMP. The CEMP should seek to retain any native vegetation present within and around the proposal area wherever possible. The CEMP should include erosion and sediment controls in accordance with *Managing urban stormwater: soils and construction* (the Blue Book).	Transport, Contractor	Pre-construction, construction
B26	Waste	All waste material and rubbish associated with the proposal, particularly chemicals, are to be removed from site and properly disposed of.	Contractor	Construction, post-construction
NV1	Noise and vibration	A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in *the Interim Construction Noise Guideline (ICNG) (DECC, 2009*) and identify: • All potential significant noise and vibration generating activities associated with the activity • Feasible and reasonable mitigation measures to be implemented, taking into account *Beyond the Pavement**: urban design policy, process and principles* (Transport, 2014). • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.	Contractor	Pre-construction

NV2	Noise and vibration	All sensitive receivers (e.g., schools and local residents) likely to be affected will be notified at least 5 days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • The proposal • The construction period and construction hours • Contact information for proposal management staff • Complaint and incident reporting • How to obtain further information.	Contractor	Pre-construction
HA1	Hazards and risk management	Hazard and risk will be managed as part of the CEMP. The CEMP will include, but not be limited to: • Details of hazards and risks associated with the activity • Measures to be implemented during construction to minimise these risks • Record keeping arrangements, including information on the materials present on the proposal area, material safety data sheets, and personnel trained and authorised to use such materials • A monitoring program to assess performance in managing the identified risks • Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations. The CEMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or Office of Environment and Heritage publications	Contractor	Construction
HA2	Bridge removal – ACM	**Mitigation method includes**: Non-friable ACM with fair condition that has a low to moderate risk of exposure can be mitigated with a combination of engineering and administrative controls. Mitigation control measures may include the ACM being enclosed, encapsulated or sealed as described below. • Enclose - Placing a fixed physical barrier between the ACM and the surrounding area reducing the risk of exposure to airborne asbestos fibres from general interaction with the material (suitable for non-friable ACM where removal is not reasonably practicable and where the ACM is at risk of damage from work activities). • Encapsulate– ACM is encapsulated in a resilient matrix (e.g. reinforced plastic, vinyls, resins, mastics, bitumen, flexible plaster or cement) to prevent the release of asbestos fibres into the air (applicable if the ACM cannot be removed or enclosed). • Seal – Covering the surface of the ACM with a protective coating (paint) to reduce fibre release and/or bind the fibres together (sealing is inappropriate where the process of sealing or applying paint will disturb or damage the ACM). Mitigation control measures are interim in nature and should be supported through regular inspections by a competent person to evaluate the ongoing effectiveness of the applied controls. Removal should be considered when the applied controls are no longer effective and degradation and damage of the applied controls is observed. The process of encapsulating and sealing ACM is considered as 'asbestos-related works' due to the direct interaction with the ACM. As such, the following should be considered when these mitigation control measures are implemented: • Engage an appropriately licensed asbestos contractor (Class A or Class B) to undertake the works.	Contractor	Construction

		• The licensed asbestos contractor is to ensure they have conducted and implemented the following: – Notified the regulator of the licensed asbestos work. – Prepared a Safe Work Method Statement and Safety Management Plan. – Limited access to the asbestos work area (e.g. barricading, signage). – Provided suitable decontamination facilities or processes. • Engage a hygienist or competent person to undertake air monitoring where asbestos-related work is being carried out, particularly if there is uncertainty as to whether the exposure standard is likely to be exceeded. **Removal method:** ACM must be removed prior to any demolition or construction works that are likely to result in the disturbance of ACM. Any work involving the removal of ACM must be undertaken under controlled conditions following obtaining all necessary licences. • The following licence requires much be following with regards to asbestos removal works: – Class A Licence - For any amount of friable ACM, asbestos containing dust and non-friable asbestos. – Class B Licence - For greater than 10 m2 of non-friable ACM and asbestos containing dust associated with the removal of non-friable ACM. – No licence required – For up to 10 m2 of non-friable ACM and asbestos containing dust associated with the removal of less than 10 m^2 of non-friable ACM. • The licensed asbestos contactor (where used as per licence requirements) is to ensure they have conducted and implemented the following: – Notified the regulator of the licensed asbestos removal work. – Prepared a Safe Work Method Statement and an Asbestos Removal Control Plan. – Limited access to the asbestos work area (e.g. barricading, signage). – Provided decontamination facilities appropriate for the type of asbestos removal works. • For Class A licensed asbestos removal works: – Ensure an independent Licensed Asbestos Assessor is engaged to conduct airborne asbestos monitoring prior to, during and following any works. ○ Airborne asbestos analysis should be undertaken by a NATA Accredited laboratory. – Ensure an independent Licensed Asbestos Assessor conducts a clearance inspection following the Class A licensed asbestos removal works. This is undertaken to assess the adequacy of the removal works and to validate that asbestos has been removed to a satisfactory standard and that the affected areas are safe for reoccupation. This must include clearance airborne asbestos monitoring and may include soil validation sampling depending of the asbestos removal work.		

		• For Class B licensed asbestos removal works: – Consider engaging an independent Licensed Asbestos Assessor or competent person to conduct airborne asbestos monitoring (e.g. at, or near sensitive locations such as public areas, a school or a hospital). ○ Airborne asbestos analysis should be undertaken by a NATA Accredited laboratory. – Ensure an independent Licensed Asbestos Assessor or competent person conducts a clearance inspection following the Class B licensed asbestos removal works. This is undertaken to assess the adequacy of the removal works and to validate that asbestos has been removed to a satisfactory standard and that the affected areas are safe for reoccupation. This may include clearance airborne asbestos monitoring and / or soil validation sampling depending of the asbestos removal work. • Clause 79 of the NSW *Protection of the Environment Operations (waste) Regulation 2014* requires asbestos waste transporters (transporting a minimum of 100 kilograms of asbestos waste, or 10 m^2 of asbestos waste that is asbestos sheeting, in any single load) to provide tracking information to the EPA via the WasteLocate online tool. ACM must also be disposed of at a suitably approved waste collection facility. All tipping dockets must be retained.		
HA3	Bridge removal – Lead Paint	Lead paint management during demolition should be conducted under controlled conditions in accordance with applicable legislation outlined in Appendix J. The following recommendations are provided when undertaking lead paint removal works. **Removal methods include:** • Removal of lead-painted products in its entirety – Material/structures covered in lead paint may be removed in its entirety (with lead paint in-situ) and replaced with new materials that do not contain lead paint. • Removal of lead paint from the structural surface – This process involves the removal of lead paint from a structure surface only. Lead paint removal may be conducted using the following methods: – Wet scraping and wet sanding – On site chemical stripping – Removal by heat gun and scraper. The removal of lead paint from structural surfaces may be defined as a lead process or lead risk work based on WHS Regulation 2017, clauses 392 and 394. As such, the following should be considered: • Seek approval from the regulator regarding the nature of the removal works with respect to lead processes and lead risk work • Where removal works are deemed a lead process or lead risk work, address relevant WHS Regulation clauses associated with lead processes. The WHS Regulation (Chapter 7) outlines specific requirements relating to lead risk work that need to be conducted by a person conducting a business or undertaking (or the contractor engaged to do the work), including: • Ensuring information is provided to workers about the risks and health effects when working with lead • Ensuring health monitoring is provided to workers before lead risk works starts and one month after starting • Ensuring a lead risk work notification form is submitted at least seven (7) days before lead works commences.	Contractor	Construction

		Other considerations include: • Preparation of a Safe Work Method Statement for the selected methodology • Limiting access to the lead paint work area (e.g. barricading, signage) • Providing suitable decontamination facilities and processes • Managing lead related waste in accordance with the requirements detailed in *Protection of the Environment Operations (Waste) Regulation 2014*. • Schedule 1 of the NSW *Protection of the Environment Operations (waste) Regulation 2014* requires lead waste transporters to provide tracking information to the EPA via the WasteLocate online tool. Lead related waste must be disposed at a suitably approved waste collection facility. All tipping dockets must be retained.		
HA4	Hazardous materials – Unexpected finds	When suspected hazardous materials are encountered, the following procedure protocol should be followed: • Cease work and restricted access by isolating the area with a barrier and warning signage. • Engage a hazardous materials consultant or equivalent specialist (e.g. licensed asbestos assessor or competent person) to undertake an assessment of the unexpected find. • Hazardous material removal may require the engagement of a licensed contractor and implementation of specific controls which may include air monitoring. • If the unexpected find is deemed to be emergency asbestos removal work, a SafeWork NSW notification is not required, however the engaged asbestos removal contractor must advise SafeWork NSW within 24 hours of being advised and/or undertaking the emergency works. • Following the removal of the hazardous material a clearance inspection may be required by a hazardous materials consultant or equivalent (e.g. licensed asbestos assessor or competent person). • Following successful hazardous material removal works and clearance certificate (where required) remove barriers and recommence demolition and redevelopment works under normal conditions.	Contractor	Construction
HA5	Accidental spill	A site-specific emergency spill plan will be developed and include spill management measures in accordance with the Transport *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport and EPA officers)	Contractor	Pre-construction
HA6	Chemical handling	The storage of chemicals and hazardous materials would be conducted in accordance with the relevant Material Safety Data Sheets and in accordance with requirements of *the Environmentally Hazardous Chemicals Act 1985*	Contractor	Construction
S1	Soil and water	An Erosion and Sediment Control Plan (ESCP) will be prepared and implemented as part of the CEMP for the main construction works (bridge removal, construction, side track, in stream works and landscape works). The ESCP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction	Contractor	Pre-construction
S2	Soil and water	An incident management plan is to be developed as a component of the CEMP and/or ESCP. The incident management plan is to include: • Locations for spill kits and floating booms to contain spills • Adopting the Transport Environmental Incident Classification and Reporting Procedure and notification of the Transport Project Manager as soon as practicable	Contractor	Pre-construction

		• Contact details for the Transport Project and Environment Managers for incident notification purposes under the POEO Act including Narrabri Shire Council, local EPA, EPA pollution line, NSW Health, SafeWork NSW and Fire and Rescue NSW.		
S3	Soil and water	Water quality control measures are to be used to prevent any materials (e.g. concrete, grout, sediment etc) entering drain inlets or waterways	Contractor	Pre-construction
S4	Soil and water	The ESCP would include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather	Contractor	Pre-construction
S5	Soil and water	Erosion and sediment control measures are to be implemented and maintained to: • Prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets • Reduce water velocity and capture sediment on site • Minimise the amount of material transported from site to surrounding pavement surfaces • Divert clean water around the site • (Erosion and sediment control measures will be in accordance with the *Landcom/Department of Housing Managing Urban Stormwater, Soils and Construction Guidelines (the Blue Book))*	Contractor	Construction
S6	Soil and water	Erosion and sedimentation controls are to be checked and maintained on a regular basis (including clearing of sediment from behind barriers) and records kept and provided on request	Contractor	Construction
S7	Soil and water	Erosion and sediment control measures are not to be removed until the works are complete, and areas are stabilised	Contractor	Construction
S8	Soil and water	Work areas are to be stabilised progressively during the works	Contractor	Construction
S9	Soil and water	The maintenance of established stockpile sites is to be in accordance with the *Roads and Maritime Services Stockpile Site Management Guideline* (EMS-TG-10)	Contractor	Construction
S10	Soil and water	An emergency spill kit is to be kept on site at all times and maintained throughout the construction work. The spill kit must be appropriately sized for the volume of substances at the work site. The spill kit must be readily accessible on the bridge and temporary instream work structures.	Contractor	Construction
S11	Soil and water	Emergency contacts will be kept in an easily accessible location on vehicles, plant and site office. All workers will be advised of these contact details and procedures	Contractor	Construction
S12	Soil and water	All workers will be advised of the location of the spill kit and trained in its use	Contractor	Construction
S13	Soil and water	Exposed areas on the creek banks (such as abutments) are to be covered with geofabric when exposed for prolonged periods	Contractor	Construction
S14	Water quality	Construction water is to be managed within the sustainable limits of the area and catchment. The Regional Environmental Manager would be contacted if water supply becomes an issue and direction would be provided	Contractor	Construction
S15	Water quality	There is to be no release of dirty water into drainage lines and/or waterways	Contractor	Construction
S16	Water quality	Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) is to be carried out on a regular basis to identify any potential spills or erosion and sediment controls	Transport Project Manager/ Contractor	Construction
S17	Water Quality	Control measures to minimise the risk of water pollution are to be implemented including:	Contractor	Construction

		• All fuels, chemicals, and liquids will be stored at least 50 metres away from the existing stormwater drainage system and stored in an impervious bunded area within the compound site • Plant and maintenance machinery is to be refuelled in impervious bunded areas in the designated compound area • Vehicle wash downs and/or concrete truck washouts are to be carried out within a designated bunded area of an impervious surface or carried out off-site.		
S18	Water quality	Geofabric or clean rock is to be used for diversion banks or instream temporary structures to prevent sediment transport	Contractor	Construction
S19	Water quality	Sediment and erosion controls are to be used for in-stream works to avoid impacts on water quality and fish passage, e.g. erosion fencing, stockpile covers and silt curtains	Contractor	Construction
S20	Water quality	Silt curtains and erosion and sediment controls are to be installed, monitored and maintained as needed to contain any sediment runoff into Spring Creek.	Contractor	Construction
H1	Flooding	A Flood Contingency Management Plan is to be prepared for the work site, compound site and ancillary areas. The plan is to: • Ensure workers and road users are aware of the flood risks • Monitor long term rainfall forecasts and schedule high risk work activities around these forecasts • Have contingency locations for the temporary flood storage of equipment and materials outside of potential inundation areas • Have contingency measures to secure and stabilise work areas and compound sites prior to flooding.	Contractor	Pre-construction
H2	Flooding	Any major changes to the bridge geometry are to be investigated for potential changes to flood characteristics. This includes changes to upstream and downstream water levels, velocities and direction	Transport Project Manager	Detailed design
H3	Flooding	Temporary instream structures are to avoid fully impeding the flow of Spring Creek.	Contractor	Construction
H4	Aquatic impacts	Substructure works are to be restricted to periods of normal flow (i.e. no work during major flood events).	Contractor	Construction
H5	Aquatic impacts	Stockpiles are to be placed in designated stockpile locations such that they are not subject to a 1 in 10 year flood event i.e. at top of banks.	Contractor	Construction
H6	Scour protection	Scour protection on the abutments would need to be undertaken and assessed on the basis of the proposed 1.5:1 slope. This would be part of the new permanent bridge design and would likely consist of larger rocks or rock mattresses.	Transport	Pre-construction, Construction, Post construction
T1	Traffic and transport	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the requirements of the current Transport *Traffic Control at Work Sites Manual* and *QA Specification G10 Traffic Management*. The TMP will include: • Confirmation of haulage routes • Site specific traffic control measures (including signage) to manage and regulate traffic movement • Requirements and methods to consult and inform the local community (including local public transport routes, freight companies and heavy vehicle owners) of impacts on the local road network	Contractor	Pre-construction

		• Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads. • A response plan for any construction traffic incident • Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • Response plan in the case of the side-track being affected by rising water within the waterway or potential flood events • Monitoring, review and amendment mechanisms.		
T2	Traffic and transport	The TMP will also include measures relating to the proposed side-track operation including: • Provision of traffic control and additional signage for side-track usage • Potential detour routes if the side-track becomes inundated • Notification to local agricultural businesses and stakeholders of closure of the bridge/ use of the side-track.	Transport	Construction
NA1	Non-Aboriginal heritage	• The *Standard Management Procedure - Unexpected Heritage Items* (Transport, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of non-Aboriginal origin are encountered. • Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Detailed design / Pre-construction
A1	Aboriginal heritage	If any suspected Aboriginal heritage items are uncovered during the works, all works in the vicinity of the find must cease and the Transport Aboriginal Cultural Heritage Officer and Environment Manager be contacted immediately. Steps in the Transport *Unexpected Heritage Items Procedure* (2022) must be followed.	Contactor	Construction
A2	Aboriginal heritage	If suspected human remains are located during any stage of the proposal, activities must be stopped immediately, and the NSW police and Transport Environment Manager must be notified.	Contactor	Construction
P1	Property lease	Property owners would be consulted, and an entry agreement arranged for the use of agricultural property required prior to construction.	Transport Project Manager	Pre-construction and construction
SE1	General notification	All businesses, residential properties and other key stakeholders (e.g. local councils and businesses) affected by the activity will be notified at least five working days prior to commencement of the activity. The notification will include: • Details of the proposal • Construction period and construction hours • Contact information for proposal management staff • Complaint and incident reporting and how to obtain further information	Transport Project Manager & Contractor	Pre-construction
W1	Waste	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to: • Measures to avoid and minimise waste associated with the proposal • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • Lead related waste is to be managed in accordance with the requirements detailed in *Protection of the Environment Operations (Waste) Regulation 2014*	Contractor	Pre-construction

		• Schedule 1 of the NSW *Protection of the Environment Operations (waste) Regulation 2014* requires lead waste transporters to provide tracking information to the EPA via the WasteLocate online tool. Lead related waste must be disposed at a suitably approved waste collection facility. All tipping dockets must be retained • Specify the measures to be implemented for the removal and disposal of asbestos containing material if found. The removal and disposal of asbestos would be carried out in accordance with the requirements of the *Code of Practice How to Safely Remove Asbestos* (Safe Work Australia, 2016) • Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal • Monitoring, record keeping and reporting The WMP will be prepared taking into account the *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime, 2014) and relevant transport Waste Fact Sheets.		
W2	Hazardous waste	As part of the WMP, measures will be implemented in relation to disposal of identified hazardous materials as outlined in Section 6.3.	Contractor	Construction, post-construction
W3	Resource use	A far as reasonably practicable, construction materials would be sourced within the local region so as to reduce transport costs and fuel usage.	Contractor	Pre-construction / construction
CA1	Air quality	Air Quality will be managed as part of the CEMP. The CEMP will include, but not be limited to: • Information on potential sources of air pollution • Mitigation and suppression measures to be implemented • Methods to manage work during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces.	Contactor	Pre-construction
CA2	Air quality	Vehicles transporting waste or other materials that may produce dust are to be covered during transportation.	Contractor	Construction
CA3	Air quality	Measures (including watering or covering exposed areas) are to be used to minimise or prevent air pollution and dust.	Contractor	Construction
CA3	Greenhouse gas and emissions	Construction vehicles, plant and equipment are to be maintained in accordance with manufacturer instructions and vehicles and equipment are to be monitored for ‘dirty’ exhaust fumes.	Contractor	Construction
C1	Cumulative impacts	Potential cumulative impacts from surrounding development activities would be reviewed as part of the development of the CEMP.	Transport Project Manager/ Contractor	Construction

7.3 Licensing and approvals

Table 7-2: Summary of licensing and approvals required

Instrument	Requirement	Timing
Fisheries Management Act 1994 (s199)	Notification to the Minister for Agriculture prior to any dredging or reclamation works. *While it is likely that impacts to aquatic environments associated with the proposed works would be negligible, Transport may be required to provide formal notification to the Department of Primary Industries under Section 199 of the FM Act as the study area is mapped as containing Key Fish Habitat. Nonetheless, requirements for works adjacent to Key Fish Habitat is determined on a case by case basis, and would be determined by consultation with a local fisheries officer.*	A minimum of 28 days prior to the start of work.
Fisheries Management Act 1994 (s219)	Permit to obstruct the free passage of fish (temporary or permanent) from the Minister for Agriculture.	Prior to start of the activity.
Roads Act 1993 (s138)	A consent under s138 for road closures associated with construction - road occupancy licence and speed zone authorisation.	Prior to the start of the activity.
Roads Act 1993 (s175)	Notice to occupier under s175 to take possession of land for the purpose of constructing roads.	Seven days written notice prior to the start of the activity.

8. Conclusion

This chapter provides the justification for the proposal taking into account its biophysical, social and economic impacts, the suitability of the proposal area and whether or not the proposal is in the public interest. The proposal is also considered in the context of the objectives of the EP&A Act, including the principles of ecologically sustainable development as defined in Section 193 of the Environmental Planning and Assessment Regulation 2021.

8.1 Justification

The REF has assessed the potential biophysical, social and economic impacts of the proposal, as well as the public interest. The proposed replacement of Spring Creek bridge would result in a number of environmental impacts including:

- Biodiversity
- Water quality risks to Spring Creek
- Changed traffic conditions and traffic delays during construction, including cumulative construction traffic impacts
- Altered visual amenity and landscape character of the proposal area during construction.

The proposal is consistent with multiple NSW and Australian Strategic documents and would support improved regional transport infrastructure within the region. The REF has concluded that the adverse impacts of the proposal would be outweighed by the long-term beneficial impacts of increased structural capacity, improved safety for all road users and improved hydraulic immunity. Therefore, the proposal is considered justified.

8.1.1 Social factors

Social and economic factors have been assessed within Sections 1.1, 6.10 and 6.11. The construction works would generally be carried out within the existing road corridor. The proposal would have a long-term, positive effect for the local and regional community, as well as regional business. This would be through the removal of the concrete culvert structure over Spring Creek along the Kamilaroi Highway, as well as ensuring continued access for agricultural machinery and heavy load vehicles and improvement in overall road user safety. The community would also benefit from the reduction in future maintenance requirements for the bridge reducing disruptions associated with bridge works and improved durability in flood events.

8.1.2 Biophysical factors

Potential environmental impacts predicted to result from the proposal are described throughout Section 6 of this REF. There is likely to be a minor biophysical impact from the loss of native vegetation, and temporary impacts to amenity, including water quality, noise and vibration and visual impacts. These impacts are not considered to be significant and would be manageable with the application of the safeguards and management measures summarised in Table 7-1.

8.1.3 Economic factors

Transport carried out value management exercises as part of the identification of the preferred option. The value management exercises concluded that full replacement of the existing bridge on the same alignment was a more economically viable option than constructing a new bridge adjacent to the existing bridge. The proposal provides the greatest value and reduces maintenance costs in the long-term.

8.1.4 Public interest

During construction, the public would likely experience the following:

- Minor traffic delays (refer to Section 6.5)
- Minor visual impacts (refer to Section 1.1).

8.2 Objects of the EP&A Act

The consistency of the proposal with the objects of the EP&A Act is provided below.

Table 8-1: Objects of the *Environmental Planning and Assessment Act 1979*

Instrument	Requirement
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The replacement of the existing bridge with a new bridge would improve the safety of road users and would provide continued access for HML vehicles which would benefit the regional economy. The proposal is consistent with this object.
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Ecologically sustainable development is discussed further in Section 8.2.1.
1.3(c) To promote the orderly and economic use and development of land.	The new bridge would be constructed on the same alignment as the existing bridge, minimising the amount of land required for the proposal area. The new bridge would allow for the continued use of the road by HML vehicles which would ensure the efficiency of freight transport through regional NSW. The proposal is consistent with this object.
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the proposal
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	The proposal would result in the removal of up to 4.3 hectares of native and exotic grassed vegetation, and two mature *Eucalyptus camaldulensis* trees, none of which were identified as a TEC. Management measures would be implemented to minimise impacts to native vegetation The proposal is consistent with this object.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal has been designed in accordance with relevant structural and civil guidelines and is anticipated to improve road safety.
1.3(g) To promote good design and amenity of the built environment.	Not relevant to the proposal
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Not relevant to the proposal
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Not relevant to the proposal
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Transport has carried out community participation throughout the development of the proposal including: • Development of a CEP to provide timely and accurate information to the community during construction. • Consultation with property owners and key stakeholders.

8.2.1 Ecologically sustainable development

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration throughout the development of the proposal.

ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are discussed below.

The precautionary principle

The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

This principle was considered during route options development (refer to Chapter 2). The precautionary principle has guided the assessment of environmental impacts for this REF and the development of mitigation measures.

The proposal does not pose a threat of serious or irreversible damage to the environment. The potential impacts described in the REF have been predicted with a reasonable level of scientific certainty. Mitigation and management measures have been proposed based on previous experience with similar proposals.

A CEMP would be prepared prior to the construction period commencing and would provide for the implementation of specific mitigation measures to reduce environmental impacts.

Intergenerational equity

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations.

The short-term and long-term impacts of the proposal have been considered and addressed through the development of the concept design and REF and on-balance would benefit both current and future generations.

Conservation of biological diversity and ecological integrity

This principle states that the “diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival”.

Database searches at both the state and federal level were carried out to determine biodiversity values of the proposal area, as well as a detailed field investigation (refer to Section 6.1). Impacts to biodiversity and the overall ecosystem would generally be minor and limited to the construction period. Mitigation measures have been prescribed to reduce impacts to the biodiversity values, both terrestrial and aquatic.

The proposal would have a limited impact on the flora and fauna and would not compromise the biological diversity or ecological integrity of the proposed area.

Improved valuation, pricing and incentive mechanisms

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by the carrying out of a proposal, including air, water, land and living things.

The proposal reflects the natural, social and economic values of the locality. This REF has examined the environmental consequences of the proposal and identified mitigation measures and safeguards to manage the potential adverse impacts. The value of environmental safeguards implementation was not able to be determined at the time this REF was prepared.

8.2.2 Conclusion

The proposed bridge replacement at Spring Creek is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration (where relevant) of conservation agreements and plans of management under the NPW Act, biodiversity stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species and ecological communities and their habitats, and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the EPBC Act.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal, as described in the REF, best meets the proposal objectives but would still result in some minor impacts on biodiversity, traffic, and visual amenity. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also improve safety for road users, ensure continued HML use along the Kamilaroi Highway and reduce on-going costs of maintenance associated with the existing bridge. On balance, the proposal is considered justified, and the following conclusions are made.

Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared nor approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on matters of national environmental significance nor the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)*. A referral to the Australian Department of Agriculture, Water and the Environment is not required.

9. Certification

This review of environmental factors 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.

Name:	Catherine Brady
Position:	Technical Director
Company name:	AECOM
Date:	12 May 2023

I certify that I have reviewed and endorsed the contents of this REF and, to the best of my knowledge, it is in accordance with the EP&A Act, the EP&A Regulation and the Guidelines approved under Section 170 of the EP&A Regulation, and the information is neither false nor misleading. I accept it on behalf of Transport.

Name:	Peter Hamilton
Position:	Senior Project Manager
Transport region/program:	Western Region
Date:	30 May 2023

10. References

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Terms and acronyms used in this REF

Table 10-1: Terms and acronyms used in this REF

Term / Acronym	Description
ACM	Asbestos Containing Material
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
ARI	Average Recurrence Interval
ASS	Acid Sulfate Soils
BC Act	*Biodiversity Conservation Act 2016 (NSW)*
CEMP	Construction environmental management plan
CEP	Community Engagement Plan
CLM Act	*Contaminated Lands Management Act 1997*
DPE	Department of Planning and Environment
DPI	Department of Planning and Industry
EPA	Environmental Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979 (NSW).* Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)*. Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process
EPL	Environmental Protection Licence
ESCP	Erosion and Sediment Control Plan
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
FM Act	*Fisheries Management Act 1994 (NSW)*
Heritage Act	*Heritage Act 1977 (NSW)*
HML	Higher Mass Limits
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local Government Area
LLS	Local Land Services
MNES	Matters of national environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)*
MWREF	Minor Works Review of Environmental Factors
NCA	Noise Catchment Area
NML	Noise Management Level
NPW Act	*National Parks and Wildlife Act 1974 (NSW)*
OOHW	Out of hours work
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PCB	Polychlorinated biphenyls

PCT	Plant Community Type
POEO	*Protection of the Environment and OperationS Act 1997*
RBL	Rating background level
REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SMF	Synthetic mineral fibres
TEC	Threatened Ecological Community
TMP	Traffic Management Plan
Transport	Transport
WAL	Water Access Licence
WM Act	*Water Management Act 1977*

Appendix A – Design Drawings

Appendix B – Demolition Report

Appendix C – Biodiversity Report

Appendix D - Consideration of section 171 factors and matters of national environmental significance and Commonwealth land

Section 171 Checklist

In addition to the requirements of the Guideline for Division 5.1 assessments (DPE 2022) and the Roads and Related Facilities EIS Guideline (DUAP 1996) as detailed in the REF, the following factors, listed in section 171 of the *Environmental Planning and Assessment Regulation 2021*, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor		Impact
a	**Any environmental impact on a community?** There would be short term noise, visual and traffic impacts to the community during construction of the proposal. With the safeguards listed in Sections 6.2.5, 6.6.4 and 6.9.4 the impacts are considered to be minor and would not extend beyond the construction phase of the proposal. The proposal would improve the safety of the road by providing compliant safety rails and a wider channel area. This would improve the overall flood resilience of the bridge, making the travel route more reliable for road users.	Short term Minor Negative Long term Moderate Positive
b	**Any transformation of a locality?** The new bridge would be built on the same alignment and using a different design to the existing culvert bridge. However, the bridge would remain similar in visibility from the road and would not likely become a prominent feature transforming the landscape. Although the abutments are set back further than the existing bridge abutments, there would be no overall change to Spring Creek. There would be minimal impact to the creek bank and riparian area as rehabilitation of these areas would occur following construction. The new bridge is designed to require minimal maintenance whereas the existing bridge requires significant ongoing maintenance works to remain operational. Following the proposal, the ongoing maintenance works would be significantly reduced resulting in a positive impact on the locality.	Long term Negligible Long term Minor Positive
c	**Any environmental impact on the ecosystems of the locality?** A Biodiversity Assessment Report (BAR) was prepared which identified the proposal would result in the disturbance of up to 4.3 hectares of native and exotic grass vegetation, and two *Eucalyptus camaldulensis.* No PCTs or TECs were identified on site, however they may have potential to occur. Spring Creek is identified as Key Fish Habitat and would likely experience minor impacts to aquatic quality through instream structures. Steel piping would be installed through working platforms to ensure fish passage and water flow is maintained during construction.	Minor Short term Negative
d	**Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?** The existing bridge would be removed and replaced by a new and modern structure, therefore would have a different character to the existing bridge. The construction period would result in a temporary decrease in visual amenity as a result of the presence of construction machinery including large cranes, and use of land for a compound/ stock site. Removal of riparian and roadside vegetation from the proposal area would also reduce the aesthetic value of the locality. These impacts would be minimised through the safeguards provided in Section 6.9.4.	Long term Minor Negative Short term Minor Negative
e	**Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?**	Nil.

Factor		Impact
	A stage 1 PACHCI assessment has been carried out for the proposal and involved a proposal area walk over by Transport's Aboriginal Cultural Heritage Officer. The assessment identified no Aboriginal artefacts, places or items within the proposal area.	
f	**Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974*)?** No threatened species were identified during an inspection of the proposal area. Removal of woody debris, a dead standing tree, and the culvert bridge structure would not likely significantly impact upon threatened fauna habitat. The proposal may have the potential to impact upon aquatic biodiversity through the use of in-stream structures, disturbance and erosion of the banks and accidental spills. Appropriate safeguards would be implemented to reduce these risks (refer to 6.1.5).	Long-term Minor Negative Short-term Minor Negative
g	**Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?** The proposal would not endanger any species of animal, plant or other form of life, whether living on land, in water or in the air. The construction work has the potential to temporarily impact on aquatic biodiversity as a result of increased erosion and sedimentation and chemical or fuel spills. The proposal is unlikely to have a significant impact on threatened species, populations or ecological communities and their habitats. Potential impacts to the habitat or protected fauna would be minimised by implementing the safeguards listed in Section 6.1.5.	Short-term Minor Negative
h	**Any long-term effects on the environment?** The proposal would improve safety for road users and improve the flood immunity of the Spring Creek bridge.	Long term Moderate Positive
i	**Any degradation of the quality of the environment?** Water quality may be temporarily impacted during the proposal resulting from erosion and sedimentation, increased turbidity, and potential fuel or chemical spills during construction. Safeguards and management measures listed in Section 6.4.4 would be implemented to minimise these impacts.	Short term Minor Negative
j	**Any risk to the safety of the environment?** The proposal would improve the safety of road users and improve the flood immunity of the bridge.	Long term Moderate Positive
k	**Any reduction in the range of beneficial uses of the environment?** The proposal would maintain traffic throughout the construction period via use of the existing approved side-track. However, should this side-track become inundated, traffic would be re-routed to another route nearby adding to the travel time of road users. Furthermore, there may be traffic delays and reduced speed zone which would increase travel times. These impacts would be mitigated through the safeguards in Section 6.6.4.	Short term Minor Negative
l	**Any pollution of the environment?** Water quality may be temporarily impacted during the proposal as a result of erosion and sedimentation, increased turbidity, and potential fuel or chemical spills during construction. Identified hazardous materials associated with the existing bridge would, if not managed appropriately, be at risk of polluting the environment. Safeguards and management measures listed in Section 6.3.4 would be implemented to minimise these impacts.	Short term Minor Negative
m	**Any environmental problems associated with the disposal of waste?**	Short term

Factor		Impact
	Waste generated by the proposal would likely consist of concrete, road pavement and metal, and includes identified hazardous materials. These hazardous materials would be identified and disposed of in accordance with the appropriate guidelines as outlined in Section 6.3.4. Waste materials would be classified in accordance with the EPA's Waste Classification Guidelines.	Minor Negative
n	**Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?** Resources required for the proposal area are readily available and are not short in supply.	Nil
o	**Any cumulative environmental effect with other existing or likely future activities?** There are two proposals likely to be constructed within Narrabri and Wee Waa at the same time as construction for the Proposal. Cumulative impacts which are expected would include increased traffic associated with construction of each proposal and increased delays in travel due to reduced enforced speed zones as part of traffic control in areas of construction. With the implementation of safeguards in Section 6.6.4 and 6.14.4.	Short term Minor Negative
p	**Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?** The proposal is not located within a coastal area and would not impact on coastal processes and coastal hazards.	Nil
q	**Applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1.** The proposal would not negatively impact on strategic documentation. Refer to Section 4.	Long term Positive
r	**Other relevant environmental factors.** No additional impacts to environmental factors are anticipated as a result of the construction or operation of the proposal.	Nil

Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act, the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of Agriculture, Water and the Environment.

A referral is not required for proposed actions that may affect nationally-listed threatened species, endangered ecological communities and migratory species. Impacts on these matters are still assessed as part of the REF in accordance with Australian Government significant impact criteria and taking into account relevant guidelines and policies.

Factor		Impact
a	Any impact on a World Heritage property?	Nil
b	Any impact on a National Heritage place?	Nil
c	Any impact on a wetland of international importance? Three RAMSAR wetlands identified over 900 kilometres away.	Nil
d	Any impact on a listed threatened species or communities?	Nil

	Factor	Impact
	The biodiversity assessment concluded that the proposal is unlikely to have a significant impact to listed threatened species or communities.	
e	Any impacts on listed migratory species? The biodiversity assessment concluded that the proposal is unlikely to have a significant impact to listed migratory species.	Nil
f	Any impact on a Commonwealth marine area?	Nil
g	Does the proposal involve a nuclear action (including uranium mining)?	Nil
h	Additionally, any impact (direct or indirect) on the environment of Commonwealth land?	Nil

Appendix E – PACHCI Clearance Letter

Appendix F - Statutory consultation checklists

Transport and Infrastructure SEPP

Certain development types

Development type	Description	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Car Park	Does the proposal include a car park intended for the use by commuters using regular bus services?	No	Narrabri Shire Council	Section 2.110
Bus Depots	Does the proposal propose a bus depot?	No	Narrabri Shire Council	Section 2.110
Permanent road maintenance depot and associated infrastructure	Does the proposal propose a permanent road maintenance depot or associated infrastructure such as garages, sheds, tool houses, storage yards, training facilities and workers' amenities?	No	Narrabri Shire Council	Section 2.110

Development within the Coastal Zone

Development type	Description	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Development with impacts on certain land within the coastal zone	Is the proposal within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land?	No	Narrabri Shire Council	Section 2.14

Note: See interactive map at ***Planning Portal NSW spatial viewer - find a property***. Note the coastal vulnerability area has not yet been mapped.

Note: a certified coastal zone management plan is taken to be a certified coastal management program.

Council related infrastructure or services

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Stormwater	Are the works likely to have a *substantial* impact on the stormwater management services which are provided by council?	No	Narrabri Shire Council	Section 2.10
Traffic	Are the works likely to generate traffic to an extent that would *strain* the capacity of the existing road system in a local government area?	No	Narrabri Shire Council	Section 2.10
Sewerage system	Would the works involve connection to a council owned sewerage system? If so, would this connection have a *substantial* impact on the capacity of any part of the system?	No	Narrabri Shire Council	Section 2.10

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Water usage	Would the works involve connection to a council owned water supply system? If so, would this require the use of a *substantial* volume of water?	No	Narrabri Shire Council	Section 2.10
Temporary structures	Would the works involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, would this cause more than a *minor* or *inconsequential* disruption to pedestrian or vehicular flow?	No	Narrabri Shire Council	Section 2.10
Road & footpath excavation	Would the works involve more than *minor* or inconsequential excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	No	Narrabri Shire Council	Section 2.10

Local heritage items

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Local heritage	Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the works? If yes, does a heritage assessment indicate that the potential impacts to the heritage significance of the item/area are more than minor or inconsequential?	No	Narrabri Shire Council	Section 2.11

Flood liable land

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Flood liable land	Are the works located on flood liable land? If so, would the works change flood patterns to more than a *minor* extent?	Yes	Narrabri Shire Council	Section 2.12
Flood liable land	Are the works located on flood liable land? (to any extent). If so, do the works comprise more than minor alterations or additions to, or the demolition of, a building, emergency works or routine maintenance?	Yes	State Emergency Services Email: erm@ses.nsw.gov.au	Section 2.13

Note: Flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled Floodplain Development Manual: the management of flood liable land published by the New South Wales Government.

Public authorities other than councils

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
National parks and reserves	Are the works adjacent to a national park or nature reserve, or other area reserved under the *National Parks and Wildlife Act 1974*, or on land acquired under that Act?	No	DPE- National parks and Wildlife Service	Section 2.15
National parks and reserves	Are the works on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone?	No	DPE- National parks and Wildlife Service	Section 2.15
Navigable waters	Do the works include a fixed or floating structure in or over navigable waters?	No	Transport - Maritime	Section 2.15
Bush fire prone land	Are the works for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?	No	Rural Fire Service (RFS) [Refer to the NSW RFS publication: *Planning for Bush Fire Protection (2006)*]	Section 2.15
Artificial light	Would the works increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (Note: the dark sky region is within 200 kilometres of the Siding Spring Observatory)	No	Director of the Siding Spring Observatory	Section 2.15
Defence communications buffer land	Are the works on buffer land around the defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in section 5.15 of Lockhart LEP 2012, Narrandera LEP 2013 and Urana LEP 2011.	No	Secretary of the Commonwealth Department of Defence	Section 2.15
Mine subsidence land	Are the works on land in a mine subsidence district within the meaning of the *Mine Subsidence Compensation Act 1961*?	No	Mine Subsidence Board	Section 2.15

Appendix G – Consultation letters

Appendix H – Hydraulic Report

Appendix I – Noise and Vibration Report

Appendix J – HAZMAT Report

KAMILAROI HWY

NARRABRI SHIRE COUNCIL

HW29 SPRING CREEK BRIDGE REPLACEMENT

AT NARRABRI

<u>NEW BRIDGE - 2022</u>
BRIDGE No: B12489
DESIGN FILE No: TBC
DESIGN STANDARD: AS 5100: 2017 - BRIDGE DESIGN

ROAD TRAFFIC LOADING: SM1600

NUMBER OF DESIGN LANES: 3
DESIGN TRAFFIC SPEED: 60km/h (TBC)
ACCOMPANYING LANE FACTORS:

NUMBER OF STANDARD DESIGN LANES LOADED	ACCOMPANYING LANE FACTOR
1	1
2	0.8
3 OR MORE	0.4

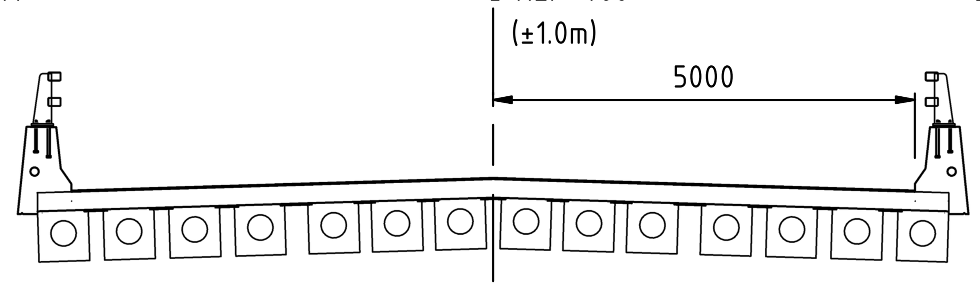
FATIGUE LOADING

NUMBER OF HEAVY VEHICLES PER LANE PER DAY: 18
ROUTE FACTOR: 0.5
THE BRIDGE HAS BEEN DESIGNED FOR TRAFFIC LOADING APPLIED TO THE FULL WIDTH BETWEEN EXTERNAL BARRIERS.

HEAVY LOAD PLATFORM LOADING: HLP 400

PROVISION FOR HLP LOADING IS RESTRICTED TO ONE VEHICLE PER CARRIAGEWAY AT ANY ONE TIME, POSITIONED AS SHOWN ON THE DIAGRAM BELOW.
THE DESIGN ACCOUNTS FOR THE ERRORS IN POSITIONING THE HLP VEHICLE UP TO 1m LATERALLY IN EITHER DIRECTION FROM THE SPECIFIED POSITION.
VEHICLE SPEED IS RESTRICTED TO 10km/h.

TRAFFIC BARRIER PERFORMANCE LEVEL: REGULAR



PEDESTRIAN LOADING : 5 kPa

MINIMUM RESTRAINT LOADING

500kN IN ANY DIRECTION.

WIND LOADING

WIND TERRAIN CATEGORY: TC2.0
WIND REGION: A3
WIND VELOCITY ULS: 48m/s
WIND VELOCITY SLS: 37m/s
AVERAGE RECURRENCE INTERVAL (ARI) ULS = 2000 YEARS
AVERAGE RECURRENCE INTERVAL (ARI) SLS = 20 YEARS

EARTHQUAKE LOADING

DESIGN CATEGORY: BEDC-2
DESIGN DUCTILITY: 3.0
SUB-SOIL CLASS: CLASS De
PROBABILITY FACTOR: 1.0
HAZARD FACTOR: 0.07

FLOOD DATA

20 YEAR ARI	FLOOD VELOCITY (m/s)	FLOOD LEVEL RL (m)	SCOUR DEPTH (m)
(i) ABUTMENT A	TBC	TBC	TBC
(ii) PIER 1, 2, AND 3	TBC	TBC	TBC
(iii) ABUTMENT B	TBC	TBC	TBC

FLOOD DATA

100 YEAR ARI	FLOOD VELOCITY (m/s)	FLOOD LEVEL RL (m)	SCOUR DEPTH (m)
(i) ABUTMENT A	4.55	207.9	4.42
(ii) PIER 1, 2, AND 3	4.55	207.9	4.42
(iii) ABUTMENT B	4.55	207.9	5.13

FLOOD DATA

2000 YEAR ARI	FLOOD VELOCITY (m/s)	FLOOD LEVEL RL (m)	SCOUR DEPTH (m)
(i) ABUTMENT A	5.0	208.76	4.17
(ii) PIER 1, 2, AND 3	5.0	208.76	4.54
(iii) ABUTMENT B	5.0	208.76	7.72

DEPTH OF DEBRIS MATTRESS = 1.2m

DIFFERENTIAL SETTLEMENT

10mm BETWEEN ADJACENT PIERS AT THE LEVEL OF THE TOP OF THE RELEVANT PIERS.

REFERENCE DESIGN REPORTS

- HW29 SPRING CREEK BRIDGE REPLACEMENT
- GEOTECHNICAL INVESTIGATION FOR REMEDIAL MEASURES

JACKING OF BRIDGE DECK FOR BEARING/ HORIZONTAL RESTRAINT REPLACEMENT

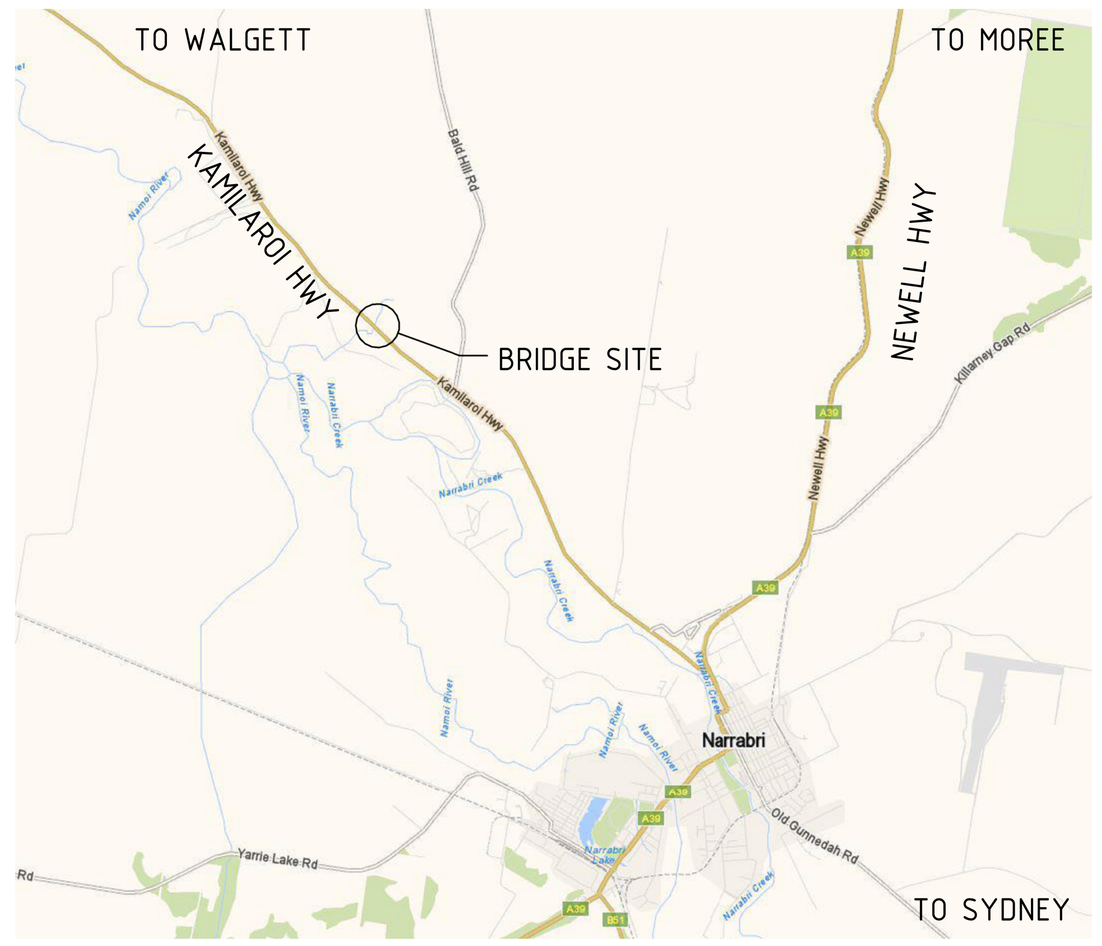
THE DESIGN INCLUDES THE FOLLOWING REQUIREMENTS:

- TRAFFIC SHOULDERS ON THE BRIDGE SHALL BE CLOSED TO TRAFFIC.
- TRAFFIC SHALL BE RESTRICTED TO 40km/h
- DYNAMIC LOAD ALLOWANCE OF a=0.1 HAS BEEN INCLUDED IN THE DESIGN.
- HLP VEHICLES SHALL NOT BE ALLOWED ON THE BRIDGE.
- REFER SHEET No'S 10, 11 AND 17 FOR JACKING LOCATIONS AND JACKING LOADS.
- ALL JACKS AT EACH SUBSTRUCTURE SHALL BE HYDRAULICALLY LINKED AND HAVE A CENTRAL MECHANISM TO ENSURE THAT THE SAME VERTICAL DISPLACEMENTS OCCUR AT EACH LIFT POINT AT ALL TIMES DURING THE JACKING OPERATION WITH A TOLERANCE OF 2mm.
- BRIDGE BEARINGS ARE DESIGNED TO BE REPLACED USING LIFTS OF NOT GREATER THAN 10mm.
- STEEL PLATES SHALL BE PLACED BETWEEN CONCRETE BEARING SURFACE AND HYDRAULIC JACK.
- MAXIMUM ULS ALLOWABLE CONTACT PRESSURE BETWEEN CONCRETE SURFACE AND STEEL PLATES SHALL BE 30MPa.
- HORIZONTAL RESTRAINTS TO BE MAINTAINED.
- JACKING UP OPERATIONS SHALL BE CARRIED OUT AT ONLY ONE ABUTMENT AT A TIME.
- JACKS TO BE VERTICAL WITH TAPERED STEEL PLATES ABOVE AND BELOW THE JACKS.

SURVEYED DATA POINTS (TO BE COMPLETED AT WAE)

LOCATION	NORTHING	EASTING	RL
ABUTMENT A			
(i) WINGWALLS (LHS)			
(ii) DECK BARRIER (LHS)			
(iii) WINGWALL (RHS)			
(iv) DECK BARRIER (RHS)			
ABUTMENT B			
(i) WINGWALLS (LHS)			
(ii) DECK BARRIER (LHS)			
(iii) WINGWALL (RHS)			
(iv) DECK BARRIER (RHS)			

SURVEY PINS TO BE LOCATED AS SHOWN No. XX
SURVEY PIN LOCATIONS TO BE SURVEYED AFTER CONSTRUCTION AND PRIOR TO OPENING OF TRAFFIC.
THE SURVEYED COORDINATES SHALL BE RECORDED IN THE ABOVE TABLE FOR WORKS-AS- EXECUTED (WAE) DRAWINGS.



LOCALITY PLAN

THE BRIDGE SITE IS APPROXIMATELY 545km BY ROAD FROM SYDNEY
NOT TO SCALE

NOT FOR CONSTRUCTION

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HW29 - KAMILAROI HWY

NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

SCHEDULE OF DRAWINGS

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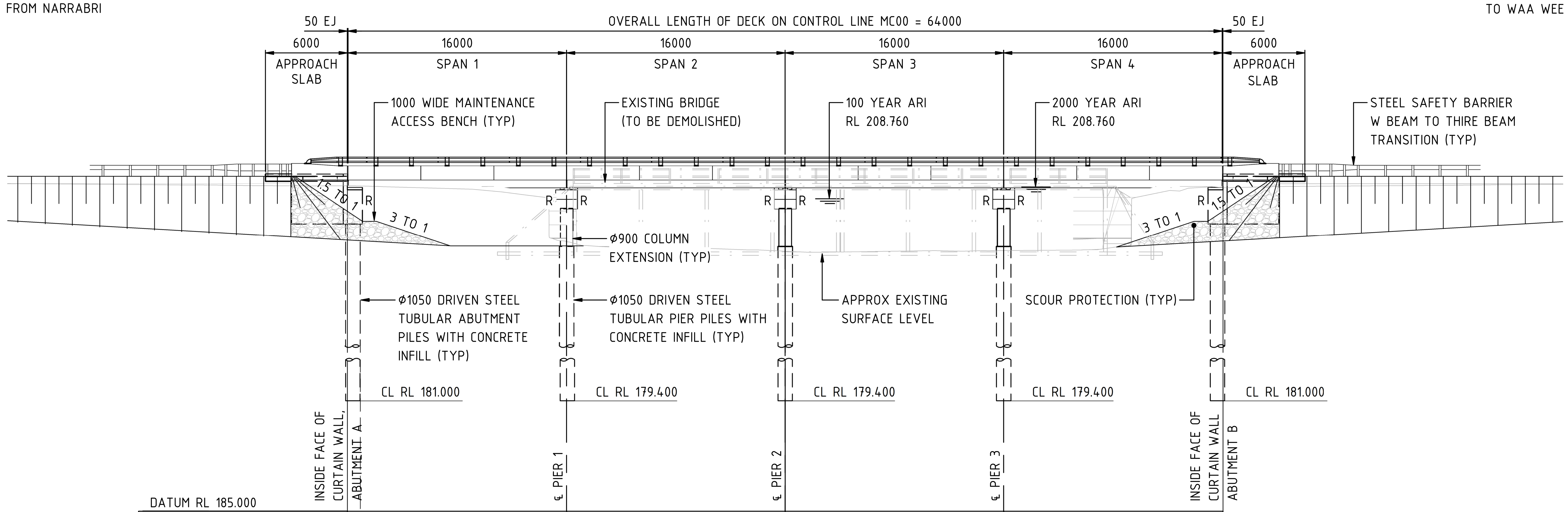
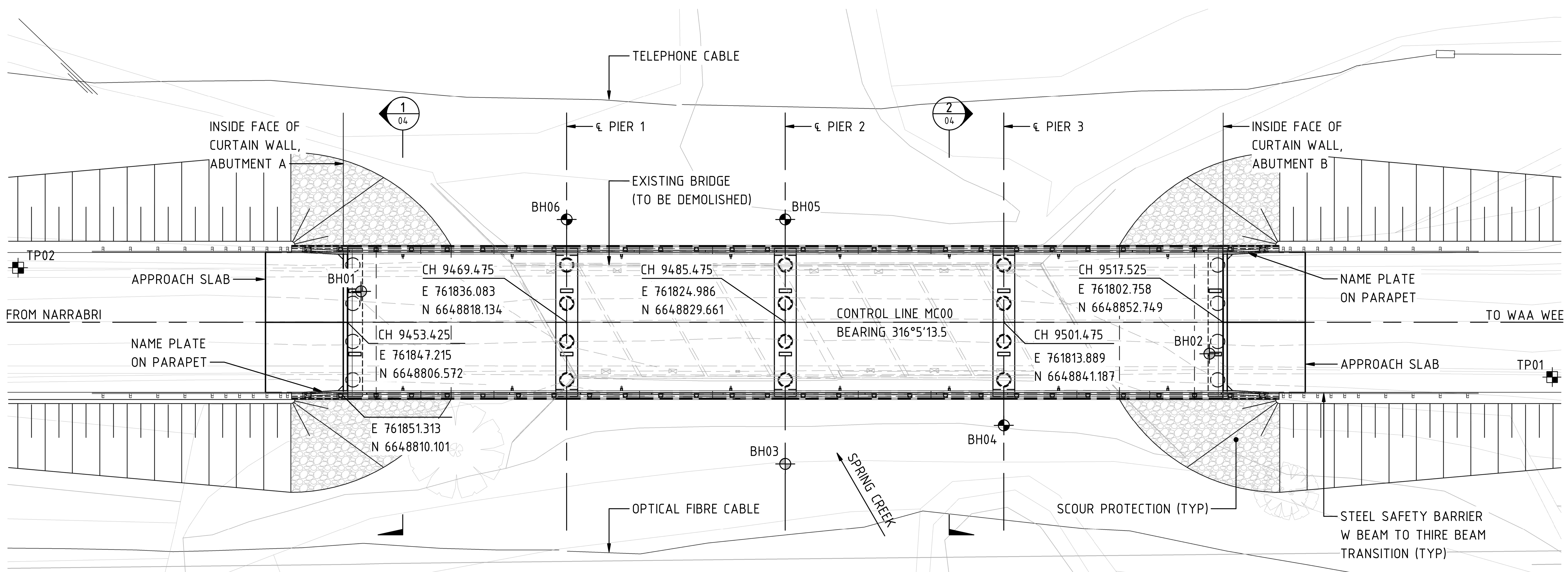


	Abutment A	Pier 1	Pier 2	Pier 3	Abutment B
DESIGN SURFACE LEVEL ON CONTROL LINE MC00	209.700	209.700	209.700	209.700	209.700
EXISTING SURFACE LEVEL ON CONTROL LINE MC00	209.2	205.0	205.0	205.0	209.2
CHAINAGE ON CONTROL LINE MC00	9453.425	9469.475	9485.475	9501.475	9517.525

ELEVATION



PLAN

GENERAL NOTES

SCALE 0 2 4 6 8 10m

ALL DIMENSIONS ARE IN MILLIMETRES..
CHAINAGES, REDUCED LEVELS AND COORDINATES ARE IN METRES.
REDUCED LEVELS ARE TO AUSTRALIAN HEIGHT DATUM (AHD).
COORDINATES ARE TO MAP GRID OF AUSTRALIA: ZONE 55 (GDA94)

CL DENOTES CONTRACT LEVEL
R DENOTES RESTRAINED BEARINGS.
EJ DENOTES EXPANSION JOINT.
DENOTES EXISTING BOREHOLE LOCATION.
DENOTES PROPOSED BOREHOLE LOCATION.
DENOTES PAVEMENT TEST PIT (CARDNO) LOCATION.

DECK WEARING SURFACE SHALL BE COMBINED SYSTEM IV IN B344/E COMPRISING:
- DOUBLE/DOUBLE SPRAYED SEAL
- FIRST LAYER: SBWM WITH 14mm COVER AGGREGATE
- SECOND LAYER: 7mm BITUMEN SPRAYED SEAL WITH 7mm COVER AGGREGATE.

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HW29 - KAMILAROI HWY
NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

GENERAL ARRANGEMENT - SHEET A

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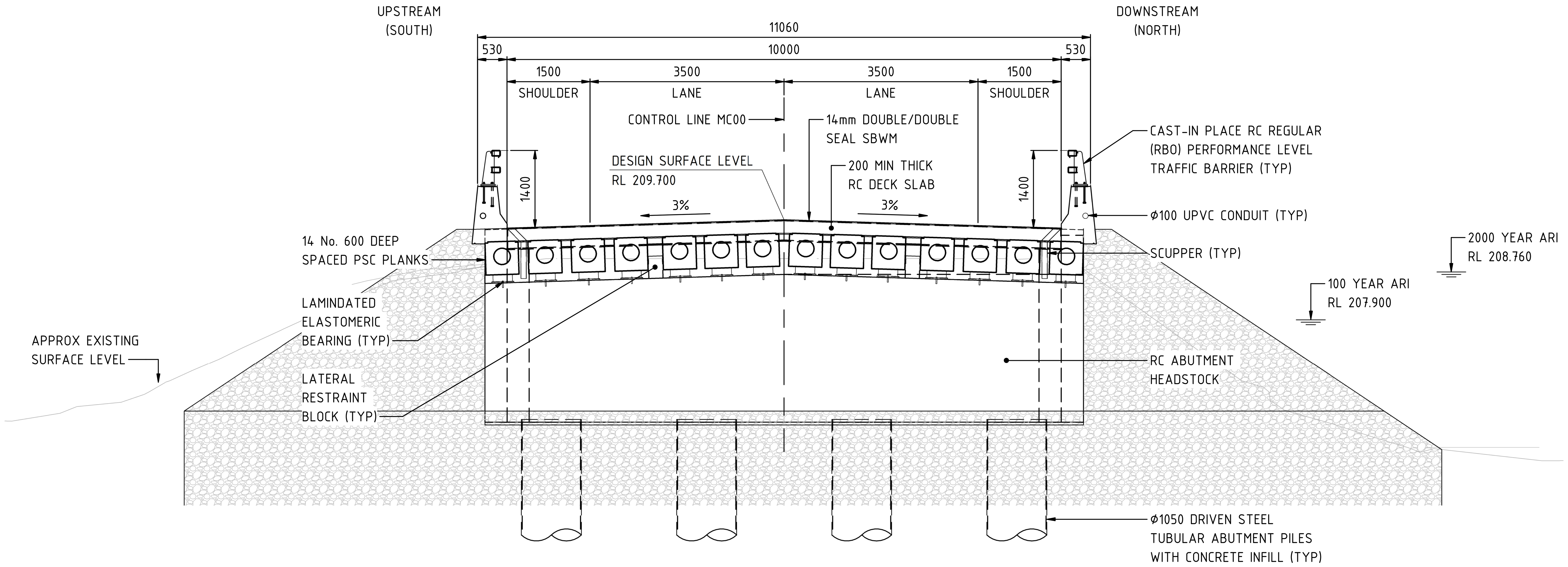
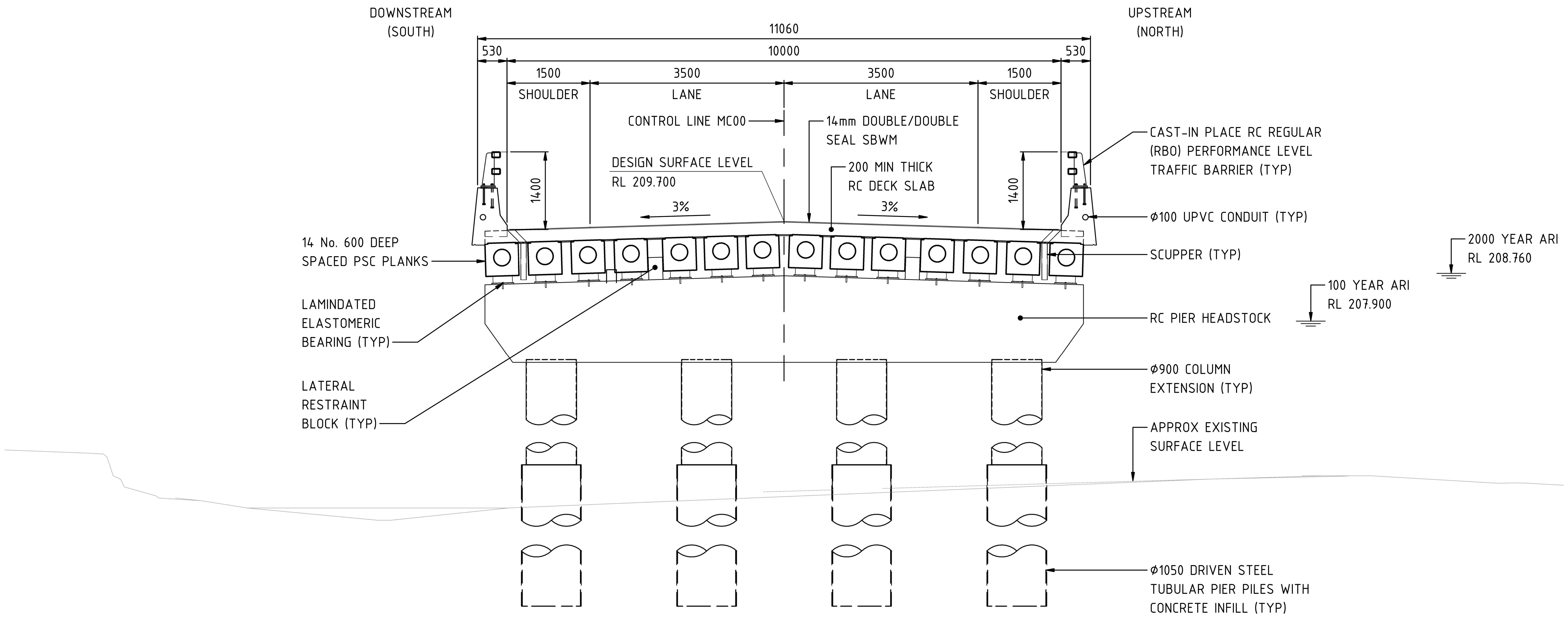


SECTION 1/03

ABUTMENT A SHOWN,
ABUTMENT B SIMILAR



SECTION 2/03

PIER 1 SHOWN,
PIER 2 AND 3 SIMILAR

GENERAL NOTES

SCALE 0 0.5 1 1.5 2 2.5m

FOR OTHER GENERAL NOTES RELATING TO THIS SHEET, SEE SHEET No. 3

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HW29 - KAMILAROI HWY
NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT
ON KAMILAROI HWY AT NARRABRI

GENERAL ARRANGEMENT - SHEET B

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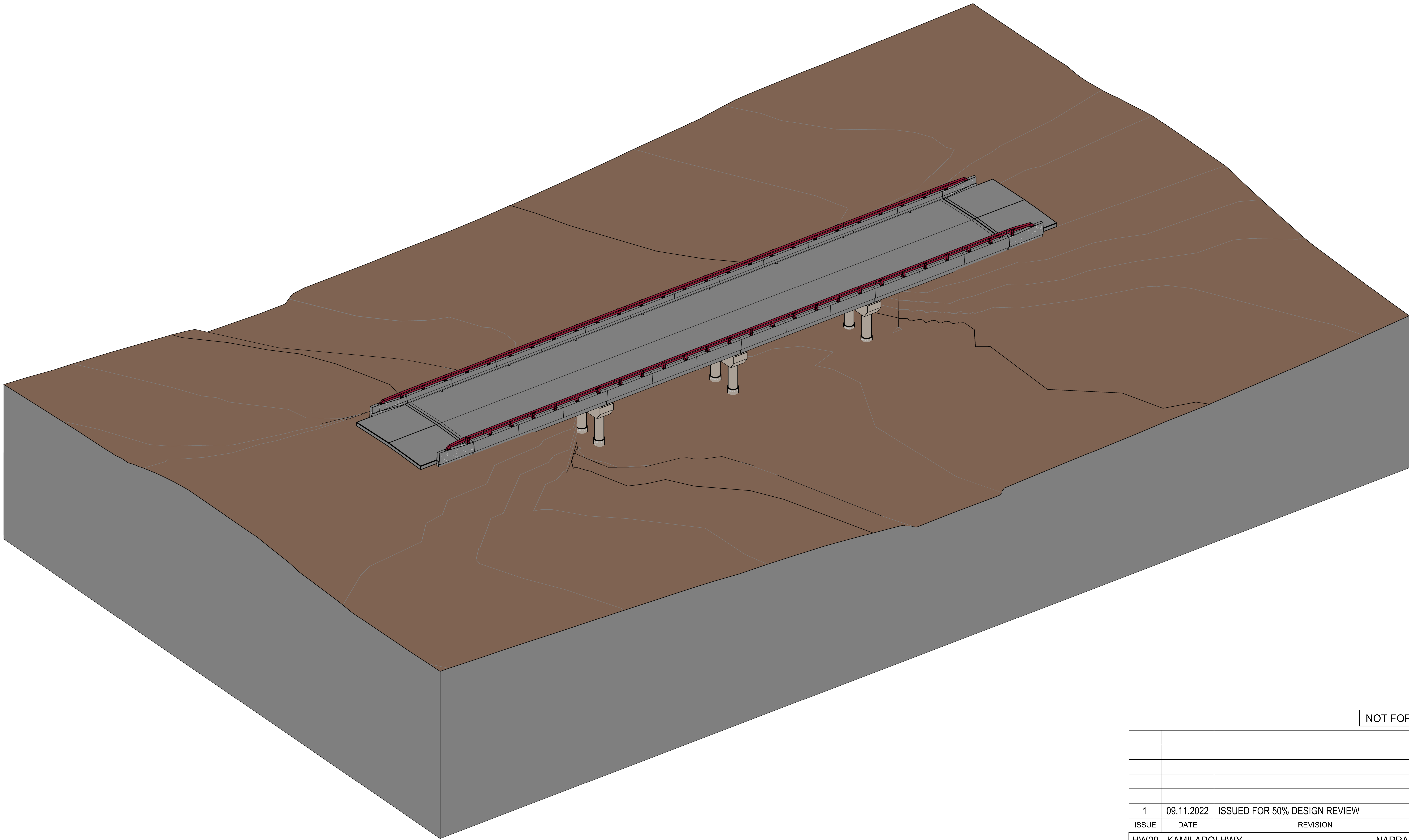

3D VIEW

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HW29 - KAMILAROI HWY

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GENERAL ARRANGEMENT - SHEET C

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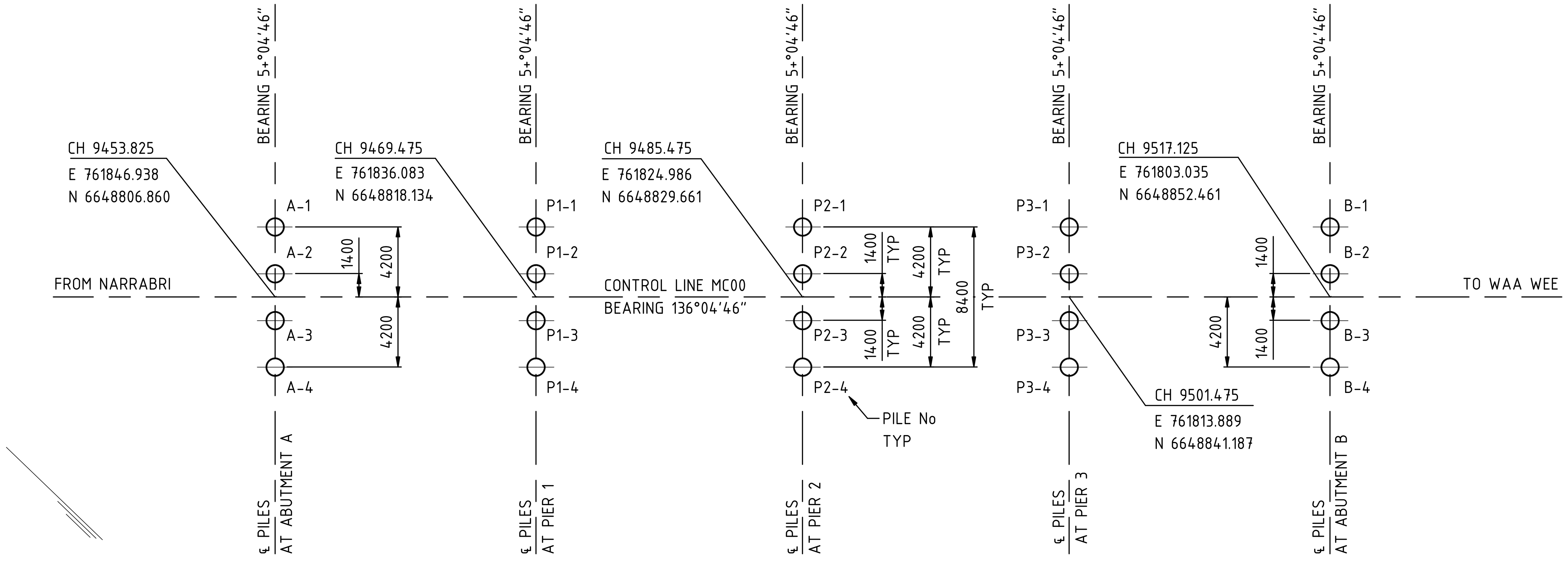

PILE LAYOUT

TABLE 1 - PILE DATA

LOCATION	PILE NO	PILE LEVELS (m) CONTRACT LEVEL RL 'A'	PILE LEVELS (m) TOP OF PILE RL 'B'	MINIMUM LENGTH OF PILE 'L' (m)	TOP OF FOUNDING MATERIAL (m)	MINIMUM NETT ENERGY (kJ) +	MINIMUM NETT ENERGY (kJ) (at 0.9fsy)	FOUNDING MATERIAL	MINIMUM PENETRATION LENGTH (m)	DESIGN MAXIMUM AXIAL COMPRESSION LOAD AT PILE ULS (kN)	DESIGN MAXIMUM AXIAL COMPRESSION LOAD AT PILE SLS (kN)	DESIGN MAXIMUM BENDING MOMENT ALONG THE PILE	PILE TESTING (PDA/CAPWAP FOR REPRESENTATIVE PILE)	PILE DIAMETER (mm)
ABUTMENT A	A-1	181	206	25	181.4			VERY DENSE SAND	25	2495	1757	3263	A1, A3	1050
	A-2													
	A-3													
	A-4													
PIER 1	P1-1	179.4	204.4	25	180.4			DENSE SAND	25	3756	2646	3920	P1-2, P1-4	1050
	P1-2													
	P1-3													
	P1-4													
PIER 2	P2-1	179.4	204.4	25	180.4			DENSE SAND	25	3661	2596	3920	P2-1, P2-3	1050
	P2-2													
	P2-3													
	P2-4													
PIER 3	P3-1	179.4	204.4	25	180.4			DENSE SAND	25	3769	2654	3920	P3-2, P2-4	1050
	P3-2													
	P3-3													
	P3-4													
ABUTMENT B	A-1	181	206	25	181.9			DENSE SAND	25	2498	1758	3301	B1, B3	1050
	A-2													
	A-3													
	A-4													

GEOTECHNICAL DRIVEN PILE

ALL PILES SHALL BE DRIVEN TO RESISTANCE AND ARE EXPECTED TO ACHIEVE THE MINIMUM PILE PENETRATION LENGTH (THE LENGTH OF THE PILE BELOW GROUND LEVEL) INDICATED IN TABLE 1.
GEOTEHCNICAL STRENGTH REDUCTION FACTOR PHI-G OF 0.8 HAS BEEN ADOPTED.
STEEL TUBE SHALL BE GRADE 350 TO AS/NZS 3678 OR APPROVE EQUIVALENT.
WELDING SYMBOLS SHALL COMPLY WITH AS1101 PART 3.
ALL WELDING SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 1554 PART 1 AND B204.
THE WELD CATEGORY SHALL BE SP IN ACCORDANCE WITH AS/NZS 1554 PART 1 AND B204.
BUTT WELDS SHALL BE FULL PENERATION.
THOROUGHLY CLEAN THE PILE SHAFT (FOR THE CONCRETE PLUG SECTION ONLY) OF ALL LOOSE MATERIAL INCLUDING MATERIAL ADHERING TO THE INSIDE OF THE CASING BEFORE REINFORCEMENT IS PLACED.
A METHOD STATEMENT OF THE CLEANING PROCESS SHALL BE SUBMITTED TO THE PRINCIPAL FOR REVIEW PRIOR TO CONSTRUCTION.
PILES ARE TO BE DRIVEN TO RESISTANCE WITH DRIVING ENERGY AND SET DETERMINED BY THE APPLICABLE REPRESENTATIVE PILE. THE CALCULATED SET AND ENERGY SHOWN ON TABLE 1 ARE INDICATIVE ONLY AND ARE NOT TO BE USED AS DRIVING PARAMETERS.
PILE DRIVING ANALYSER (PDA) AND PILE DRIVING MONITOR (PDM) SHALL BE CONDUCTED. CONCURRENTLY TO ESTABLISH CORRELATION FOR DRIVING IMPACT ENERGY AND PILE CAPACITY FOR ALL REPRESENTATIVE PILES. PDM SHALL BE UNDERTAKEN DURING THE INSTALLATION OF ALL PILES WITH SUFFICIENT SENSORS TO MONITOR THE PERFORMANCE OF THE HAMMER. CALCULATE THE NET TRANSFERRED ENERGY AND STRESSES IN THE PILE, ESTIMATE THE MOBILISED CAPACITY OF THE PILE AND DETERMINE THE PILE SET.
DRIVING STRESSESS SHALL NOT EXCEED 0.9 x FSY (OR 0.8 x FSY DURIN SUSTAINED HARD DRIVING). MAXIMUM DRIVING ENERGY TO LIMIT DRIVING STRESSES ARE TO BE ADJUSTED AS REQUIRED BASED ON MONITORING AND TESTING OF REPRESENTATIVE PILES.
THE PILING CONTRACTOR SHALL ASSESS THE DRIVING CONDITIONS AND MAY INCREASE THE WALL THICKNESS OF THE STEEL TUBULAR PILE AND ADJUST THE DRIVING SHOE DETAIL TO SUIT THEIR .

GENERAL NOTES

SCALE 0 2 4 6 8 10m OR AS SHOWN

CONCRETE EXPOSURE CLASSIFICATION FOR PILES: B1
MINIMUM 28 DAYS COMPRESSIVE STRENGTH OF CONCRETE FOR PILES SHALL BE 50MPa.
CONCRETE WORKS TO COMPLY WITH RMS SPECIFICATION B80.
ALL PILE SHALL BE CONSTRUCTED IN ACCORDANCE WITH RMS QA SPECIFICATION B58.
THE PLACING OF CONCRETE IN THE PILES SHALL BE CARRIED OUT IN ONE CONTINUOUS OPERATION UNLESS OTHERWISE SPECIFIED.
IRRESPECTIVE OF THE AS BUILT POSITION OF THE PILE, THE COLUMN EXTENSION, INCLUDING STARTER BAR POSITIONS SHALL BE CONSTRUCTED IN THE DESIGN POSITION.

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HW29 - KAMILAROI HWY — NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

PILE LAYOUT AND DATA

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DRAWING	O. Fernando	D. Carroll
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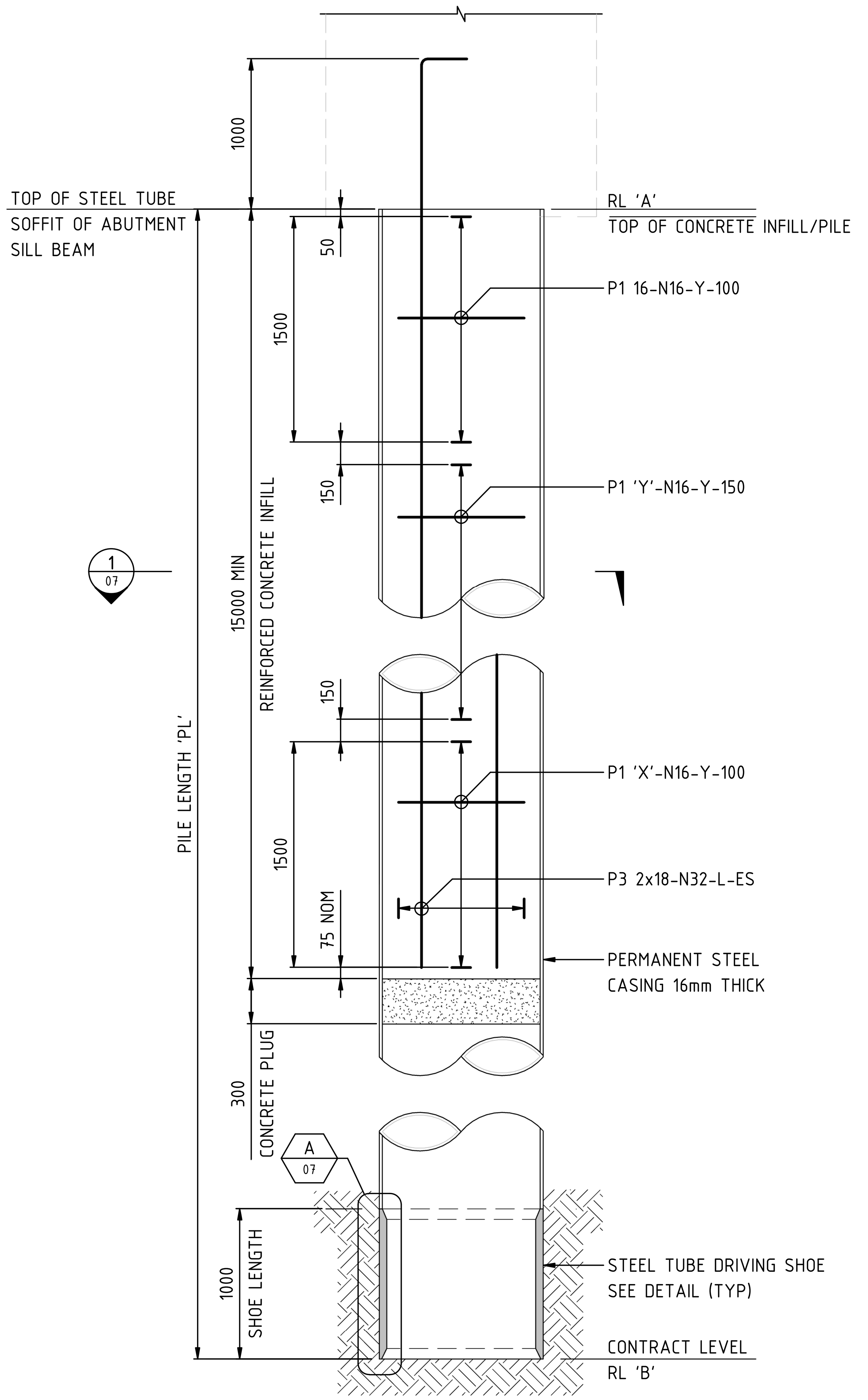
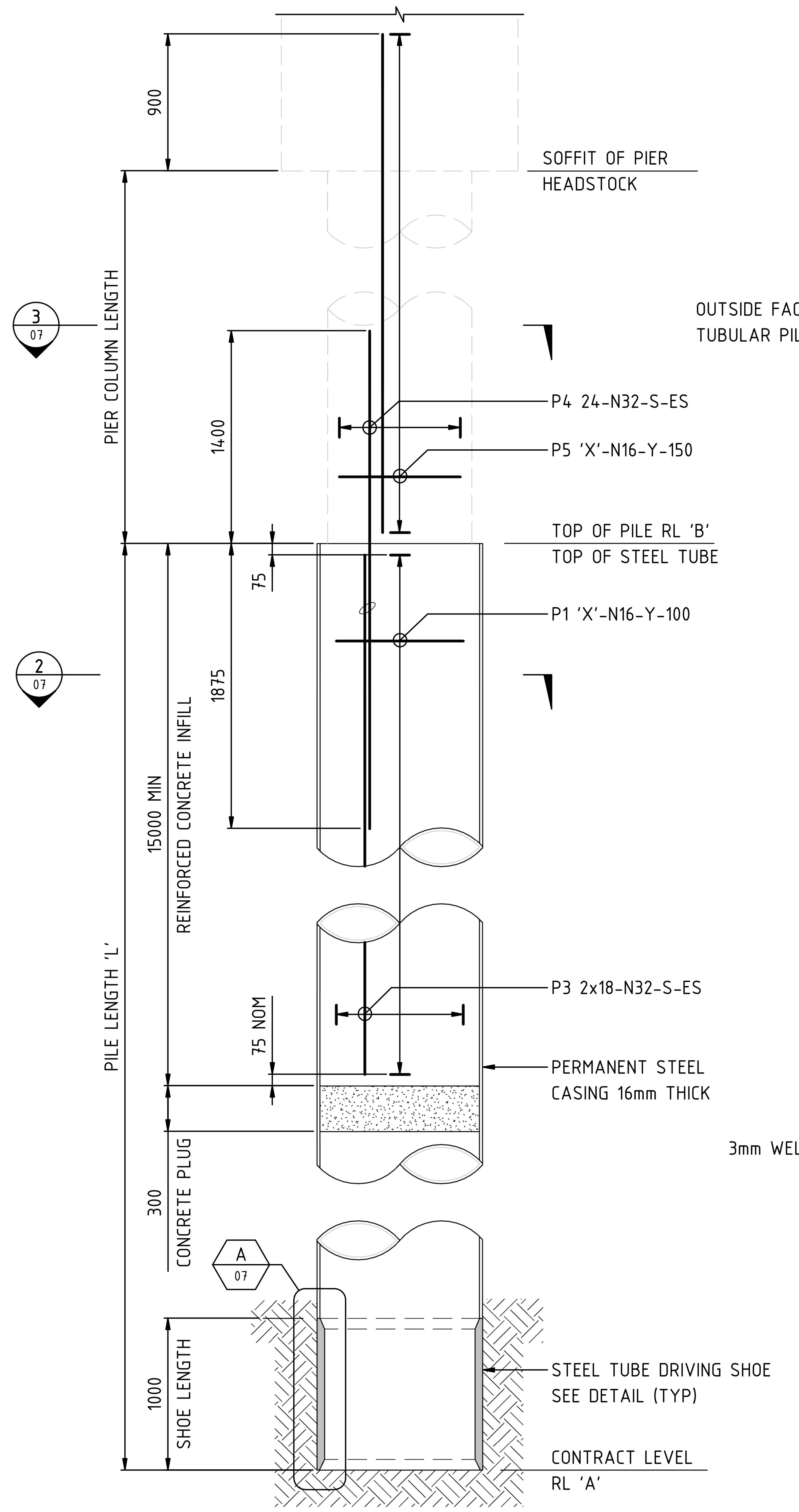


TYPICAL ABUTMENT PILE ELEVATION

PILE NOS A-1, A-2, A-3, A-4, B-1, B-2, B-3 AND B-4

FOR VALUES OF 'A', 'B', 'L', 'Ls', 'X' AND 'Y' SEE TABLE 1 ON SHEET No 6

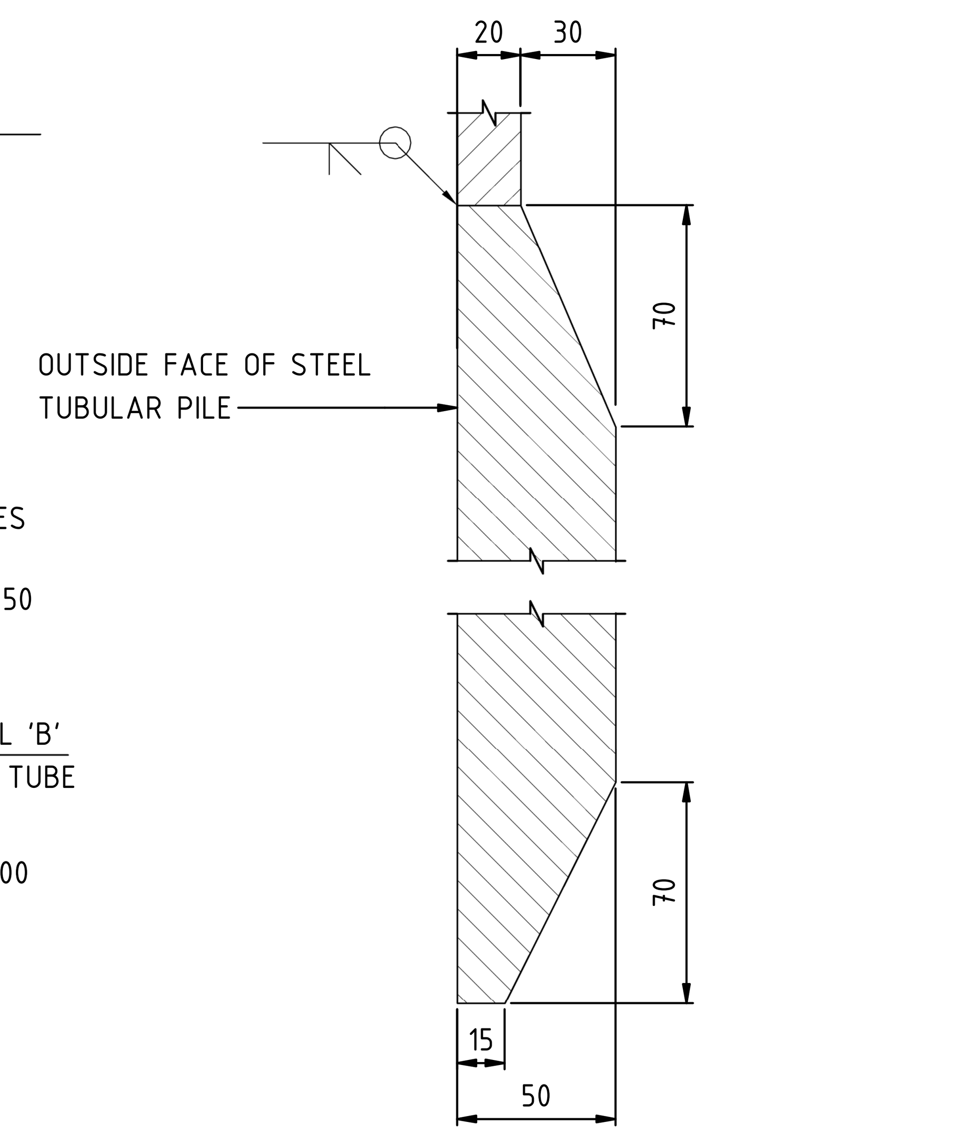


PIER PILE ELEVATION

PILE NOS P1-1, P1-2, P1-3, P1-4, P2-1, P2-2, P2-3, P2-4,

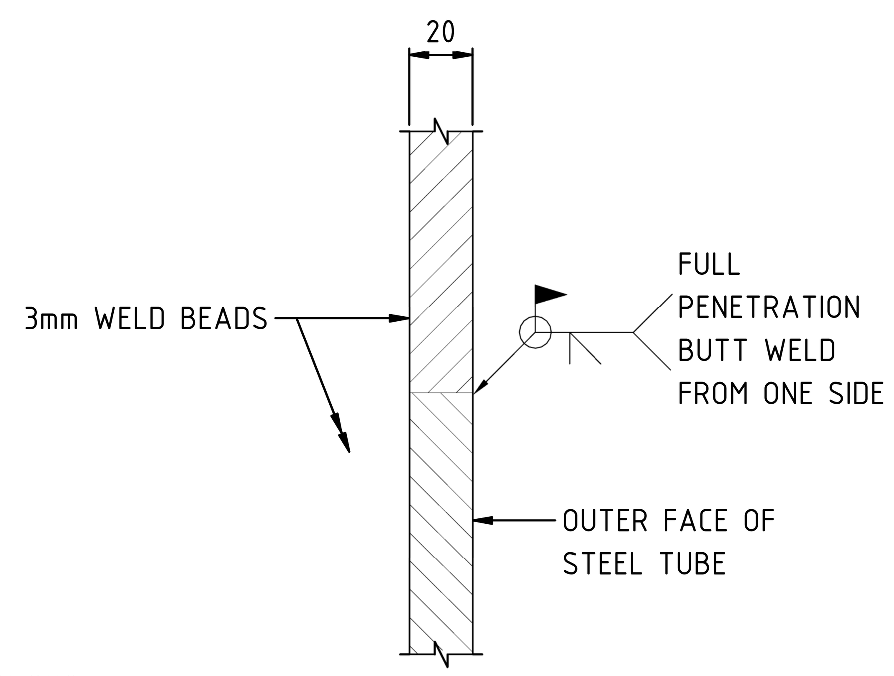
P3-1, P3-2, P3-3 AND P3-4

FOR VALUES OF 'A', 'B', 'L', 'Ls', 'X' AND 'Y' SEE TABLE 1 ON SHEET No 6



DETAIL A 07

0 20 40 60 80 100mm



WELD SPLICE DETAIL

IN STEEL TUBE

0 20 40 60 80 100mm

REINFORCEMENT

REQUIRED CONCRETE COVER TO REINFORCEMENT NEAREST CONCRETE SURFACE SHALL BE 70mm UNLESS SPECIFIED OTHERWISE.
UNLESS OTHERWISE SHOWN ON THE DRAWINGS, LAPS ON ADJACENT BARS ON ANY FACE SHALL BE STAGGERED (OFFSET) BY NO LESS THAN THE LAP LENGTH.
HELICAL REINFORCEMENT SHALL BE SPLICED WITHIN ITS LENGTH EITHER BY WELDING OR MECHANICAL MEANS.
HELIX SHALL BE ANCHORED AT EACH END WITH 1.5 TURNS ADJUSTED TO ZERO PITCH AND ANCHORED BY A STANDARD HOOK AROUND A MAIN BAR.
UNLESS OTHERWISE SPECIFIED, THE MINIMUM DEVELOPEMENT LENGTHS AND LENGTHS OF LAPS SHALL BE AS FOLLOWS:

BAR SIZE: mm	N12	N16	N20	N24	N28	N32	N36
a) HORIZONTAL BARS WITH>300mm OF CONCRETE CAST BELOW THE BAR:	-	-	-	-	-	-	-
b) LAP LENGTH - OTHER BARS:	350	500	650	900	1150	1400	1700
c) DEVELOPMENT LENGTH:	350	500	600	750	900	1100	1350

LAPS NOT SHOWN ON THE DRAWINGS SHALL BE STAGGERED SO THAT NO MORE THAN 50% OF BARS ARE LAPPED IN ANY ONE FACE OF CROSS SECTION.
WHERE MORE THAN 50% OF BARS ARE LAPPED IN ANY ONE FACE OF CROSS SECTION, THE LAPS SHOWN IN THE TABLE ABOVE SHALL BE INCREASED BY A FACTOR OF 1.3
CLEAR DISTANCE BETWEEN LAPPED BARS SHALL NOT EXCEED 3 x THE BAR DIAMETER.
REINFORCEMENT MAY BE DISPLACED SLIGTHLY WHERE NECESSARY TO CLEAR SPLICE BAR OR GENERAL FITMENTS.

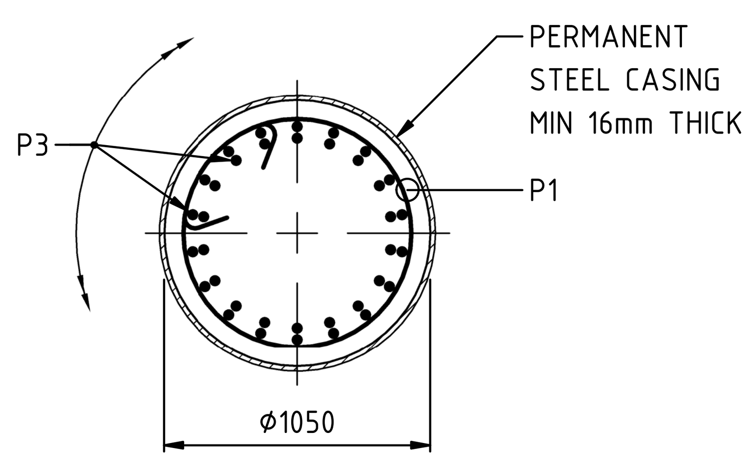
DRIVING SHOE

A MINIMUM DRIVING SHOE THICKNESS OF 50mm IS RECOMMENDED HOWEVER, THE PILING CONTRACTOR IS RESPONSIBLE FOR ASSESSING DRIVING CONDITIONS AND ADJUST THE WALL THICKNESS OF THE STEEL CASING AND DRIVING SHOE DETAIL TO SUIT THEIR ASSESSMENT.

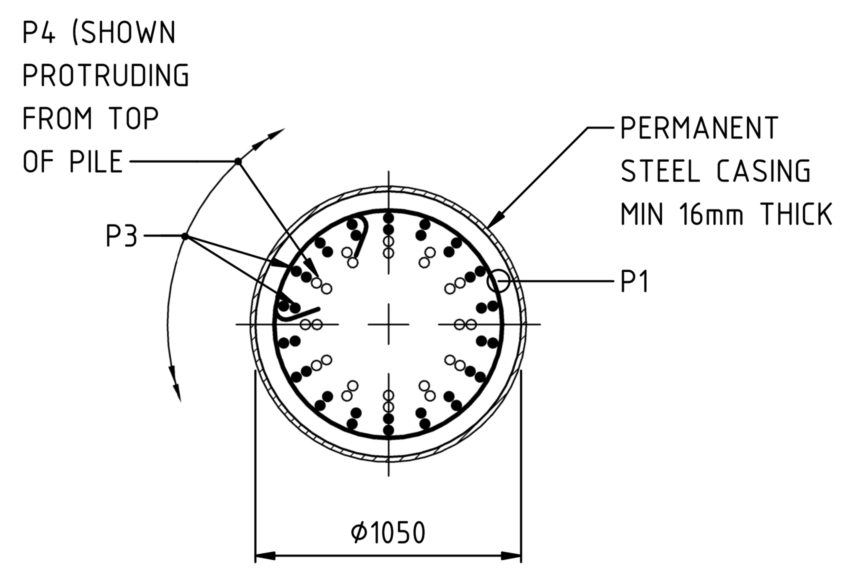
GENERAL NOTES

SCALE 0 0.3 0.5 0.8 1 1.3m OR AS SHOWN

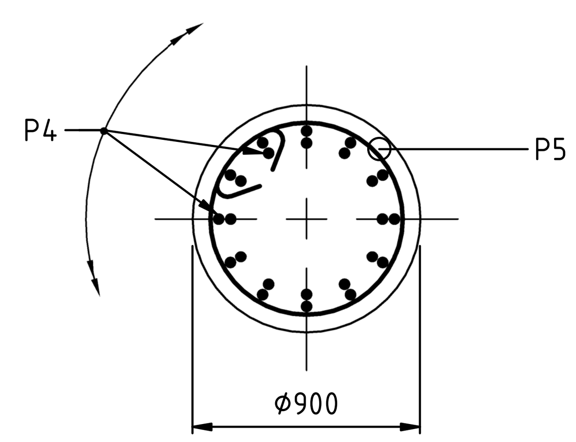
FOR OTHER GENERAL NOTES RELATING TO THIS SHEET, SEE SHEET No 6.



SECTION 1 07



SECTION 2 07



SECTION 3 07

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HW29 - KAMILAROI HWY — NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

PILE DETAILS

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Level 9, The Forum, 203 Pacific Highway
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Tel: 02 9496 7700 Fax: 02 9439 5170
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DESIGN	J. Guzman	L.Bai
DRAWING	O. Fernando	D. Carroll
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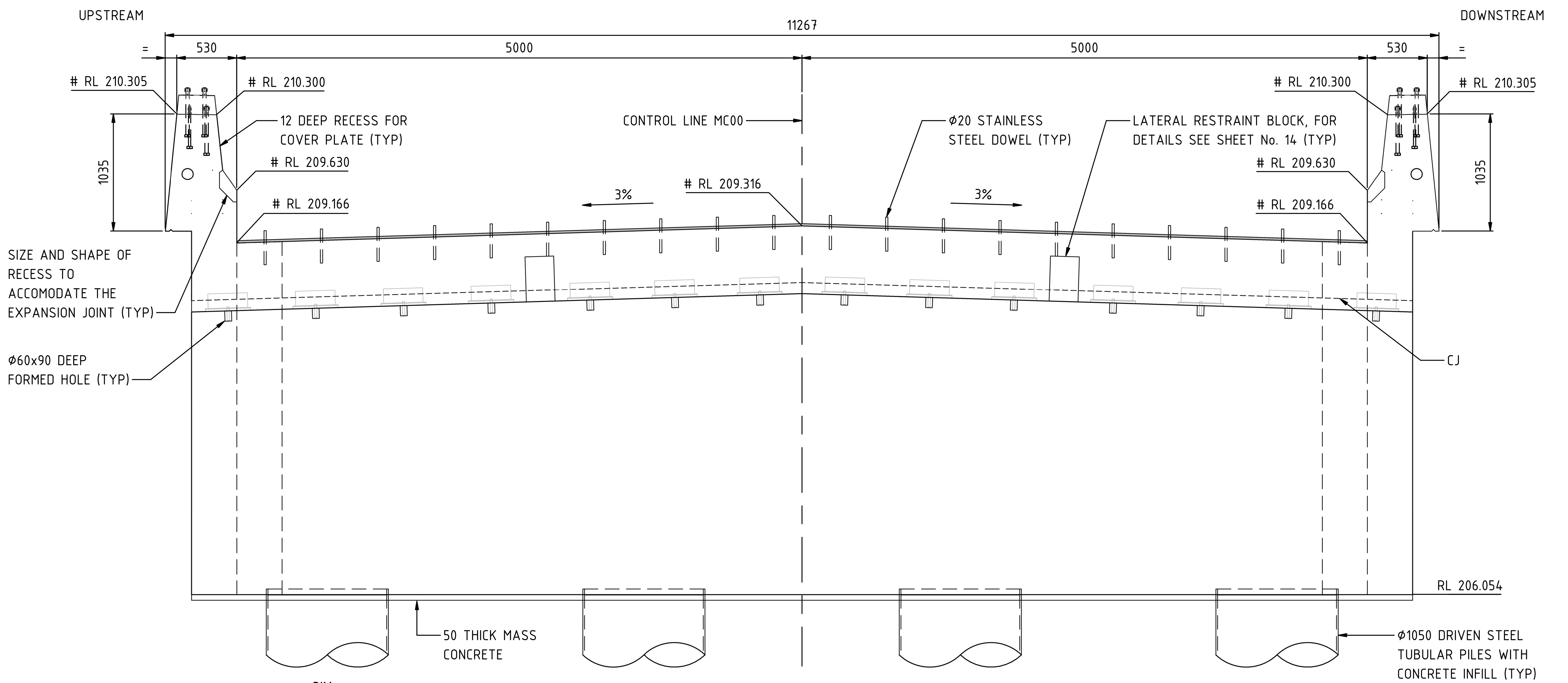
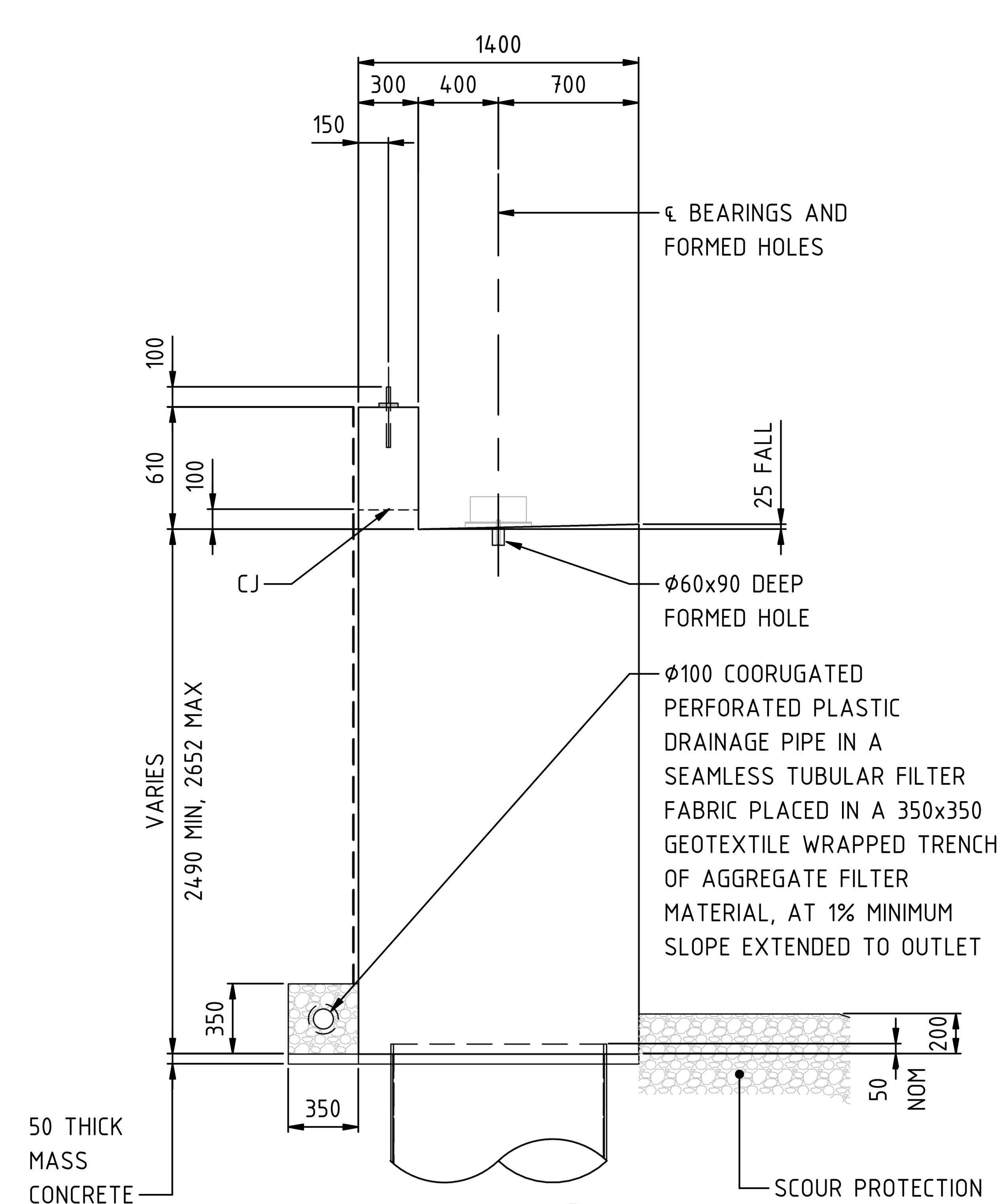
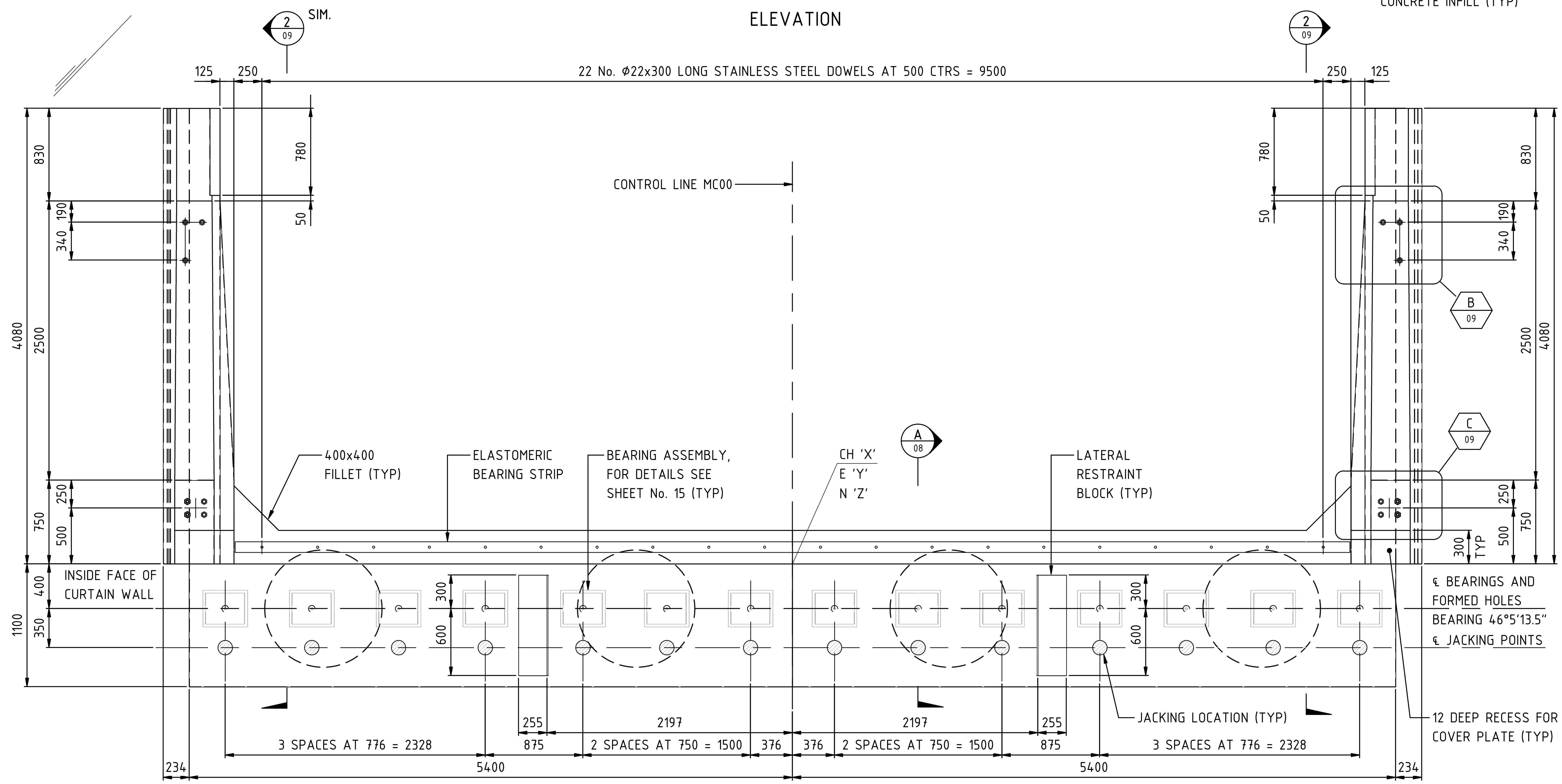


ELEVATION



SECTION A 08



PLAN

ABUTMENT A SHOWN,
ABUTMENT B SIMILAR

GENERAL NOTES

SCALE 0 0.3 0.5 0.8 1 1.3m

CONCRETE EXPOSURE CLASSIFICATION: B1
MINIMUM 28 DAY COMPRESSIVE STRENGTH OF ALL CONCRETE SHALL BE 50MPa.
EDGE SHALL BE CHAMFERED 20x20 AND RE-ENTRANT ANGLES FILLETED 20x20mm UNLESS SPECIFIED OTHERWISE.
NCF DENOTES NO CHAMFER OR FILLET.
CJ DENOTES CONSTRUCTION JOINT.
JACK TO BE ADEQUATE FOR: 600kN (ULS), 450 (SLS)
JACK LOCATIONS PROVIDED FOR FUTURE JACKING FOR BEARING REPLACEMENT
▨ DENOTES JACK LOCATION.
# DENOTES RLS ARE GIVEN ALONG INSIDE FACE OF CURTAIN WALL AND TOP OF COVER PLATE
FOR LOCATION AND PLACEMENT OF CAST-IN FERRULES FOR COVER PLATES, THE COVER PLATES MAY BE USED AS A TEMPLATE, SEE SHEET No. 23 FOR FURTHER DETAILS.

TABLE 1 - ABUTMENT SETOUT DATA

LOCATION	CHAINAGE 'X'	EASTING 'Y'	NORTHING 'Z'
ABUTMENT A	9453.425	761847.215	6648806.572
ABUTMENT B	9517.525	761802.758	6648852.749

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HW29 - KAMILAROI HWY
NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

ABUTMENT CONCRETE - SHEET A

NORTHWEST REGION

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Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
Level 9, The Forum, 203 Pacific Highway
St. Leonards, NSW 2065
Tel: 02 9496 7700 Fax: 02 9439 5170
Web: www.cardno.com.au

NSW GOVERNMENT Transport for NSW

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APPROVED/ DESIGN QA RECORDS	DIRECTOR	

DRAWING SET No DS2022/000622
BRIDGE No BR12489
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ISSUE | No OF SHEETS 31 | SHEET No 08

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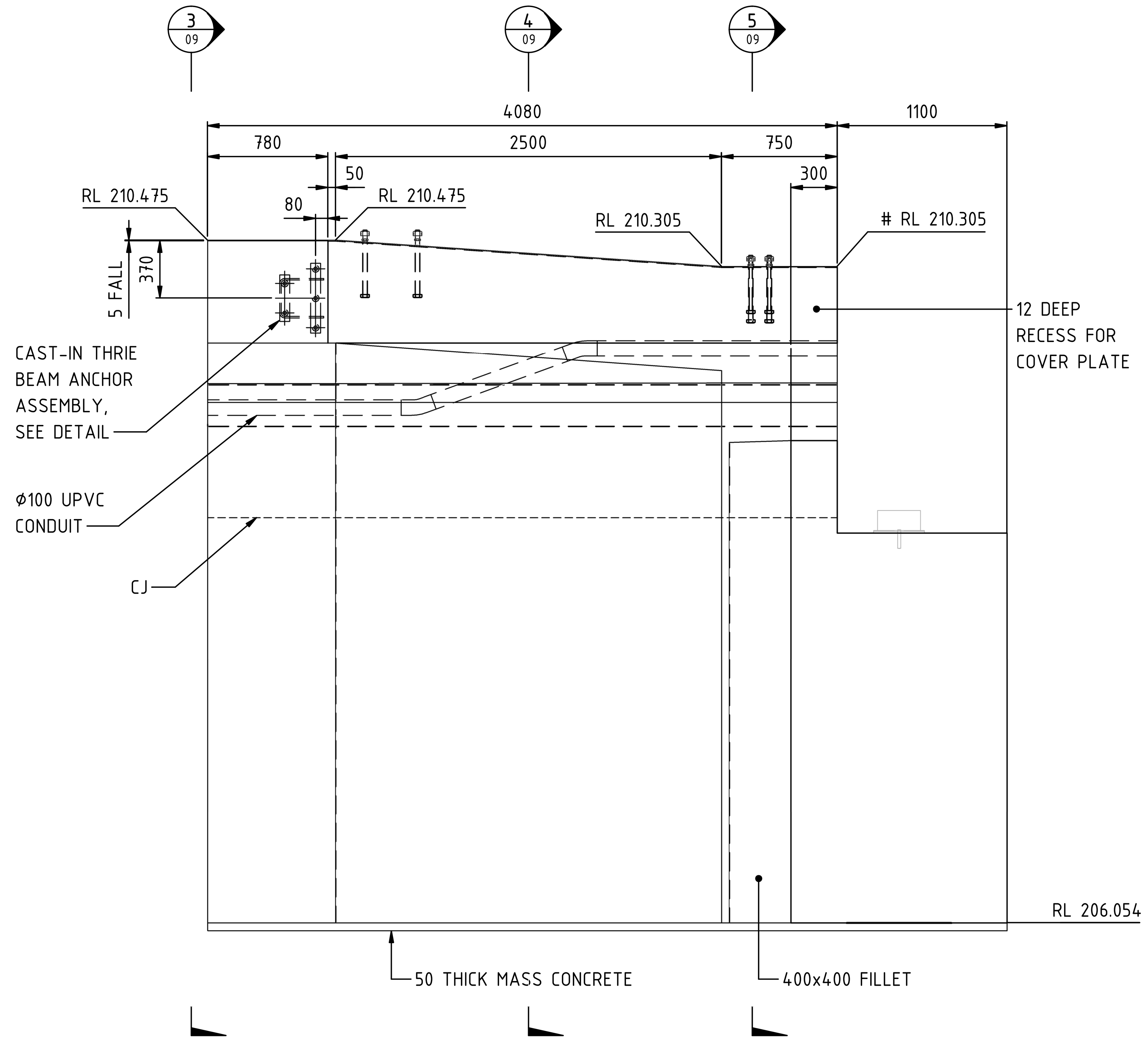
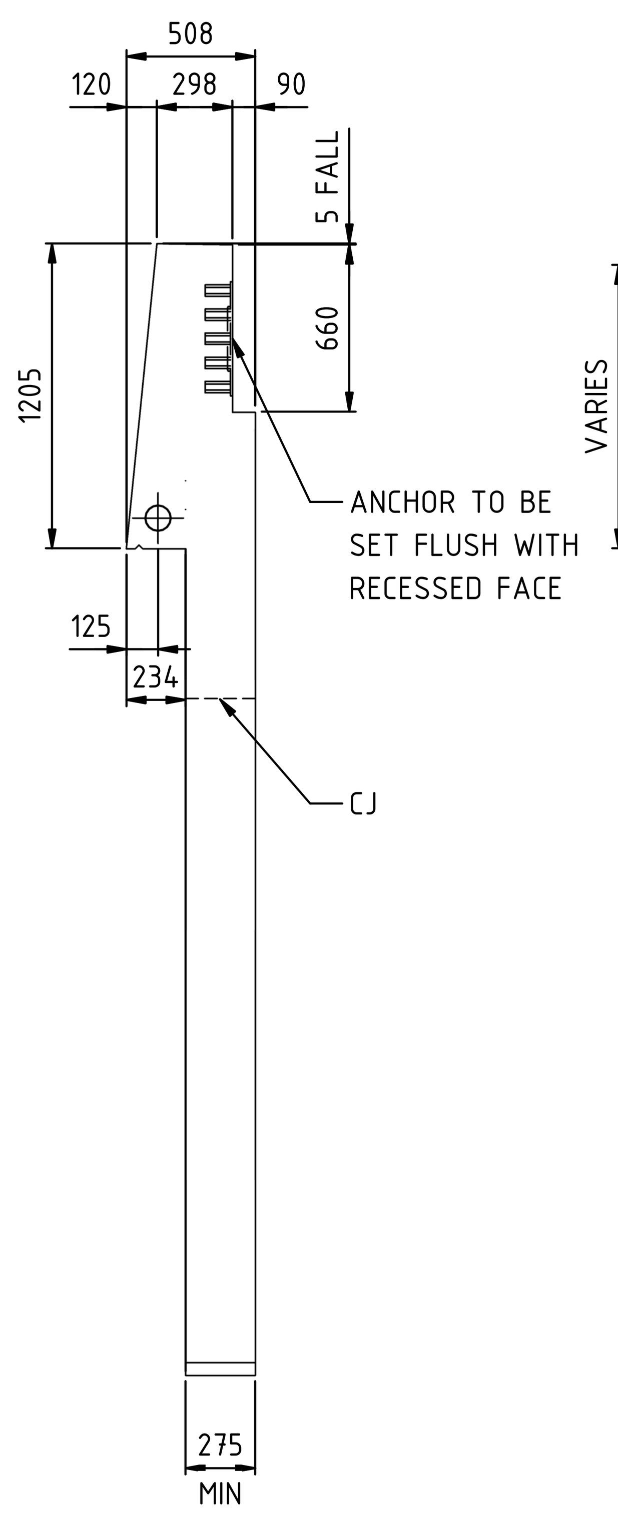
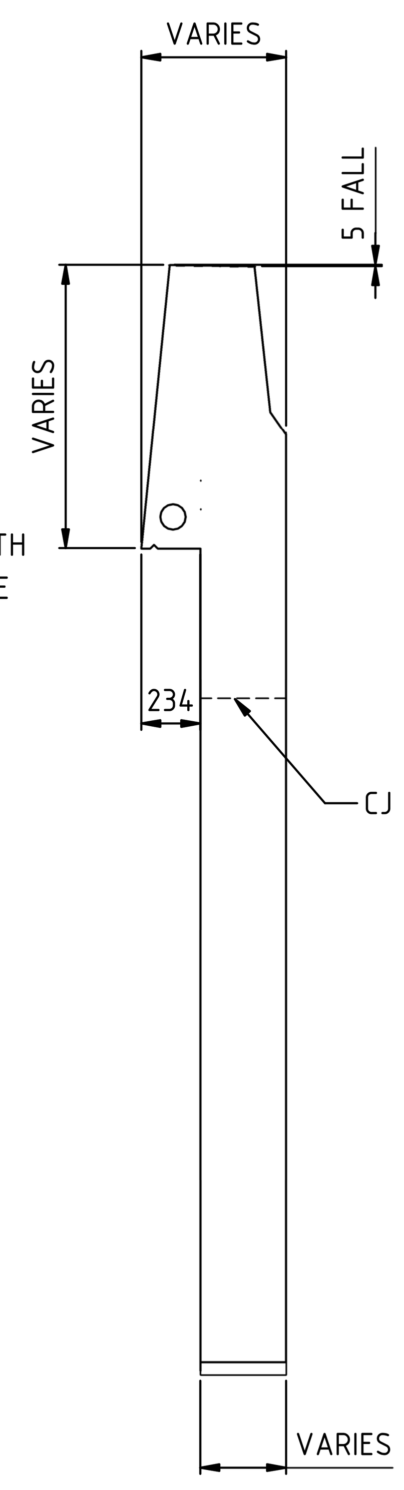


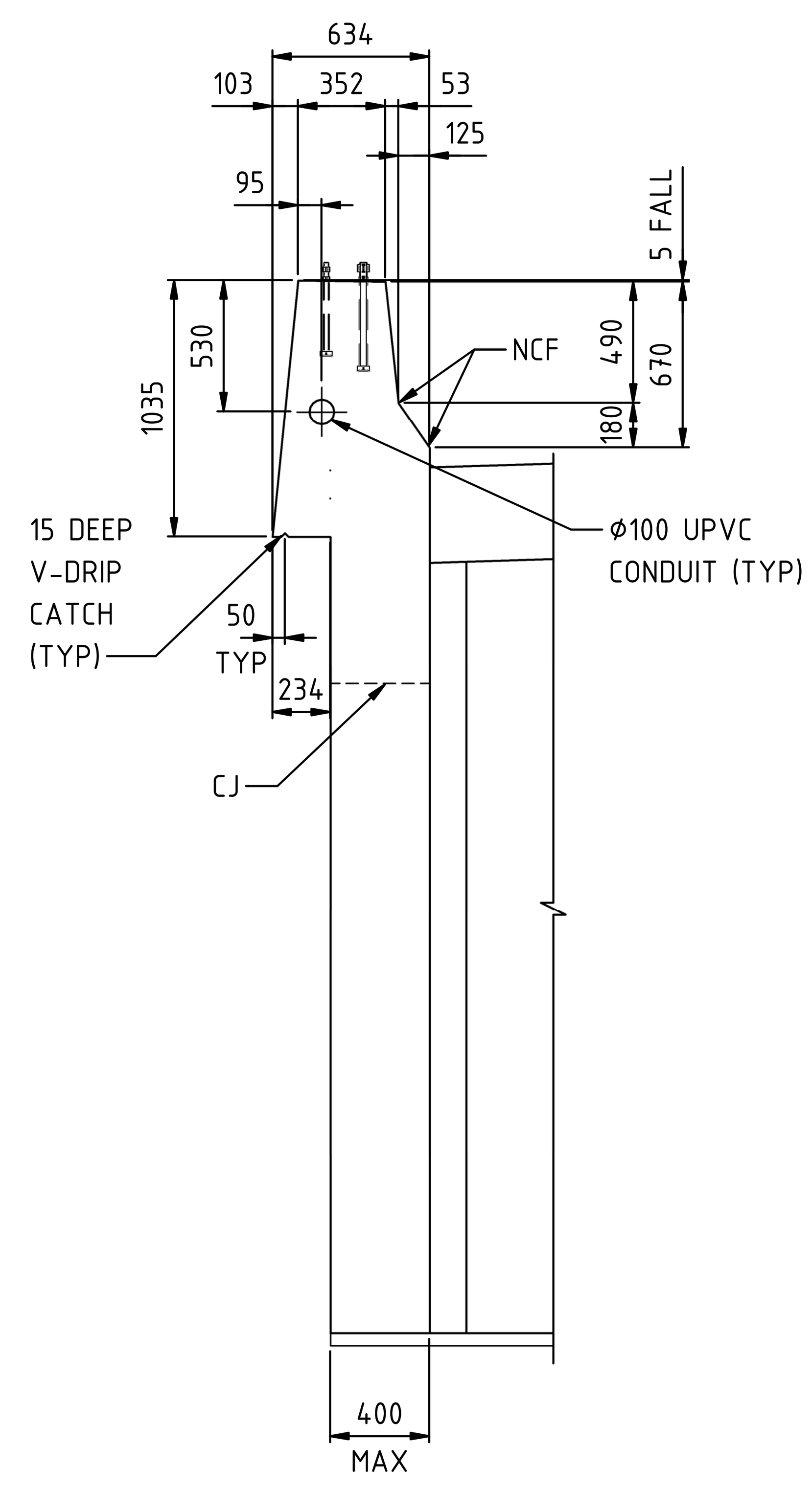
VIEW 2 08



VIEW 3 09



SECTION 4 09



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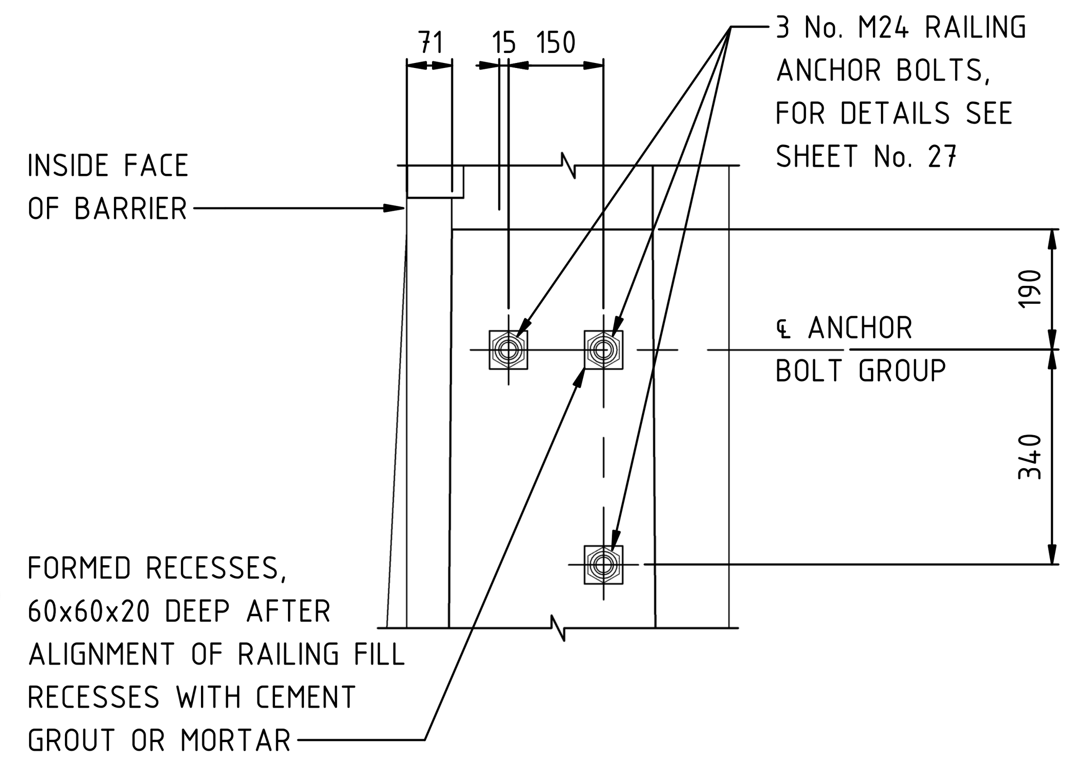
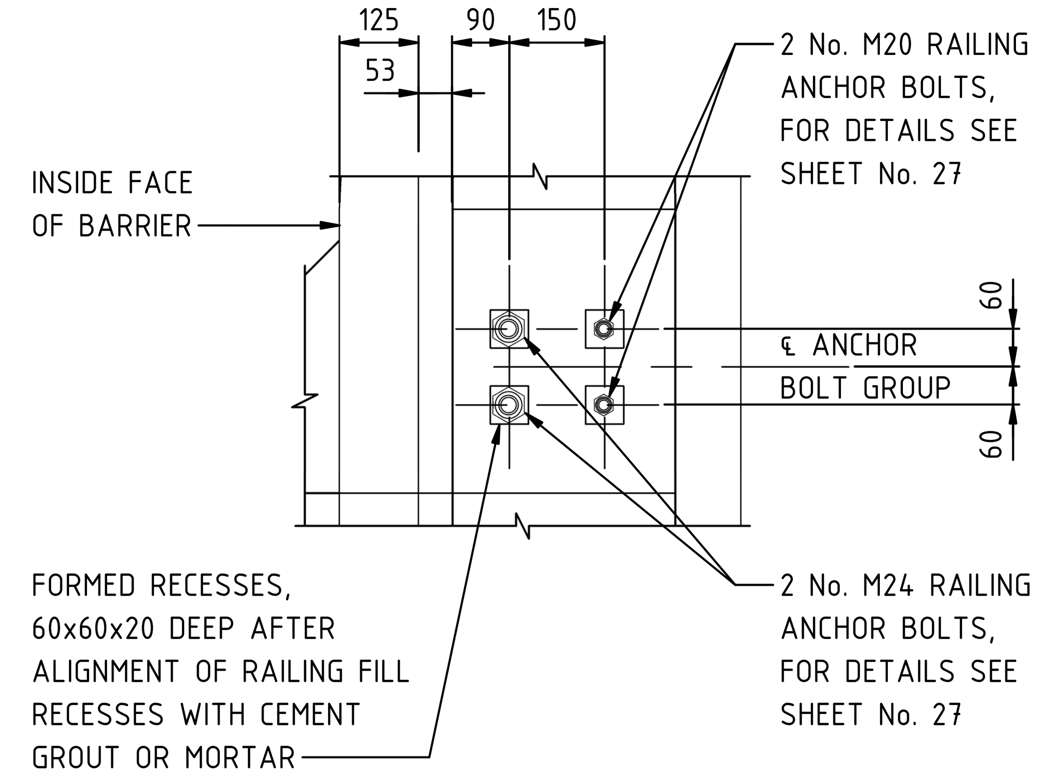


DETAIL B 08

0 0.1 0.2 0.3 0.4 0.5m



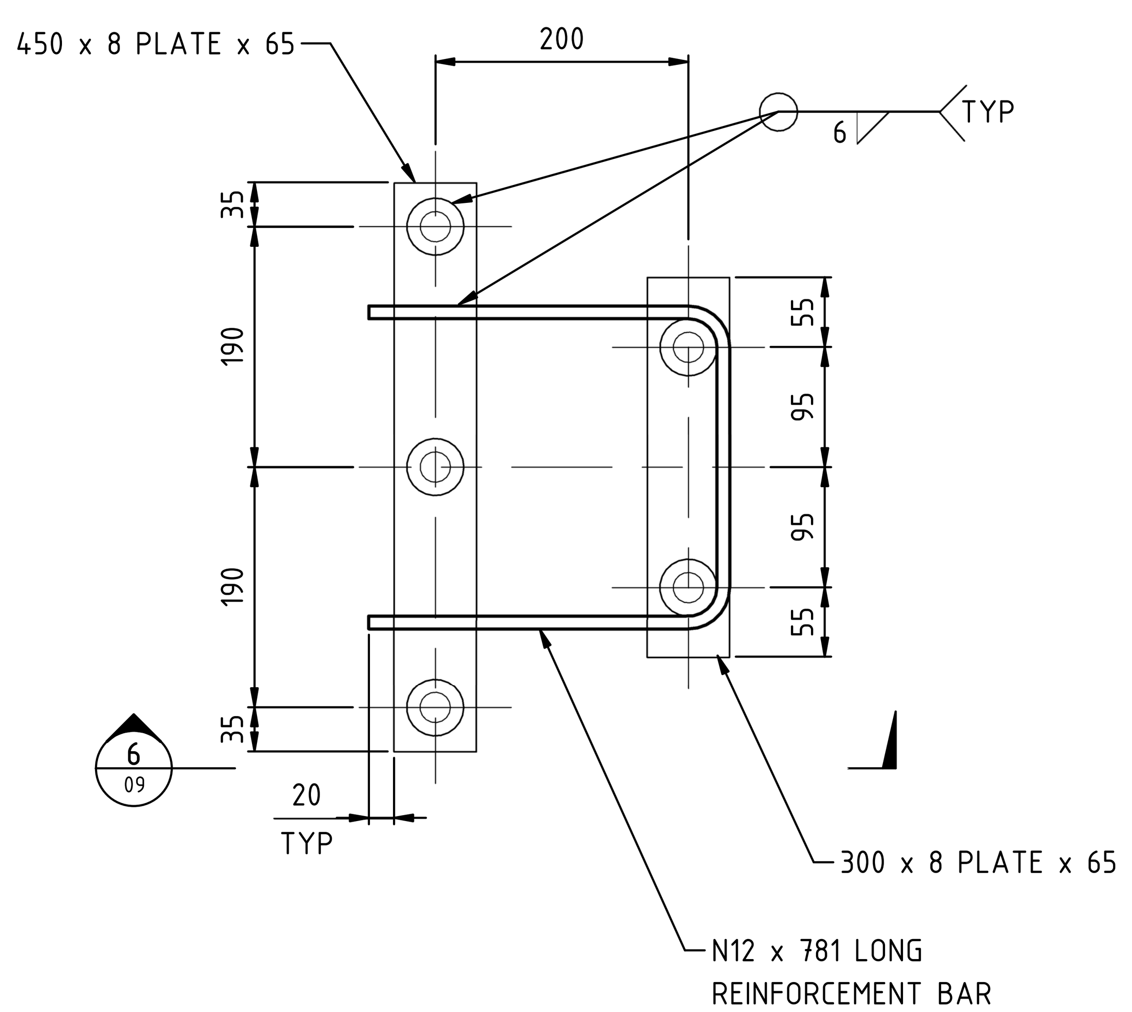
DETAIL C 08

0 0.1 0.2 0.3 0.4 0.5m

GENERAL NOTES

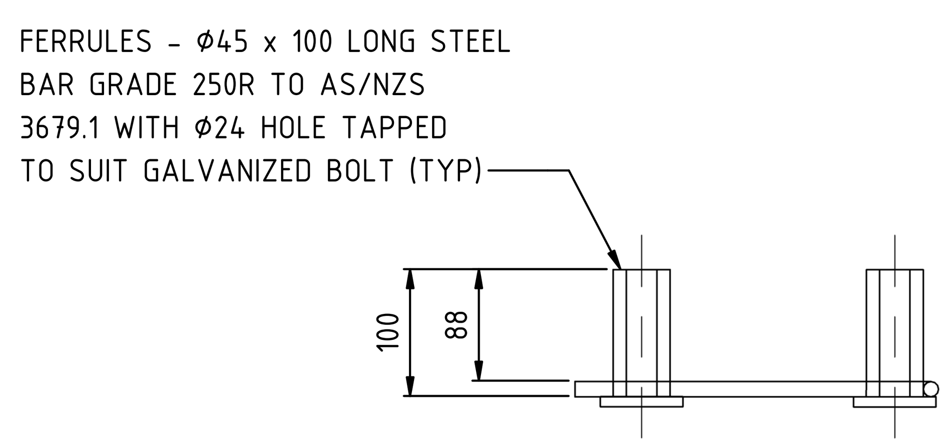
SCALE 0 0.3 0.5 0.8 1 1.3m OR AS SHOWN.

FOR OTHER GENERAL NOTES RELATING TO THIS SHEET, SEE SHEET No. 5



ANCHOR ASSEMBLY ELEVATION

4 ASSEMBLIES REQUIRED



SECTION 6 09

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HW29 - KAMILAROI HWY — NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

ABUTMENT CONCRETE - SHEET B

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St. Leonards, NSW 2065
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	PREPARED	CHECKED
DESIGN	J. Guzman	L.Bai
DRAWING	O. Fernando	D. Carroll
APPROVED/ DESIGN QA RECORDS		
	DIRECTOR	

DRAWING SET No: DS2022/000622

BRIDGE No: BR12489

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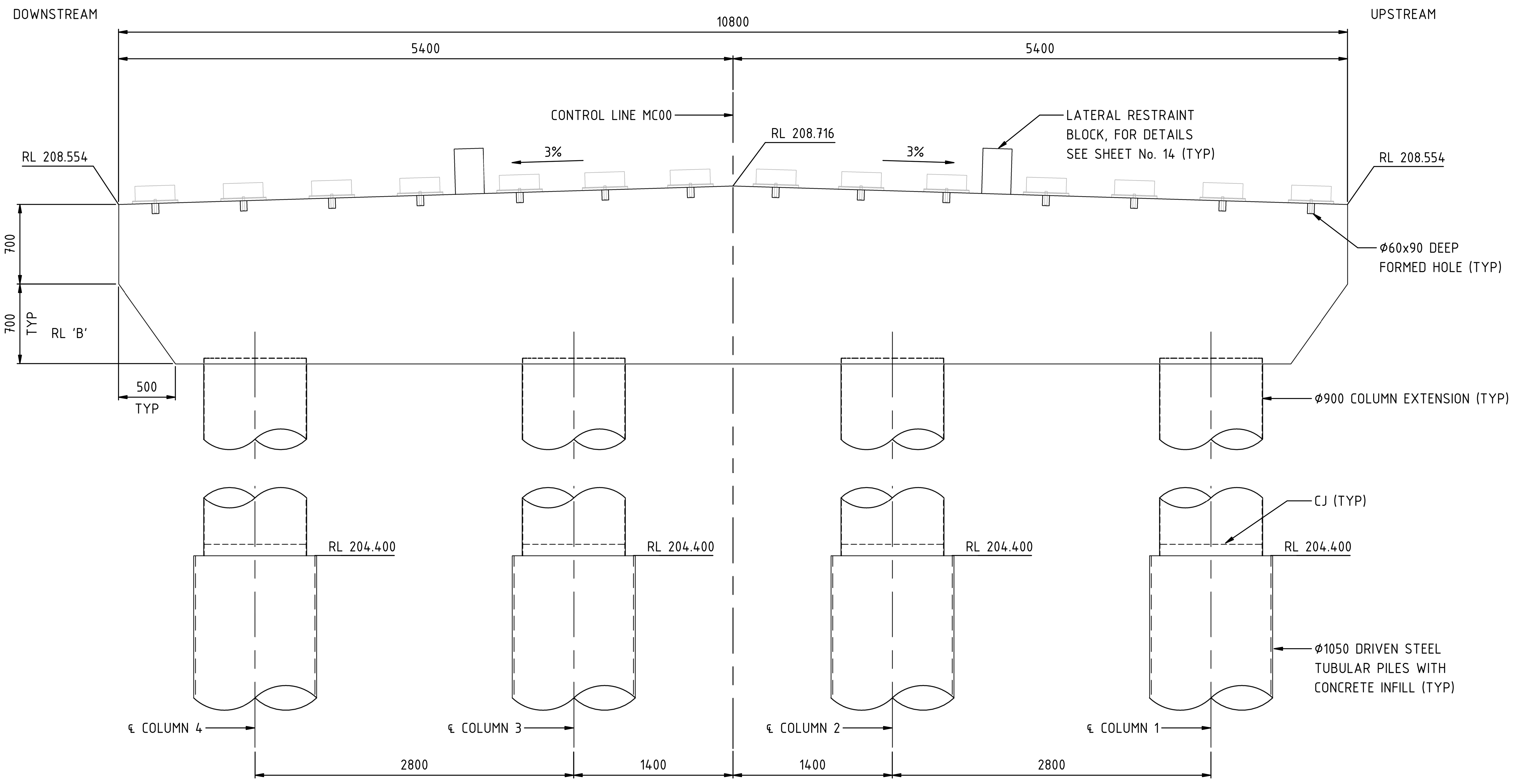
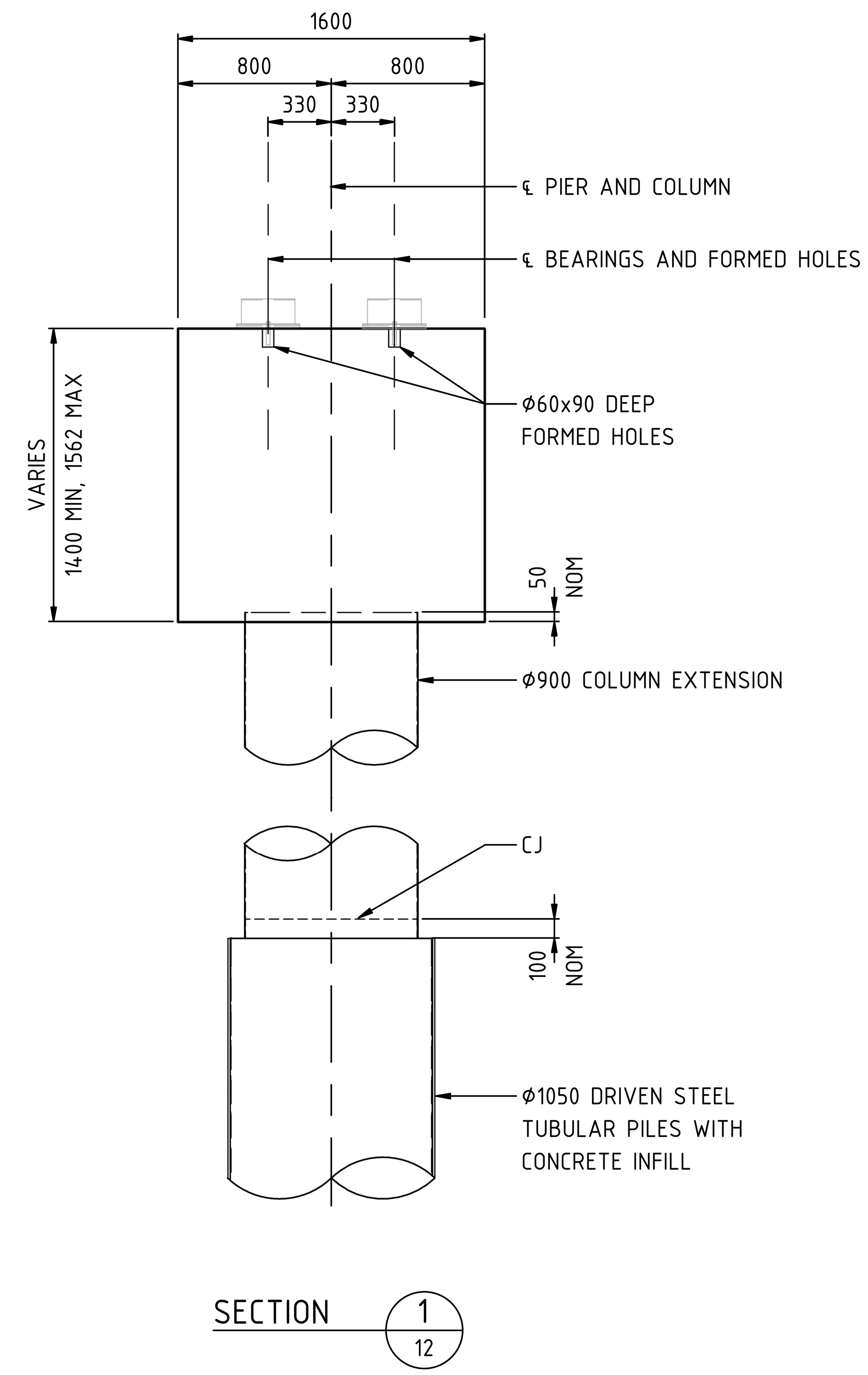


ELEVATION
FOR VALUES 'A', 'B', 'C', 'D' AND 'E' SEE TABLE 1

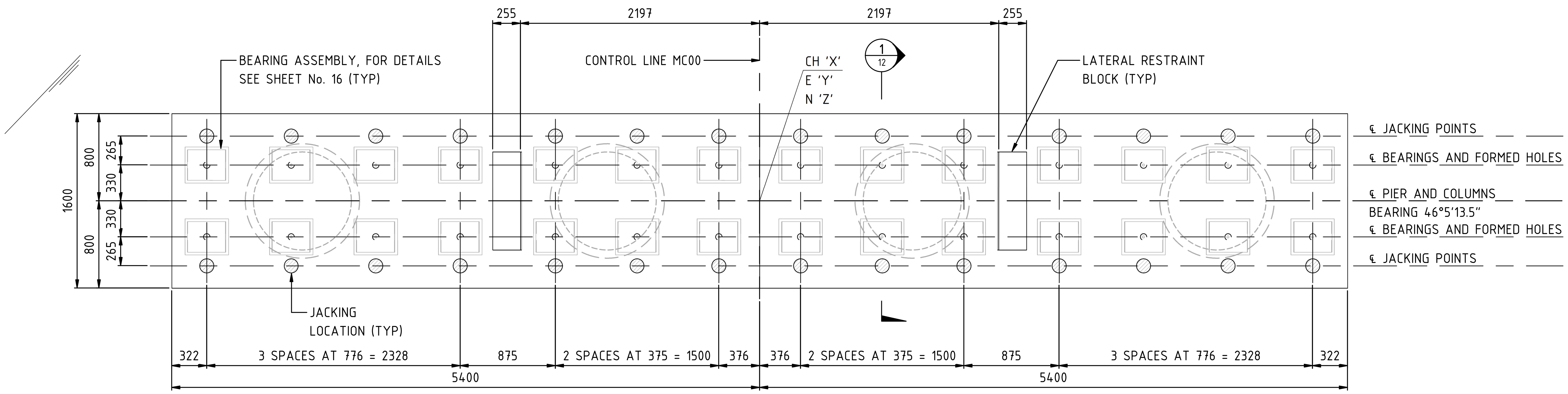


SECTION 1/12

GENERAL NOTES

SCALE 0 0.3 0.5 0.8 1 1.3m

CONCRETE EXPOSURE CLASSIFICATION: B1
MINIMUM 28 DAY COMPRESSIVE STRENGTH OF ALL CONCRETE SHALL BE 50MPa.
EDGE SHALL BE CHAMFERED 20x20 AND RE-ENTRANT ANGLES FILLETED 20x20mm UNLESS SPECIFIED OTHERWISE.
CJ DENOTES CONSTRUCTION JOINT.
JACK TO BE ADEQUATE FOR: 600kN (ULS), 450 (SLS)
JACK LOCATIONS PROVIDED FOR FUTURE JACKING FOR BEARING REPLACEMENT
▨ DENOTES JACK LOCATION.



PLAN

TABLE 1 - PIER SETOUT DATA

LOCATION	CHAINAGE 'X'	EASTING 'Y'	NORTHING 'Z'
PIER 1	9469.475	761836.083	6648818.134
PIER 2	9485.475	761824.986	6648829.661
PIER 3	9501.475	761813.889	6648841.187

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HW29 - KAMILAROI HWY
NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT
ON KAMILAROI HWY AT NARRABRI
PIERS CONCRETE

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Level 9, The Forum, 203 Pacific Highway
St. Leonards, NSW 2065
Tel: 02 9496 7700 Fax: 02 9439 5170
Web: www.cardno.com.au

	PREPARED	CHECKED
DESIGN	J. Guzman	L.Bai
DRAWING	O. Fernando	D. Carroll
APPROVED/ DESIGN QA RECORDS		
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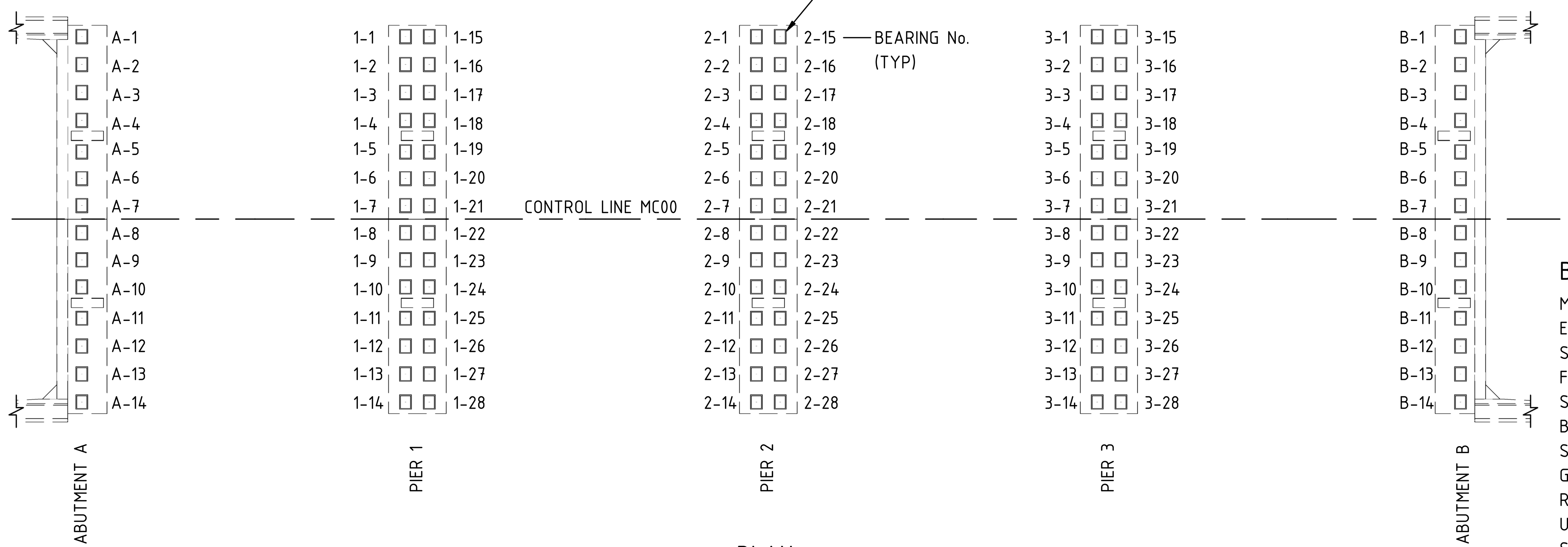


PLAN
BEARING LAYOUT

TABLE 1 - LONGITUDINAL GRADE ON TOP OF BEARING BASEPLATE

SPAN No	MEASURED HOG	Ma	Mb
1		%	%
2		%	%
3		%	%

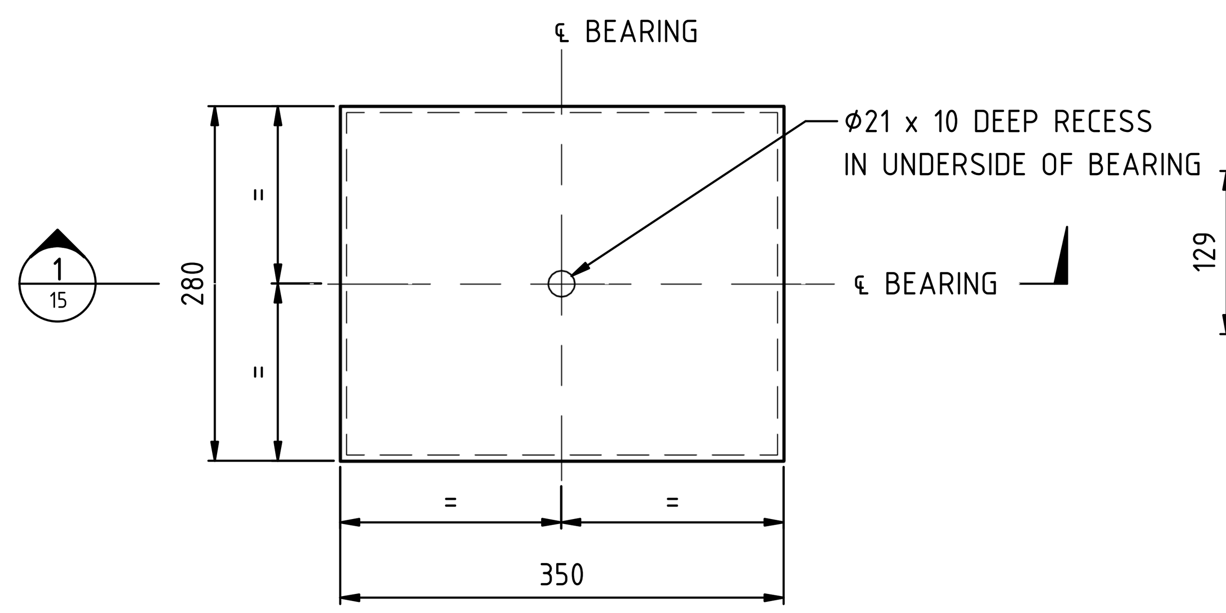
HOGS SHALL BE MEASURED WITHIN TWO WEEKS PRIOR TO THE ERECTION OF THE PLANKS AND THE GRADE OF THE TOP OF BASEPLATES SHALL BE DETERMINED FROM THE FIGURES IN TABLE 1 ACCORDINGLY.

BEARING INSTALLATION SEQUENCE

MEASURE PLANK HOG NOT MORE THAN 2 WEEKS BEFORE THE ERECTION OF PLANKS.
SET UP STEEL BEARING BASE PLATE TO CORRECT LEVEL.
FILL SPACE WITH GROUT.
SETTING OF STEEL BEARING BASE PLATE AND INSTALLATION OF BEARING TO BE IN ACCORDANCE WITH ROADS AND MARITIME QA SPECIFICATION B284.
GROUTING SHALL BE CARRIED TO ENSURE THAT THE FORMED RECESSES ARE COMPLETELY FILLED AND THAT THERE ARE NOT VOIDS UNDER THE BASE PLATES.
SIDE FACES OF GROUT PADS SHALL BE VERTICAL.
THE FRAMEWORK FOR THE GROUT PADS MUST REMAIN IN PLACE FOR A MINIMUM OF 3 DAYS AND CURING COMPOUND SHALL APPLIED TO THE SIDE OF THE GROUT PADS AFTER THE REMOVAL OF FORMWORK.
INSTALL ELASTOMERIC BEARINGS ONTO STEEL BEARING BASE PLATE.
TOP OF STEEL BEARING BASE PLATE TO BE CLEANED PRIOR TO INSTALLING ELASTOMERIC BEARING.
ERECT PLANKS AND TEMPORARILY PROVIDE BLOCKING OR BRACING. THE BLOCKING OR BRACING IS TO BE REMOVED AFTER SLAB CAST.

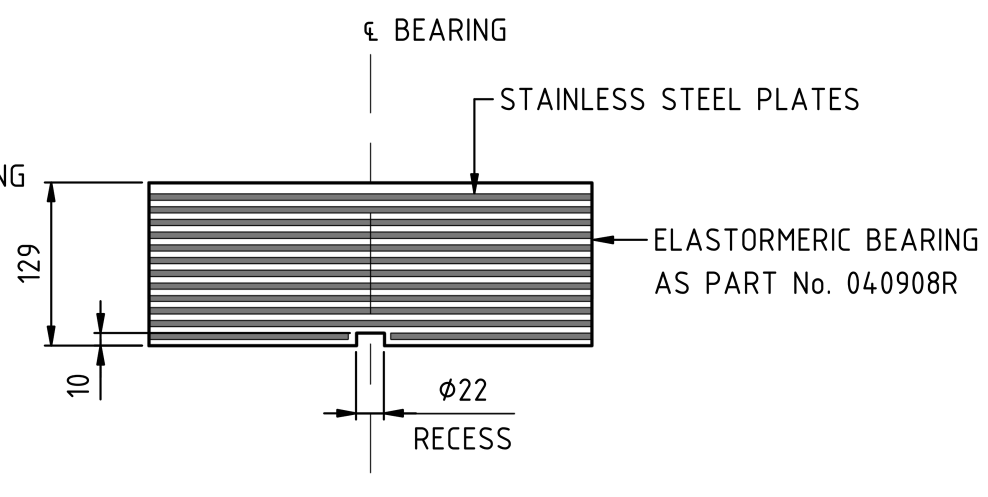
TABLE 2

LOCATION	BEARING No.	RL 'X'
ABUTMENTS	A1, A14, B1, B14	208.718
	A2, A13, B2, B13	208.742
	A3, A12, B3, B12	208.765
	A4, A11, B4, B11	208.788
	A5, A10, B5, B10	208.815
	A6, A9, B6, B9	208.837
	A7, A8, B7, B8	208.860
PIERS	1-1, 1-15, 2-1, 2-15, 3-1, 3-15, 1-14, 1-28, 2-14, 2-28, 3-14, 3-28	208.718
	1-2, 1-16, 2-2, 2-16, 3-2, 3-16, 1-13, 1-27, 2-13, 2-27, 3-13, 3-27	208.742
	1-3, 1-17, 2-3, 2-15, 3-3, 3-17, 1-12, 1-26, 2-12, 2-26, 3-12, 3-26	208.765
	1-4, 1-18, 2-4, 2-18, 3-4, 3-18, 1-11, 1-25, 2-11, 2-25, 3-11, 3-25	208.788
	1-5, 1-19, 2-5, 2-19, 3-5, 3-19, 1-10, 1-24, 2-10, 2-24, 3-10, 3-24	208.815
	1-6, 1-20, 2-6, 2-20, 3-6, 3-20, 1-9, 1-23, 2-9, 2-23, 3-9, 3-23	208.837
	1-7, 1-21, 2-7, 2-21, 3-7, 3-21, 1-8, 1-22, 2-8, 2-22, 3-8, 3-22	208.860



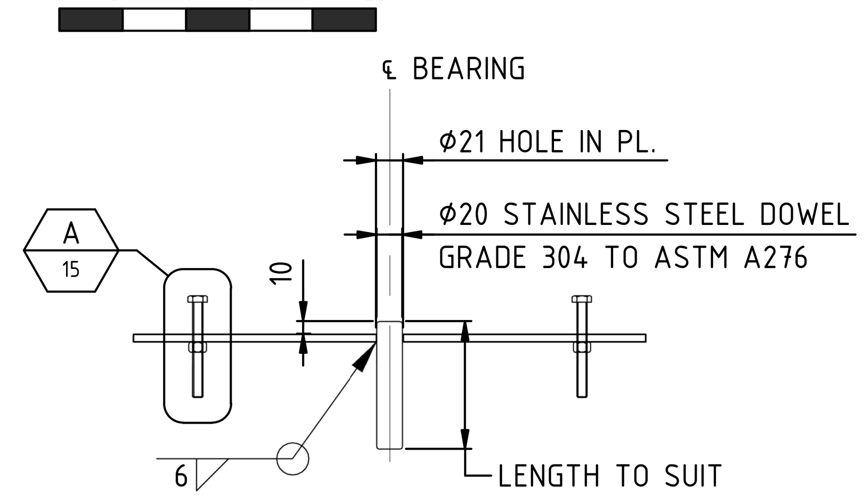
PLAN
TYPICAL ELASTOMERIC BEARING

112 REQUIRED

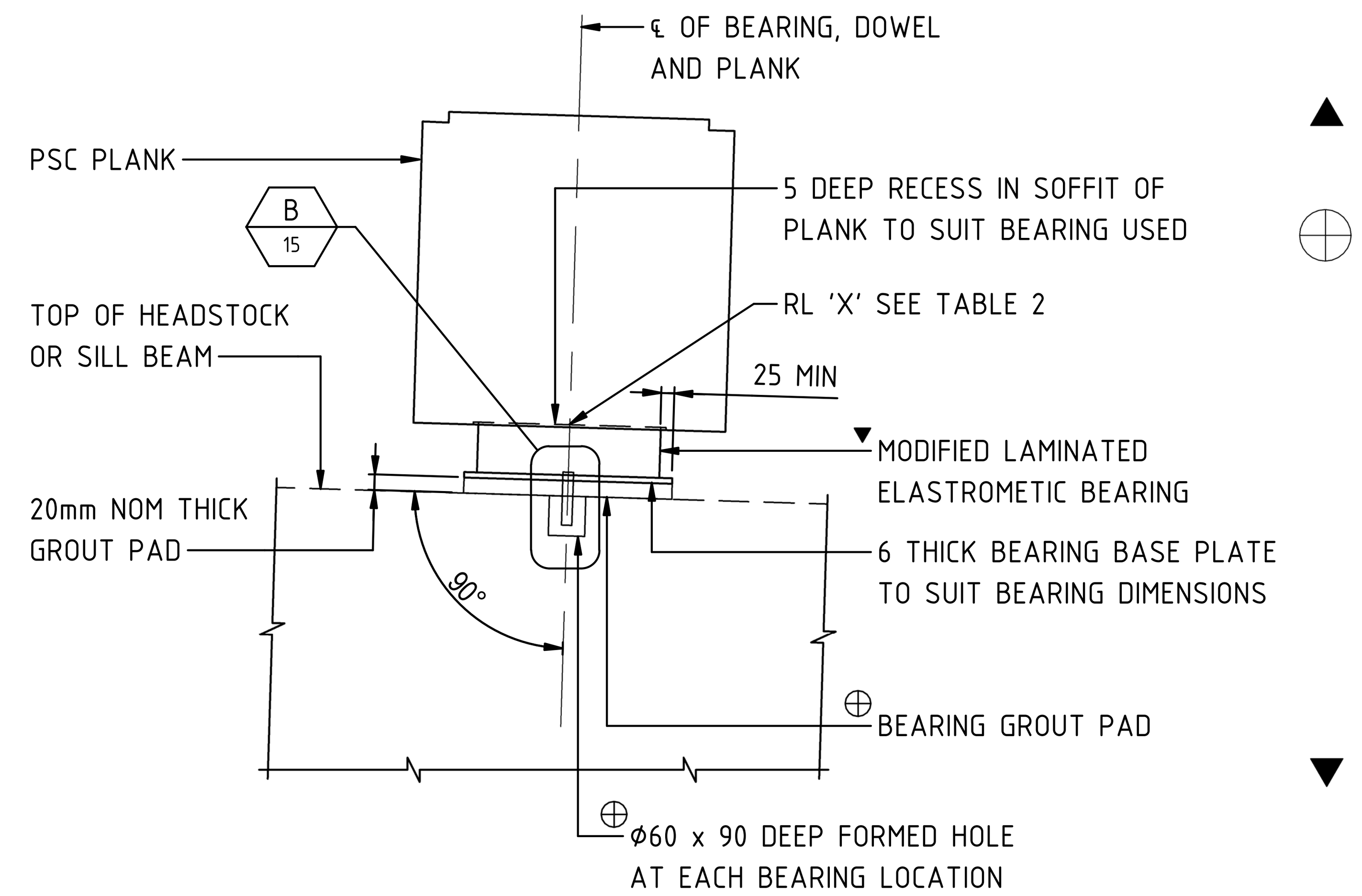


SECTION 1/15

112 REQUIRED



SECTION 2/15



ELEVATION TYPICAL BEARING ASSEMBLY

GENERAL NOTES

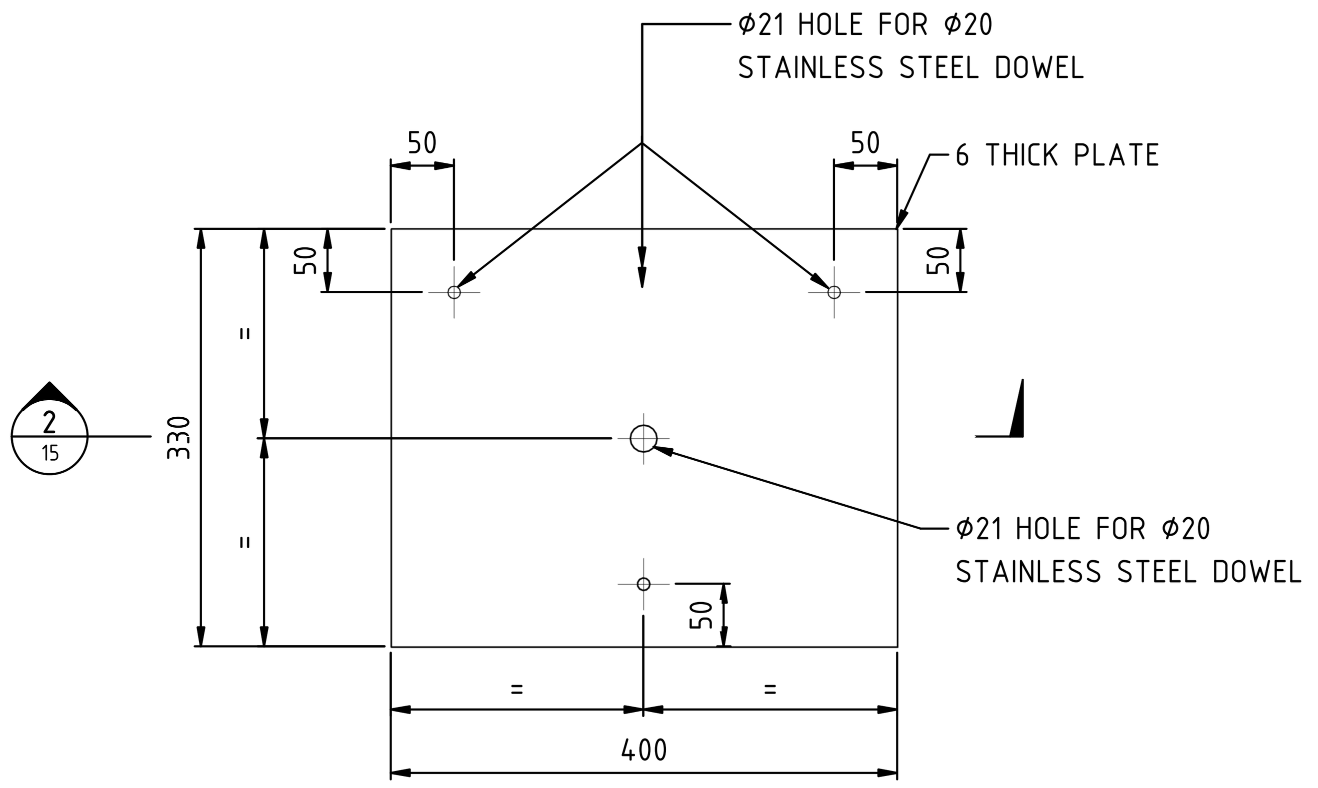
SCALE 0 1 2 3 4 5m OR AS SHOWN

THE MINIMUM 28 DAY COMPRESSIVE STRENGTH OF GROUT SHALL BE 40MPa
STEEL PLATE SHALL BE STAINLESS STEEL GRADE 304 TO ASTM A276.
THE WELD CATEGORY SHALL BE 1C, IN ACCORDANCE WITH AS/NZS 1554.6
WELDNG SYMBOLS COMPLY WITH AS 1101.3.

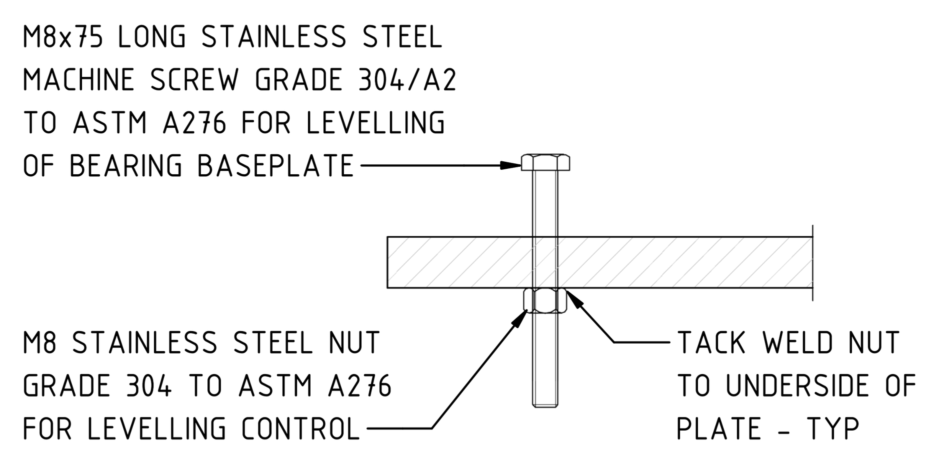
▲ DENOTES THE MINIMUM AND MAXIMUM THICKNESS OF GROUT SHALL BE 15mm AND 70mm AT ANY LOCATION.

⊕ DENOTES THE GROUT USED TO FILL FORMED RECESSES AND CONSTRUCT GROUT PADS AND SHALL BE SHRINKAGE COMPENSATED HIGH FLOW CEMENTITIOUS GROUT EPIREZ SUPERFLOW HF OR APPROVED EQUIVALENT. MINIMUM COMPRESSIVE STRENGTH OF GROUT SHALL BE 40MPa
GROUTING SHALL BE CARRIED OUT TO ENSURE THAT THE FORMED RECESSES ARE COMPLETELY FILLED AND THAT THERE ARE NO VOIDS UNDER THE BASE PLATES
SIDE FACES OF GROUT PADS SHALL BE VERTICAL AND FLUSH WITH EDGES OF BASE PLATES.
THE FORMWORK FOR THE GROUT PADS MUST REMAIN IN PLACE FOR A MINIMUM OF 3 DAYS AND CURING COMPOUNDS SHALL BE APPLIED TO THE SIDES OF THE GROUT PADS AFTER THE REMOVAL OF FORMWORK

▼ DENOTES THAT BEARINGS MAY BE INSTALLED ON AN INCLINE PROVIDED THE SHEAR DEFLECTION DUE TO SELF WEIGHT OF THE SUPERSTRUCTURE IS LESS THAN 6mm.

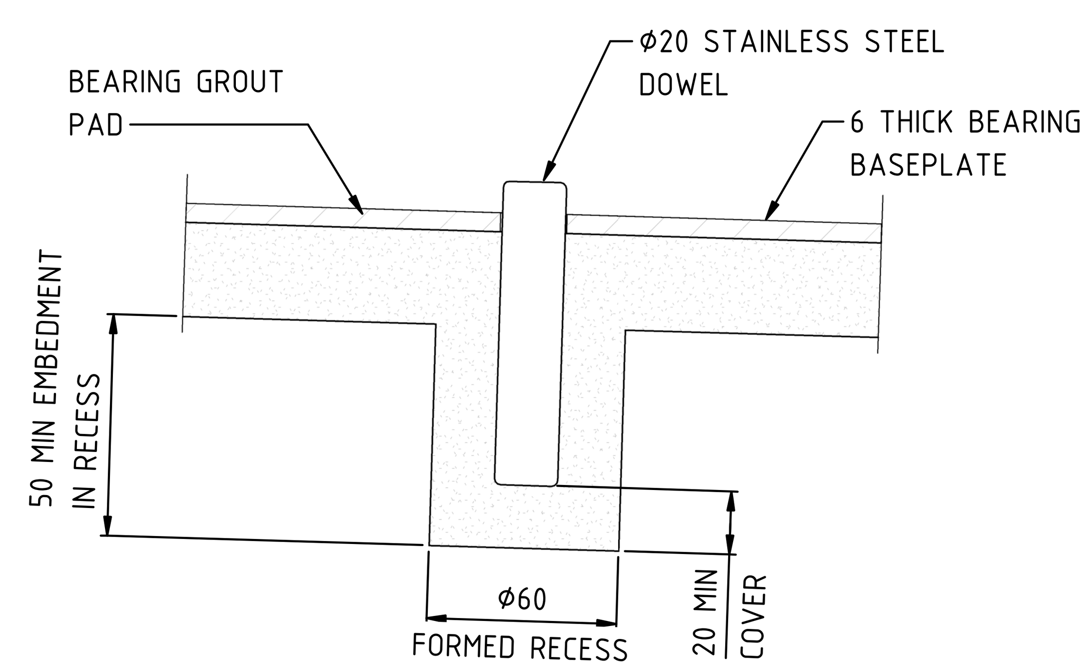


PLAN
BEARING BASEPLATE ASSEMBLY



DETAIL A/15

LEVELLING SCREWS SHALL BE REMOVED WHEN GROUT PAD HAS SET AND VOID SHALL BE FILLED WITH GROUT



DETAIL B/15

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HW29 - KAMILAROI HWY
NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT
ON KAMILAROI HWY AT NARRABRI

BEARING LAYOUT AND DETAILS

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St. Leonards, NSW 2065
Tel: 02 9496 7700 Fax: 02 9439 5170
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	PREPARED	CHECKED
DESIGN	J. Guzman	L.Bai
DRAWING	O. Fernando	D. Carroll
APPROVED/ DESIGN QA RECORDS	P.Boesch	
	DIRECTOR	

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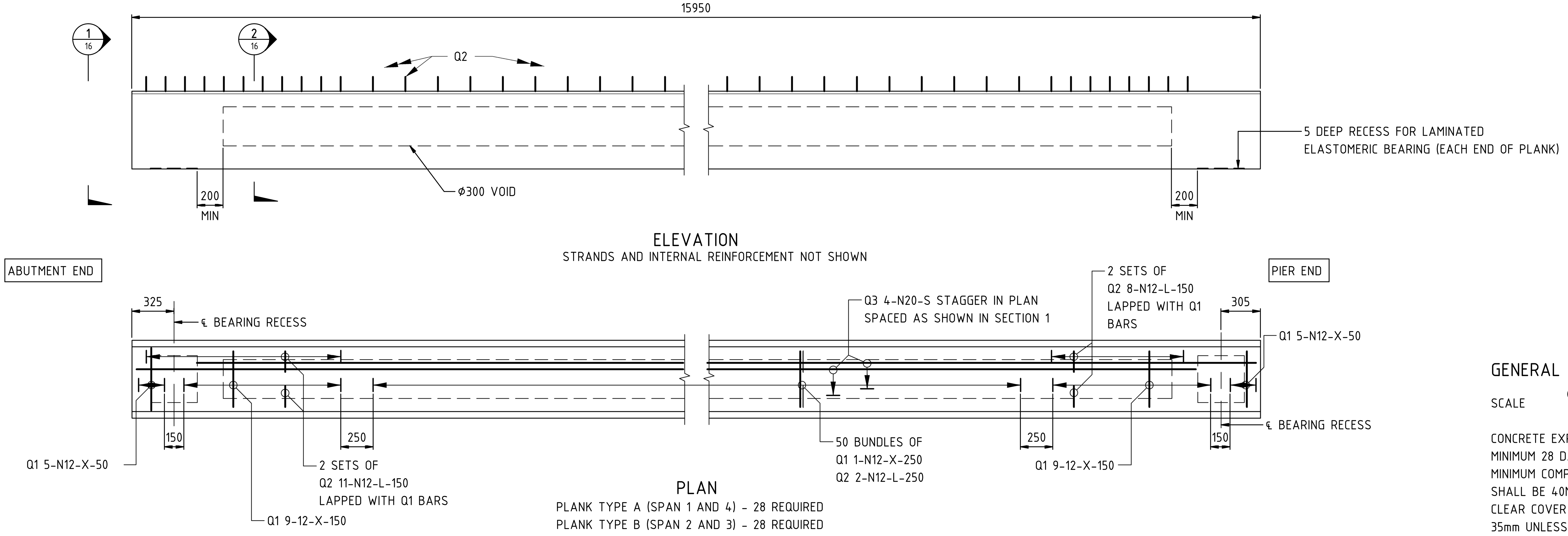
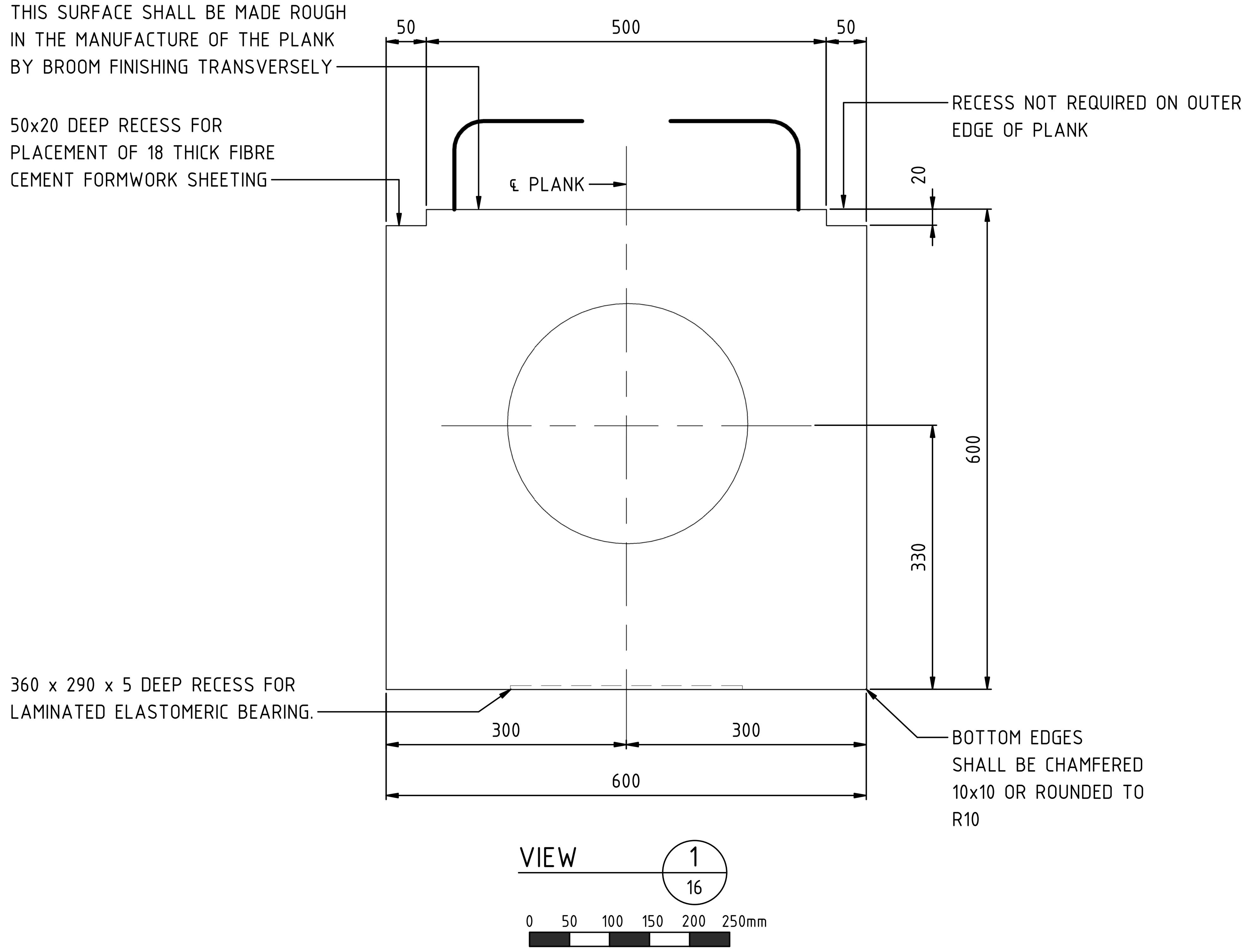
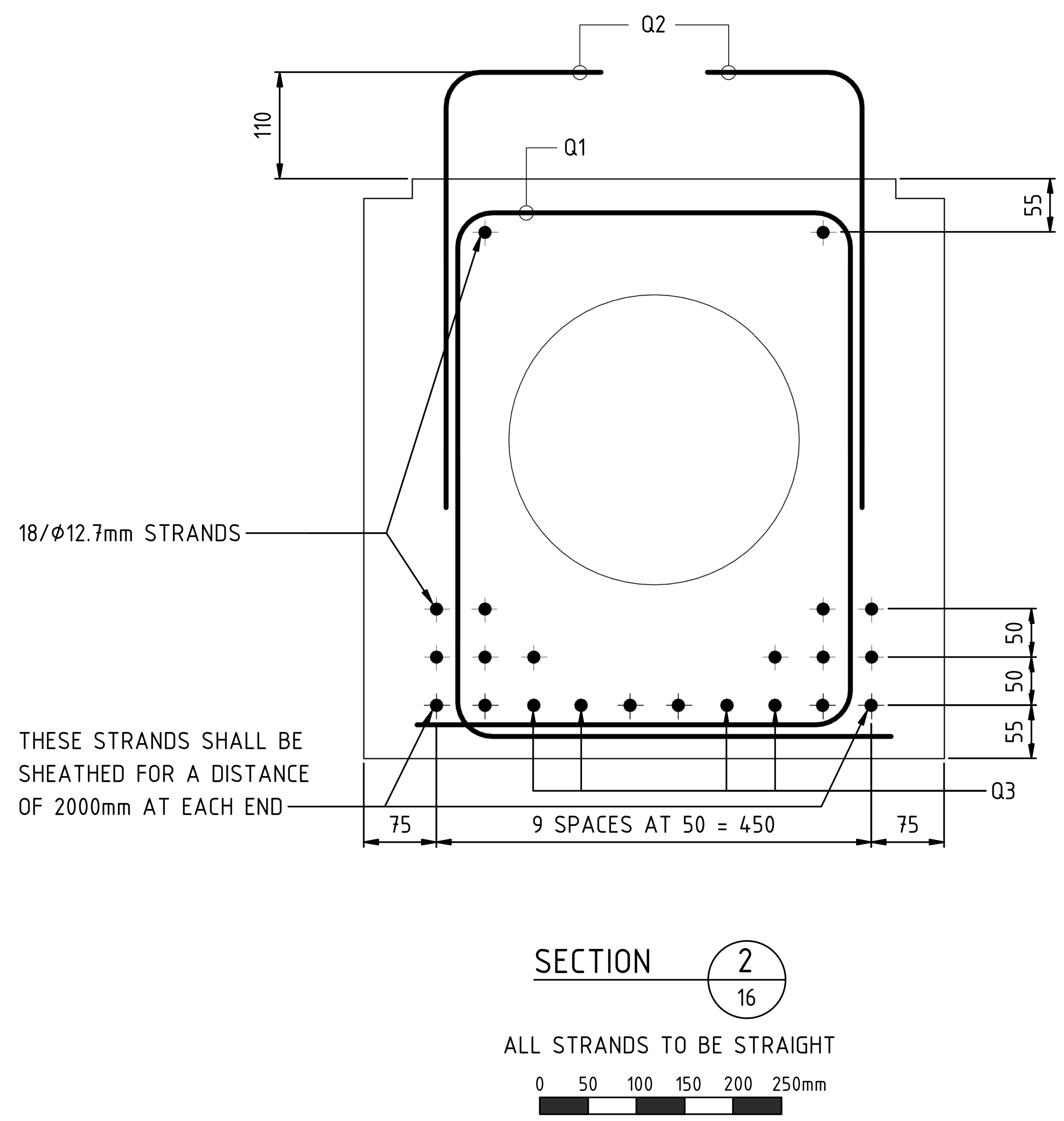
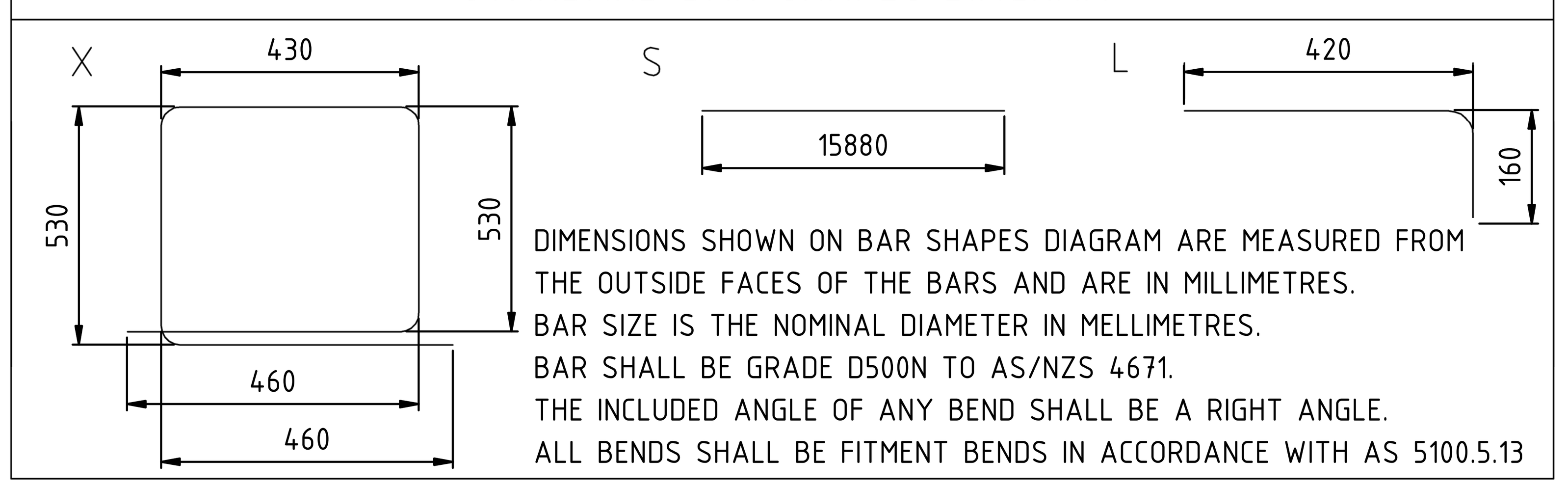






STANDARD BAR SHAPES DIAGRAM



DIMENSIONS SHOWN ON BAR SHAPES DIAGRAM ARE MEASURED FROM THE OUTSIDE FACES OF THE BARS AND ARE IN MILLIMETRES.
BAR SIZE IS THE NOMINAL DIAMETER IN MELLIMETRES.
BAR SHALL BE GRADE D500N TO AS/NZS 4671.
THE INCLUDED ANGLE OF ANY BEND SHALL BE A RIGHT ANGLE.
ALL BENDS SHALL BE FITMENT BENDS IN ACCORDANCE WITH AS 5100.5.13

GENERAL NOTES

SCALE 0 0.2 0.4 0.6 0.8 1m OR AS SHOWN

CONCRETE EXPOSURE CLASSIFICATION: B1
MINIMUM 28 DAY COMPRESSIVE STRENGTH OF ALL CONCRETE SHALL BE 50MPa.
MINIMUM COMPRESSIVE STRENGTH OF CONCRETE AT TRANSFER OF PRESTRESS SHALL BE 40MPa.
CLEAR COVER TO REINFORCEMENT NEAREST TO THE CONCRETE SURFACE SHALL BE 35mm UNLESS SPECIFIED OTHERWISE.
STRANDS SHALL BE 7-WIRE, ORDINARY, 12.7mm DIA, TENSILE STRENGTH 1870 MPa, RELAX 2 TO AS/NZS 4672.1 WITH MINIMUM BREAKING FORCE 184kN,
THE FORCE IN EACH 12.7mm DIA STRAND AT THE MID-SPAN OF PLANK IMMEDIATELY AFTER THE RELEASE OF THE TENSIONING JACK SHALL BE 138kN.
AFTER TRANSFER OF PRESTRESS, STRANDS SHALL BE CUT FLUSH WITH END OF PLANK AND EXPOSED STRANDS SEALED AGAINTS CORROSION BY THE APPLICATION OF EXPOXY RESIN.

HOG OF PLANK	(mm)
AT TRANSFER	12.0
AT 30 DAYS	17.0
AT 60 DAYS	19.0
AT 90 DAYS	20.0
DEFLECTION DUE TO DECK SLAB	-4.0

ASSUMING
- -DENSITY = 2550 kg/m
- -ELASTIC MODULUS AT TRANSFER = 32800 MPa
- -STEAM CURING AT 70°C FOR 8 HOURS AFTER CASTING
- -STORAGE IN OPEN AIR, AFTER STEAM CURING, AT 20°C AVERAGE TEMPERATURE AND RELATIVE HUMIDITY IN RANGE OF 50% - 75%
- -NO LOADS EXCEPT PLANK SELF WEIGHT

MASS OF PLANK IS APPROXIMATELY 11.9 TONNES.
DURING STORAGE, TRANSPORT AND HANDLING, PLANK SHALL BE IN AN UPRIGHT POSITION AND SUPPORTED AT NOT MORE THAN 600mm FROM EACH END.
DESIGN LOADING: SM1600.

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HW29 - KAMILAROI HWY
NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

15.9m SPACED PSC PLANK

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Level 9, The Forum, 203 Pacific Highway
St. Leonards, NSW 2065
Tel: 02 9496 7700 Fax: 02 9439 5170
Web: www.cardno.com.au

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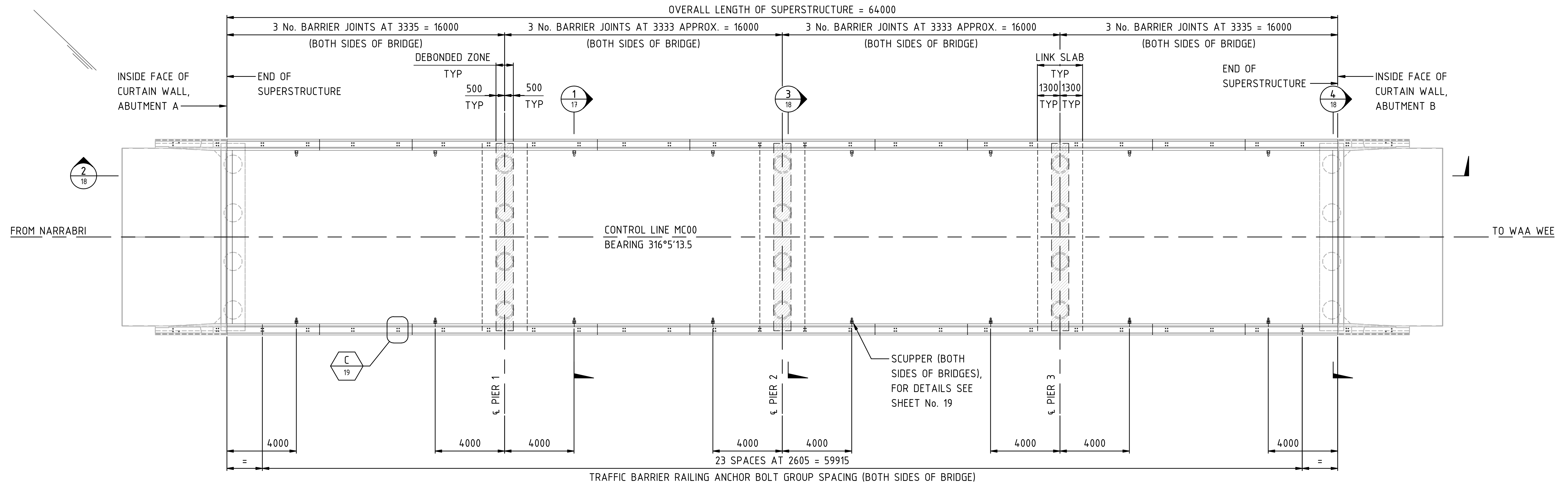
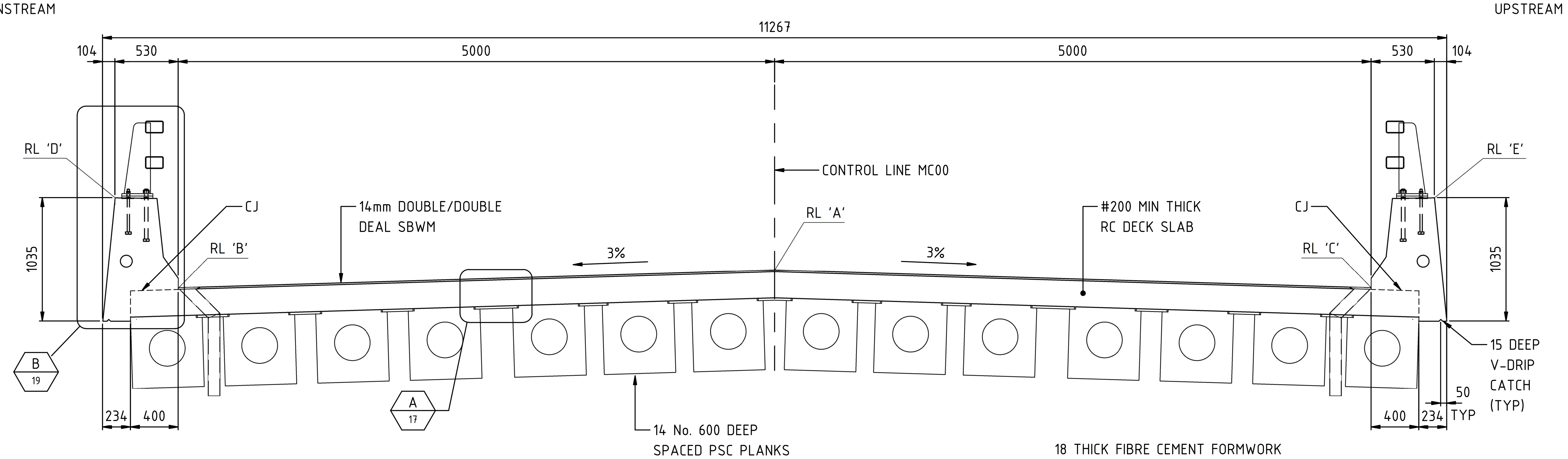
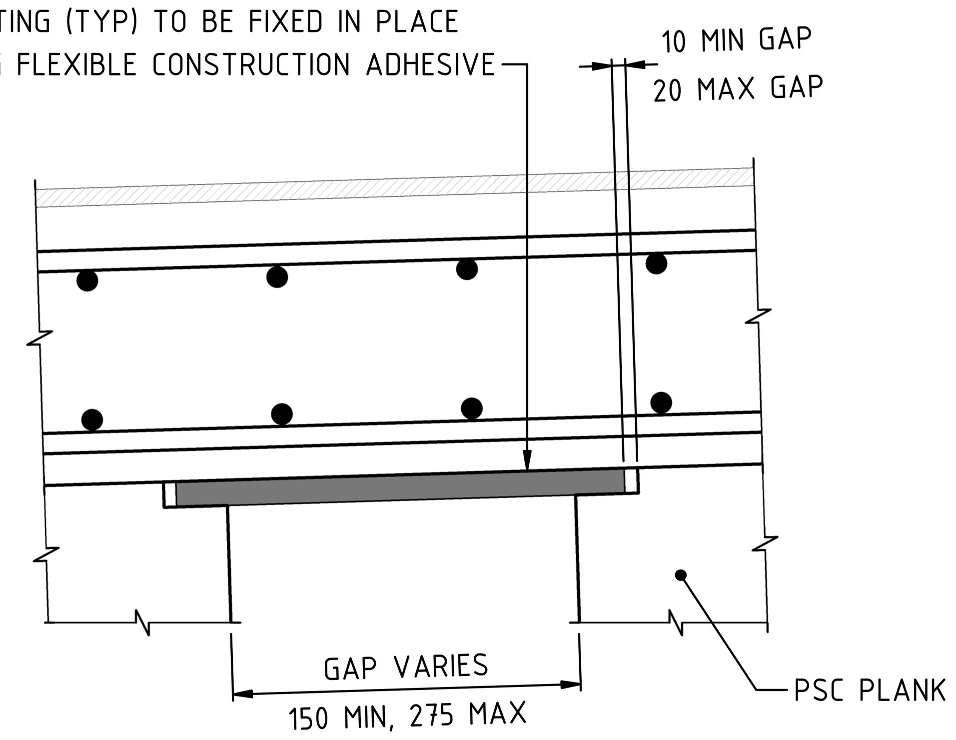


PLAN



SECTION 1/17



DETAIL A/17

GENERAL NOTES

SCALE 0 0.3 0.5 0.8 1 1.3m OR AS SHOWN

CONCRETE EXPOSURE CLASSIFICATION: B1
MINIMUM 28 DAY COMPRESSIVE STRENGTH OF ALL CONCRETE SHALL BE 40MPa.
EDGE SHALL BE CHAMFERED 20x20 AND RE-ENTRANT ANGLES FILLETED 20x20mm UNLESS SPECIFIED OTHERWISE.
NCF DENOTES NO CHAMFER OR FILLET
CJ DENOTES CONSTRUCTION JOINT.
EJ DENOTES EXPANSION JOINT.
# DENOTES NOMINAL DIMENSIONS AT MID-SPAN. VARIES ELSEWHERE DUE TO GIRDERS HOG. REFER TO SHEET No. 16 FOR NOTES ON PLANK HOG.
CALCULATED MID SPAN DEFLECTION DUE TO WEIGHT OF CAST-IN-PLACE CONCRETE IS APPROX: 4mm FOR SPAN 1, 2, AND 3
REDUCED LEVELS AT THE TOP OF PARAPETS, ABUTMENT WINGWALL AND APPROACH SLABS TO BE ADJUSTED ACCORDINGLY.
CAST-IN PLACE CONCRETE BETWEEN CONSTRUCTION JOINTS ON EACH SIDE OF PIER SHALL NOT BE PLACED SOONER THAN 3 DAYS AFTER PLACEMENT OF ADJACENT DECK CONCRETE.
CELLULAR POLYSTRENE SHEET TO BE CLASS H IN ACCORDANCE WITH AS 1366.3.
DECK CONCRETE TO BE WET CURED FOR A MINIMUM OF 7 DAYS.

TABLE 1 - DECK SETOUT DATA

LOCATION	CHAINAGE	COORDINATES		POINT RL'A'	POINT RL'B'	POINT RL'C'	POINT RL'D'	POINT RL'E'
		EASTING	NORTHING					
END OF SUPERSTRUCTURE, ABUTMENT A	9453.475	761847.180	6648806.608	209.700	209.550	209.550	210.305	210.305
℄ PIER 1	9469.475	761836.087	6648818.131	209.700	209.550	209.550	210.305	210.305
℄ PIER 2	9485.475	761824.973	6648829.674	209.700	209.550	209.550	210.305	210.305
℄ PIER 3	9501.475	761813.895	6648841.181	209.700	209.550	209.550	210.305	210.305
END OF SUPERSTRUCTURE, ABUTMENT B	9517.475	761802.792	6648852.713	209.700	209.550	209.550	210.305	210.305

ALL RL'S ARE TO TOP OF DESIGN SURFACE INCLUDING WEARING SURFACE.

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HW29 - KAMILAROI HWY
NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

DECK CONCRETE - SHEET A

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Level 9, The Forum, 203 Pacific Highway
St. Leonards, NSW 2065
Tel: 02 9496 7700 Fax: 02 9439 5170
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	PREPARED	CHECKED
DESIGN	J. Guzman	L.Bai
DRAWING	O. Fernando	D. Carroll
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ISSUE 1 No OF SHEETS 31 SHEET No 17

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DATE PLOTTED: 10/11/2022 10:17:38 AM
FILE PATH: Autodesk Docs://304100824 SPRING CREEK BRIDGE/304100824_Spring_Creek_Replacement_v2022.rvt
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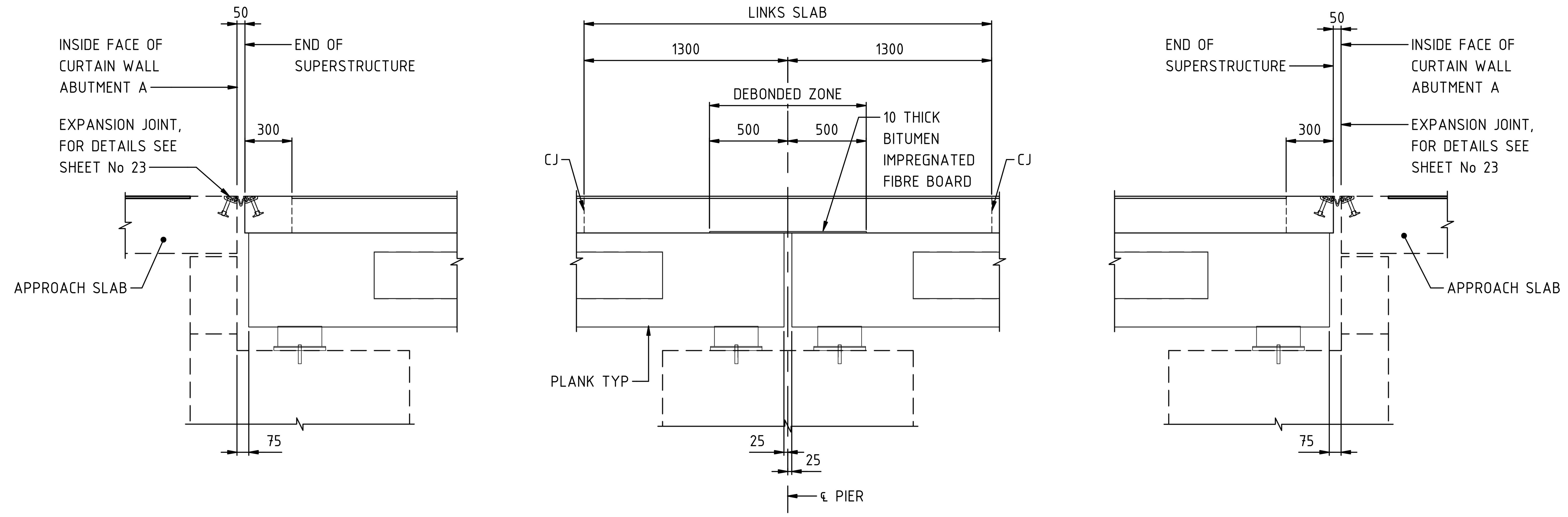


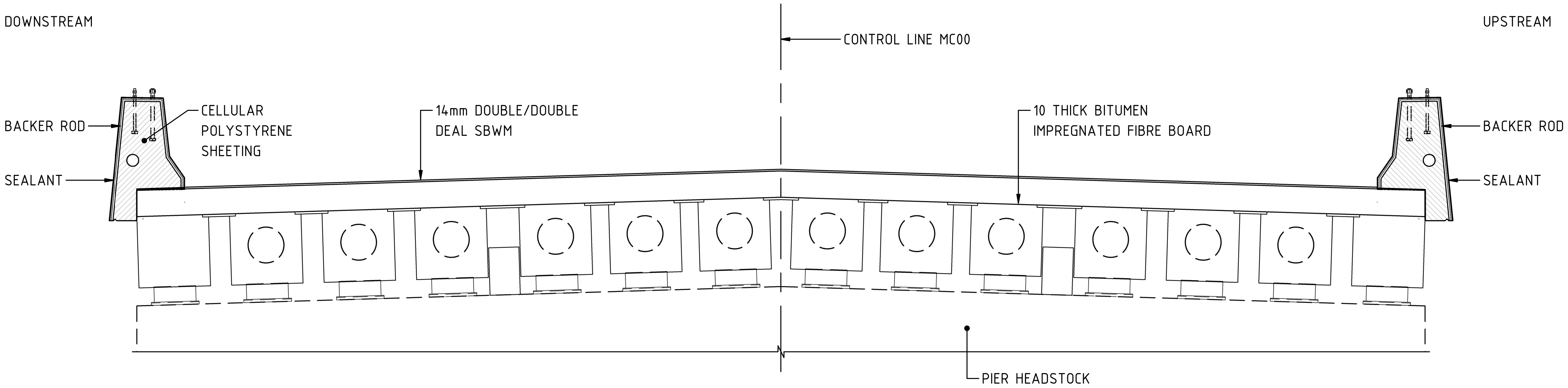
ABUTMENT A
SECTION ALONG CARRIAGEWAY

PIER 1 SHOWN,
PIER 2 AND 3 SIMILAR
SECTION ALONG CARRIAGEWAY

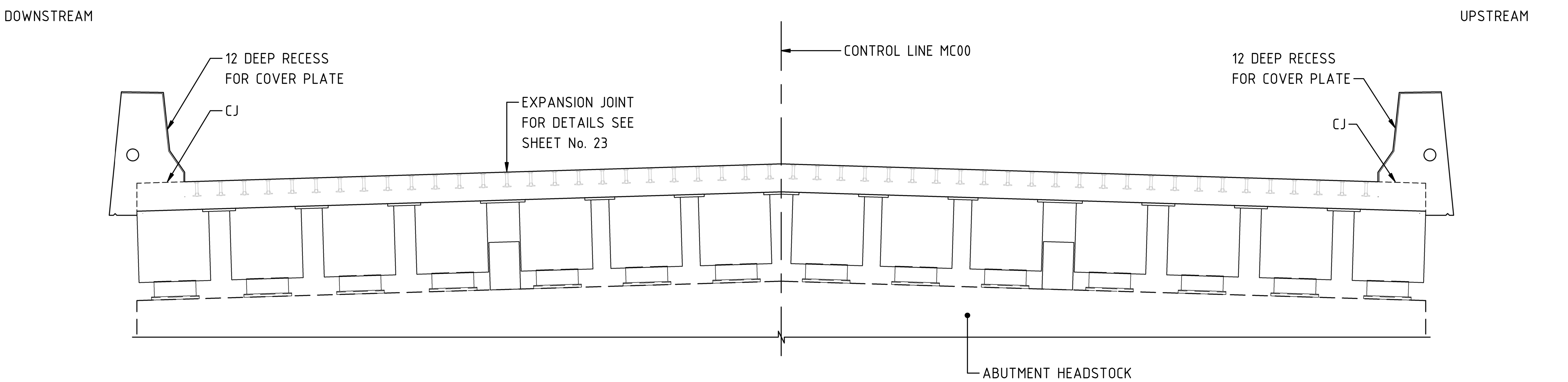
ABUTMENT B
SECTION ALONG CARRIAGEWAY

SECTION 2/17

0 0.2 0.4 0.6 0.8 1m



SECTION 3/17



SECTION 4/17

GENERAL NOTES

SCALE 0 0.3 0.5 0.8 1 1.3m OR AS SHOWN

FOR GENERAL NOTES RELATING TO THIS SHEET, SEE SHEET No. 17

NOT FOR CONSTRUCTION

ISSUE	DATE	REVISION	PREP	CHECK	AUTH
1	09.11.2022	ISSUED FOR 50% DESIGN REVIEW	OF	LB	

HW29 - KAMILAROI HWY — NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

DECK CONCRETE - SHEET B

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St. Leonards, NSW 2065
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NORTHWEST REGION
NSW GOVERNMENT
Transport for NSW

	PREPARED	CHECKED
DESIGN	J. Guzman	L.Bai
DRAWING	O. Fernando	D. Carroll
APPROVED/ DESIGN QA RECORDS	DIRECTOR	

DRAWING SET No: DS2022/000622
BRIDGE No: BR12489
ISSUE STATUS: PRELIMINARY
ISSUE | No OF SHEETS 31 | SHEET No 18

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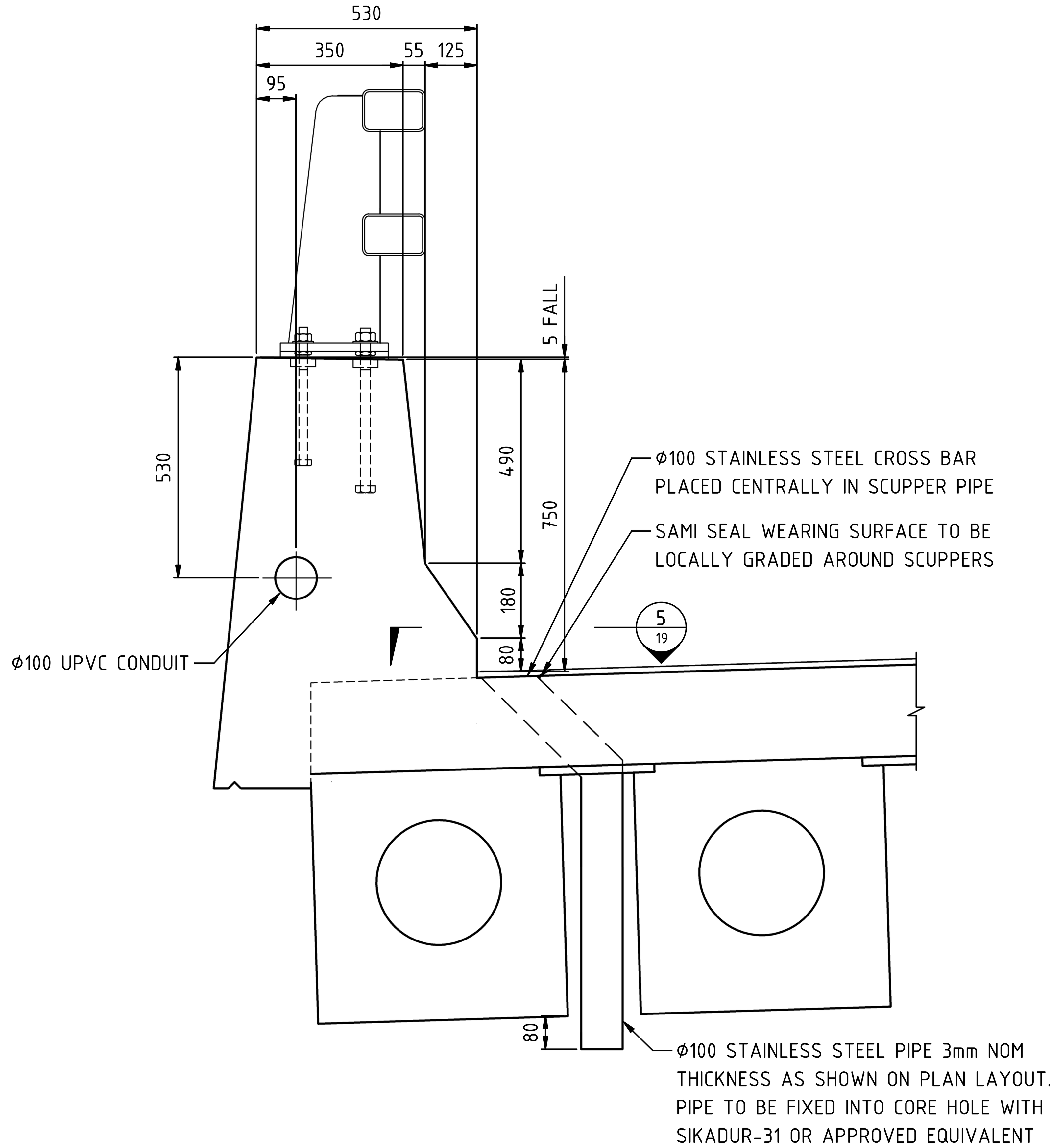
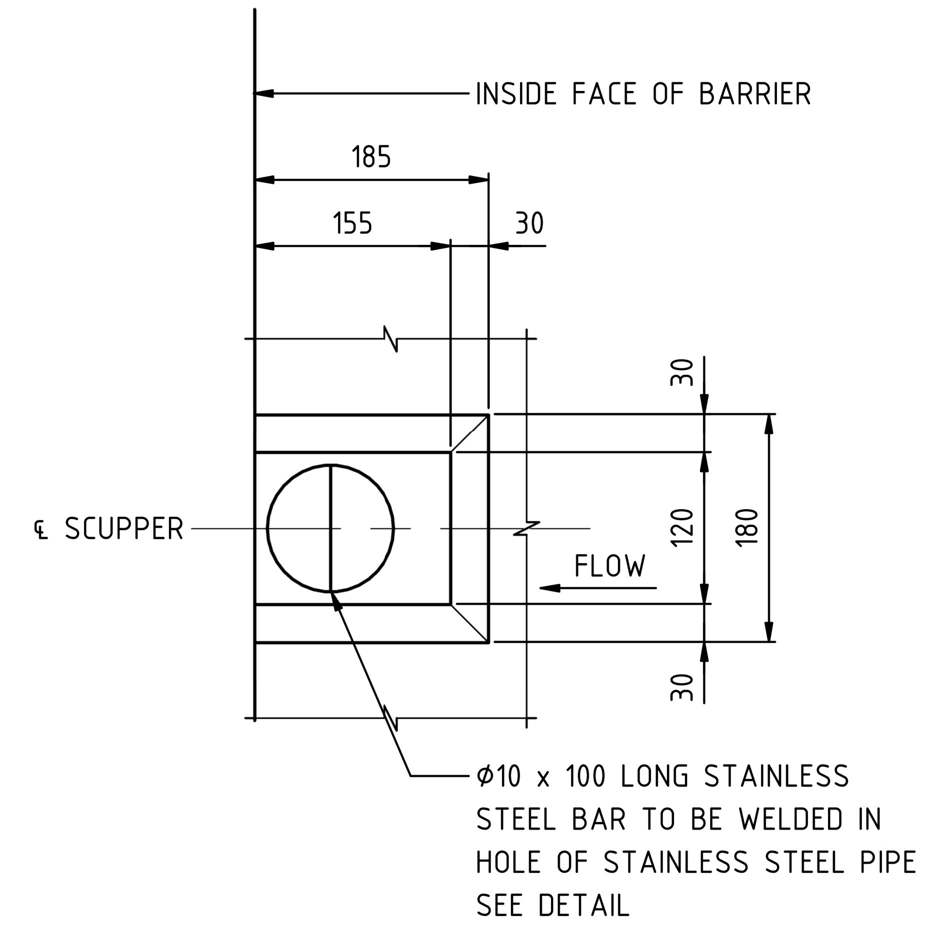


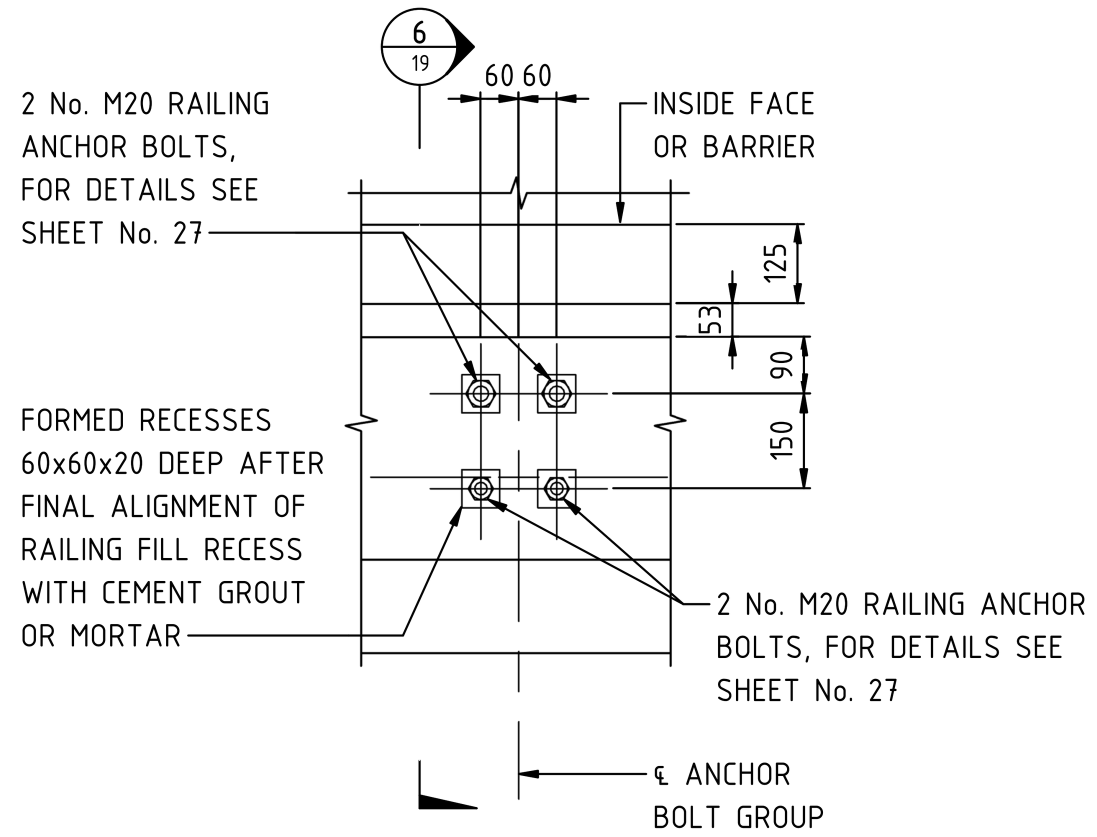
DETAIL B/17

0 0.1 0.2 0.3 0.4 0.5m



SECTION 5/19

0 50 100 150 200 250mm



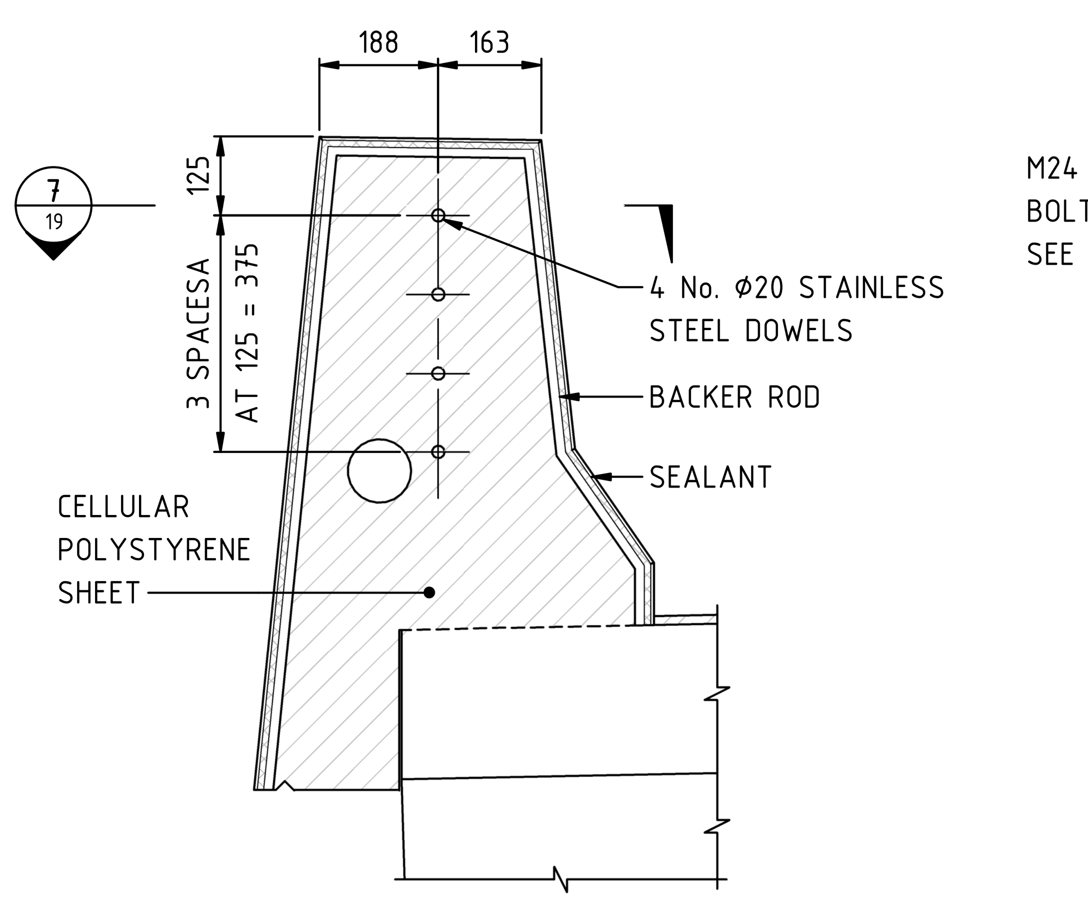
DETAIL C/17

0 0.1 0.2 0.3 0.4 0.5m

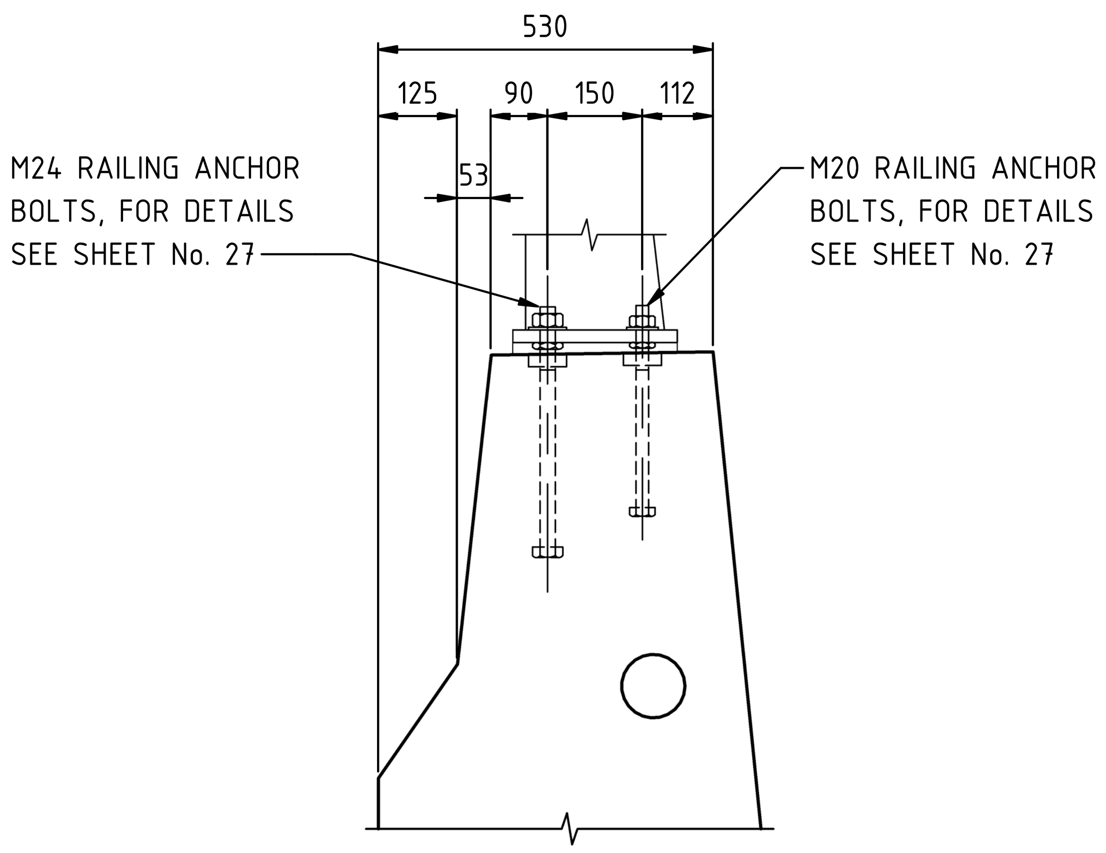
GENERAL NOTES

SCALE 0 0.1 0.2 0.3 0.4 0.5m OR AS SHOWN

FOR GENERAL NOTES RELATING TO THIS SHEET, SEE SHEET No. 40
STAINLESS STEEL CROSS BAR SHALL BE GRADE 304 TO ASTM A276.
STAINLESS STEEL PIPE SHALL BE GRADE 316 ATP ASTM A240M.
STAINLESS STEEL SURFACE SHALL BE TREATED BY PICKELING TO AS 1527.5
WELDING OF STAINLESS STELL SHALL COMPLY WITH AS/NZS 1554.6.

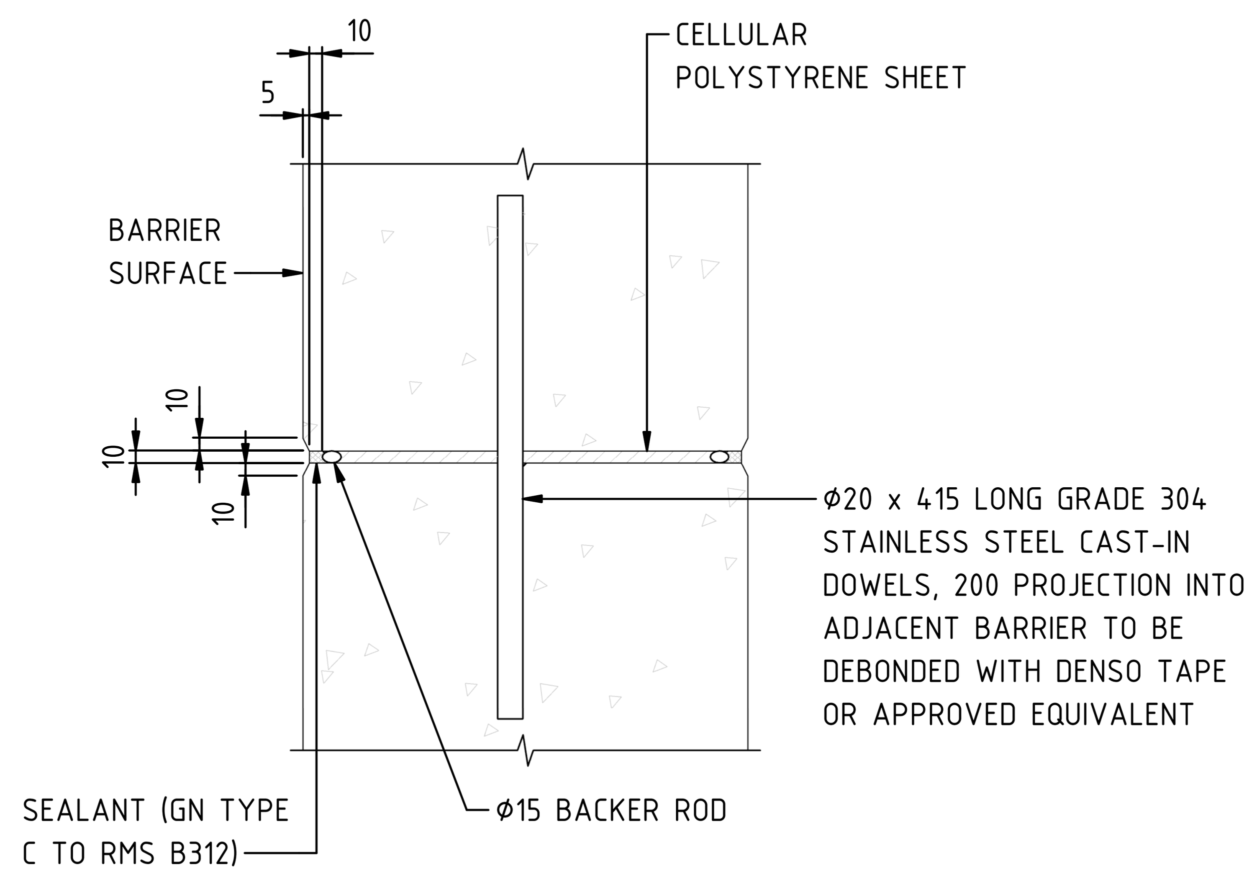


TYPICAL SECTION AT DOWNSTREAM TRAFFIC BARRIER JOINT



SECTION 6/19

0 0.1 0.2 0.3 0.4 0.5m



SECTION 7/19

0 50 100 150 200 250mm

NOT FOR CONSTRUCTION

ISSUE	DATE	REVISION	PREP	CHECK	AUTH
1	09.11.2022	ISSUED FOR 50% DESIGN REVIEW	OF	LB	

HW29 - KAMILAROI HWY NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

DECK CONCRETE - SHEET C

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Level 9, The Forum, 203 Pacific Highway
St. Leonards, NSW 2065
Tel: 02 9496 7700 Fax: 02 9439 5170
Web: www.cardno.com.au

NORTHWEST REGION

	PREPARED	CHECKED		
DESIGN	J. Guzman	L.Bai	DRAWING SET No	DS2022/000622
DRAWING	O. Fernando	D. Carroll	BRIDGE No	BR12489
APPROVED/ DESIGN QA RECORDS			ISSUE STATUS:	PRELIMINARY
DIRECTOR			ISSUE	No OF SHEETS 31 SHEET No 19

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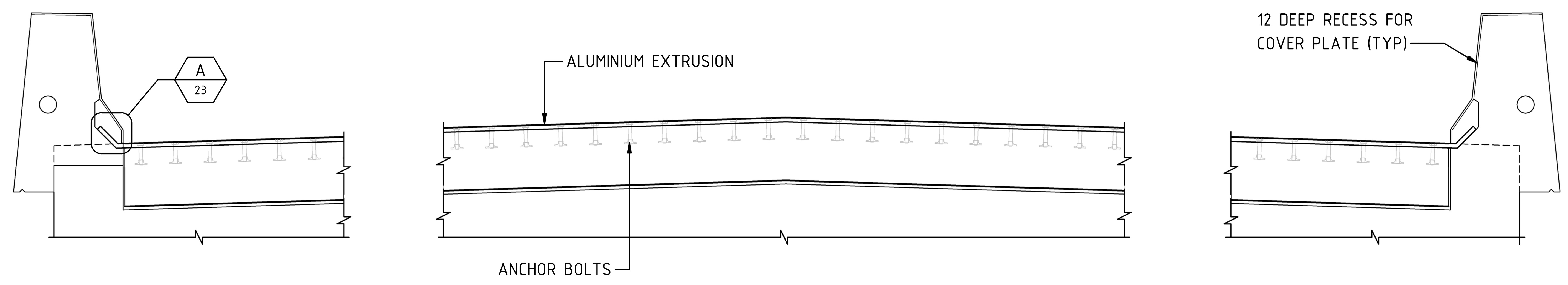
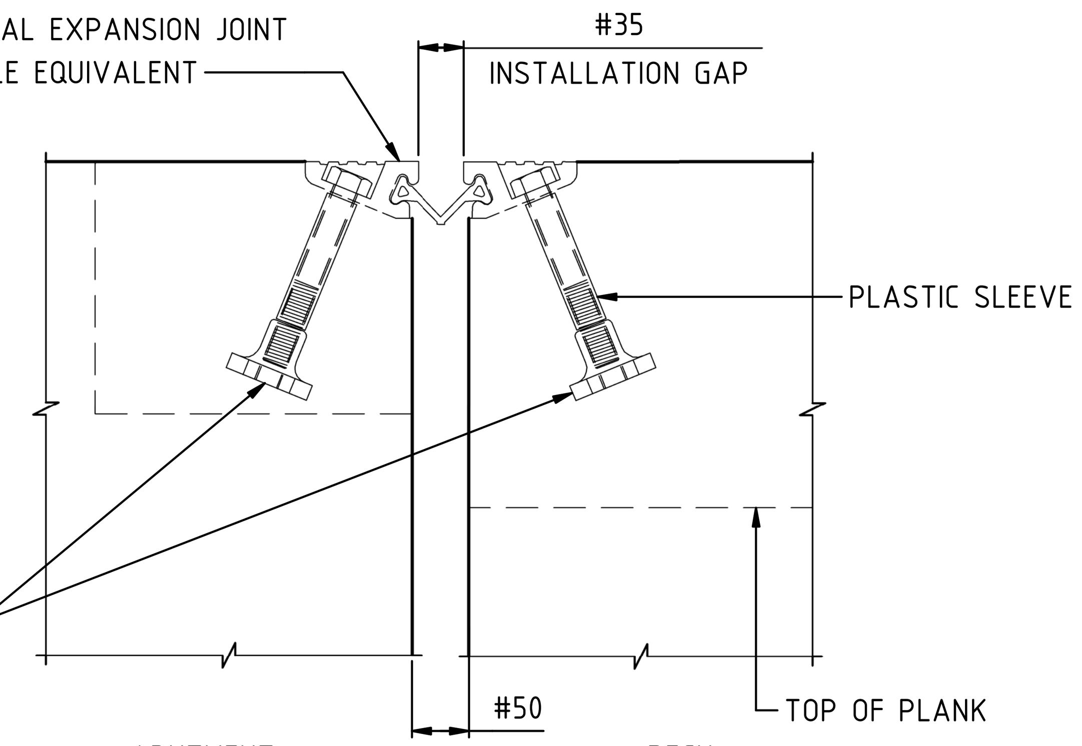


SECTION 1/23

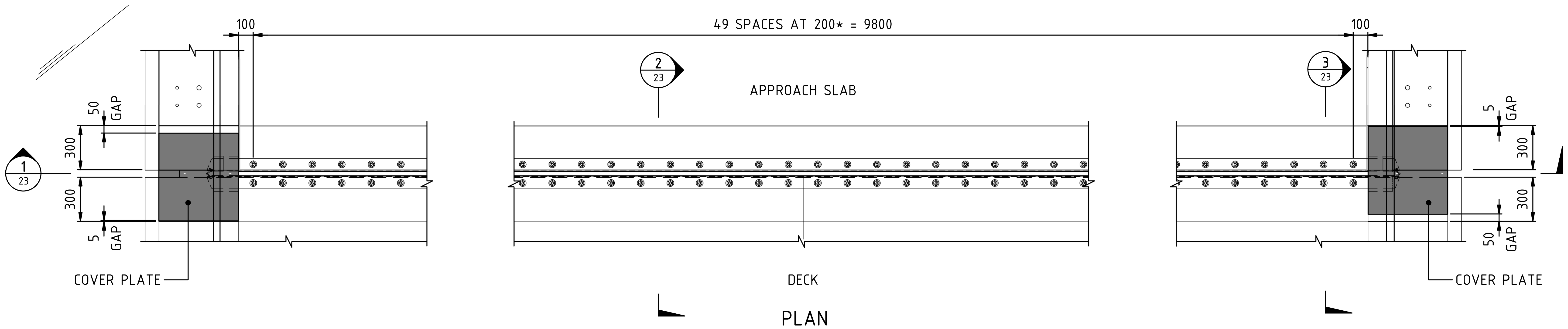
M20 x 180 LONG GALVANIZED HIGH STRENGTH STEEL BOLTS PROPERTY CLASS 8.8 TO AS/NZS 1252 WITH SUITABLE FERRULES. THREADS OF BOLTS SHALL BE LUBRICATED WITH GREASE PRIOR TO PLACEMENT OF FERRULES. FERRULES SHALL BE FINGER TIGHT AND FIRM AGAINST PLASTIC SLEEVE PRIOR TO PLACEMENT OF CONCRETE. BOLTS SHALL BE TIGHTENED VIA THE SNUG TIGHT PLUS PART TURN METHOD IN ACCORDANCE WITH AS 5100 AFTER ADEQUATE CONCRETE STRENGTH HAS BEEN ACHIEVED. MINIMUM BOLT TENSION SHALL BE 145kN. BOLTS SHALL BE SET IN PLACE USING A SUITABLE TEMPLATE



SECTION 2/23

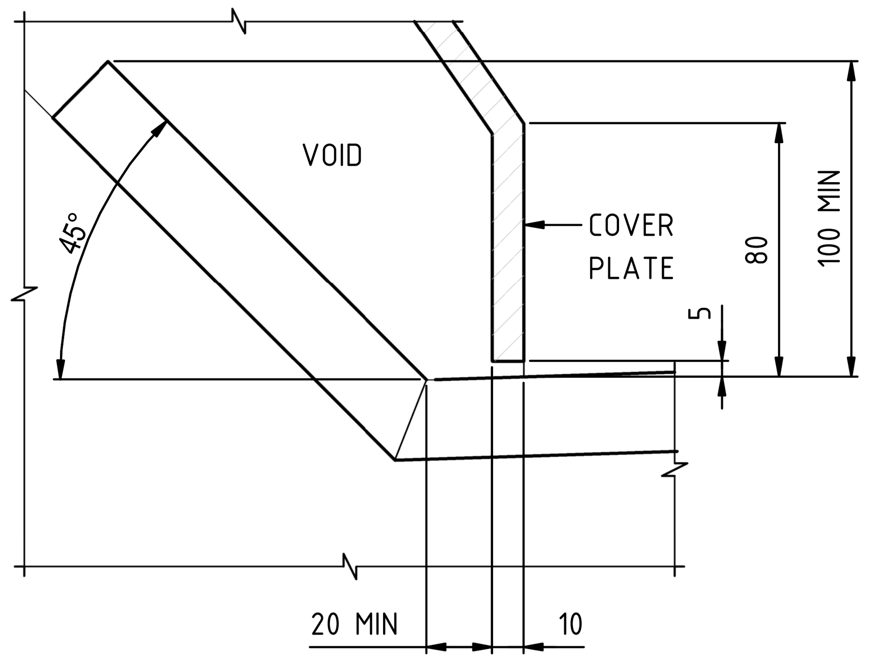
JOINT AT ABUTMENT A SHOWN,
JOINT AT ABUTMENT B SIMILAR

0 50 100 150 200 250mm



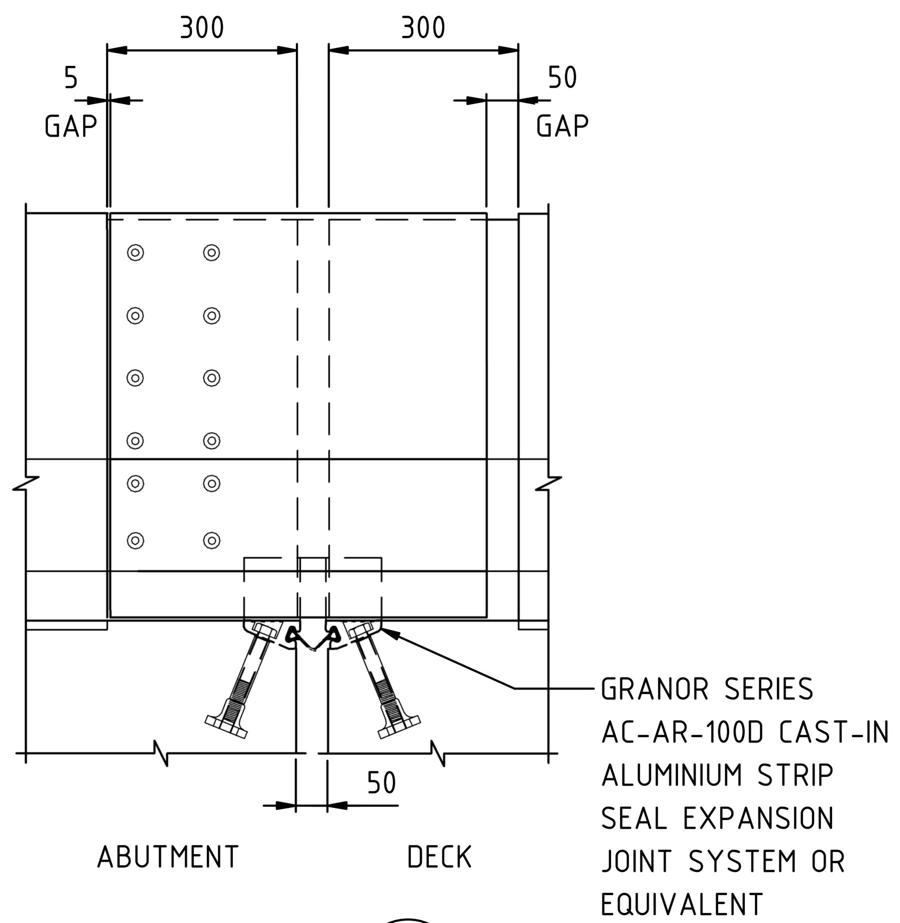
PLAN

ABUTMENT A SHOWN
ABUTMENT B SIMILAR



DETAIL A/23

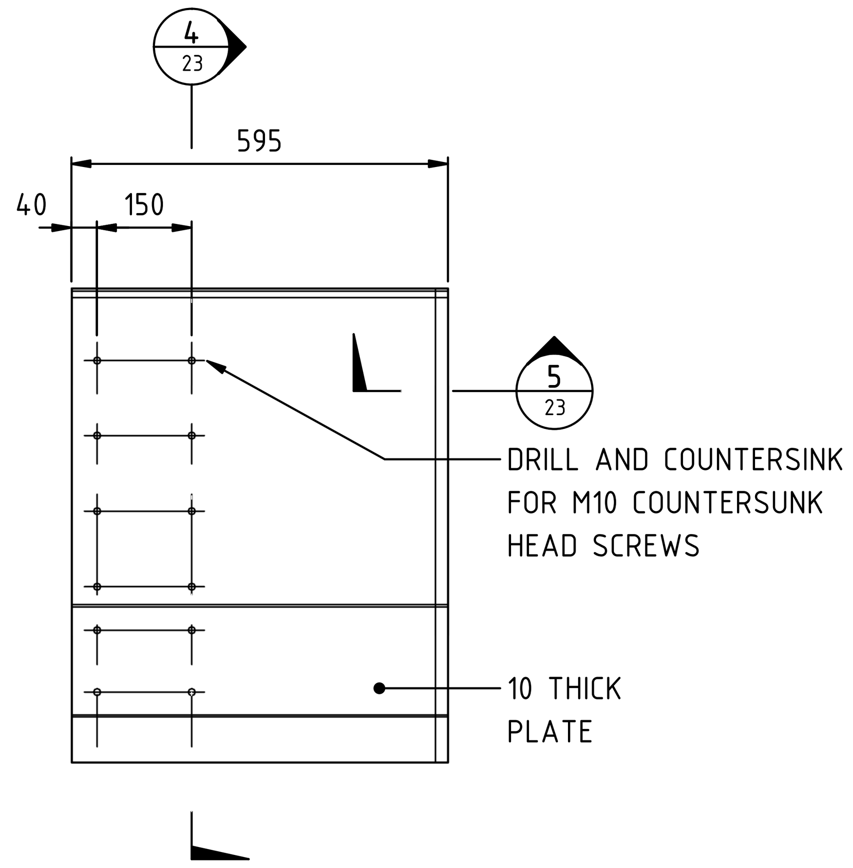
0 20 40 60 80 100mm



SECTION 3/23

COVER PLATE AT ABUTMENT A SHOWN,
ABUTMENT B SIMILAR

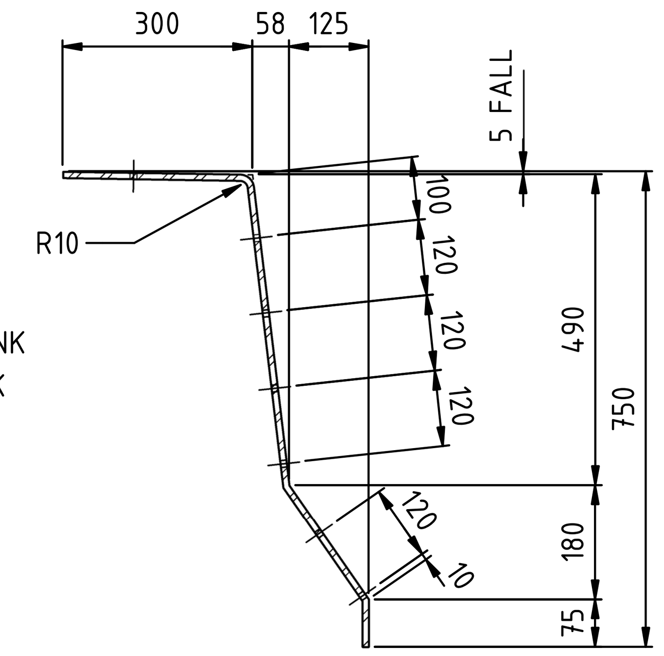
0 0.1 0.2 0.3 0.4 0.5m



COVER PLATE ELEVATION

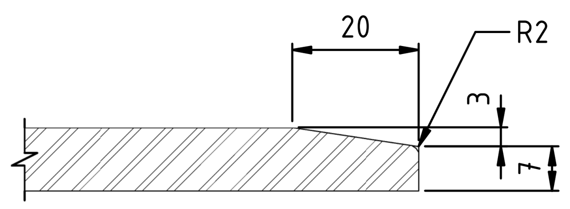
4 REQUIRED

0 0.1 0.2 0.3 0.4 0.5m



SECTION 4/23

0 0.1 0.2 0.3 0.4 0.5m



SECTION 5/23

0 10 20 30 40 50mm

GENERAL NOTES

SCALE 0 0.2 0.4 0.6 0.8 1m OR AS SHOWN

SEAL ELEMENT TO BE INSTALLED IN ONE LENGTH.
STEEL CHEQUER PLATES SHALL BE GRADE 250 TO AS 3678.
COUNTERSUNK HEAD SCREWS SHALL CONFORM TO AS/NZS 1427.
ALL STEEL COMPONENTS EXCEPT STAINLESS STEEL ITEMS SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH THE SPECIFICATION.
EDGES TO BE PROTECTIVE TREATED SHALL BE ROUNDED TO A RADIUS OF 1.5mm UNLESS SPECIFIED OTHERWISE.
# DENOTES NOMINAL DIMENSION AT 20°C±5°C. THE CALCULATED TEMPERATURE MOVEMENT OF THE JOINT GAP IS APPROX 1mm PER ±3°C.
JOINT SHALL BE INSTALLED STRICTLY IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
THE CAST IN FERRULES FOR THE COVER PLATES SHALL BE HELD IN POSITION DURING THE PLACING OF THE CONCRETE BY THE COVER PLATES THEMSELVES OR BY EQUIVALENT TEMPLATE.
* DENOTES DIMENSIONS MAY BE ADJUSTED TO SUIT MANUFACTURER'S REQUIREMENTS, BUT THE SPACING OF ANCHOR BOLTS SHALL BE THE EQUIVALENT OF 200mm MAX.
JOINTS SHALL COMPLY WITH CLAUSE 17.3.2 AS 5100.4.
STEEL MACHINE SCREWS SHALL CONFORM TO AS 1427.
SCREW AND MANSORY ANCHORS SHALL BE GRADE 316 STAINLESS STEEL.

NOT FOR CONSTRUCTION

ISSUE	DATE	REVISION	PREP	CHECK	AUTH
1	09.11.2022	ISSUED FOR 50% DESIGN REVIEW	OF	LB	

HW29 - KAMILAROI HWY — NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

DECK JOINTS AND COVER PLATES

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Level 9, The Forum, 203 Pacific Highway
St. Leonards, NSW 2065
Tel: 02 9496 7700 Fax: 02 9439 5170
Web: www.cardno.com.au

NSW GOVERNMENT — Transport for NSW — NORTHWEST REGION

	PREPARED	CHECKED
DESIGN	J. Guzman	L.Bai
DRAWING	O. Fernando	D. Carroll
APPROVED/ DESIGN QA RECORDS	DIRECTOR	

DRAWING SET No DS2022/000622
BRIDGE No BR12489
ISSUE STATUS: PRELIMINARY
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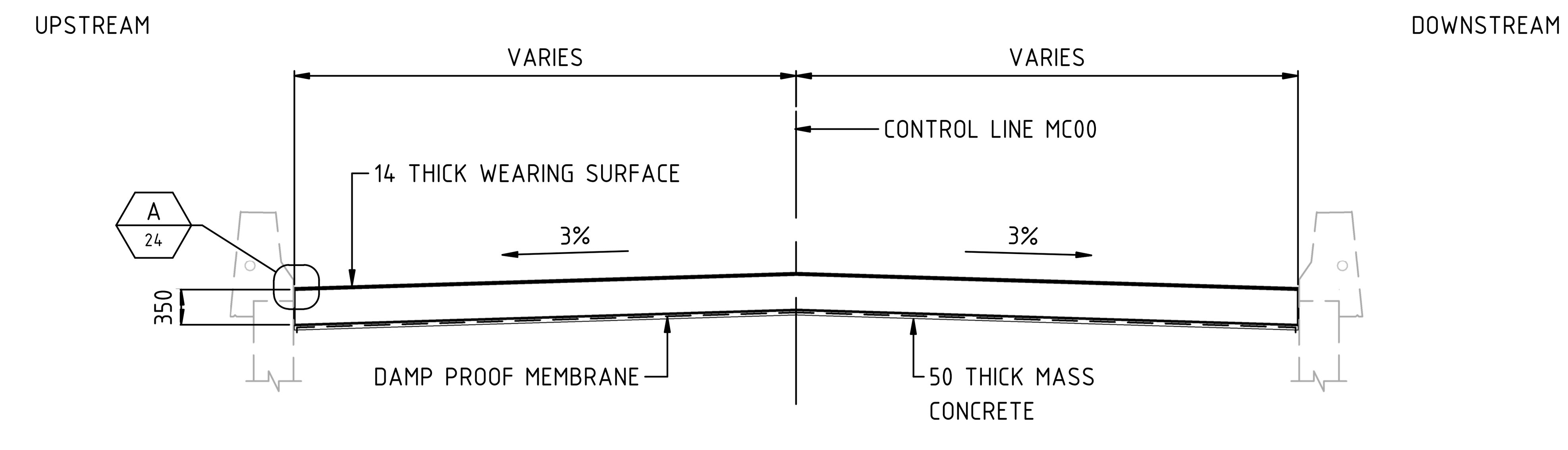
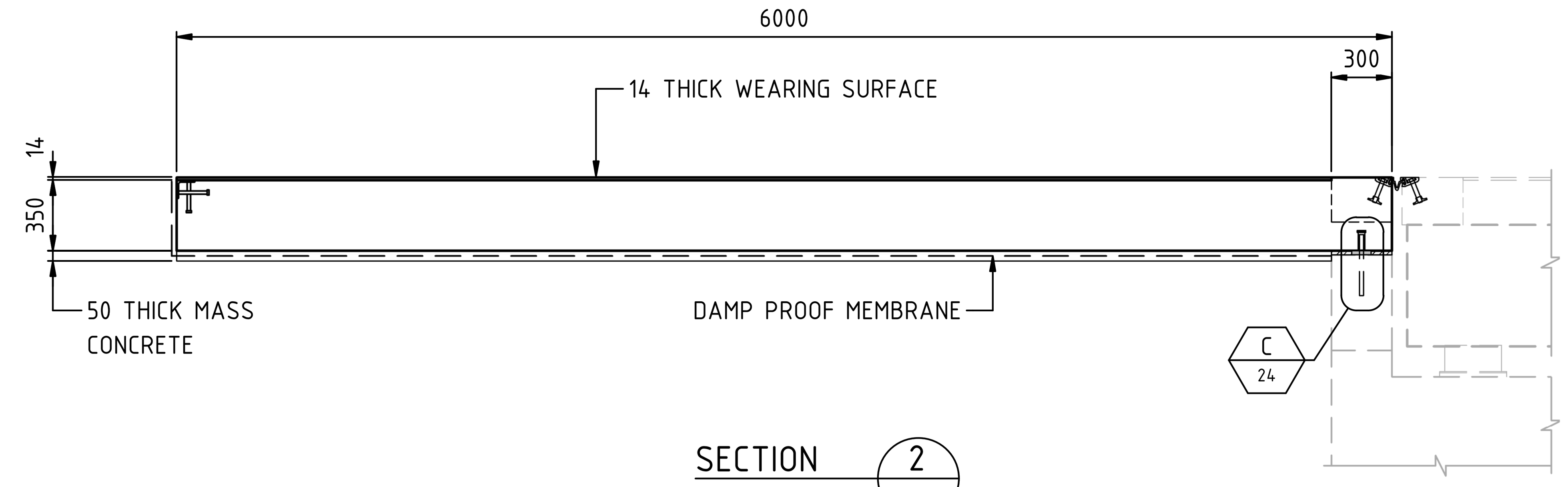
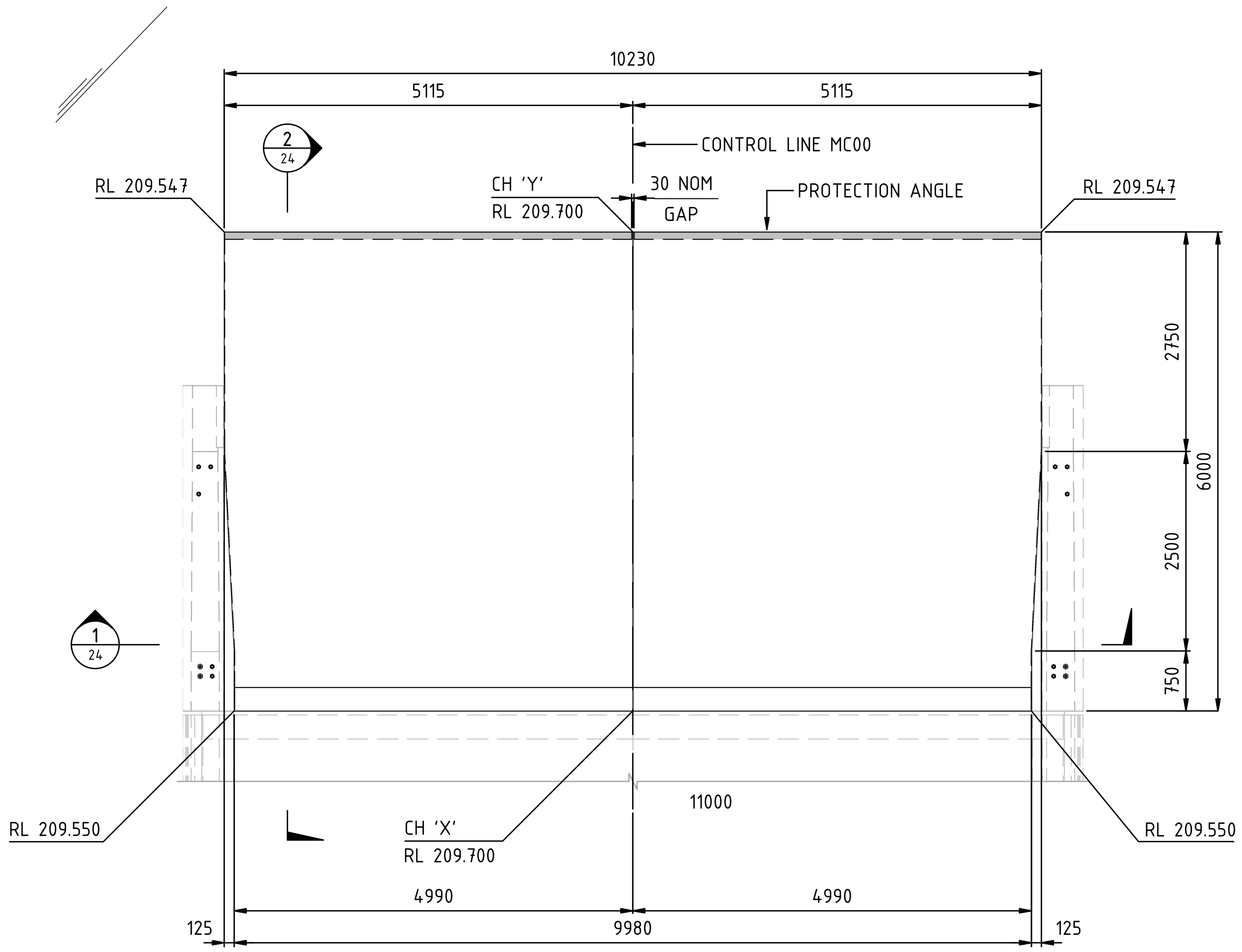


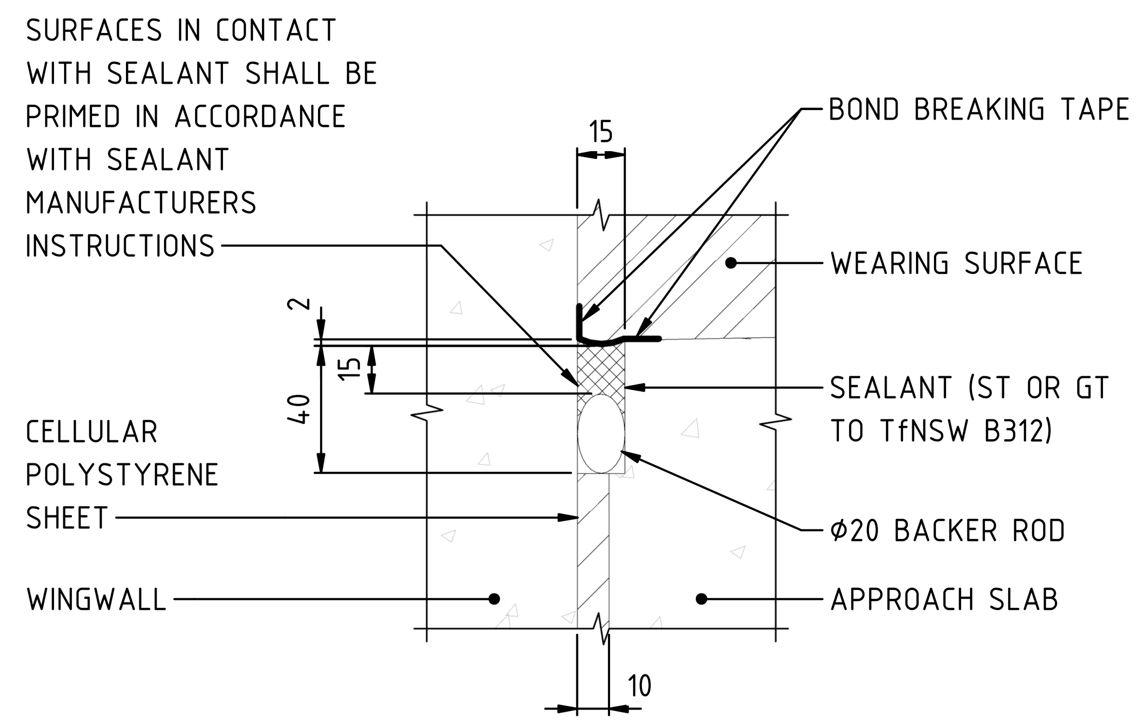
SECTION 1/24



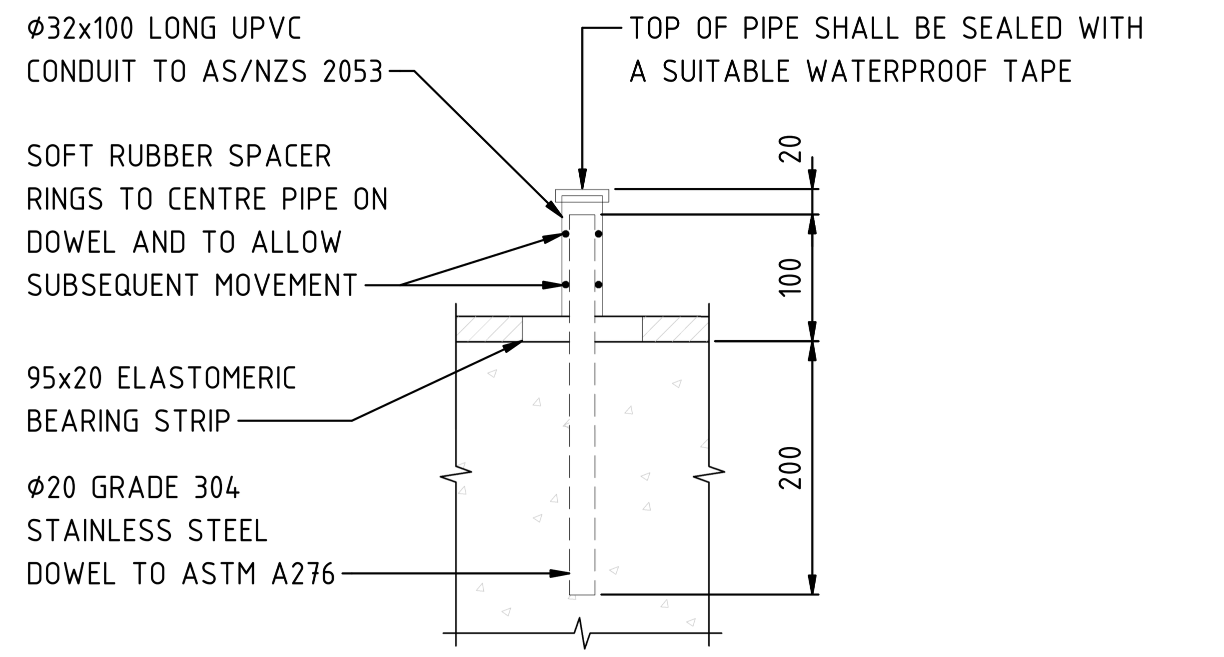
SECTION 2/24



PLAN
ABUTMENT A SHOWN,
ABUTMENT B SIMILAR



DETAIL A/24



DETAIL C/24 A A

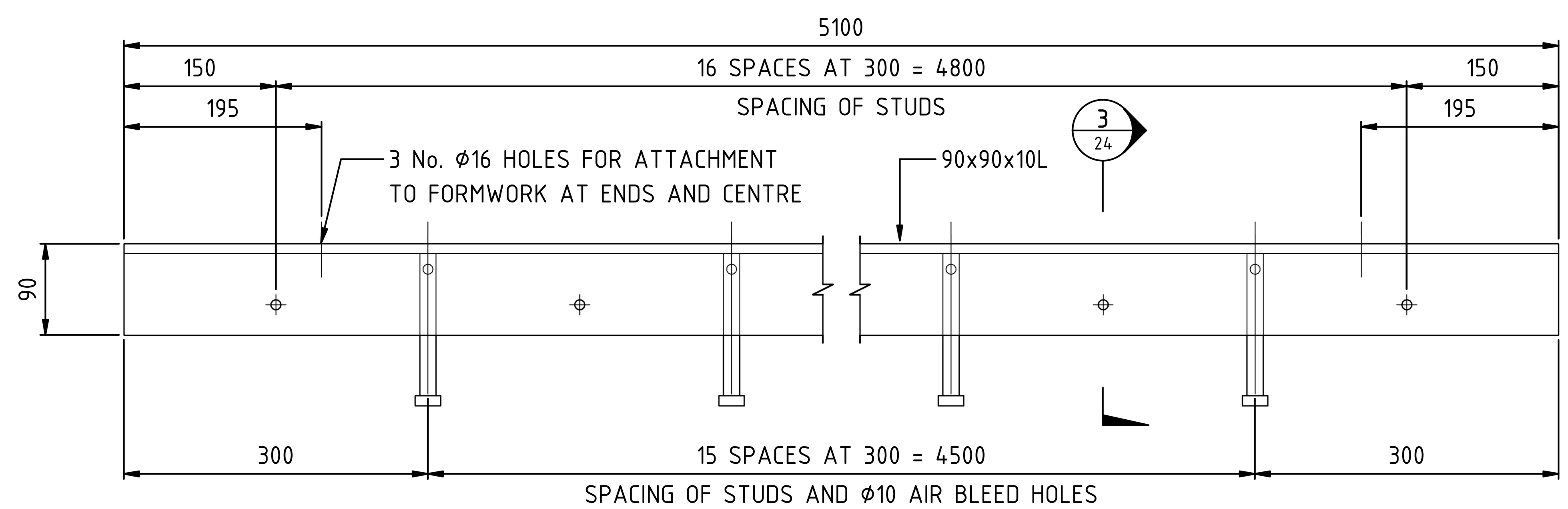
TABLE 1 - APPROACH SLAB SETOUT DATA

LOCATION	CHAINAGE 'X'	CHAINAGE 'Y'
AT ABUTMENT A	9453.425	9547.425
AT ABUTMENT B	9517.525	9523.525

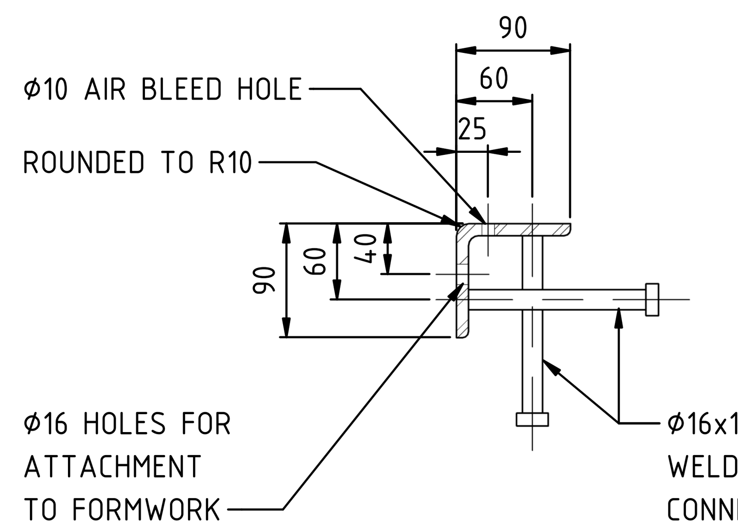
GENERAL NOTES

SCALE 0 0.5 1 1.5 2 2.5m OR AS SHOWN

CONCRETE EXPOSURE CLASSIFICATION: B1
MINIMUM 28 DAY COMPRESSIVE STRENGTH OF ALL CONCRETE SHALL BE 50MPa.
EDGE SHALL BE CHAMFERED 20x20 AND RE-ENTRANT ANGLES FILLETED 20x20 UNLESS SPECIFIED OTHERWISE.
APPROACH SLABS SHALL BE CAST ON A DAMP PROOF MEMBREANE.
DAMP PROOF MEMBRANE SHALL BE 500g POLYTHENE SHEET.
CELLULAR POLYSTYRENE SHEET SHALL BE CLASS H IN ACCORDANCE WITH AS 1366.3
ALL RL'S ARE TO TOP OF DESIGN SURFACE INCLUDING WEARING SURFACE.



PROTECTION ANGLE PLAN
2 REQUIRED AT ABUTMENT A
2 REQUIRED AT ABUTMENT B
0 50 100 150 200 250mm



SECTION 3/24
0 50 100 150 200 250mm

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ISSUE	DATE	REVISION	PREP	CHECK	AUTH
1	09.11.2022	ISSUED FOR 50% DESIGN REVIEW	OF	LB	

HW29 - KAMILAROI HWY — NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT
ON KAMILAROI HWY AT NARRABRI

APPROACH SLAB CONCRETE

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Level 9, The Forum, 203 Pacific Highway
St Leonards, NSW 2065
Tel: 02 9496 7700 Fax: 02 9439 5170
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NORTHWEST REGION
NSW GOVERNMENT Transport for NSW

	PREPARED	CHECKED		
DESIGN	J. Guzman	L.Bai	DRAWING SET No	DS2022/000622
DRAWING	O. Fernando	D. Carroll	BRIDGE No	BR12489
APPROVED/ DESIGN QA RECORDS	DIRECTOR		ISSUE STATUS:	PRELIMINARY
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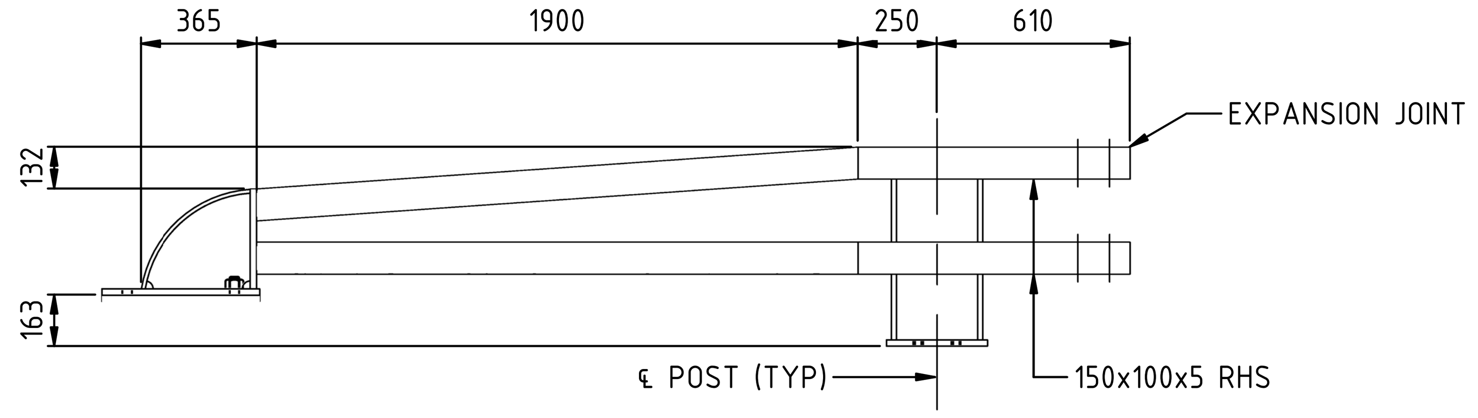
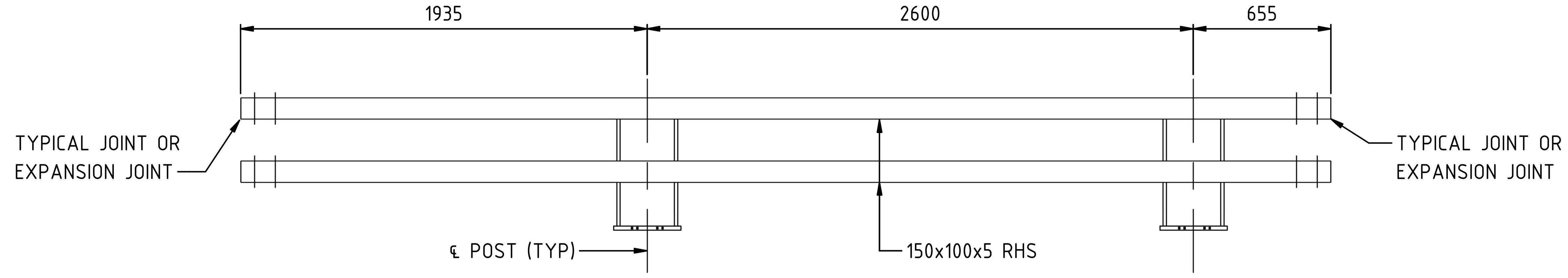
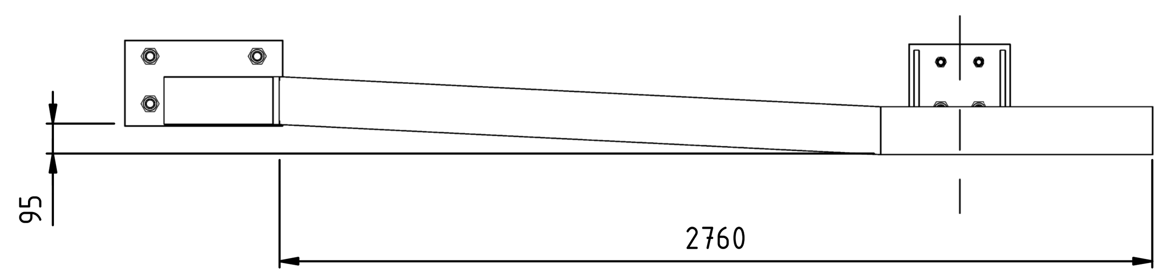


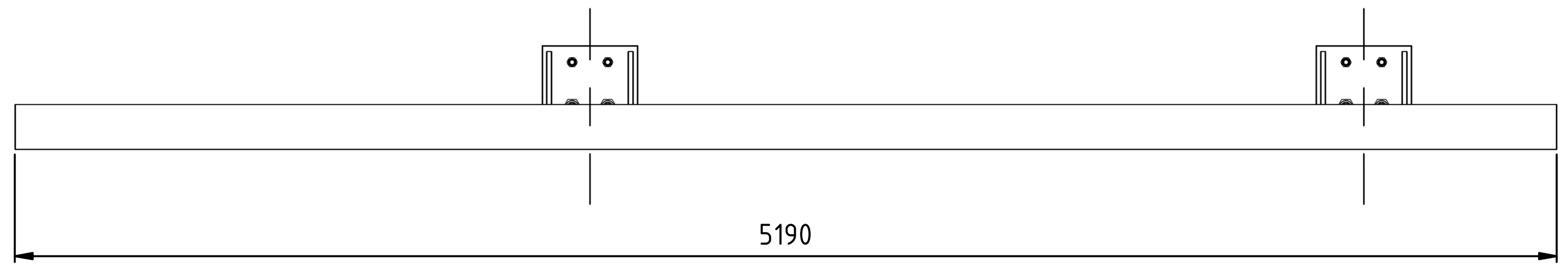
ELEVATION
VIEW FROM BRIDGE CARRIAGEWAY



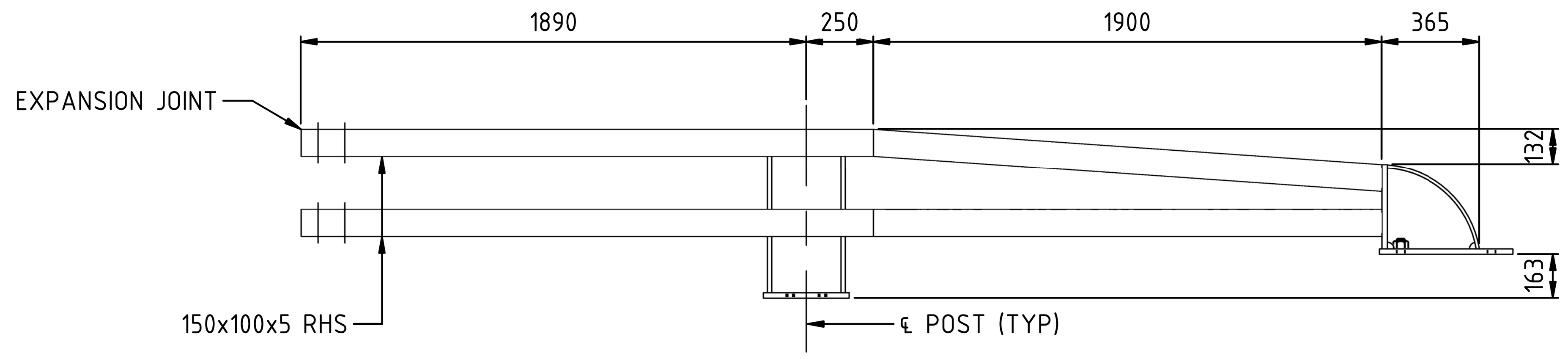
ELEVATION
VIEW FROM BRIDGE CARRIAGEWAY



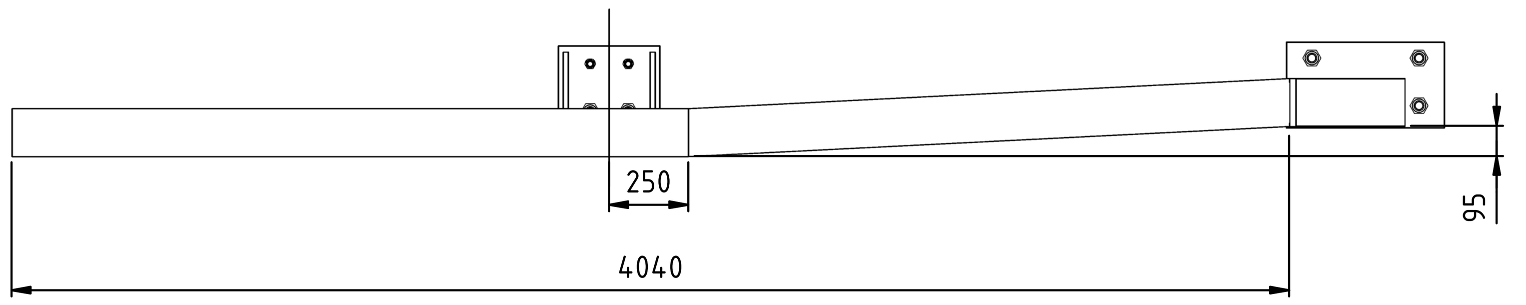
PANEL TYPE TA PLAN
2 REQUIRED



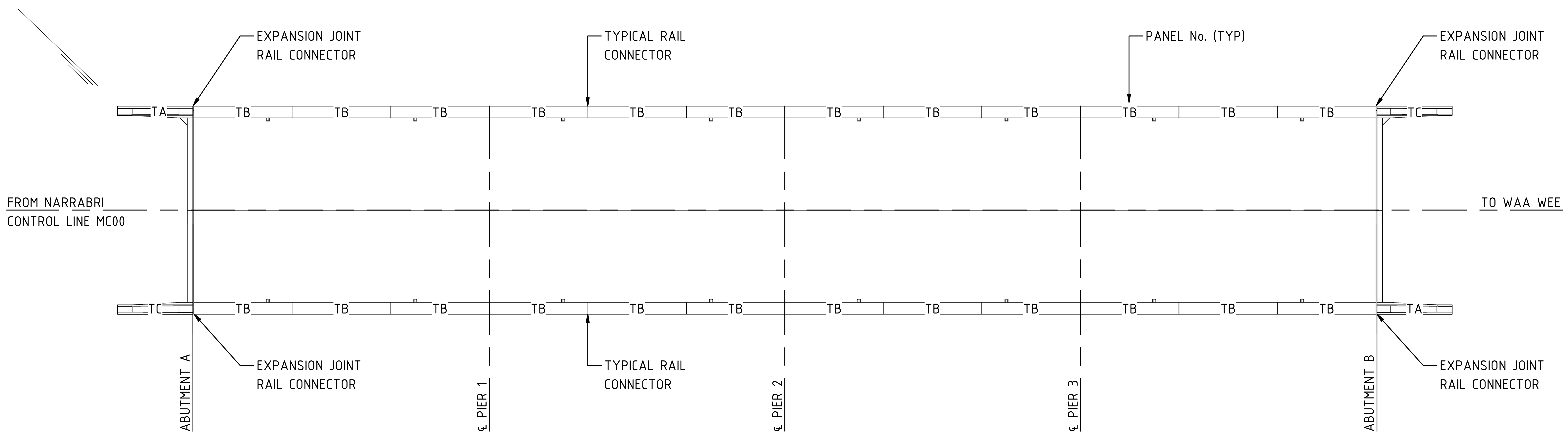
PANEL TYPE TB PLAN
24 REQUIRED



ELEVATION
VIEW FROM BRIDGE CARRIAGEWAY



PANEL TYPE TC PLAN
2 REQUIRED



PANEL LAYOUT
NOT TO SCALE

GENERAL NOTES

SCALE 0 0.3 0.5 0.8 1 1.3m OR AS SHOWN.

FOR OTHER GENERAL NOTES RELATING TO THIS SHEET, SEE SHEET No. 27

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ISSUE	DATE	REVISION	PREP	CHECK	AUTH
1	09.11.2022	ISSUED FOR 50% DESIGN REVIEW	OF	LB	

HW29 - KAMILAROI HWY
NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

TRAFFIC BARRIER RAILING LAYOUT

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Level 9, The Forum, 203 Pacific Highway
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Tel: 02 9496 7700 Fax: 02 9439 5170
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NORTHWEST REGION
NSW GOVERNMENT
Transport for NSW

	PREPARED	CHECKED
DESIGN	J. Guzman	L.Bai
DRAWING	O. Fernando	D. Carroll
APPROVED/ DESIGN QA RECORDS		

DIRECTOR

DRAWING SET No DS2022/000622
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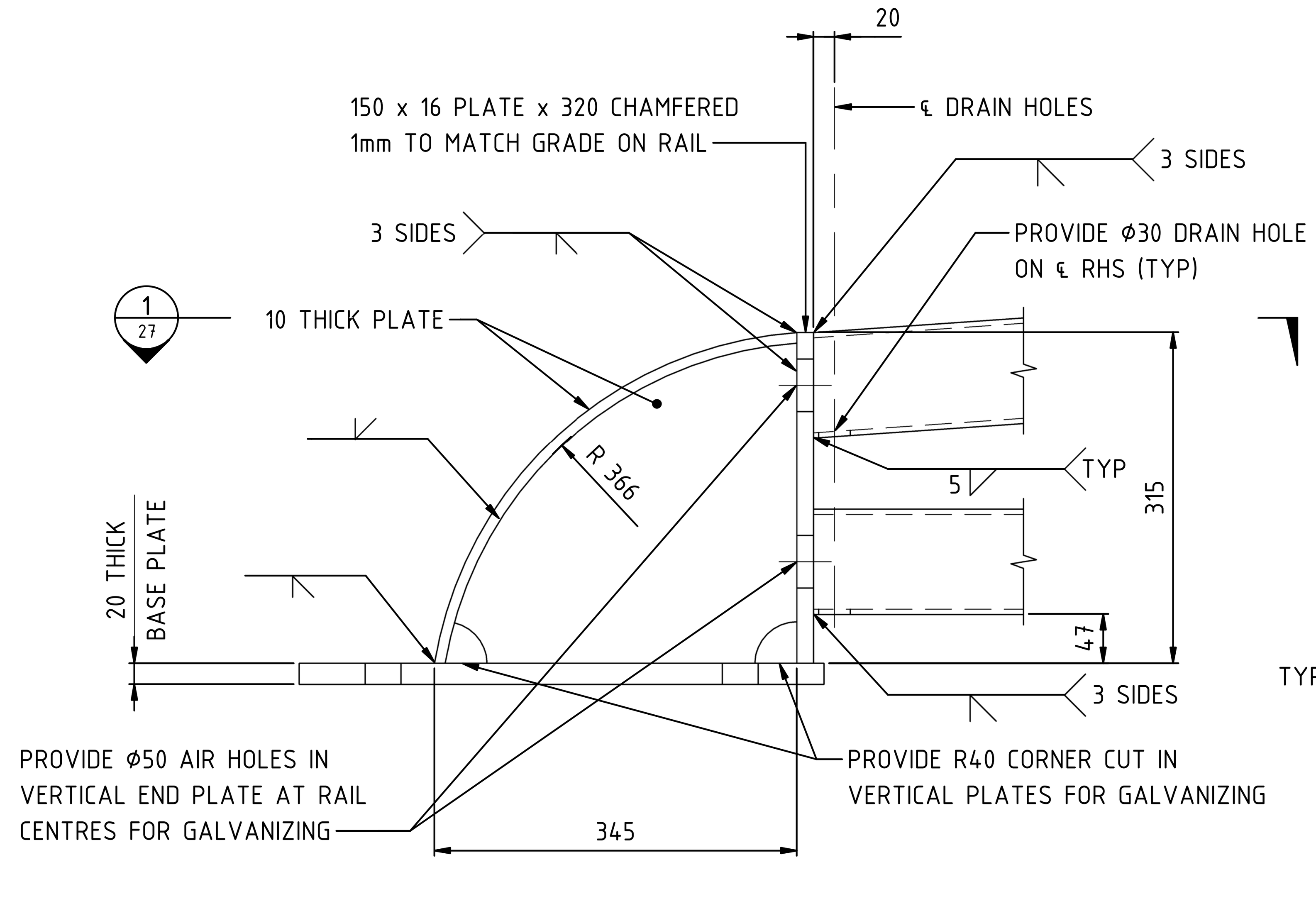
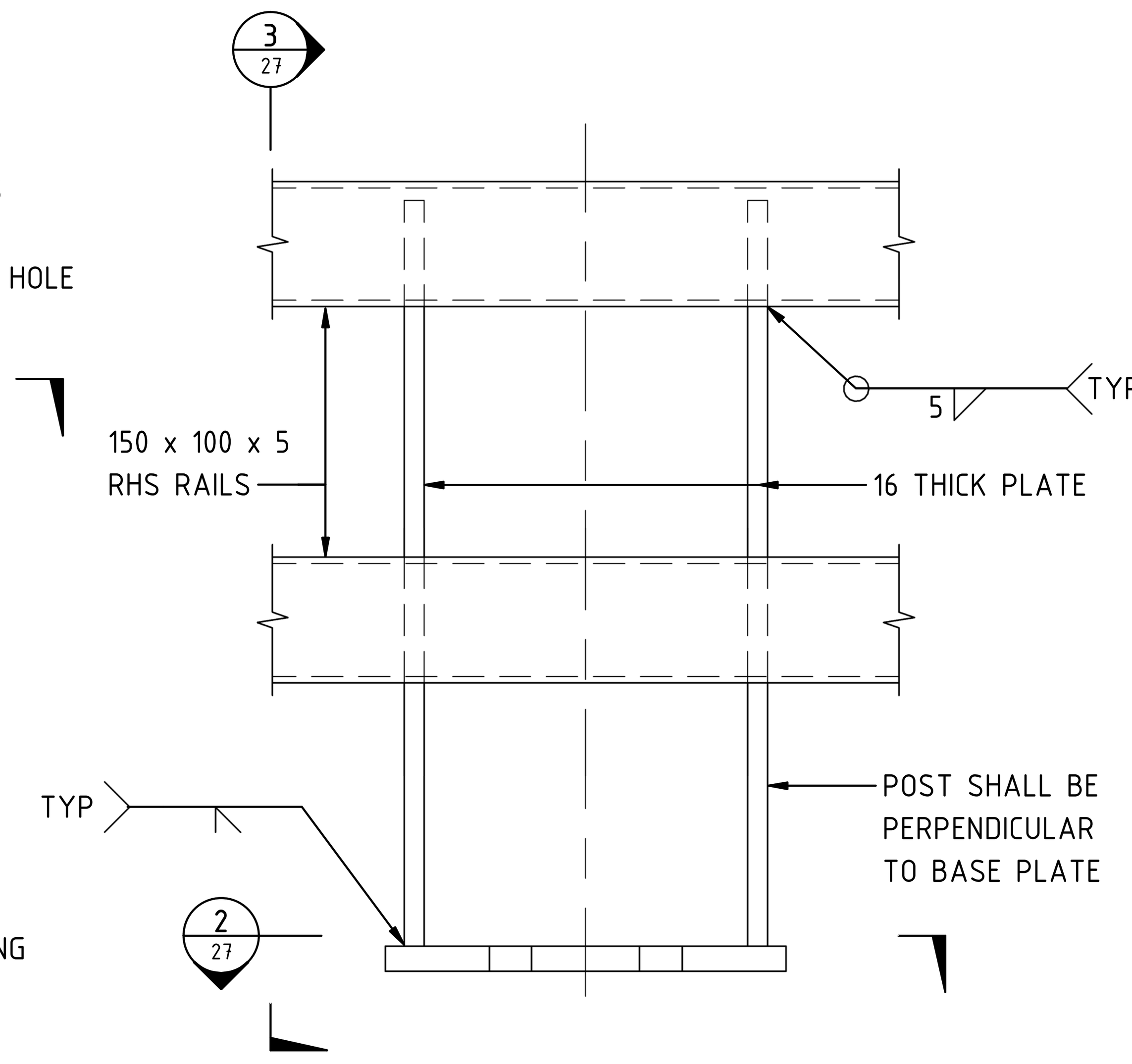
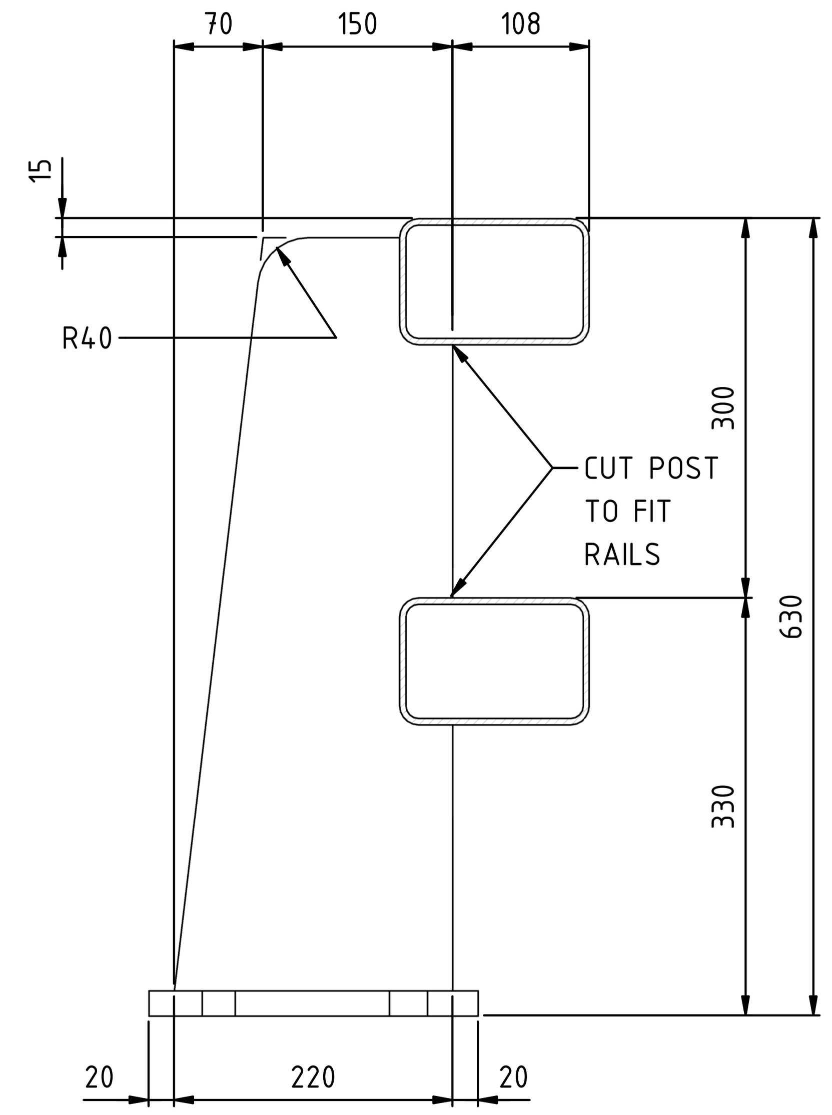


DETAIL A

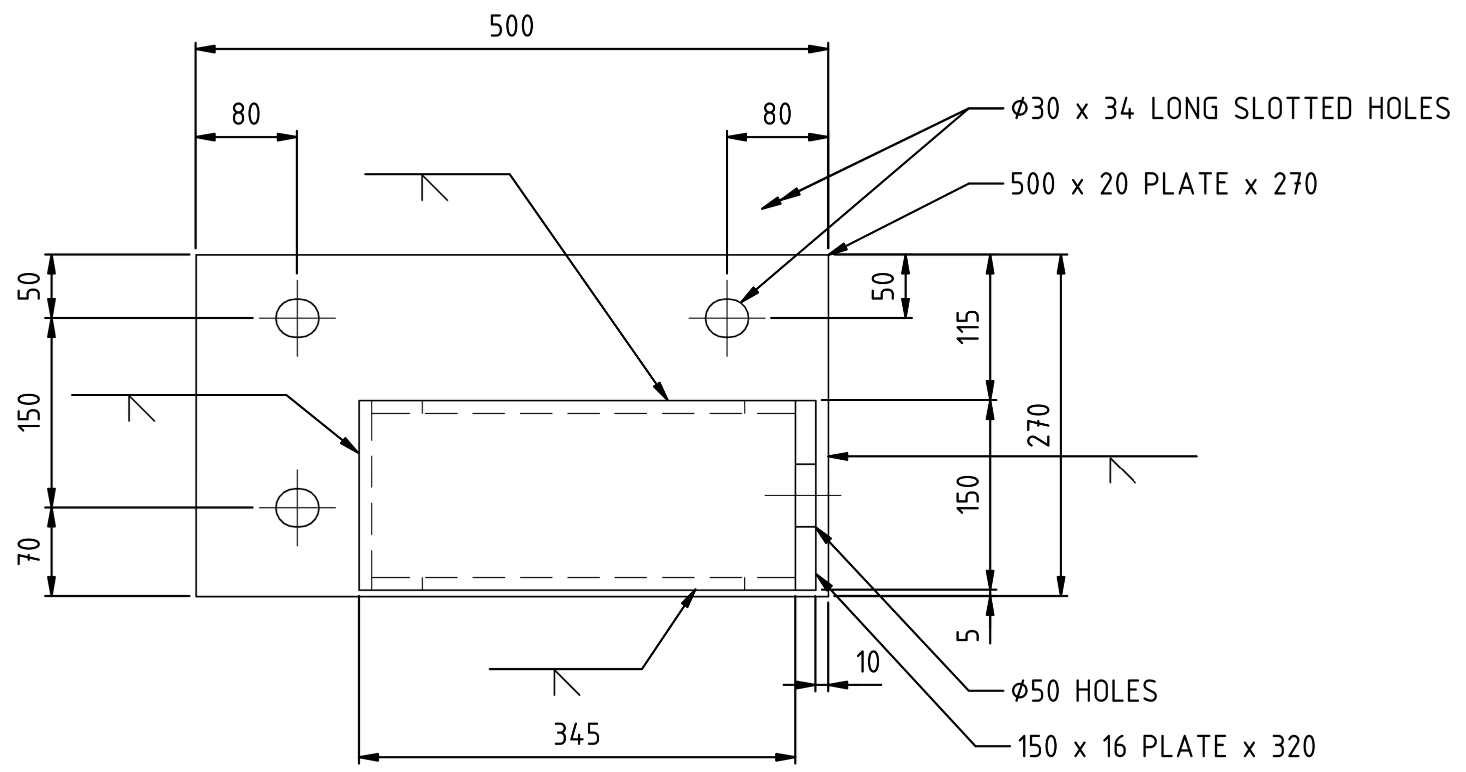


INTERMEDIATE POST ELEVATION

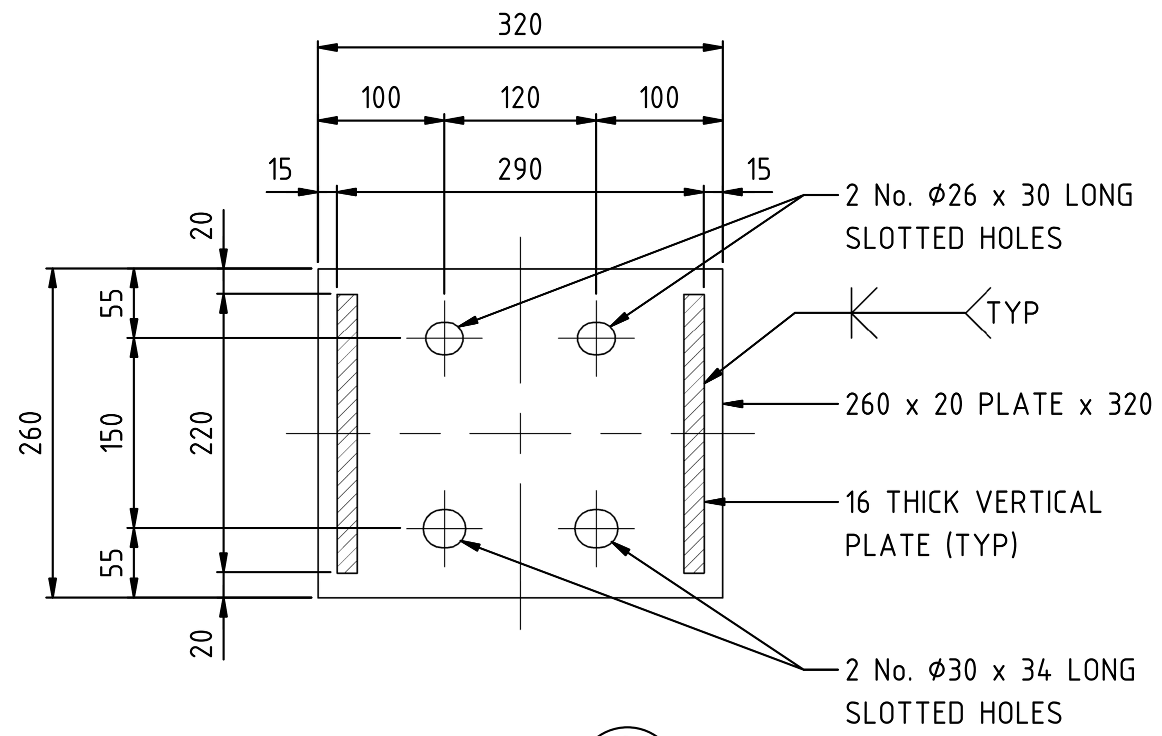
VIEWED FROM BRIDGE CARRIAGEWAY



SECTION 3



VIEW 1

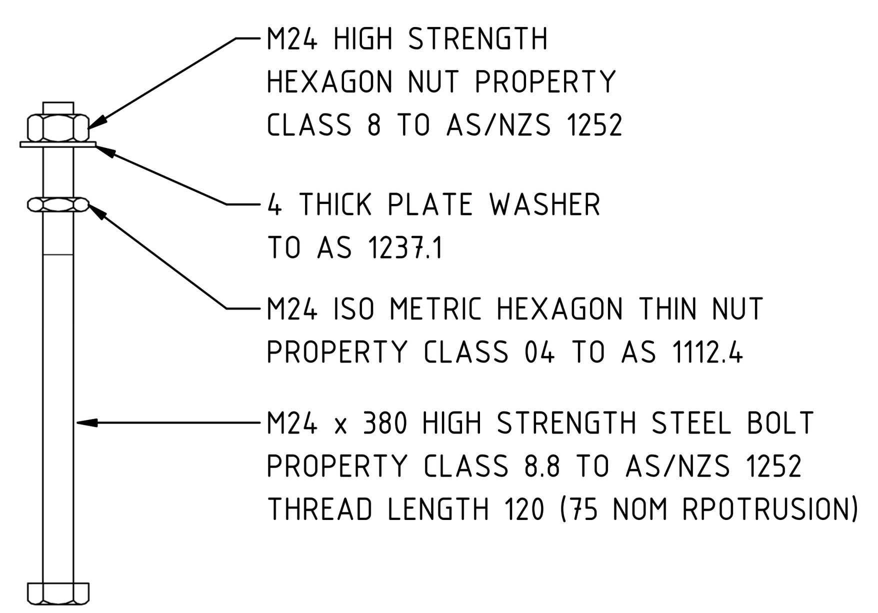


SECTION 2

GENERAL NOTES

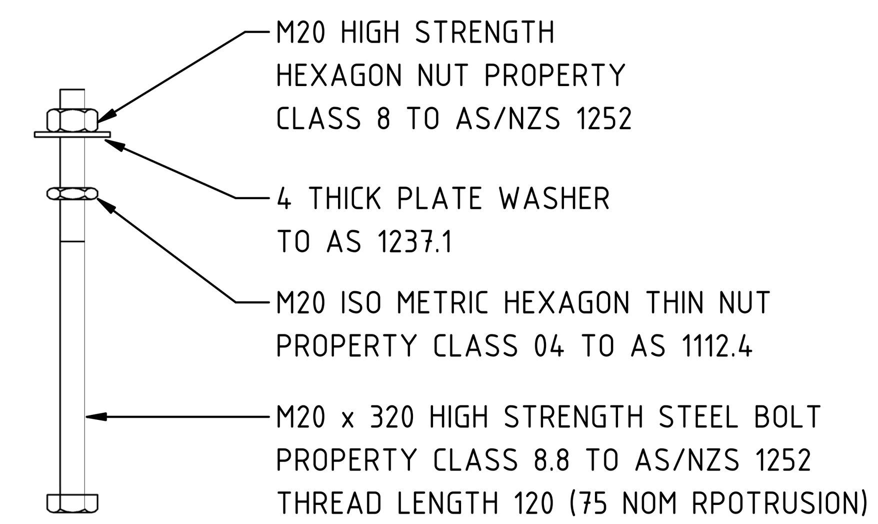
SCALE 0 0.3 0.5 0.8 1 1.3m OR AS SHOWN.

STEEL SHALL BE GRADE 250 TO AS 3678.
STEEL SECTIONS SHALL BE GRADE 250 TO AS/NZS 3679.1.
HIGH-STRENGTH STEEL BOLTS SHALL BE PROPERTY CLASS 8.8 TO AS/NZS 1252.
HIGH-STRENGTH STEEL NUTS SHALL BE PROPERTY CLASS 8 TO AS/NZS 1252.
HIGH-STRENGTH STEEL WASHERS SHALL CONFORM TO AS/NZS 1252.
BOLTING CATEGORY FOR HIGH-STRENGTH STEEL BOLTS SHALL BE 8.8/S IN ACCORDANCE WITH AS 4100.
ISO METRIC HEXAGON THIN NUTS SHALL BE PROPERTY CLASS 04 TO AS/NZS 1112.
SPLIT COTTER PINS SHALL CONFORM TO AS 1236
BLACK STEEL WASHERS (NORMAL AND LARGE SERIES) SHALL CONFORM TO AS 1237. THE WELD CATEGORY SHALL BE GP IN ACCORDANCE WITH AS 1554 PART 1.
WELDING SYMBOLS ARE TO AS 1101 PART 3.
EDGES TO BE PROTECTIVE TREATED SHALL BE ROUNDED TO A RADIUS OF 1.5mm UNLESS SPECIFIED OTHERWISE.
ALL COMPONENTS EXCEPT STAINLESS STEEL ITEMS SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH RMS SPECIFICATION B220.
BOLTS, NUTS AND WASHERS SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH AS 1214.
EXPOSED BUTT WELDS SHALL BE GROUND FLUSH.
THE LONGITUDINAL SEAM IN RHS SECTIONS SHALL BE ON THE UNDERSIDE OF HORIZONTAL SECTIONS AND INSIDE OF VERTICAL SECTIONS.
THE GROUT USED TO CONSTRUCT GROUT PADS AND FILL FORMED RECESSES SHALL BE SHRINKAGE COMPENSATED HIGH FLOW CEMENTITUOUS GROUT.
GROUTING SHALL BE CARRIED OUT TO ENSURE THE FORMED RECESSES ARE COMPLETELY FILLED AND THAT THERE ARE NO VOIDS UNDER THE BASE PLATE.
SIDE FACES OF THE GROUT PADS SHALL BE VERTICAL AND FLUSH WITH EDGES OF STEEL PLATE.
THE FORMWORK FOR THE GROUT PADS SHALL REMAIN IN PLACE FOR A MINIMUM 3 DAYS AND CURING COMPOUNDS SHALL BE APPLIED TO THE SIDES OF GROUT PADS AFTER THE REMOVAL OF FORMWORK.



M24 ANCHOR BOLT ASSEMBLY

116 REQUIRED



M20 ANCHOR BOLT ASSEMBLY

104 REQUIRED

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ISSUE	DATE	REVISION	PREP	CHECK	AUTH
1	09.11.2022	ISSUED FOR 50% DESIGN REVIEW	OF	LB	

HW29 - KAMILAROI HWY — NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

TRAFFIC BARRIER RAILING DETAILS - SHEET A

Cardno

Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
Level 9, The Forum, 203 Pacific Highway
St. Leonards, NSW 2065
Tel: 02 9496 7700 Fax: 02 9439 5170
Web: www.cardno.com.au

NORTHWEST REGION

NSW GOVERNMENT — Transport for NSW

	PREPARED	CHECKED
DESIGN	J. Guzman	L.Bai
DRAWING	O. Fernando	D. Carroll
APPROVED/ DESIGN QA RECORDS	DIRECTOR	

DRAWING SET No DS2022/000622

BRIDGE No BR12489

ISSUE STATUS: PRELIMINARY

ISSUE — No OF SHEETS 31 — SHEET No 27

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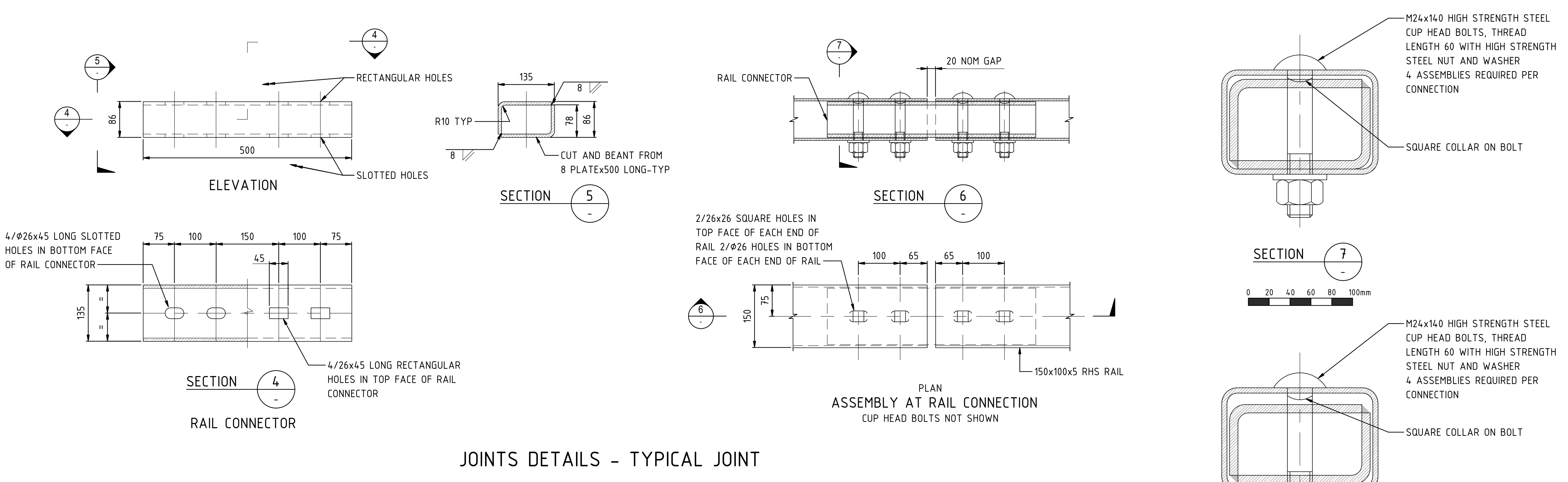

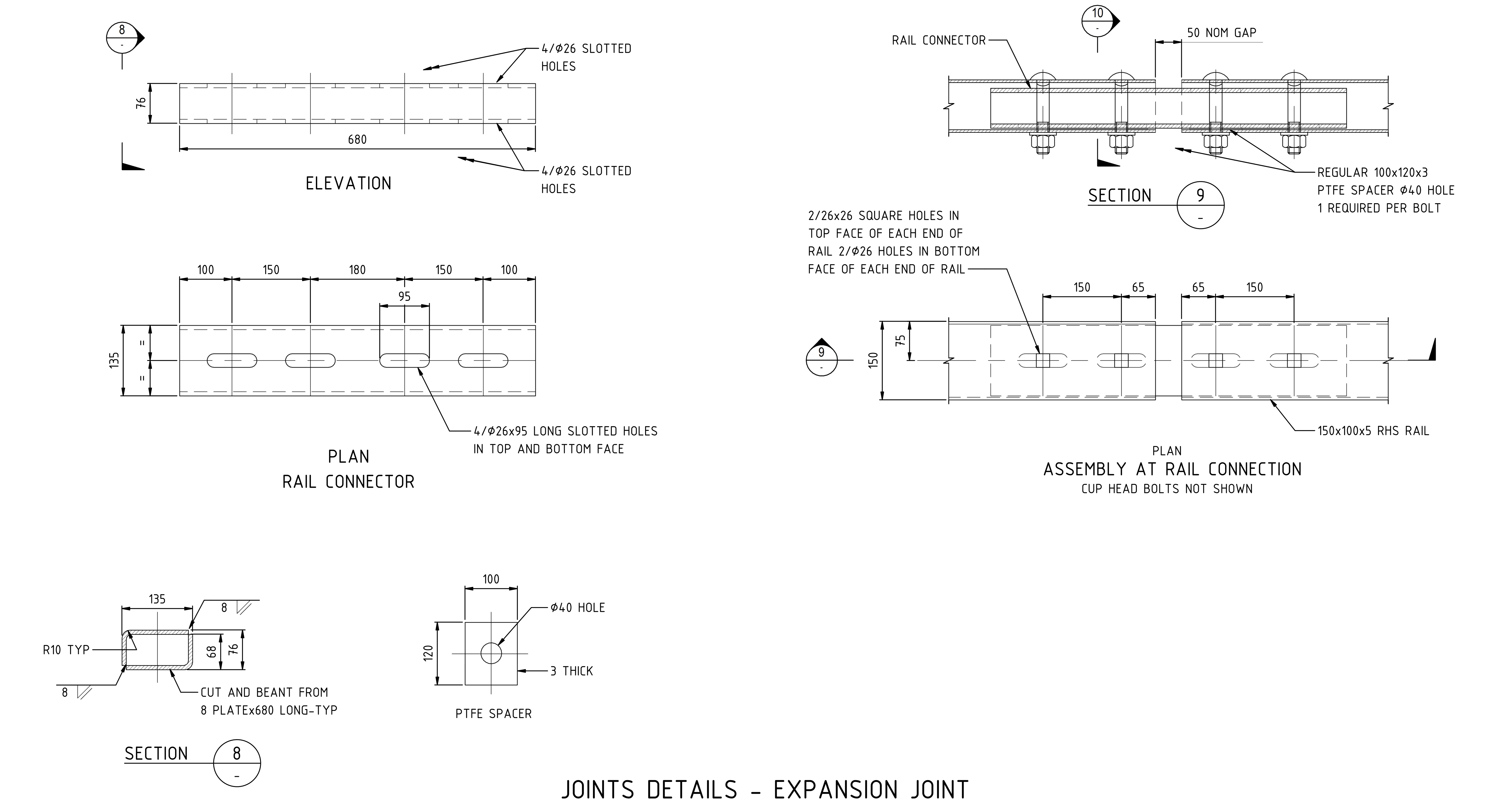

GENERAL NOTES

SCALE 0 50 100 150 200 250mm OR AS SHOWN.

FOR OTHER GENERAL NOTES RELATING TO THIS SHEET, SEE SHEET No. 27

NOT FOR CONSTRUCTION

ISSUE	DATE	REVISION	PREP	CHECK	AUTH
1	09.11.2022	ISSUED FOR 50% DESIGN REVIEW	OF	LB	

HW29 - KAMILAROI HWY — NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

TRAFFIC BARRIER RAILING DETAILS - SHEET B

Cardno — NORTHWEST REGION — NSW GOVERNMENT Transport for NSW

Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
Level 9, The Forum, 203 Pacific Highway
St. Leonards, NSW 2065
Tel: 02 9496 7700 Fax: 02 9439 5170
Web: www.cardno.com.au

	PREPARED	CHECKED
DESIGN	J. Guzman	L.Bai
DRAWING	O. Fernando	D. Carroll
APPROVED/ DESIGN QA RECORDS	DIRECTOR	

DRAWING SET No DS2022/000622

BRIDGE No BR12489

ISSUE STATUS: PRELIMINARY

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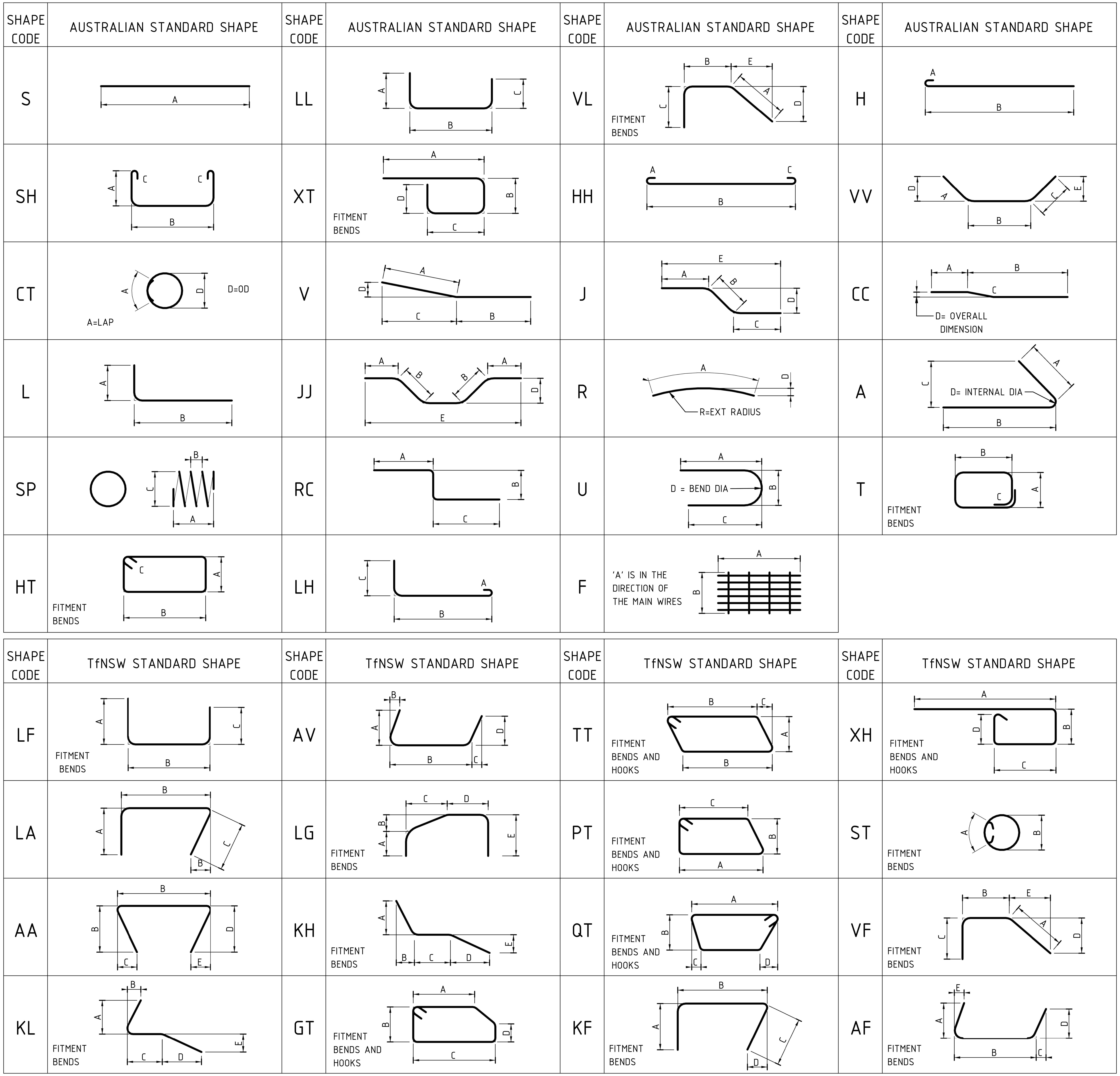

BAR MARKING LEGEND

THE METHOD USED TO LABEL REINFORCEMENT ON THE DRAWING IS AS FOLLOWS:

A1 10-N16-S-300EF

- INFORMATION FOR PLACING. REFER TO NOTE 11
- SPACE ALONG LIMIT LINE
- BAR SHAPE CODE
- BAR SIZE IN MILLIMETRES
- BAR STRUCTURAL PROPERTIES
- NUMBER OF BARS IN THE SET
- BAR NUMBER IN SEQUENCE
- STRUCTURE ELEMENT DENOTATION

STRUCTURE ELEMENT DENOTATIONS COMMONLY USED ARE:

- A DENOTES ABUTMENTS OR ABUTMENT A
- B DENOTES ABUTMENT B
- D DENOTES DECK
- F DENOTES PIERS
- G DENOTES GIRDER
- M DENOTES MAINTENANCE ACCESS WALKWAY
- P DENOTES PILES
- S DENOTES APPROACH SLAB

REINFORCEMENT NOTES

1. AUSTRALIAN STANDARD BAR SHAPES ARE IN ACCORDANCE WITH AS 1100.501.
2. BAR SIZE IS THE NOMINAL DIAMETER IN MILLIMETRES, OR THE AS/NZS 4671 FABRIC NUMBER.
3. THE GRADE OF REINFORCEMENT, IF NOT STATED ON THE DRAWINGS, MUST BE D500N TO AS/NZS 4671.
4. WHERE SHOWN ON THE DRAWINGS, "W" MUST DENOTE PLAIN ROUND REINFORCING BARS EQUIVALENT TO GRADE R500L TO AS/NZS 4671.
5. WHERE SHOWN ON THE DRAWINGS, RL AND SL MUST DENOTE WELDED REINFORCING BAR (RECTANGULAR AND SQUARE), RESPECTIVELY.
6. DIMENSIONS SHOWN ON BAR SHAPES DIAGRAM ARE MEASURED FROM THE OUTSIDE FACES OF THE BARS AND ARE IN MILLIMETRES.
7. THE INCLUDED ANGLE OF ANY BEND MUST BE RIGHT ANGLE IF NO DIMENSIONS SHOWN.
8. BARS OF DIAMETER GREATER THAN 24mm MUST NOT BE REBENT.
9. BAR BENDING AND HOOK DETAILS MUST BE IN ACCORDANCE WITH SECTION 5.13 OF AS 5100-BRIDGE DESIGN.
10. FOR ADDITIONAL BAR SHAPES SEE SHEET No 79.
11. INFORMATION FOR PLACING
    - NF - NEAR FACE
    - FF - FAR FACE
    - EF - EACH FACE
12. REINFORCEMENT ABBREVIATIONS ON THE DRAWINGS AND NOT DEFINED IN AS/NZS 1100 ARE AS FOLLOWS:
13. LS DENOTES LAP TO BE STAGGERED
14. ES DENOTES EQUAL SPACES OR EQUALLY SPACED.

NOT FOR CONSTRUCTION

ISSUE	DATE	REVISION	PREP	CHECK	AUTH
1	09.11.2022	ISSUED FOR 50% DESIGN REVIEW	OF	LB	

HW29 - KAMILAROI HWY

NARRABRI SHIRE COUNCIL

SPRING CREEK BRIDGE REPLACEMENT

ON KAMILAROI HWY AT NARRABRI

BAR SHAPES DIAGRAM - SHEET A

Cardno

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NORTHWEST REGION

NSW GOVERNMENT Transport for NSW

	PREPARED	CHECKED
DESIGN	J. Guzman	L.Bai
DRAWING	O. Fernando	D. Carroll
APPROVED/ DESIGN QA RECORDS		
	DIRECTOR	

DRAWING SET No: DS2022/000622

BRIDGE No: BR12489

ISSUE STATUS: PRELIMINARY

ISSUE 2 | No OF SHEETS 31 | SHEET No 30

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Transport for NSW

Bridge over Spring Creek B03858 near Narrabri, NSW

Demolition Report

Revision 0

May 2023

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Appendices

1. Introduction

Focus Bridge Engineering (FBE) has been engaged by Transport for NSW (TfNSW) to complete a demolition options report as detailed in our proposal dated 26 September 2022.

The findings from this report will be used by TfNSW to confirm the preferred method and inform the contract documentation and specifications.

1.1 General

Spring Creek Bridge (culvert) is on the Kamilaroi Highway (HW29) approximately 10 km northwest of Narrabri, NSW and was built in 1968 (see Figure 1-1).

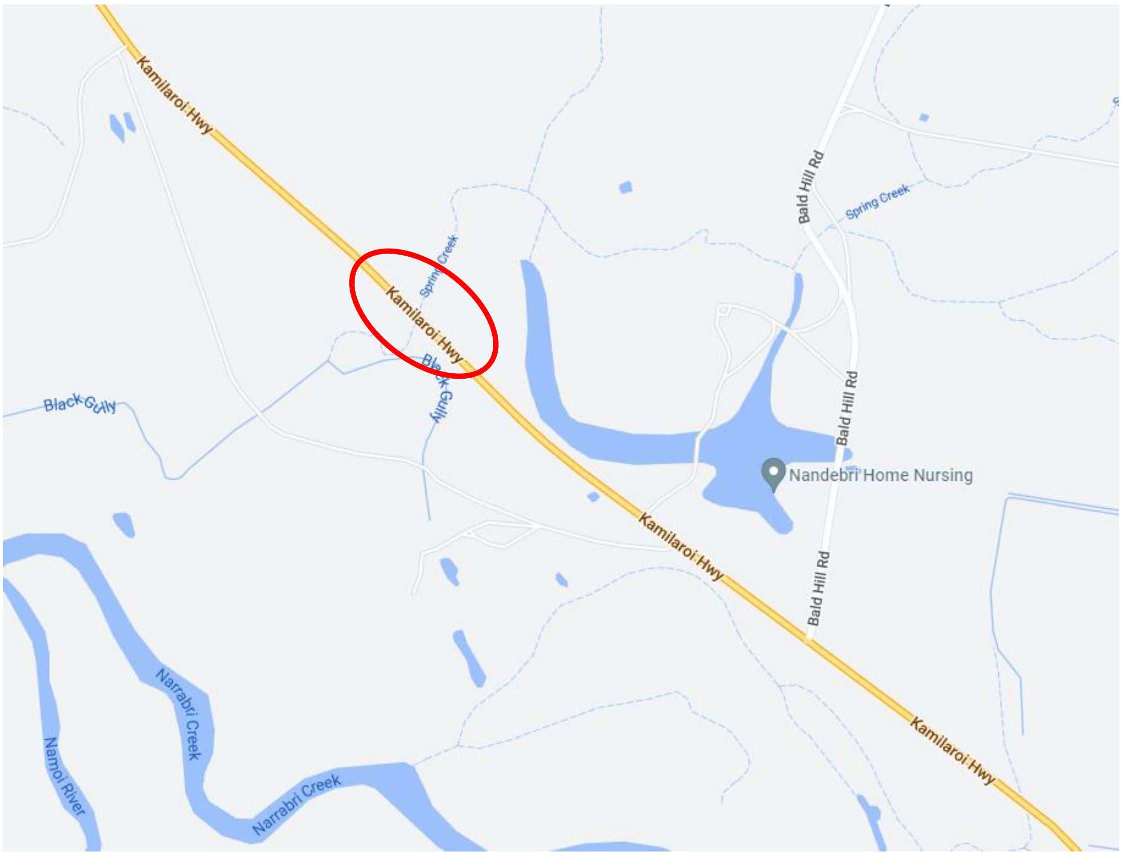


Figure 1-1 Spring Creek Bridge location plan (Source: TfNSW)

1.2 Project background

The culvert has a history of concerns dating back to the original construction. TfNSW state that soon after the construction of the culvert, cracks were observed in the wing walls, abutment walls, and intermediate pier walls. The cracks were patched with an epoxy resin and mapped at the time. The WAE drawings show the observed cracks at this time.

TfNSW stated that major cracks in the deck and wing walls were identified during an inspection in 1978. The source of these cracks was identified as highly expansive black soils used as fill behind the abutments. It was removed and replaced with free flow granular materials. The cracks were mapped and filled with an epoxy resin.

During the 2019 Level 3 (L3) inspection completed by TfNSW, it was noted that there was settlement of Cells 3 and 4 and uplift at the joint at Abutment A. The nomenclature adopted in this report is shown in Figure 1-2 and adopted throughout the report. Segment identification has been added to the adopted convention to facilitate the demolition methodology.

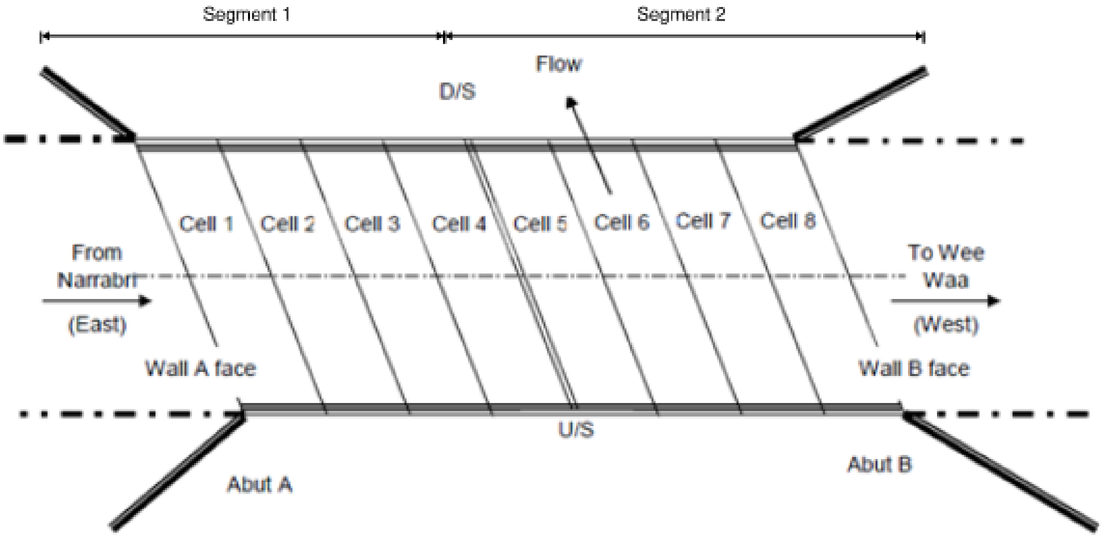


Figure 1-2 Structure plan nomenclature (Source: TfNSW and FBE)

During October 2020 it was further damaged during floods that caused a significant scour event. The scour undermined the base slab under Cells 1 to 4 and resulted in the eastern segment settling approximately 260 mm at the segment joint relative to the western structure. Cell 1 remained essentially un-displaced after this event. It is not clear if that is the complete settlement to date or relative to settlement that was observed during 2019.

Emergency works were undertaken to fill under the base slab using mass concrete and arrest any further subsidence. Using an asphalt overlay, the pavement over the structure was adjusted and increased up 380 mm over the segments to remove any of the segment displacement in the carriageway and provide a safer ride quality. Temporary propping was then installed in Cells 3 and 4 initially with props added in Cells 1 and 2 later.

Following the scour event and damage to the structure, FBE completed a preliminary desktop investigation for TfNSW including structural modelling and recommendations for the damaged culvert.

TfNSW nominated the bridge to be replaced with a precast plank bridge to be constructed online. The design of the proposed structure is currently being completed by Cardno.

1.3 Project scope

FBE has been engaged to provide a demolition report. This report has been prepared in discussion with TfNSW.

The following provides a brief scope of work:

- One site inspection and inception meeting with TfNSW.
- Demolition methodologies for both wet and dry sites to achieve environmental requirements and/or compliance.
- Methodologies to consider waterway management and any temporary works required to manage demolition methodology.
- Assessment and methodology for removal of existing props.

- Assessment of the existing structure for locked in stresses between the dropped culvert sections (modules) and the tensile stresses in the top slab, refer to FBE preliminary desktop investigation report dated May 2022.
- Site and project constraints, including quantity and mass take-offs.
- Risk assessment.
- Waste management.
- Basic programme.
- One review by TfNSW

This report may only be used and relied on by TfNSW for the purpose agreed to between FBE and TfNSW as set out in this report and our proposal dated 26 September 2022.

FBE otherwise disclaims responsibility to any person other than TfNSW arising in connection with this report. FBE otherwise disclaims responsibility to any person other than TfNSW arising in connection with this report. The services undertaken are limited to those specifically detailed in the report and are subject to the scope and limitations set out herein.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. FBE has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared and issued.

FBE excludes and disclaims all liability for all claims, expenses, losses, damages and costs, including indirect, incidental or consequential loss, legal costs, special or exemplary damages and loss of profits, savings or economic benefit that FBE may incur as a direct or indirect result of this report for any reason being inaccurate.

1.4 General assumptions

It has been assumed that the bridge information supplied by TfNSW is accurate for existing bridge details and condition states. This information forms the basis of our demolition options report.

This report has been prepared on the basis of information provided by TfNSW and others, including Government Authorities which have not been independently verified or checked beyond the agreed scope of work. Consequently, FBE does not accept liability in connection with such unverified information including any resultant errors and omissions in the report.

The opinions, conclusions and any recommendations in this report are based on our assumptions and disclaim any liability arising from any of these assumptions being incorrect.

Where information provided was not sufficient, assumptions have been made to complete the assessment. These assumptions have been made based on discussions with TfNSW, historic information, and guidelines or limitations within current Australian Standards.

The following has not been included in our report:

- Dilapidation survey.
- Utility relocation and/or consideration.
- Traffic management plans and staging.
- Road shutdown management.
- Preparation or input into contract documentation.

- The report will not include any structural assessments including computer modelling, assessments or evaluations to current design standards.
- No allowance for any statutory or regulatory approvals.
- Unknown issues not identified at this demolition concept stage.

1.5 Specific assumptions

This report has been prepared during the early planning of the works where the project has not been fully detailed. Consequently, at this stage the following project specific assumptions have been made, which include but are not limited to:

- New bridge and road construction and any clashes with the existing bridge to be dealt with on the Cardno design drawings.
- Services – DBYD outcomes and relocations are being dealt with by the project overall and it has been assumed there are no impacts from services.
- Land acquisitions – property boundary outcomes do not impact on the demolition methodology proposed but may impact the construction access road
- Existing bridge foundations are as per WAE drawings.
- No additional approach road works or ancillary civil works is required.
- No allowance for hazardous materials (for example asbestos), contaminated fill or disposal to specialist licenced landfill.
- The REF was not available during the preparation of this report.

1.6 Supplied information

The information supplied by TfNSW is shown in Table 1-1.

Table 1-1 Supplied information (Source: TfNSW)

Document	Drawing Number
Level 3 Inspection and Structural Assessment	Dated 2 October 2020
Culvert over Spring Creek WAE drawings sheet 1 to 2	Dated 23 June 1967
R.C.B.C of Spring Creek – Modified Wing Walls	Dated 14 November 1967
MR127 8 cell 15 x 15 R.C.B.C at Spring Creek – Plan showing extent of cracking at 7-6-68	Dated 7 June 1968

2. Bridge description

Bridge B03858 over Spring Creek is on the Kamilaroi Highway HW29 near Narrabri, NSW. The bridge was built in 1968.

The bridge is a cast in situ reinforced concrete box culvert with eight box cells measuring 15’ 0” (4.572 m) square internally. The structure comprises two segments with each segment containing four cells. The segments are separated by a vertical joint of rigid foam plastic (or similar) between the segment walls. The two segments are doweled in the base slab at 1’ 0” (305 mm) centres. The culvert cells are on a 30-degree skew.

The crown slab varies from 1’ 2” (356 mm) thick at the kerb line to 1’ 2.5” (368 mm) thick at the centre line of the structure. The base slab is 10” (254 mm) thick with a 1’ 6” (457 mm) deep cut off wall under the base slab at the inlet and outlet. The cut off wall and internal walls are 8” (203 mm) thick.

The culvert wing walls are on a 135-degree angle to the centre line of the structure and taper down from kerb height on the carriageway to 3’ 9” (1143 mm) high above the base slab at the ends. The wing walls are 8” (203 mm) thick. Based on the WAE drawings, the wing walls were modified during construction with a buttress wall added to each wing wall on the eastern abutment. It is not clear from the drawings whether the buttress walls were added to the western abutment wing walls.

The width between kerbs is 24’ 0” (7.315 m) and comprises an eastbound and westbound carriageway. The kerb on both carriageways comprises formed openings with 3” (75 mm) diameter asbestos scuppers through the crown slab at 16’ 0” (4.9 m) centres.

The barrier over the structure comprises 5” x 2.5” x 0.25” (127 mm x 63 mm x 6 mm) steel posts at 11’ 5.25” (3.5 m) centres with two 4” x 4” x 0.1875” (102 mm x 102 mm x 4.8 mm) steel rails. The rails are bolted to a 4” x 3” (102 mm x 75 mm) unequal angle that is welded to the posts. The posts are fixed to the kerb with a base plate and 0.875” (22 mm) diameter U-bolts cast into the kerb.

Figure 2-1 and Figure 2-2 show an elevation and plan of the culvert extracted from WAE drawings

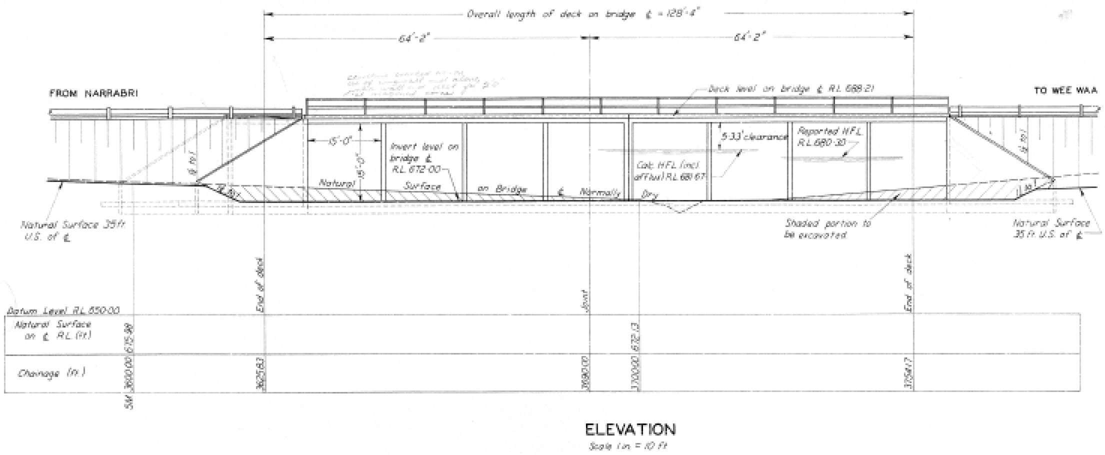


Figure 2-1 **Elevation of Spring Creek Culvert (Source: WAE drawings)**

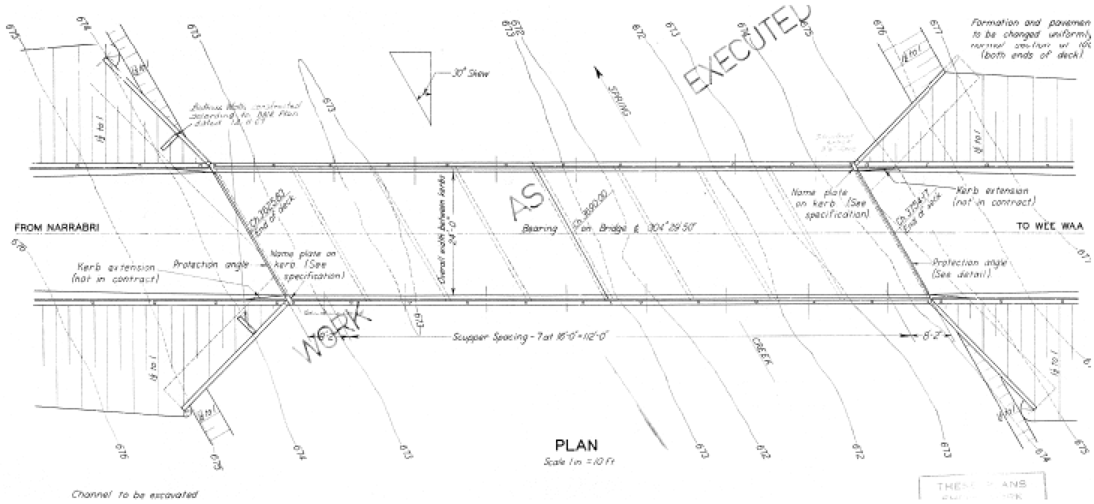


Figure 2-2 **Plan of Spring Creek Culvert (Source: WAE drawings)**

The WAE bridge drawings can be found in Appendix A and the Level 3 inspection of the bridge is included in Appendix B.

3. Site inspection

Mark Tilley and Alan Michie from FBE and Peter Hamilton and Adrienne Pierini from TfNSW attended the site on the 17 November 2022. At the time of inspection, the culvert had water in all cells and was not accessible. An inspection of the top of the structure from the carriageway was undertaken.

Previously, Mark Tilley, James Crace, and Steve Brown from FBE and Peter Hamilton, Adrienne Pierini, and Louis Nakad from TfNSW inspected the culvert to facilitate the culvert remediation report produced by FBE. The inspection was completed on the 1 March 2022. The inspection was completed on a sunny day with an average temperature of 25 degrees Celsius.

As a condition assessment is outside the scope of this project, a high-level overview of the condition of the structure based on the previous two site inspections with reference to the most recent TfNSW L3 inspection is provided below.

3.1 General observations

The existing culvert was observed to be in fair to poor condition. There has been a significant change to the condition of the structure due to a flood event in 2020 that resulted in significant scour and settlement of the segments. Prior to the scour event in 2020, TfNSW completed a Level 3 inspection and structural assessment and rated the culvert as “fair”.

3.1.1 Traffic barriers and deck

The existing post and rail barrier is generally in fair condition. There is surface corrosion evident throughout the barrier. The barrier does not meet current design standards and is substandard for the volume of traffic and the number of heavy vehicles that use the route.

There is a significant difference in the horizontal plane of the rails at the segment joint due to the differential settlement between the two segments. As the rail length matches the spacing of the post centres, there is a joint in the rail at each post that eliminates any continuous barrier rails over the structure. Due to the construction methodology adopted for the rails, the rails have accommodated the settlement without any significant distress to the barrier.

Figure 3-1 View of traffic barrier and kerb (Source: FBE)

The kerb is in poor condition over Cells 1 to 4 and fair condition for the remaining cells. Due to the settlement, significant flexural cracks are visible along the kerb over the first four cells in the top of the kerb. The cracks are the result of the high tensile stress that developed in the crown slab and kerb following the settlement.

The pavement is in fair to good condition. There is a reflective crack through the pavement at the vertical joint between Cells 4 and 5.

3.1.2 Abutment walls and wing walls

The previously completed L3 inspection identified the abutment walls and wing walls as a fair condition. There are vertical and horizontal cracks throughout the structure with most previously repaired cracks still intact. Previously repaired cracks at the obtuse angle of the wing wall and abutment walls have reopened.

A comprehensive crack map has been provided in TfNSW L3 report. Refer to Appendix B for the TfNSW L3 Inspection and Structural Assessment Report.

Figure 3-2 Abutment and wing wall cracks (Source: FBE)

3.1.3 Cells 1 to 8

Similar to the abutment and wing walls, the cell walls and soffit of the crown slab of all cells have a significant amount of vertical and horizontal cracks evident. Based on defect mapping by TfNSW, it is noted that most cracks were existing and had been previously sealed. Some cracks were existing and previously treated for sealing but never sealed. There are also cracks varying from 0.05 mm to 0.2 mm throughout the structure that may have developed in the recent settlement events.

Figure 3-3 Cell wall cracks (Source: FBE)

Due to the settlement, there is also a significant misalignment between the segments at the vertical joint between Cell 4 and 5.

Figure 3-4 Segment misalignment (Source: FBE)

Temporary propping has been installed in Cells 1 to 4 to provide support due to the additional dead load from the asphalt overlay and to supplement the reduction in capacity due to the changed structural behaviour of the segments.

Figure 3-5 Temporary propping in Cells 1 to 4 (Source: FBE)

3.2 Observations specific to the demolition

The following observations may have an impact on the bridge demolition and would need to be addressed as part of the demolition methodology. These include but are not limited to the following:

3.2.1 Internal wall stability

The complete structure comprises two segments with four cells in each segment. In each segment, the internal two walls are recessed into the base slab by approximately 25 mm. At the base slab connection to the wall the reinforcement terminates at the bottom of the wall with no reinforcement continuity between the walls and the base slab. During demolition, the crown slab on either side of the walls would be removed and the internal walls would become unsupported at the top. Without a moment connection at the base, the walls would likely be unstable at this stage.

The WAE drawings show that the internal walls are the same height as the clear span between walls. If the walls were to fall uncontrolled there is a risk, they would impact an adjacent wall that is still required to support the structure.

Consideration to the stability of the walls during the demolition of the structure would need to be considered and may require temporary supports.

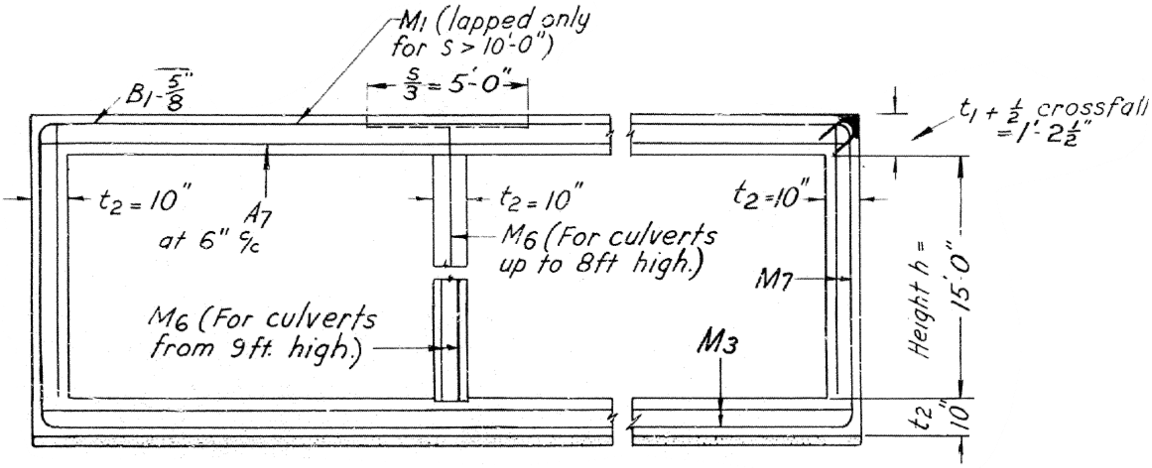


Figure 3-6 **Culvert reinforcement detail (Source: WAE drawings)**

3.2.2 Abutment stability

The abutments and wing walls are stable through the global stability provided by the segment combined with the heel slab and key at the wing walls. During demolition, the crown slab would be removed, and the abutment wall and wing wings would be unsupported at the top. Unlike the internal walls, there is reinforcement continuity at the abutment walls, and the wall would likely remain stable with only earth pressure.

There is a risk that an unsupported wall with the additional surcharge loading from plant sitting behind the abutment may increase the design actions beyond what the base of the wall can accommodate.

Consideration to the stability of the abutment walls during the demolition of the structure would need to be considered. Abutment A is currently braced diagonally with temporary bracing, but Abutment B is unsupported and may require temporary bracing. Depending on the demolition methodology adopted, the earth pressure behind the abutments could be alleviated through removal prior to demolition of the crown slab, although, this would require demolition of the crown slab to be completed from the base slab level instead of the top of the segments.

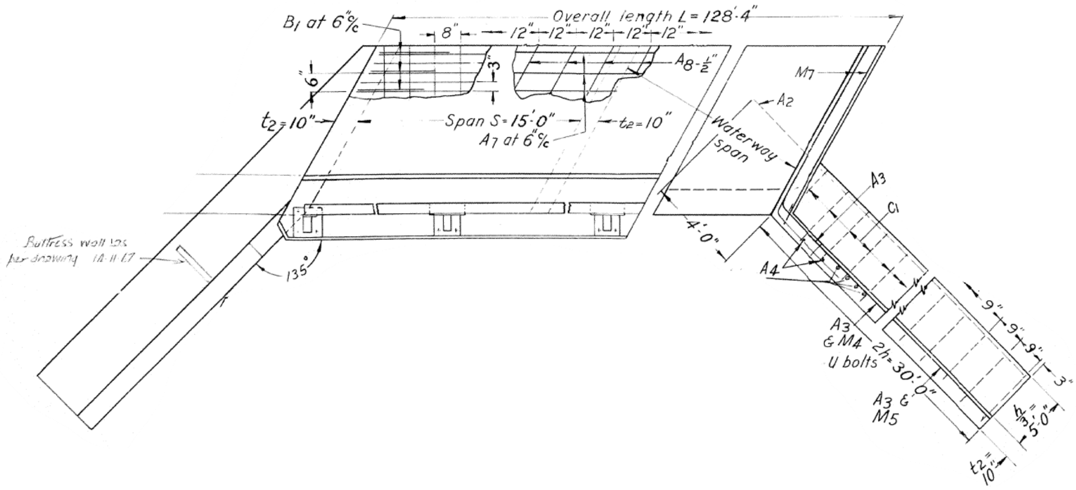


Figure 3-7 **Plan view wing walls (Source: WAE drawings)**

3.2.3 Existing settlement

The cells within the first segment have settled considerably throughout the life of the structure, although, the segments appear currently stable. However, there is a risk that Cells 1 to 4 are propping/supporting Cells 5 to 8. During demolition of the first segment, any support provided by the segment would be released and there is a risk the second segment may displace.

The segment should be monitored during and after the demolition of the first segment to ensure its stability and structural integrity is maintained. Significant displacement may result in high tensile stresses in the crown slab of the second culvert segment that may reduce the load carrying capacity of the structure. Any reduction in capacity may result in additional temporary works in the second segment during demolition to ensure the plant can operate on the culvert safely.

3.2.4 Hazardous materials

The culvert was assessed by AECOM to confirm the presence of any hazardous materials including:

- Asbestos containing materials (ACM).
- Lead in paint.
- Synthetic mineral fibre (SMF).
- Polychlorinated biphenyls (PCB).

A summary of the findings from the report are provided below. Refer to Appendix D for the Hazardous Material Survey Report.

Asbestos scuppers

The hazardous materials report identified non-friable asbestos in the moulded scupper surrounds. The WAE drawings also indicate the surrounds are non-removable fibro-cement formers. Due to access at the time of the hazardous materials survey, the scuppers would not have been accessible for testing. The WAE drawings note that the scuppers are also asbestos pipe. The pipes would need to be removed prior to the demolition of the segments. Due to the geometry of the scuppers, local demolition of the kerb may be required to enable over size core holes through the crown to remove the scuppers.

A licensed asbestos contractor should be consulted to ensure the mitigation and removal is in accordance with statutory obligations. Refer to Figure 3-8 for local demolition of kerb and asbestos locations.

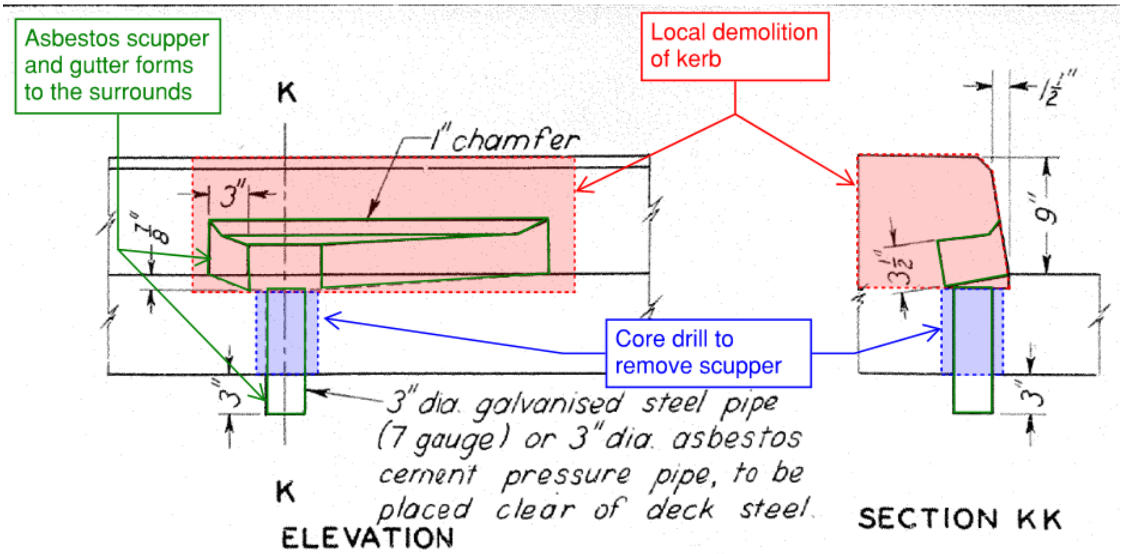


Figure 3-8 **Scupper removal (Source: WAE drawings and FBE)**

Lead paint

The hazardous materials report identified lead paint above the assessment criteria (0.1% w/w) on the traffic barrier. Lead paint above the criteria was not consistently found throughout the paint system on the barrier, although, the barrier in its entirety shall be treated as containing lead paint over the assessment criteria. The traffic barrier shall be removed, transported, and disposed of in accordance with statutory obligations.

3.2.5 Temporary props

Following the scour event, TfNSW installed temporary vertical props in Cells 1 to 4. In addition to the vertical props, a diagonal brace was added to Abutment A. All props are still within the structure and further assessment on their requirement during demolition would be required to be completed.

Depending on the demolition methodology adopted, the temporary props may be able to be salvaged during the demolition stages where all super imposed dead loads and traffic loads have been removed from the structure. The props may be removed progressively as each crown slab is demolished, with props remaining in place in cells where plant would be located during the demolition.

Figure 3-9 **Temporary props with Cells 1 to 4 (Source: FBE)**

3.2.6 Monitoring equipment

Monitoring equipment installed by TfNSW is located throughout the structure.

Figure 3-10 Monitoring equipment (Source: FBE)

It is assumed that the monitoring equipment would be removed by TfNSW prior to demolition.

3.3 Level 3 inspection

A L3 inspection was completed by TfNSW in August 2019, the completed inspection also facilitated a structural assessment to be completed by TfNSW in October 2020. There is no reference to the additional settlement that occurred in October 2020, so it is not clear if the structural assessment included the additional settlement.

Refer to Appendix B for the TfNSW L3 Inspection and Structural Assessment Report.

4. Project constraints

4.1 New bridge design and side track

Based on the staging proposed by TfNSW and Cardno, the new bridge will be constructed following the demolition of the existing structure. During the demolition of the existing structure and the construction of the new bridge, traffic will be diverted to a side track on the northern side of the structure.

There will be a clearance of approximately 18 m between the existing structure and the rock armouring on the side track. There will also be riprap scour protection (250 mm to 650 mm) and a rock platform shown as pink and grey diagonals respectively between the side track and the existing structure.

Based on the location of the side track and the rock armouring that will be in place, demolition access is expected to be completed from the downstream side of the structure. A temporary construction access track will be required on the southern side of the culvert.

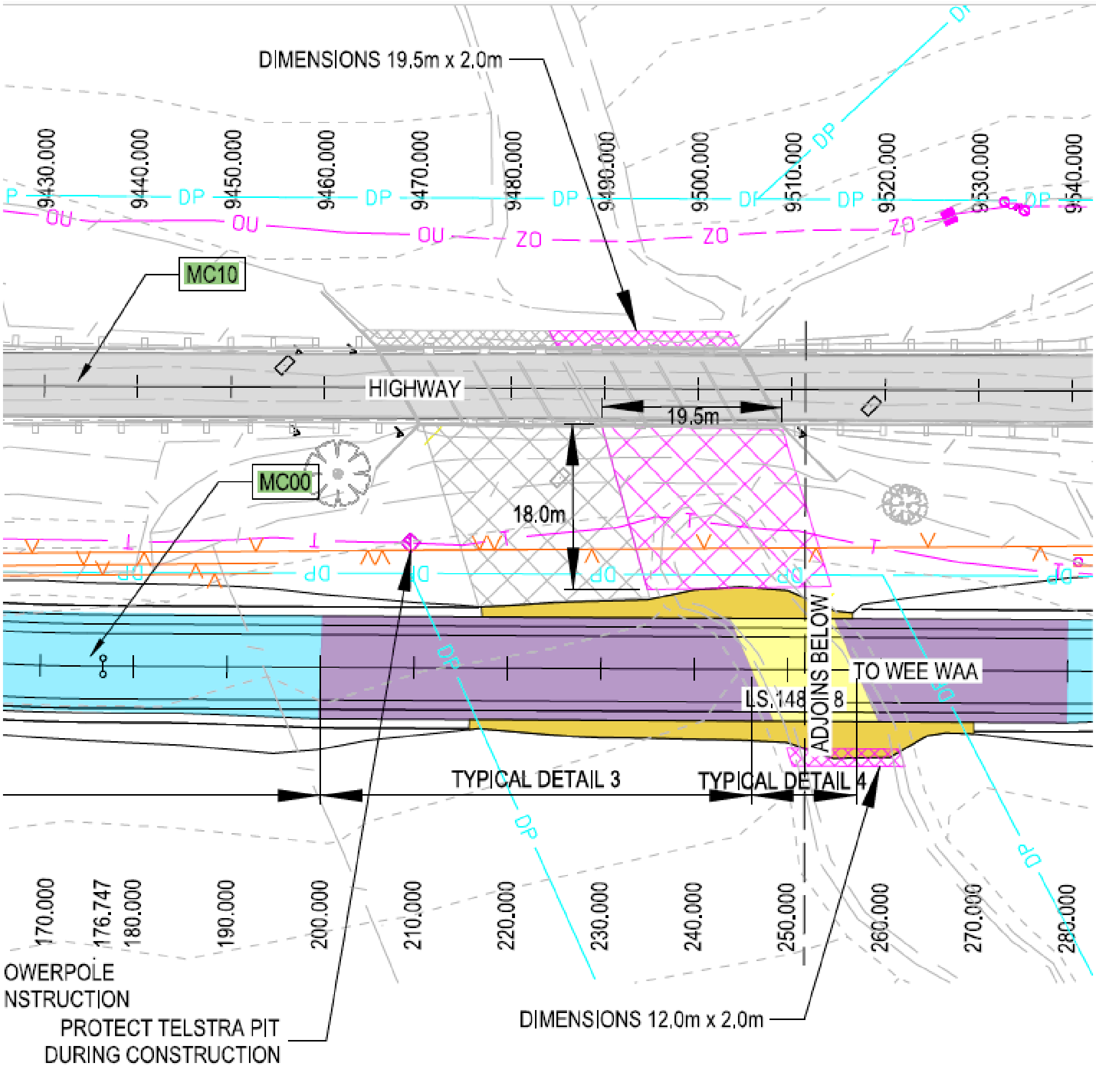


Figure 4-1 **Detour side track (Source: TfNSW)**

4.2 Statutory approvals

No allowances have been made for the impacts of any statutory or planning approvals.

4.3 Environmental

In addition, no allowances have been made during this investigation stage for the following potential environmental impacts:

- Fisheries.
- Flora and fauna.
- Aboriginal heritage.
- Acid sulphate soils and land contamination issues.
- Soils and water quality.
- Changes to hydrology and flooding.
- Aquatic ecology.
- Terrestrial flora and fauna.
- Noise and vibration.
- Traffic and access.

5. Site constraints

5.1 Geotechnical site conditions

TfNSW has completed preliminary site investigations comprising three boreholes at the existing bridge location. No geotechnical reporting has been completed with only borehole logs available to date.

5.1.1 Geology

Cardno have interpreted the borehole logs and provided an overview with reference to the 1:250,000 Geological Series of Narrabri (Sheet SH 55-12) published by the Geological survey of New South Wales Department of Mineral resources. The site is underlain by Quaternary Alluvium comprising gravel, sand, silt, and clay. The alluvials overlie bedrock comprising the Pilliga Sandstone (quartz sandstone, conglomerate, claystone) of the Mesozoic Age.

The alluvial profiles found during the site investigation are consistent with the geological sheets. The boreholes were terminated at 27.75 m to 32.45 m below ground level. Rock was not encountered within the boreholes.

5.2 Hydraulics and hydrology

The impacts of flooding have been assessed by Cardno as part of the bridge replacement. The reporting provided by Cardno was completed for the concept design submission. The report is yet to be updated to align with the current design status and does not provide much commentary on the existing condition of the culvert and its performance during flood events.

Cardno note that there is a reduction in the 100-year average recurrence interval (ARI) upstream of the bridge in the design condition with the new bridge in place. This puts the 100-year ARI flood level at approximately RL 209 m AHD in the existing condition. This level is approximately 700 mm below the existing carriageway surface.

During demolition, the detour side track will be constructed on the upstream side of the culvert. It is not clear what impacts this would have on the existing culvert during flood events and whether this has been assessed. There is a chance the behaviour of the flood waters would vary from what has been assessed and may impact the frequency and level the culvert has flow through the cells.

From recent experience, the inside of the culvert would be inaccessible during low level high frequency events. Consideration for the management of the waterway and stability of the structure during the demolition would need careful consideration.

5.3 Access

Access during demolition will be on the southern side of the culvert with an access track provided by TfNSW. It is assumed that the access track would be entered from the Kamilaroi Highway on the eastern side of the culvert with a one-way track exiting on the western side of the culvert.

The access track will be located within the creek and may be inundated during low flow events. It is expected that the access track will need to maintain flow during construction and may require temporary pipe culverts, similar to the detour side track to maintain the flow.

The location of the construction access track may be driven by the existing utilities and property boundaries. There are buried utilities on the southern side adjacent to the existing property boundaries that may impact the location of the construction access track. Refer to Section 5.4 and Section 5.5 for further information.

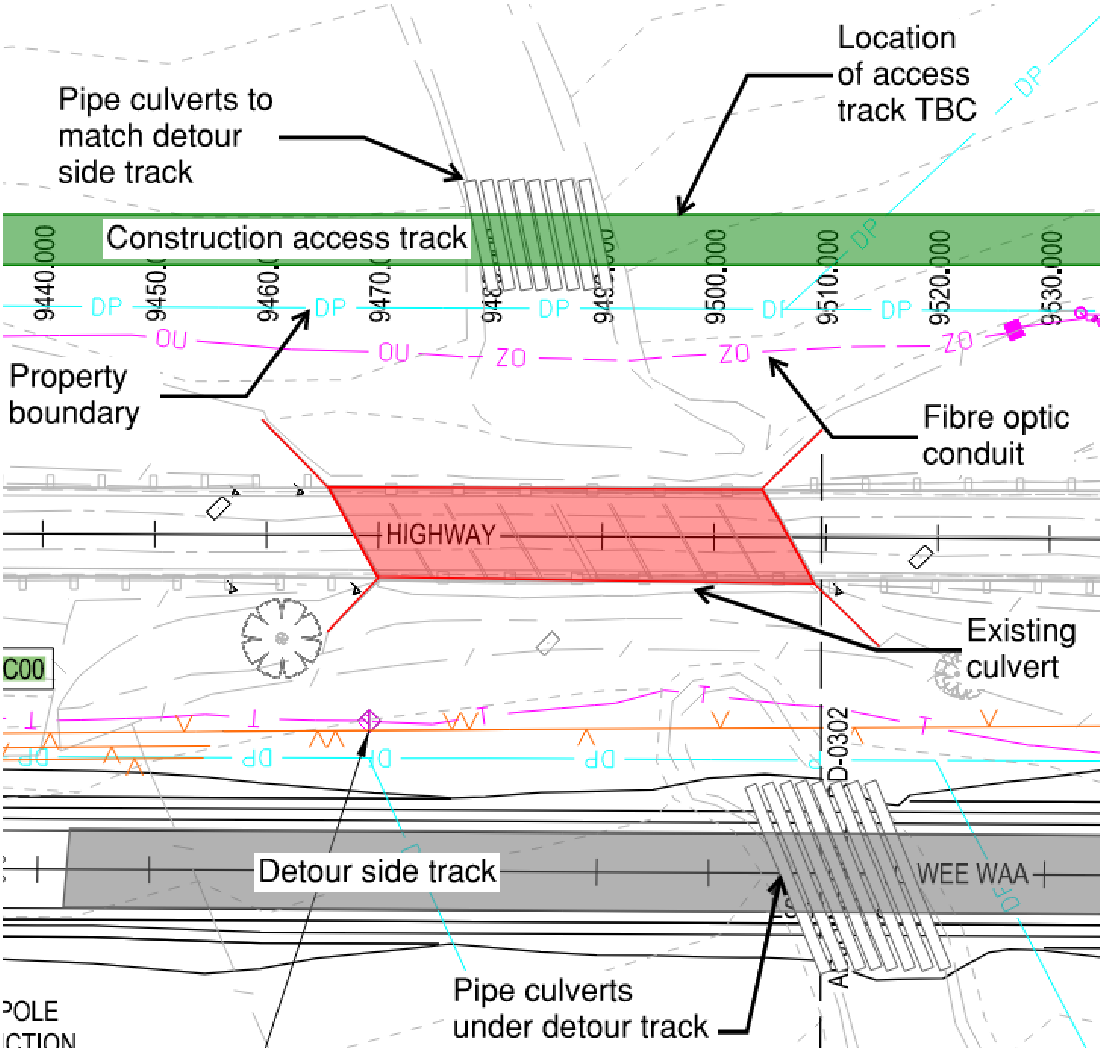


Figure 5-1 **Indicative construction access (Source: TfNSW)**

5.4 Land ownership

Spring Creek Bridge is surrounded by the following properties as shown in Figure 5-2 and Figure 5-3. Information can also be found at the following website http://maps.six.nsw.gov.au.

The road corridor is approximately 40 m wide at the bridge (see Figure 5-2 and Figure 5-3) with utilities on both side of the culvert parallel to the propoerty boundaries.

Figure 5-2 **Landownership information from NSW Department of Land and Property Information (Source: SIXMaps)**

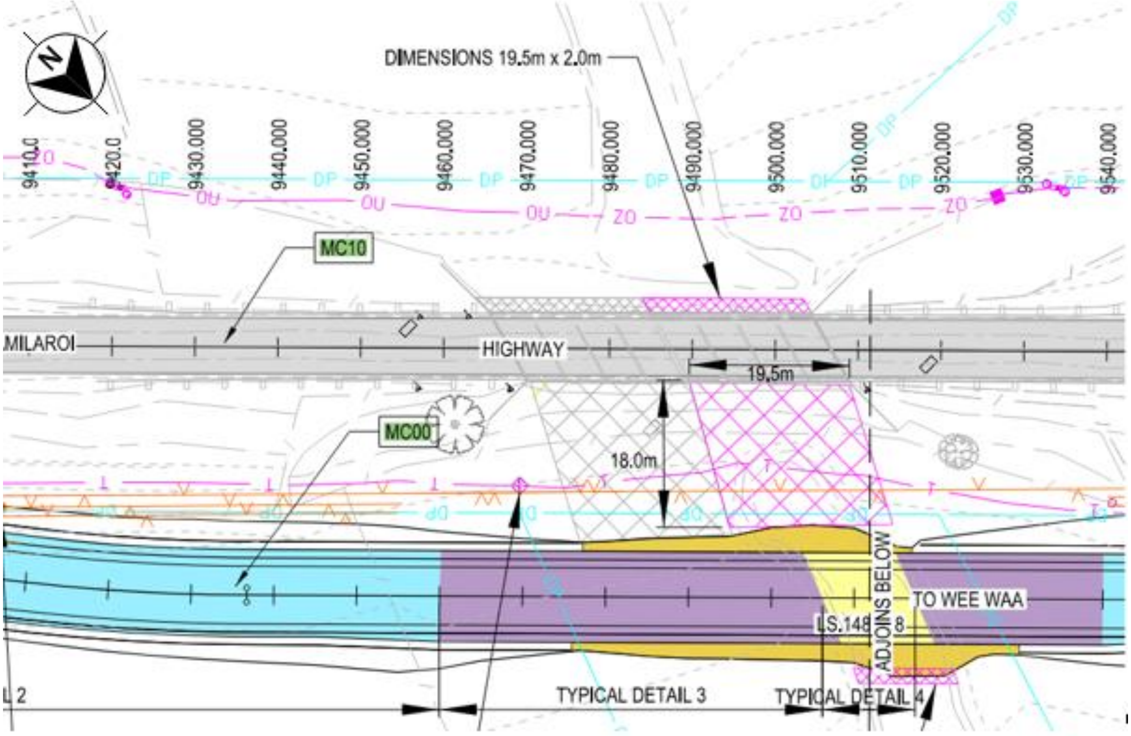


Figure 5-3 **Side track plan showing property boundary (Source: TfNSW)**

5.5 Public utilities

Enquiries were made to the public utilities and other authorities via Dial Before You Dig request job reference 33307115. The results were compared to the utilities identified by Cardno for the bridge replacement. A summary of the identified utilities is provided in Table 5-1.

Table 5-1 Dial-before-you-dig summary (Source: DBYD)

Public utility	Status
Essential Energy	• Not impacted • Overhead on the northern side of bridge
Telstra (fibre optic)	• Not impacted • Buried on the southern side of bridge

Cardno and TfNSW have identified a buried Telstra cable on the northern side of the bridge that was not identified on the DBYD plans. Refer to Figure 5-4 for the identified utilities and legend. It is recommended that all utilities are located accurately by potholing and protected (if required) prior to demolition operations.

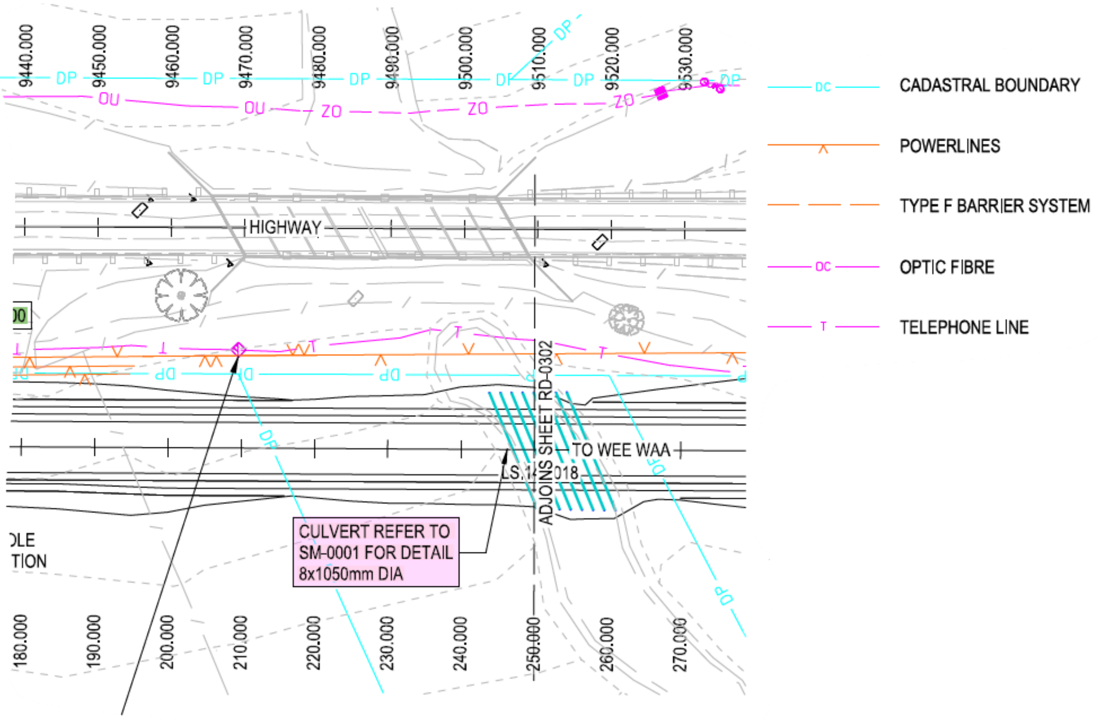


Figure 5-4 Existing utilities (Source: TfNSW)

5.5.1 Overhead powerlines

For the purposes of this report, it has been assumed that the overhead powerlines on the upstream side (see Figure 5-3 and Figure 5-5) are not being relocated for the project and are to remain in place. The overhead will need to be protected and isolated before and during the existing bridges demolition.

Figure 5-5 Overhead powerlines (Source: FBE)

5.5.2 Fibre optic

A fibre optic cable is located on the southern (downstream) side of the culvert. The plans provided by Telstra indicate a 100 mm diameter PVC conduit between cable joining pits. No further information is provided.

The location of the fibre optic may drive the location of the construction and access road and any potential excavations required for the access road or pipe culverts.

5.5.3 Communications

A Telstra conduit has been identified on the northern side of the culvert by TfNSW and Cardno. This is assumed to be a communications conduit. It was not identified by Telstra on the DBYD plans they provided.

The location of this conduit is not expected to impact the demolition of the culvert.

5.6 Other considerations

The following will also potentially impact the demolition but also the project in general:

- **Traffic.** Traffic management during construction and demolition will need to be considered including traffic and vehicle management plans.
- **Landowners.** The impact to the local landowners and community will need to be considered.

6. Demolition method

Based on discussions with TfNSW and the assessment of feasible demolition options, it has been assumed the culvert would be demolished with conventional construction plant including excavators with rock hammers and shears.

To ensure the hydraulic performance of the creek is maintained during demolition, it is assumed that the culvert would need to be demolished in stages. Each segment would be demolished in its entirety to ensure the remaining segment can accommodate the creek flows during demolition of the adjacent segment.

6.1 Demolition option selection and refinement

Once the preferred option is developed by the Demolition Contractor it will be necessary to undertake a risk management workshop with the key stakeholders to ensure its feasibility and that there are no surprises in terms of demolition parameters, constructability, programme, safety, and cost.

6.2 General basic methodology

The following general basic demolition methodology has been proposed, which can also be found in Appendix B.

For stages 1 to 3, each possible stage would be completed for each segment starting with the segment comprising Cells 1 to 4 and then repeated for Cells 5 to 8. This would allow the flow of the creek to be maintained through Cells 5 to 8 whilst the adjacent cells are demolished. Following the demolition of the first segment, the flow would be directed through the original location of Cells 1 to 4 whilst the second segment is demolished.

The basic staging is shown in Figure 6-1:

1. Stage 1: Superstructure (Red)

   Remove Crown slabs, traffic barrier, kerb, and superimposed dead loads.

2. Stage 2: Substructure (Green)

   Remove substructure down to ground/creek level.

3. Stage 3: Foundations (Blue)

   Remove base slab and tidy site.

The demolition of the structure is based on the demolition of the crown slab being undertaken from above the crown slab. This allows for an excavator with a hydraulic breaker attachment to sit on top of the segments and demolish the crown slab from above.

Alternatively, the crown slab could be demolished from the creek level. This would require a larger excavator relative to the other option to achieve the height required to demolish the structure. This method would require hydraulic breakers and/or concrete shears depending on the reach of the excavator. Additional rock platforms would also be required adjacent to the structure to demolish the crown slab from the creek level.

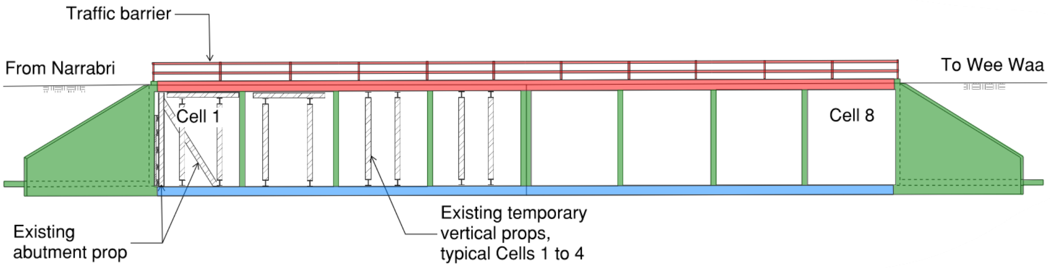


Figure 6-1 Demolition stages 1 to 3 (Source: FBE)

6.3 Pre-demolition preparation

6.3.1 Establishment

- Fence the entire site.
- Isolate and/or relocate services and implement mitigation measures.
- Hardstand area required for recycling and storage.
- Environmental requirements as required by the project.
- Prepare access and exclusion zones.
- Implement traffic, vehicle, and pedestrian management plans.

6.3.2 Preparation

- Removal of monitoring equipment (if not previously completed)
- Removal of approach barriers
- Removal of asphalt pavement over structure
- Identify and mark out scupper and asbestos removal
- Mark out location of supporting walls.

6.4 Stage methodology

Prior to Stage 1 for each segment, the creek flow is to be directed to the adjacent segment. The natural flow of the creek is between Cells 5 to 8. The first stage of demolition comprises Cells 1 to 4, the creek alignment may not be required for the initial stage.

Depending on whether the demolition would be undertaken during a dry site or wet site would impact the methodology adopted. Based on current and recent flow conditions of the creek, it is expected that the demolition of the culvert would be undertaken during a period of flow within the creek and would be considered a wet site.

6.4.1 Wet site

A temporary creek diversion during the demolition will be required and may comprise a temporary cofferdam (refer Figure 6-2), water filled aqua barrier, or lined diversion bank. The diversion will be required upstream and downstream of the segment to ensure the works can be completed within the segment whilst there is flow in the adjacent segment. The diversion would be in addition to conventional silt barriers and environmental management measures surrounding the segment being demolished.

Figure 6-2 Temporary cofferdam (Source: PMA Australia)

The creek diversion could be installed between the side track and the existing culvert on the northern side and the existing culvert and the access road on the southern side of the culvert. This would provide a dry site for demolition and waste removal during periods of flow through the culvert.

The first segment to be demolished comprises Cells 1 to 4, a diversion could be provided through Cell 5 on the eastern side of the pipe culverts between both the detour side track and the construction access. Following Stage 3 of the first segment, the diversion could be realigned to provide a dry site for the second segment.

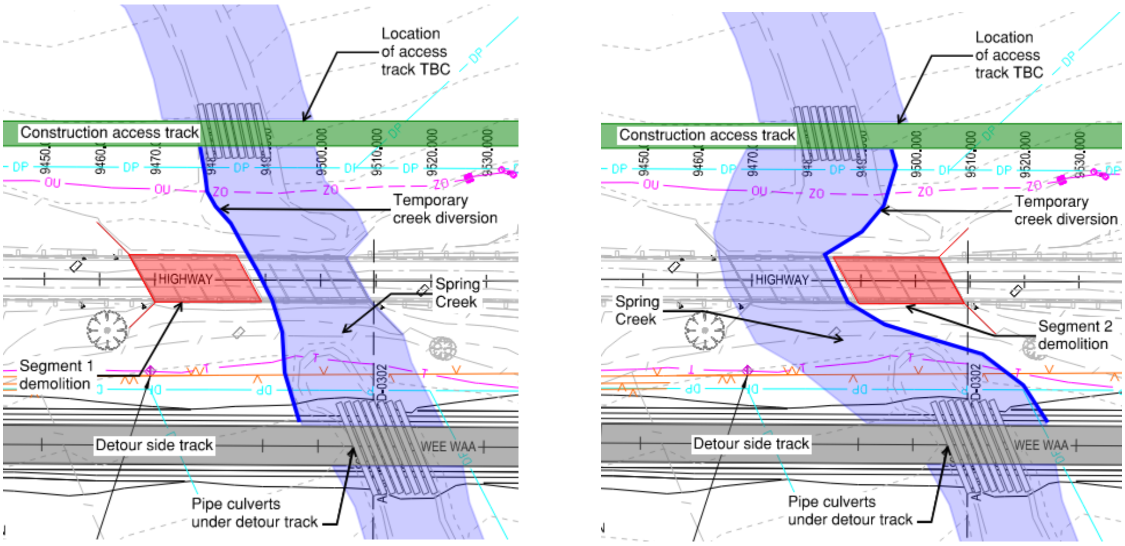


Figure 6-3 Indicative temporary creek diversion (Source TfNSW & FBE)

The current detour side track drawings have a design surface level approximately 500 mm above the invert of the culvert. Assuming the access track provided on the southern side of the culvert is at a similar design surface through the creek, the access track will be accessible whilst there is approximately 500 mm of water depth through the culvert.

At water depths greater than 500 mm through the culvert, both the detour track and the construction access would not be accessible.

Consideration to the design surface of the access track and the impacts to hydraulic performance of the culvert during demolition will need to be considered prior to construction of the construction access track. Depending on the frequency of having 500 mm of water through the culvert, there may be an opportunity to vary the design surface of the access track to ensure the construction access is accessible at an acceptable frequency.

Consideration will need to be given to how the site is managed in periods where the diversion is overtopped and at what frequency this can be expected. Once the diversion is overtopped, there is a greater risk of waterway contamination as a large area of the site may be inundated with water that is not easily controlled.

6.4.2 Dry site

If the demolition is undertaken during a period of no flow, the similar methodology to a wet site could be adopted. As there would be no water through the culvert, the area surrounding the segment being demolished would require conventional silt barriers and environmental management measures to ensure the waterway is protected from demolition debris and runoff.

Similar to the wet site, consideration would need to be given to how the site is managed if water does enter the site and how the potential contamination is contained.

6.5 Demolition from above

6.5.1 Stage 1 - Superstructure demolition

The following work is to be completed once the site has been granted access and all planning, risk assessments, demolition plans, etc have been completed and signed off by TfNSW or its representative.

Stages 1 to 3 are repeated for each segment. The first segment to be demolished is the eastern segment comprising Cells 1 to 4.

Stage 1.1: Remove Cell 4 crown slab

- Refer to Figure 6-4
- Remove traffic barrier
- Locally demolish kerb and remove asbestos gutter surrounds and scuppers
- Remove temporary props within Cell 4 (not required for western segment)
- Demolish crown slab above Cell 4 with plant located above Cell 3.

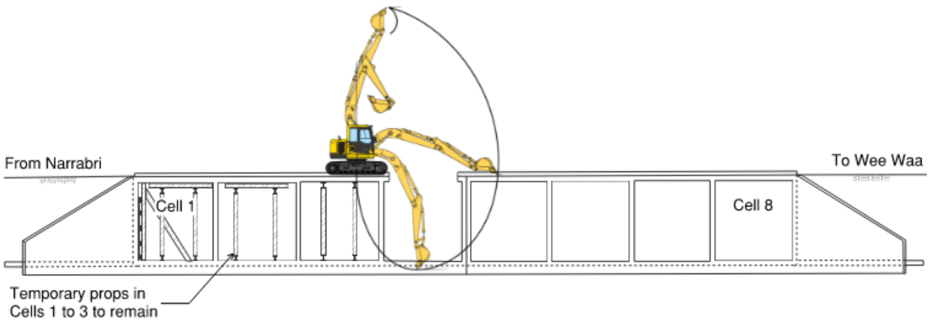


Figure 6-4 Demolition Stage 1.1 Cell 4 (Source: FBE)

Stage 1.2 – 1.4: Remove Cell 3 to 1 crown slab

- Refer to Figure 6-5 to Figure 6-7
- Install temporary diagonal bracing for internal wall between Cells 3 and 4
- Remove temporary props within Cell 3 (not required for western segment)
- Demolish crown slab above Cell 3 with plant located above Cell 2
- Repeat steps for Cells 2
- Following demolition of Cell 2, repeat steps for Cell 1

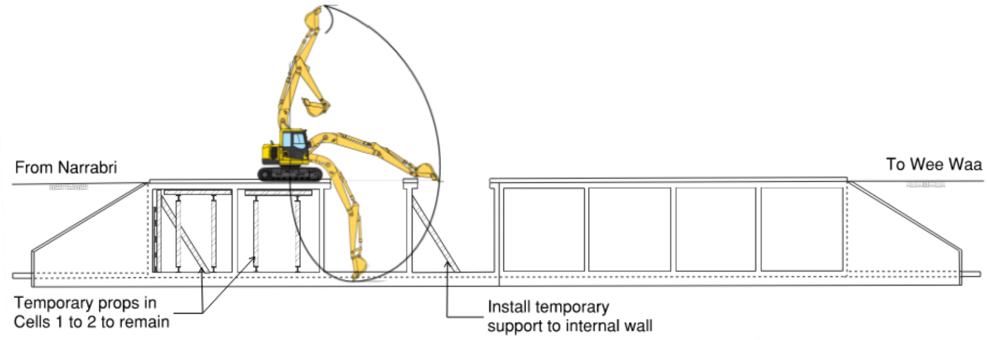


Figure 6-5 Demolition Stage 1.2 Cell 3 (Source: FBE)

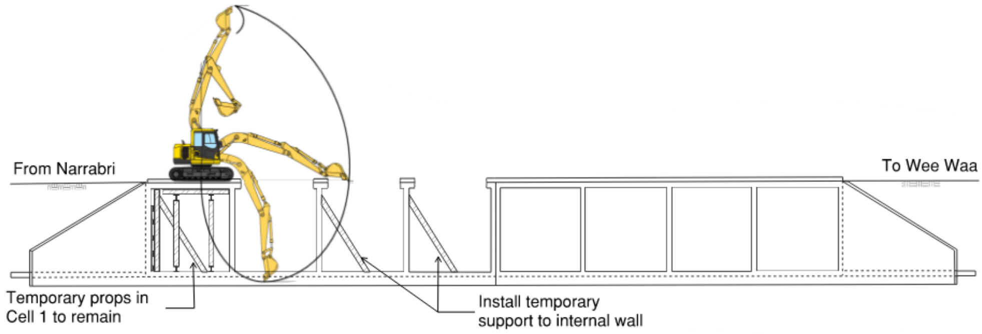


Figure 6-6 Demolition Stage 1.3 Cell 2 (Source: FBE)

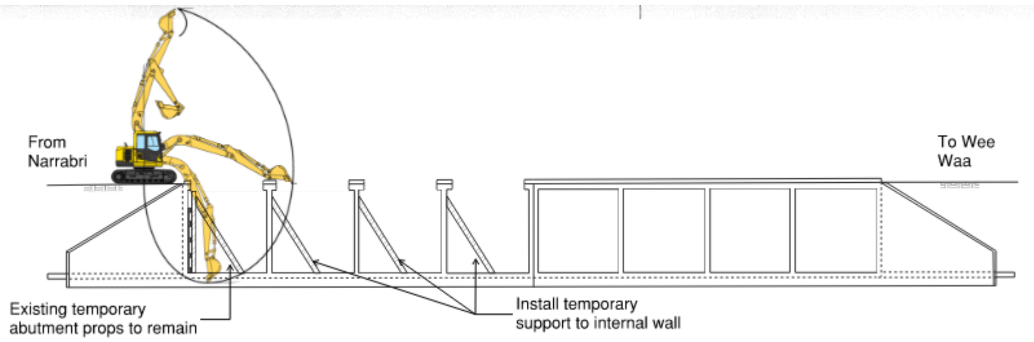


Figure 6-7 Demolition Stage 1.4 Cell 1 (Source: FBE)

6.5.2 Stage 2 – Substructure demolition

- See Figure 6-8
- Excavate behind abutment
- Demolish Abutment A using excavators with jack hammers to ground/creek level.

- Remove internal walls and temporary wall bracing.

Note that during and/or after the deck removal above Cell 1, the abutments may become unstable. Care must therefore be taken in this regard by the Demolition Contractor to ensure live loads and plant locations consider these risks. Temporary diagonal bracing is provided to Abutment A, although the adequacy of the bracing would need to be considered by the Demolition Contractor.

There is currently no temporary props or diagonal bracing provided to any of the structure within Cells 5 to 8, any requirement for support would need to be considered by the Demolition Contractor. Based on the condition of the western segment, it is not expected that temporary vertical props are required within segments to support the crown slab during demolition. Further assessment may be required depending on the final demolition methodology adopted and plant proposed by the Demolition Contractor.

In addition, high creek water levels, flooding and rapid draw-down effects may exacerbate these risks.

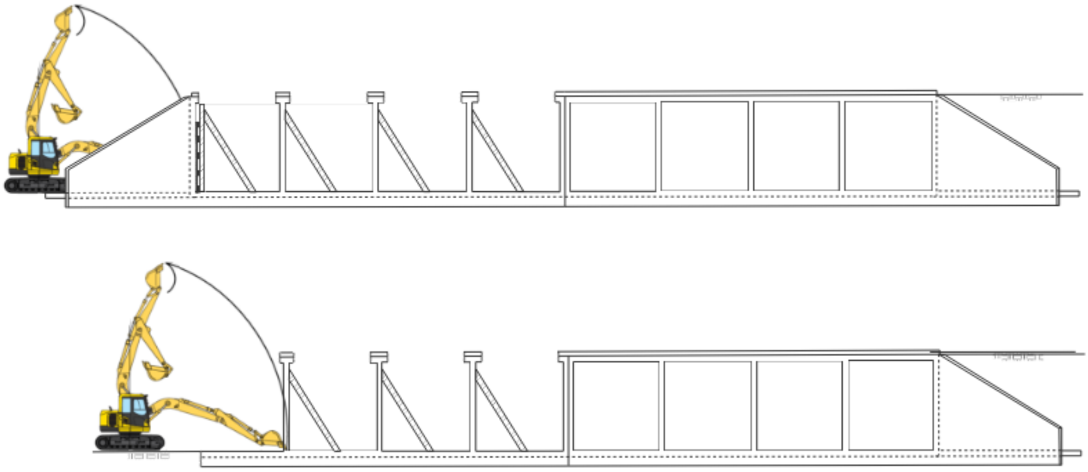


Figure 6-8 Demolition Stage 2 (Source: FBE)

6.5.3 Stage 3 – Foundations capped and demobilise

- Remove base slab and cut off wall.
- Concrete to be recycled offsite.
- Tidy site.
- Redirect flow through the now demolished segment.
- Complete Stages 1 to 3 for the western segment.

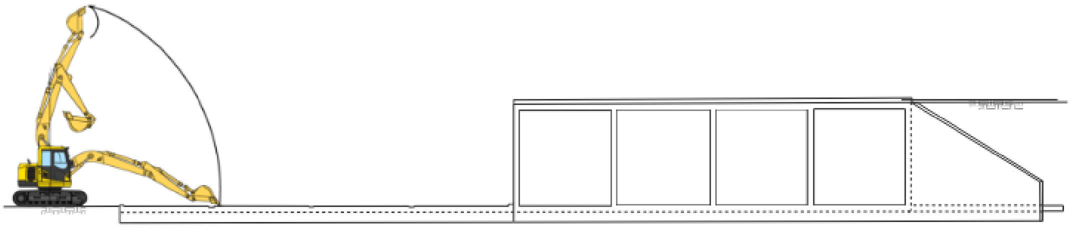


Figure 6-9 Demolition Stage 3 Segment 1 completed (Source: FBE)

6.6 Demolition from the creek

6.6.1 Stage 1 - Superstructure demolition

The following work is to be completed once the site has been granted access and all planning, risk assessments, demolition plans, etc have been completed and signed off by TfNSW or its representative.

Stages 1 to 3 are repeated for each segment. The first segment to be demolished is the eastern segment comprising Cells 1 to 4.

Stage 1.1: Remove Cell 4 crown slab

- Refer to Figure 6-10
- Remove traffic barrier
- Locally demolish kerb and remove asbestos gutter surrounds and scuppers
- Remove temporary props within Cell 4 (not required for western segment)
- Demolish crown slab above Cell 4 with plant located within creek adjacent to segments.

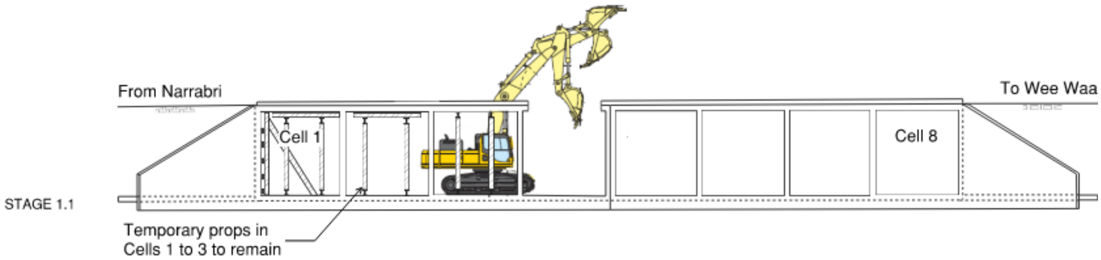


Figure 6-10 Demolition Stage 1.1 Cell 4 (Source: FBE)

Stage 1.2 – 1.4: Remove Cell 3 to 1 crown slab

- Refer to Figure 6-11 to Figure 6-13
- Remove temporary props within Cell 3 (not required for western segment)
- Demolish crown slab above Cell 3 with plant located within creek adjacent to segments
- Repeat steps for Cells 2
- Following demolition of Cell 2, repeat steps for Cell 1

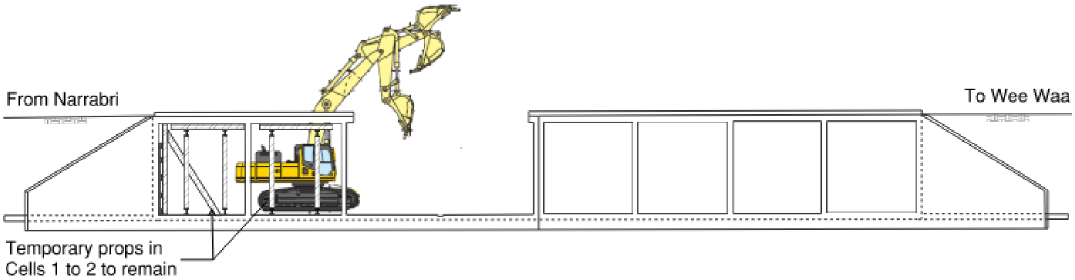


Figure 6-11 Demolition Stage 1.2 Cell 3 (Source: FBE)

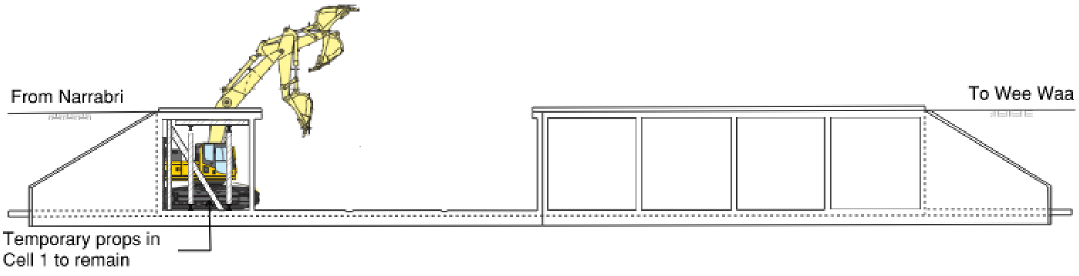


Figure 6-12 **Demolition Stage 1.3 Cell 2 (Source: FBE)**

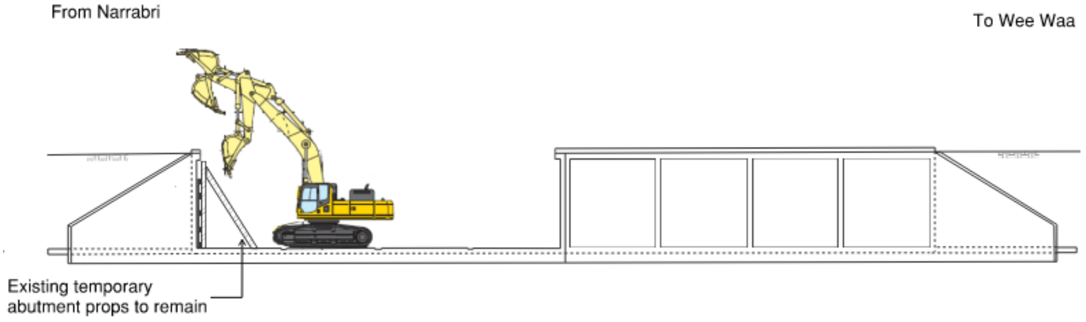


Figure 6-13 **Demolition Stage 1.4 Cell 1 (Source: FBE)**

6.6.2 Stage 2 – Substructure demolition

- See Figure 6-14
- Excavate behind abutment
- Demolish Abutment A using excavators with jack hammers to ground/creek level.

Note that during and/or after the deck removal above Cell 1, the abutments may become unstable. Care must therefore be taken in this regard by the Demolition Contractor to ensure live loads and plant locations consider these risks. Temporary diagonal bracing is provided to Abutment A, although the adequacy of the bracing would need to be considered by the Demolition Contractor.

There is currently no temporary props or diagonal bracing provided to any of the structure within Cells 5 to 8, any requirement for support would need to be considered by the Demolition Contractor. Based on the condition of the western segment, it is not expected that temporary vertical props are required within segments to support the crown slab during demolition. Further assessment may be required depending on the final demolition methodology adopted and plant proposed by the Demolition Contractor.

In addition, high creek water levels, flooding and rapid draw-down effects may exacerbate these risks.

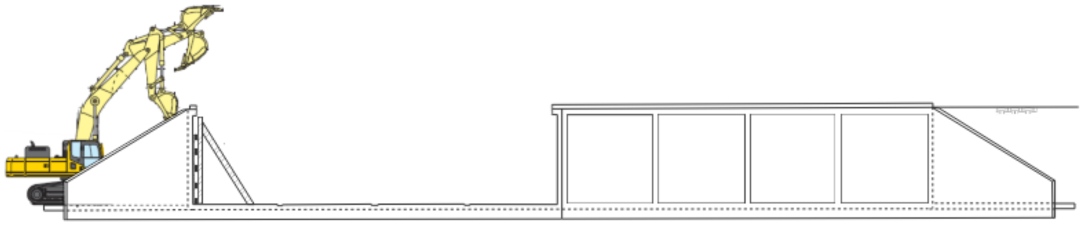


Figure 6-14 **Demolition Stage 2 (Source: FBE)**

6.6.3 Stage 3 – Foundations capped and demobilise

- Remove base slab and cut off wall.
- Concrete to be recycled offsite.
- Tidy site.
- Redirect flow through the now demolished segment.
- Complete Stages 1 to 3 for the western segment.

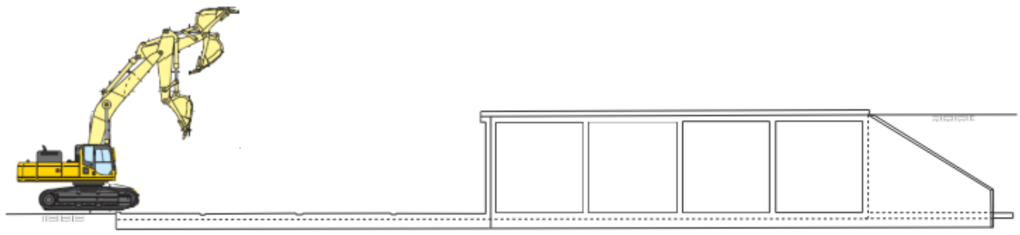


Figure 6-15 Demolition Stage 3 Segment 1 completed (Source: FBE)

6.7 Demolition considerations

The outlined methodology would also need consideration given to the following items:

- **Temporary abutment and internal wall bracing.** The methodology assumes that the bracing is sacrificial unless a safe methodology can be achieved to remove. The bracing could be steel SHS or CHS members with plates attached for fixing to the base slab and walls. The base plate could provide additional fixing locations to allow for flexibility in fixing locations to avoid reinforcement clashes.
- **Concrete reinforcement.** The methodology assumes the demolition of the structure would be completed with excavators with rock hammers. Following the demolition of the crown slab, there would likely be large amounts of reinforcement that is continuous over the internal walls. At these locations the reinforcement may be required to be cut, it is assumed this can be completed with hydraulic shears on an excavator.
- **Demolition method.** The methodology adopted will drive the size of the plant required and the associated works within the creek. Demolition from above the segments can potentially be completed with smaller plant than what would be required if completed from within the creek. The use of concrete shears/crushers may be required in lieu of hydraulic breakers. Demolition within the creek would also require rock platforms within the creek, this may be integrated with the rip rap scour protection provided during the temporary detour works.

The above list is not exhaustive.

7. Risk management

The following risk management criteria would typically be used as the basis to assess the preferred demolition methods and consider any potential alternative demolition methods. For Spring Creek Bridge the demolition risk assessments would focus on removal of the culvert using excavators with jack hammer and shear attachments.

For the purposes of this report the general bridge arrangement has been assumed as shown in Figure 7-1.

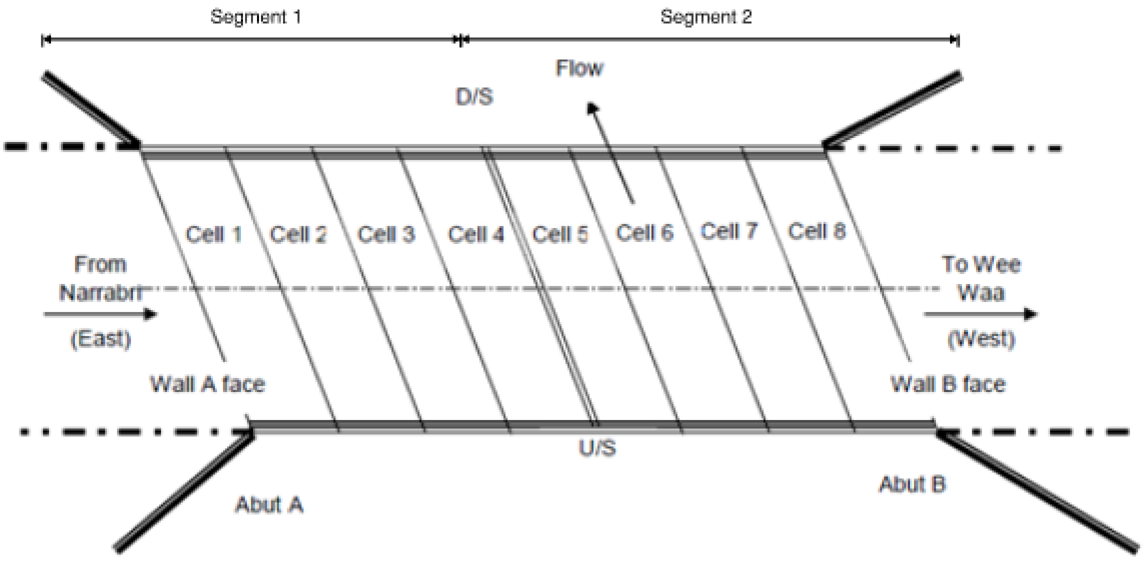


Figure 7-1 Culvert general arrangement (Source: TfNSW and FBE)

The following risk management section will be used as the basis to assess:

- TfNSW's and the Tenderer's preferred demolition methods.
- Assess any potential alternative demolition methods using the same format.

The risk management would also inform the tender assessment and weightings criteria.

7.1 Demolition constraints

The general constraints and risks associated with demolition would include but not necessarily be limited to the following criteria:

- **Existing bridge condition.** The condition of the bridge may preclude or favour some demolition methods over others.
- **Access.** To the bridge is available via the road and the yet to be constructed access track.
- **Safety.** Both for the contractor and the public.
- **Height.** The bridge road deck level is approximately 5 m in height above the invert of the base slab.
- **Approvals.** The demolition contractor will have to supply a demolition licence, plan that complies to AS2601: The Demolition of Structures, and appropriate TfNSW and SafeWork NSW demolition notifications and approvals.
- **Dust.** The level of particulates in the air may need to be established.

- **Noise.** This impact will have to be assessed and monitored if required.
- **Vibration.** The peak particle velocity (ppv) will need to be set.
- **Lead paint management.** This will have to be covered by a person competent to manage lead with appropriate lead management documentation and if necessary monitoring and controls. If lead paint is present and above prescribed safe levels, then personnel involved in the handling will need to undergo health monitoring (lead blood testing). The Demolition Contractor would also need to notify SafeWork NSW of the works to be undertaken.
- **Community.** It is anticipated that TfNSW would manage this aspect of the works in conjunction with the successful demolition contractor.
- **Habitat, flora and fauna.** The demolition activities will need to comply with the requirements of the REF.
- **Exclusion zones.** This will need to be set by with the demolition contractor in conjunction with SafeWork NSW.
- **Specifications.** TfNSW QA B341 – Demolition of Existing Structures and AS2601 – The demolition of structures and the NSW Code of Practice: Demolition Work, August 2019. These specifications will need to be considered and included in the demolition risk assessments.
- **Waste management.** This would include concrete and metal recycling options.

The above list is not exhaustive.

7.2 Risk matrix

The demolition hazards are typically assessed using the risk matrix in Table 7-1 covering at least the following risks including the environment, safety (including risk to workers), damage to the new structure and the community.

Table 7-1 Risk Matrix (Source: TfNSW)

Consequences C_R	H	3	4	5
	M	2	3	4
	L	1	2	3
		L	M	H
	Likelihood L_R			

where L = Low, M = Medium and H = High.

7.3 Risk assessment

Table 7-2 shows a preliminary risk assessment completed for this project and is provided for information only.

The contractor must complete its own independent risk assessment as part of their demolition plan.

Table 7-2 Preliminary risk assessment (Source: FBE)

Hazard	L_R	C_R	Risk Rank	Comments
Risk to Environment				
Contamination of road corridor	L	M	2	Risk to the road corridor as the deck will be cut and locally demolished with jack hammers. Sedimentation controls will be required in creek. Potential for cofferdams depending on the site at the time. Noise will be apparent during jack hammering and removal. Not located within a highly populated location.
Contamination of creek	M	H	4	
Noise from demolition of structure	M	L	2	
Risk to Workers				
Working on or under an unstable structure that could collapse	M	H	4	A crew will need to work on and around the structure. There is a greater risk of internal walls and abutments becoming unstable during demolition. Temporary props are located within Cells 1 to 4 that will need to be removed prior to demolition of each crown slab. Temporary diagonal bracing will also be required to stabilise the internal walls and abutments during demolition. There is a risk to workers working in and around the temporary props during removal. It has been assumed that the overhead powerlines will be outside of demolition site but will need to be isolated or protected. The construction access track is adjacent to the fibre optic, it is assumed that the conduit will be located and protected during demolition. The bridge will be demolished under an approved demolition plan by pre-qualified contractors skilled in such work. Workers may be exposed to at heights risks but over a short period of time. As the culvert is dismantled / removed it will be difficult to maintain a fall arrest system. Temporary traffic barriers on the road approaches during construction will delineate the site and provide a safe working area.
Removing temporary props	M	H	4	
Overhead powerlines	L	H	3	
Other services (fibre optic, Telstra)	M	H	4	
Falling from heights	L	H	3	
Unplanned collapse	L	H	3	
Risk from traffic	L	H	3	

Table 7-2 Preliminary risk assessment continued (Source: FBE)

Hazard	L_R	C_R	Risk Rank	Comments
Damage to Existing Structure				
Unknown details of the bridge design and construction.	H	M	4	Site investigations of the existing bridge required. Additional works including remedial works might not be captured.
Abutment and wing wall stability	M	H	4	Excavators and cranes in creek or behind existing abutments require stability/safety checks to be completed.
Community				
Adverse community reaction	L	M	2	The demolition process should have a low community impact. However, consultation may be required.
Risk to pedestrians and road users.	L	H	3	Exclusion zone and traffic, vehicle and pedestrian management plans to be in place during demolition.
Total Risk Score			45/70	

8. Demolition plan

This report is not a demolition plan and the demolition contractor will be required to prepare a demolition plan covering for example the following:

8.1 Licences, notifications and approvals

The following provides a summary of licences, notifications and approvals required to demolish, dismantle and remove the concrete culvert:

8.1.1 Table of dates

Commencement: dd/mm/yy.

Anticipated completion: dd/mm/yy

8.1.1 Notification to SafeWork NSW

SafeWork NSW must be notified in writing no later than 5 working days prior to demolition commencing on site:

http://www.workcover.nsw.gov.au/licences-and-registrations/notifications-and-permits/demolition-notifications

Date notified: dd/mm/yy

Expiry: dd/mm/yy

LICENCE NO. AA1234567 (Expires mm/yy)

8.1.1 Controlling Codes

- AS 2601 – Demolition of Structures.
- B341 TfNSW Demolition of Structures.
- Work Health & Safety Act 2011.
- Work Health & Safety Regulation 2011.
- AS 4361.1 – Guide to Lead Paint Management – Industrial Applications.

8.2 Procedure summary

8.2.1 Termination of services

Any and all terminations and/or suspension of services must be detailed here.

8.2.2 Exclusion/drop zones, temporary fencing and signage

Prior to any works being carried out, appropriate signage and barriers for the protection of the public and employees will be placed at nominated positions as instructed by the site foreman and/or demolition works supervisor.

The site will be completely closed off from the public for the proposed works with temporary fencing.

Exclusion/drop zones required for demolition works will be demarcated and signed to ensure that there is no unauthorised access by site personnel to these designated areas. Access to the demolition area must be approved by the demolition manager before any persons enter the area.

Ideally a full time spotter should be in place to prevent unauthorised access of men or machinery.

Typical signs would include:

Figure 8-1 **Danger, Keep Out, Authorised Personnel Only (Source: FBE)**

Figure 8-2 **Danger, Keep Out, No Access (Source: FBE)**

Figure 8-3 **Danger, Demolition in Progress, Keep Out (Source: FBE)**

Figure 8-4 **Danger, Construction Site, Do Not Enter (Source: FBE)**

In addition, contact sign details for work supervisor, phone number (24 hr), UHF channel XX.

8.2.1 Minimum PPE requirements

The minimum site PPE is as follows:

- Safety helmet AS 1801.
- Safety vests/long sleeve shirt.
- Long pants.
- Gloves.
- Safety footwear to AS 2210.
- Eye protection (safety glasses) to AS 1337.

Additional PPE stored on site and distributed by the demolition supervisor as required:

- Leather gauntlets for oxy-cutting, harnesses, static line, inertia reel, etc.

- Hearing protection (ear plugs).
- Hand protection (nylon or leather gloves).
- Harness for working at height.

8.3 Methodology

The bridge deconstruction, dismantling and demolition methods will need to be carefully documented and detailed. This will need to include but not be limited to the following:

- Demolition engineering and sign off.
- Temporary works designs and clear instructions for temporary bracings if required.
- Detailed methodology and procedures. Great care will be required around any proposed saw cuts, including clashes with existing reinforcing bars and temporary props.
- Safety plan including SWMS, work methods/ staging, traffic plans, MSDS, exclusion zones licences, certification, induction records, prestart briefings, training records.
- Demolition specifications.
- Risk assessment.
- Plant and equipment to be used.
- Safe access and safe work areas.
- Essential services.
- Adjacent structures.

8.4 Lead paint management

Lead-based paint has been identified as potentially being on certain members of the existing structure for e.g., handrails and barriers. Consequently, a risk assessment should be completed to AS 4361.1.

Red lead-specific controls and activities will be as follows:

- Oxyacetylene operators are to be briefed in regards to potential contamination.
- Handrail to be unbolted where possible and carefully removed.
- All lead painted steel sections will be removed, re-used or disposed whilst minimising disturbance of the paint surface and substrate.
- All lead painted members will be stored on a layer of geofabric, stockpiled separately and will be covered in wet or windy conditions.

8.5 Asbestos removal

The asbestos should be removed in accordance with the NSW Code of Practice – How to manage and control asbestos in the workplace (2003).

9. Programme

An overall high level indicative demolition programme has been developed with the main activities summarised in Table 9-1

Table 9-1 Preliminary estimated programme (Source: FBE)

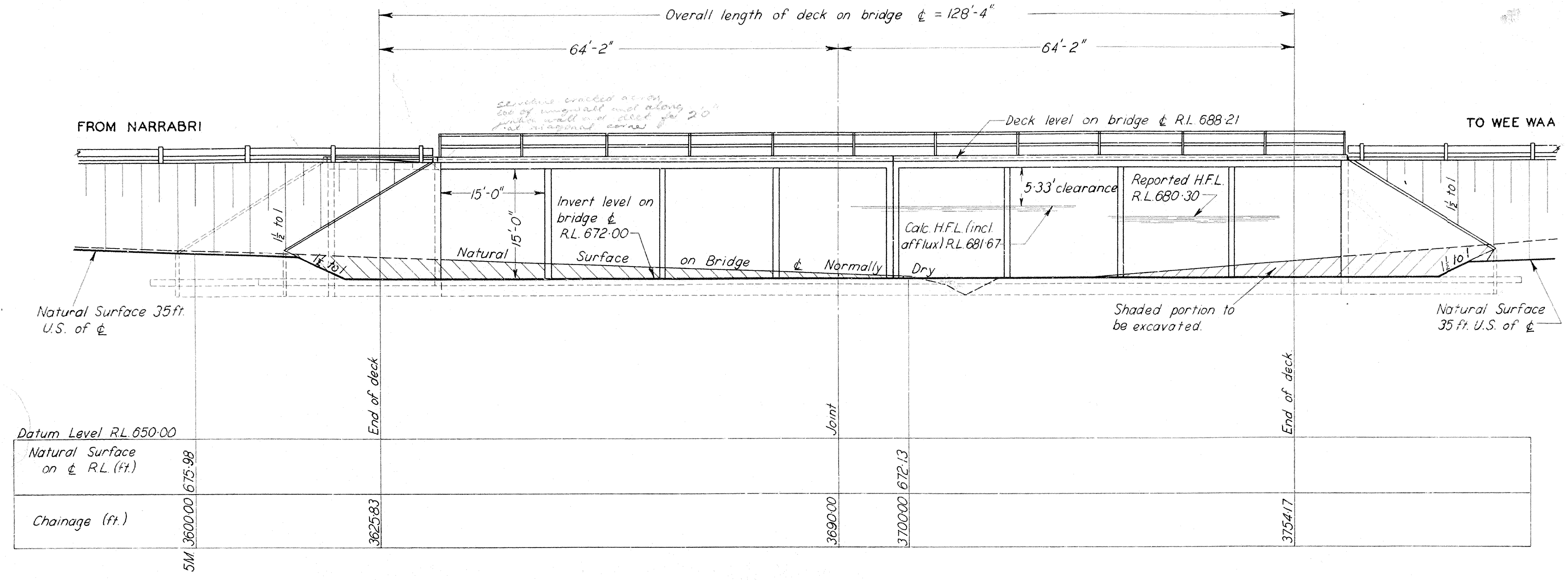
Item	Activity	Start	Finish
Establishment			
0.1.1	Fence site and exclusion zone	Week 1	Week 1
0.1.4	Prepare access	Week 1	Week 3
0.2.2	Environmental and traffic controls	Week 1	Week 1
3.1.1	Prepare demolition plan and approvals	Week 1	Week 2/3
Demolition			
1.1.4	Install creek diversion and environmental protection	Day 1	Day 2
1.1.5	Remove traffic barrier	Day 2	Day 2
1.1.6	Demolish kerb and remove asbestos	Day 2	Day 3
1.2.1	Demolish crown slab of Cells 1 to 4	Day 3	Day 8
1.2.2	Remove temporary props	Day 4	Day 8
1.2.3	Demolish Abutment A	Day 8	Day 8
1.2.4	Demolish substructure and base slab	Day 9	Day 10
1.2.5	Realign creek into demolished segment and install cofferdam and environmental protection	Day 11	Day 12
1.3.1	Demolish crown slab of Cells 5 to 8	Day 13	Day 15
1.3.2	Demolish Abutment B	Day 16	Day 16
1.3.3	Demolish substructure and base slab	Day 17	Day 18
1.3.4	Tidy site and demobilise	Day 19	Day 20
	Contingency – wet weather and staging delays	*Nil*	*Nil*

The timeframes for all activities are based on best case scenarios and there is no float or allowances for delays due to funding, approvals, wet weather, etc. The programme assumes all services and utilities have been relocated prior to demolition commencing.

FBE does not take any responsibility for the delivery of the project to target deadlines and remains the responsibility of the Contractor.

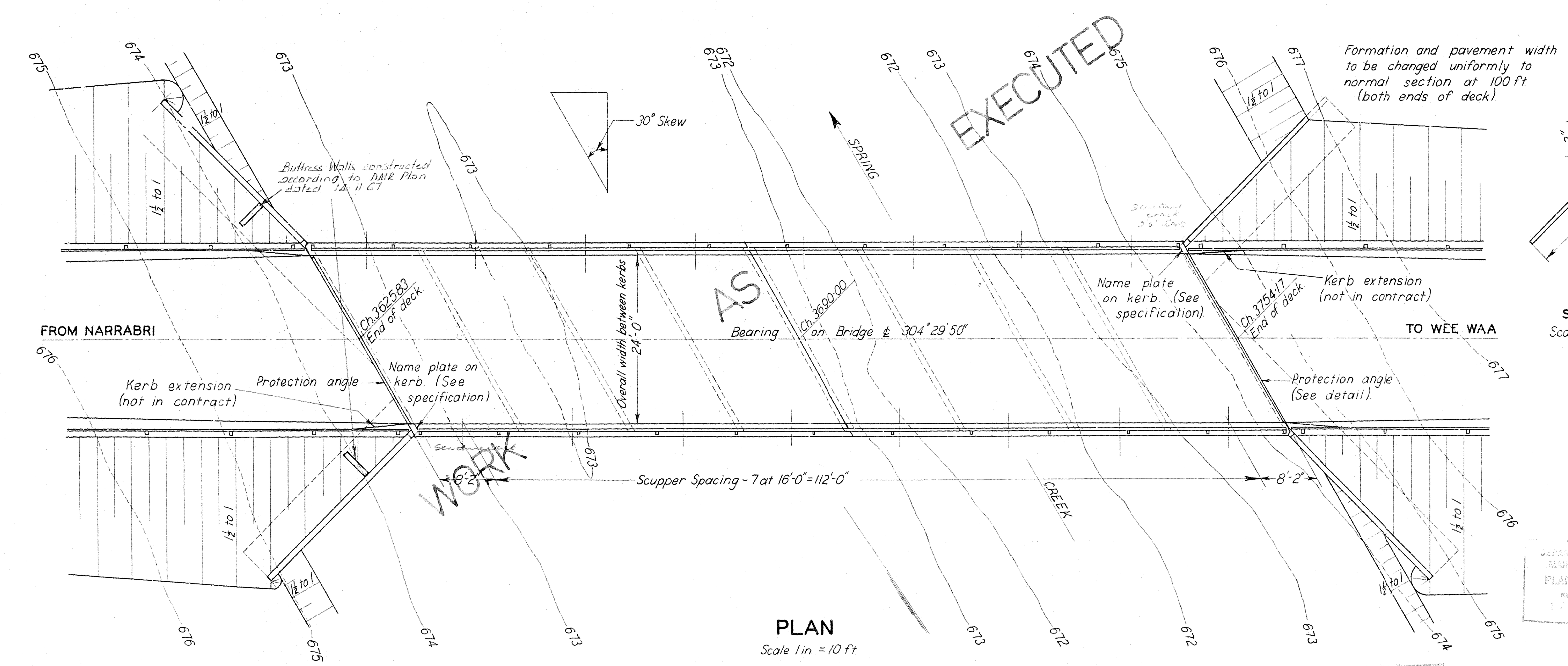
Appendices

Appendix A – WAE Bridge drawings



ELEVATION

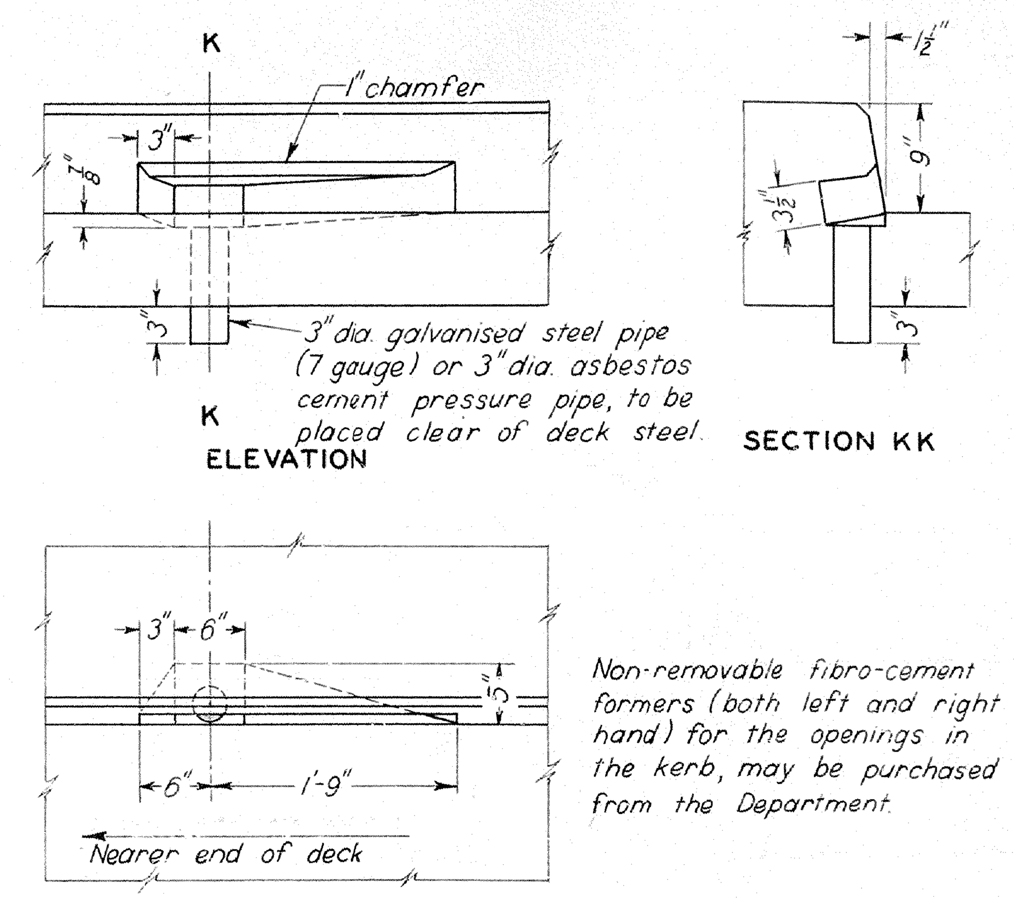
Scale 1 in. = 10 ft.



PLAN

Scale 1 in. = 10 ft.

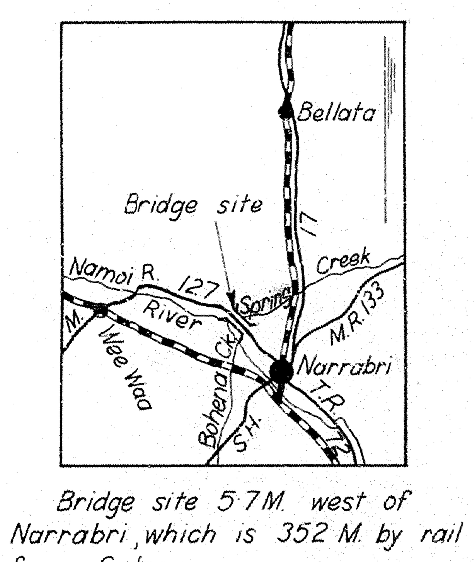
Channel to be excavated for 50 ft. U.S., and D.S. of bridge ℄. (In bridge contract)



SCUPPER

Scale: 1 in. = 1 ft.

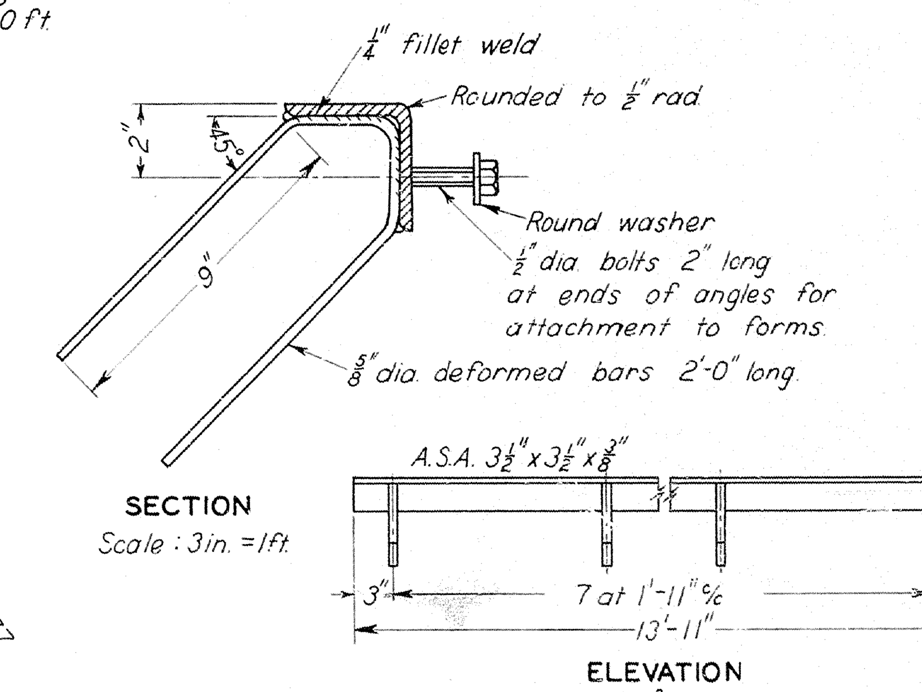
8 required as shown and 8 opposite hand



Bridge site 5.7M. west of Narrabri, which is 352 M. by rail from Sydney.

LOCALITY PLAN

Scale 1 in. = 16 M.



PROTECTION ANGLES

The class of finish on concrete surfaces shall be :-

- Kerbs: .... Class A
- All areas exposed to view .... Class B
- All hidden areas, except areas in contact with earth fill .... Class C

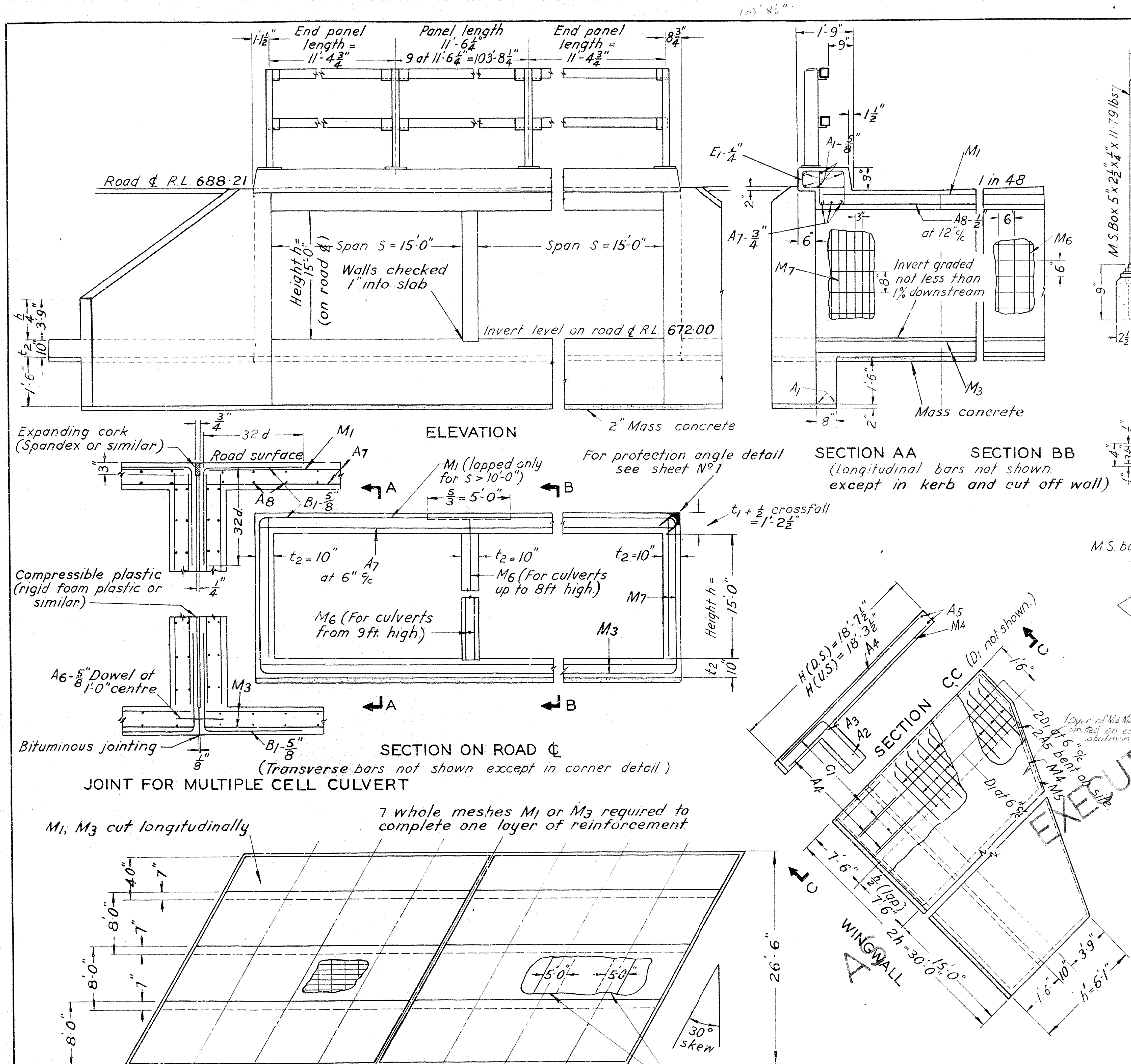
Bridge contract does not include approaches, guardrailing on approaches or rubble backing at weepholes.

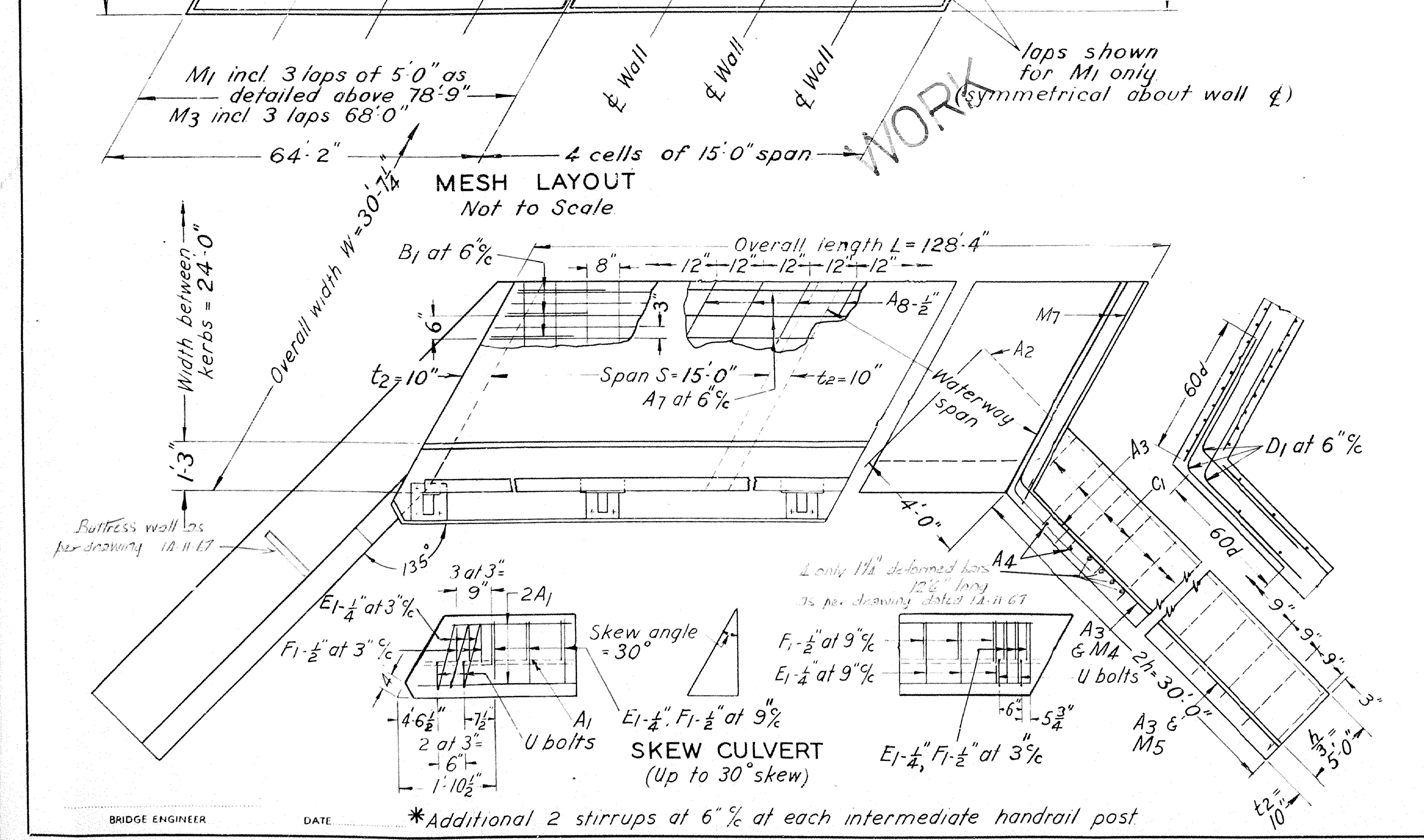
Bench mark on box 63 ft. right of chainage 3620 at R.L. 676·45

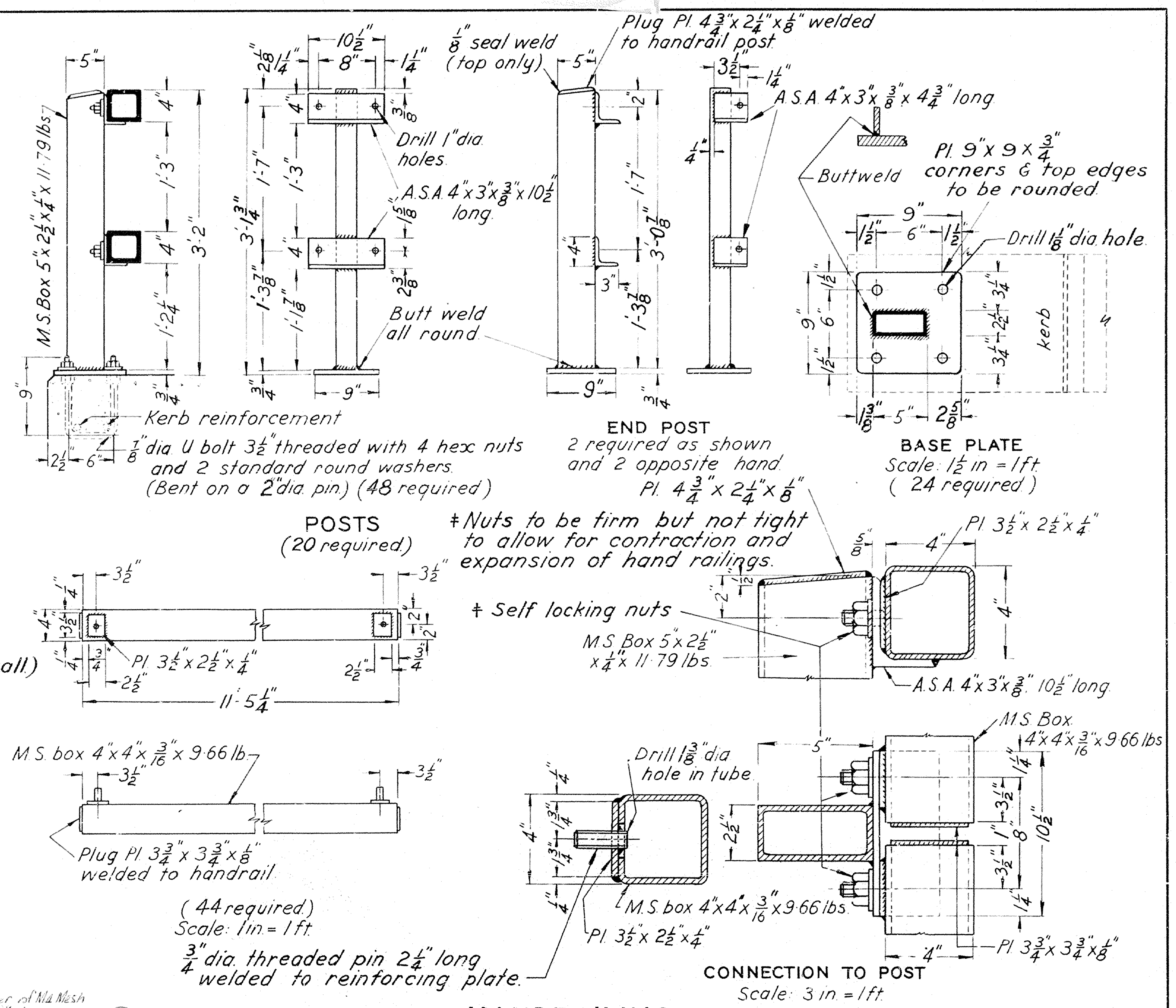
SHEET 3 of 4 0127 318B C0523

APPROVED J. C. Cook for CHIEF ENGINEER DATE 26-6-67	DEPARTMENT OF MAIN ROADS, N.S.W.
	MAIN ROAD No 127 — SHIRE OF NAMOI
	2/4 CELL 15 FT. x 15 FT. CULVERT OVER SPRING CREEK AT 5M. 3700' WEST OF NARRABRI
	PLAN, ELEVATION AND SCUPPER
	PREPARED / CHECKED — DESIGN / DRAWING — REGN. No. OF PLANS 27B523
	DESIGNING ENGINEER FOR BRIDGES — DESIGN LOADING D.M.R. 1957
	for ASSOCIATE BRIDGE ENGINEER 23/6/67 — SHEET No. 1 — No. OF SHEETS 2

J. C. Cook 26-6-67
BRIDGE ENGINEER DATE







HANDRAILING

*Additional 2 stirrups at 6" % at each intermediate handrail post

STANDARD BENDS

Dia	D
½"	5"
⅝" & ¾"	7"

MINIMUM LAPS

A.S. A84 Nº	End lap	Side lap
301, 302, 300	17"	4"
303, 304	9"	4"
305, 306	11"	4"
603	7"	7"
Bars	32 dia.	

BAR STEEL LIST

Shape	Mark	Dia (in.) Max. height 9'	15'	L_1	Length	Nº reqd	Total Length	Total Weight (lb)
A	A_1	⅝"			• 65'-9"	28	1841	1920
	A_2		⅝"		34'-0"	4	136	142
	A_3		⅝"		30'-0"	4	120	125
	A_4		⅝"		18'-0"	8	144	149
	A_5		⅝"		32'-0"	8	256	267
	A_6	⅝"			1'-6"	31	47	49
	A_7	¾"			• 65'-11"	108	7119	10693
	A_8	½"			30'-5"	128	3894	2601
B_1	B_1		⅝"	1'-8"	3'-2"	424	1343	1401
C_1	C_1		⅝"	5'-6"	7'-1"	160	1133	1182
D_1	D_1		⅝"	3'-2"	6'-4"	378	2393	2496
E_1*	E_1	¼"			3'-7"	388	1424	238
F_1*	F_1	½"			3'-9"	388	1455	972
								22,235

• Including one lap

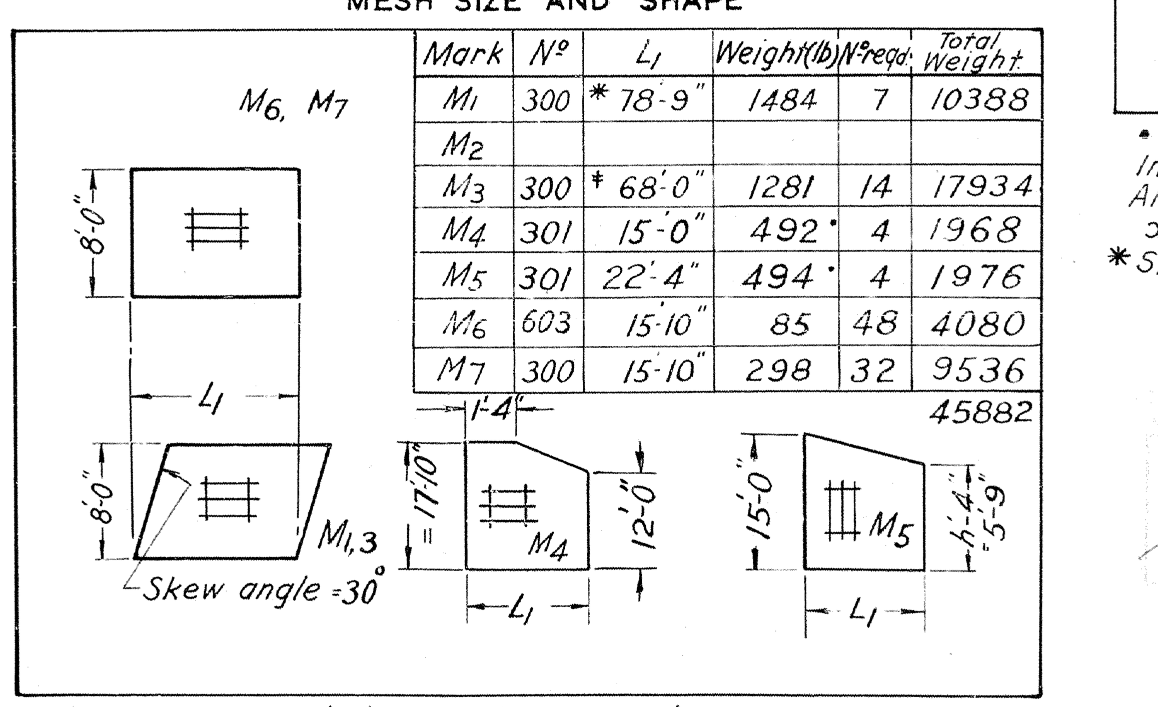
In the steel list all dimensions are from centres of bars

All bars hard grade, deformed (welding not permitted) except E, F

$x = 165°$ (189 required) ; $x = 105°$ (189 required)

* Structural steel, plain, bent around 1" dia. pin.

MESH SIZE AND SHAPE



Mark	Nº	L_1	Weight (lb)	Nº reqd.	Total Weight
M_1	300	* 78'-9"	1484	7	10388
M_2					
M_3	300	‡ 68'-0"	1281	14	17934
M_4	301	15'-0"	492 •	4	1968
M_5	301	22'-4"	494 •	4	1976
M_6	603	15'-10"	85	48	4080
M_7	300	15'-10"	298	32	9536
					45882

* Including 3 laps as shown
‡ Including 3 end laps.
• weights include sidelaps as required

Concrete cover to outside of bar = 1½" (2" at top of deck slab to include wearing surface)
Concrete class: 2·5K
All exposed corners chamfered 1" and all re-entrant angles filleted 1" unless otherwise shown.
Deck slab thickness shown is for concrete wearing surface.

AS EXECUTED

23·7·68

29 JUL 1968

SHEET 4 of 4 0127 318BC0523

DEPARTMENT OF MAIN ROADS, N.S.W.

MAIN ROAD Nº 127 SHIRE OF NAMOI

2/4 CELL 15FT x 15FT CULVERT

OVER SPRING CREEK

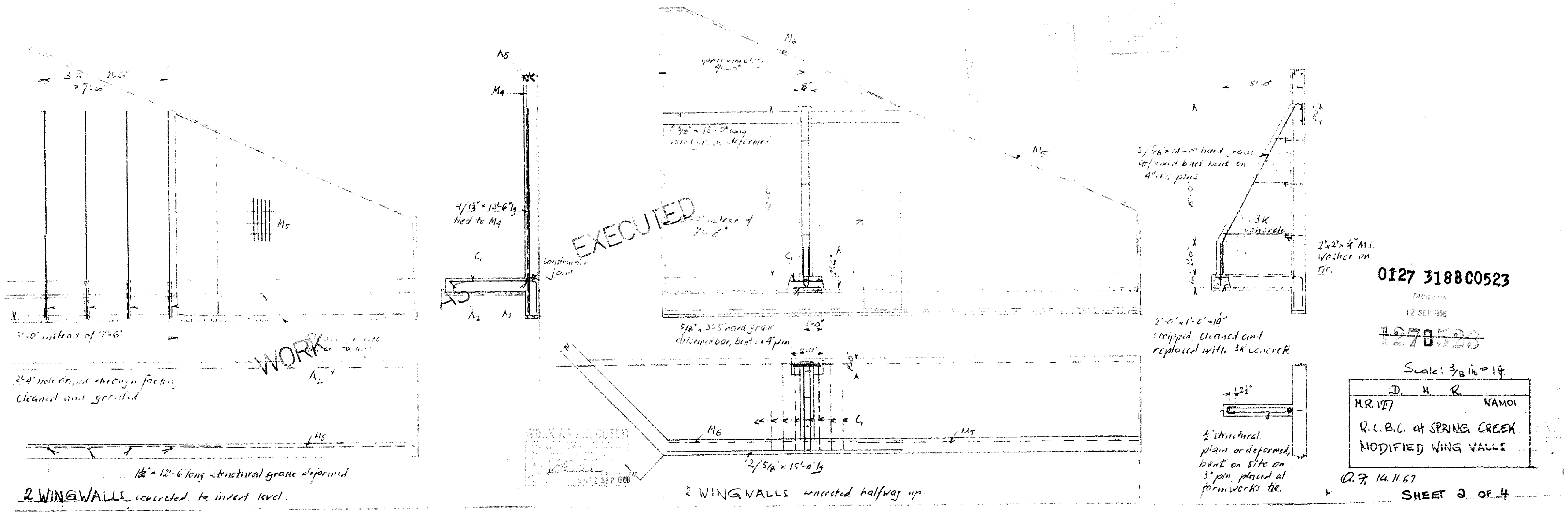
AT 5M. 3700' WEST OF NARRABRI.

BOX CULVERT WITH WEARING SURFACE

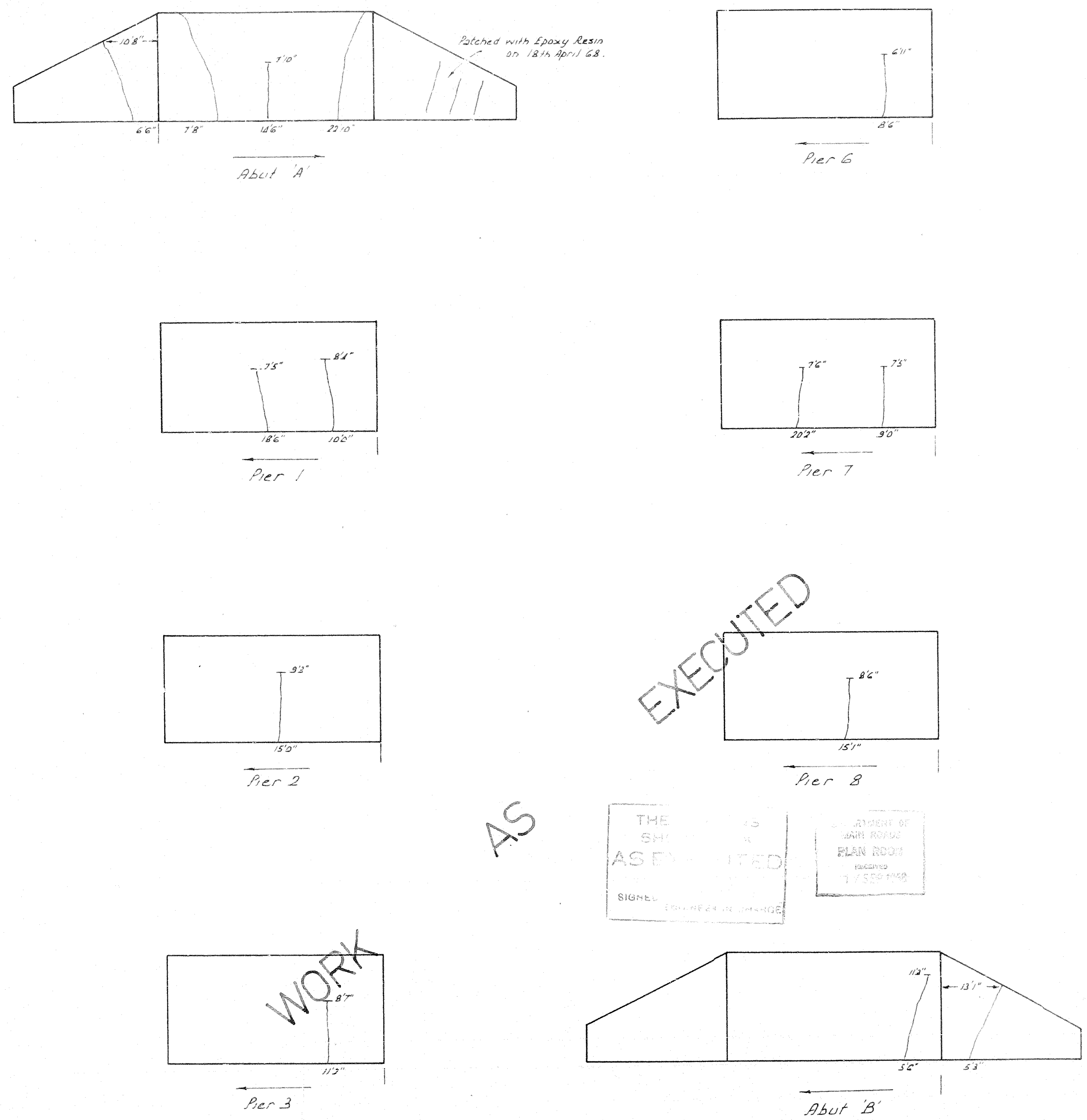
PREPARED	CHECKED	REGN Nº OF PLANS
DESIGN S.M.Y.		~~127B523~~
DRAWING S.M.Y.		
Supervising Eng. A. Fried 20.6.67		
DESIGNING ENGINEER FOR BRIDGES 23/6/67		
ASSOCIATE BRIDGE ENGINEER 23/6/67		SHEET Nº 2 · Nº OF SHEETS 2

B F

BRIDGE ENGINEER DATE



2 WINGWALLS concreted to invert level
2 WINGWALLS concreted halfway up
WORK AS EXECUTED
Continuous joint
Stripped, cleaned and replaced with 3K concrete.
2"x2"x ¼" M.S. Washer on tie.
0127 318BC0523
12 SEP 1968
Scale: 3/8 in = 1 ft.
D. M. R.
M.R. 127
NAMOI
R.C.B.C. at SPRING CREEK
MODIFIED WING WALLS
14.11.67
SHEET 2 OF 4



WORK AS EXECUTED

Not to Scale.

0127 318BC0523

~~127 0523~~

SHIRE OF NAMOI

M.R. 127. 8 cell 15 x 15 R.C.B.C. at Spring Creek 5.7 mile west of Narrabri.

Plan showing extent of cracking at 7-6-68

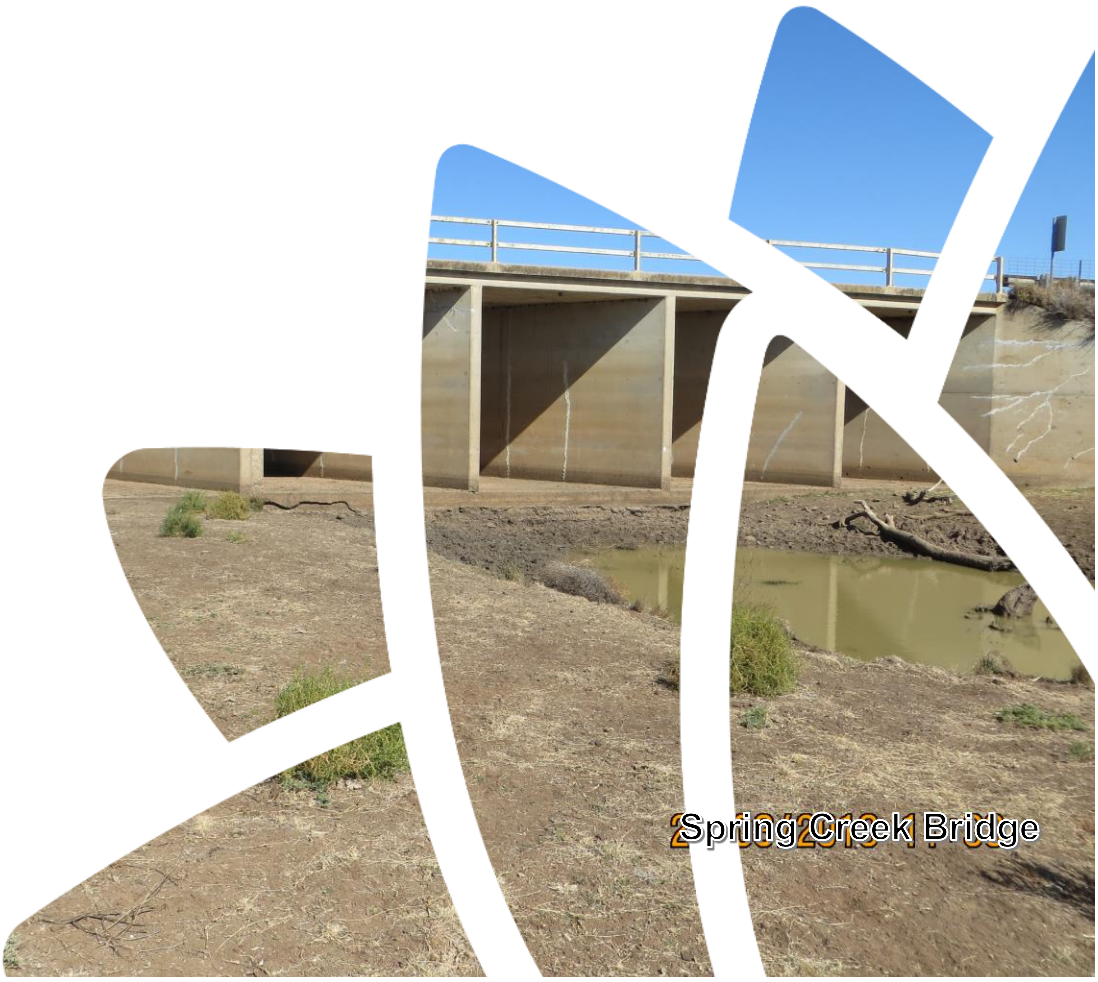
SHEET 1 of 4

Appendix B – TfNSW Level 3 inspection report

B03858 Bridge over Spring Creek near Narrabri

Level 3 Inspection and Structural Assessment Report

October 2020



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<tr><td>Business unit</td><td colspan="5">Western Region, Bridge Maintenance Western
Community and Place
Regional & Outer Metropolitan</td></tr>
<tr><td>Person responsible</td><td colspan="5">Daniel Weber, Bridge Maintenance Planner</td></tr>
<tr><td colspan="6">Prepared by</td></tr>
<tr><td>Business unit</td><td colspan="5">Assessment & Evaluation
Bridge and Structural Engineering, Engineering Services
Technical Services, Infrastructure & Place</td></tr>
<tr><td>Person responsible</td><td colspan="5">Shah M Parvez
Senior Bridge Engineer, Bridge Assessment & Evaluation</td></tr>
<tr><td>Contact details</td><td>T: 8837 0840</td><td>M: 0411 275 826</td><td>F: 8837 0052</td><td colspan="2">E: Parvez.Shah@rms.nsw.gov.au</td></tr>
<tr><td colspan="2">Prepared By</td><td colspan="2">Reviewed By</td><td colspan="2">Checked & Approved By</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2">Muhammad Khattak & Warren Lin
Project Engineers
Assessment & Evaluation</td><td colspan="2">Singh Santhanam
Bridge Engineer Assessment & Evaluation</td><td colspan="2">Shah M Parvez
Senior Bridge Engineer Assessment & Evaluation</td></tr>
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02/10/2020	**Rev. 0**	**First issue for review and comment**	**P. Shah**
Date	**Rev. No.**	**Comments**	**Approved by**

This report must be read in its entirety, including all the Appendices, in order to interpret and adopt any of the recommendations made in this report for future maintenance and risk management of this bridge. This report catalogues and summarises the Level 3 inspection findings at a given point in time and subsequent theoretical assessment study. Its findings and recommendations may not be relevant or applicable in a future point in time. As such for day to day approved load limit for this bridge always refer to Bridge Information System (BIS) authorised and maintained by Senior Bridge Engineer, Assessment and Evaluation, Parvez Shah. For any emergency risk management strategies and/or any load limit always contact either Parvez Shah and/or A/Director Bridges and Structures John Govan.

EXECUTIVE SUMMARY

The Bridge Maintenance Planner, Western region requested to carry out the L3 Inspection of Bridge over Spring Creek at Crankies plain on Kamilaroi Highway near Narrabri (B3858). The bridge is a cast in situ, concrete box culvert type with 8 cells. A set of 4 cells are acting as one segment, separated by joint. The carriageway carries two lanes of traffic, one in each direction. The bridge was built in 1968.

The L3 inspection was carried out on 20th August 2019. The bridge was found in overall fair condition except the differential movement of Cell 5 due to scour/erosion related settlement. The cell walls, Abutment's wing walls and deck soffit were found with vertical and longitudinal cracks respectively and they were found treated/sealed with some material in the past. Most of these cracks were found still intact however some re-opened again. The major issue was movement/rotation of the Cell 5 due to scour/erosion at upstream side in channel/creek along with possible black soil presence. This rotation/movement of the Cell 5 has caused the level difference in above deck road surface which was found covered up with asphalt. Previous L3 inspection carried out in 2004 was also reviewed and summary is included in Section 6.2 of this report. Detailed inspection findings are tabulated in Section 4.0, photos are attached in Appendix A and crack mapping is attached in Appendix B of this report.

The bridge is currently approved for HML loading under Mass Limit Review (MLR) study since August 2011. Therefore, structural analysis of the bridge was carried out using HML ST45.5t loading. Different load combination were used to analyse the structure which are presented under Section 5 of this report. ***The analysis found that the rating factors (RF) are satisfactory under the self-weight, super imposed dead load and live load only. However, the RFs were found to be low to very low when earth pressure and surcharge loading were applied.*** *It is understood that the earth pressure and surcharge loading are generally conservative and the L3 inspection found no significant structural distress other than the movement of the Cell 5.*

The bridge can continue carrying the currently approved loading provided that it is monitored more frequently until the strengthening, repair and maintenance strategies identified under Section 7.0 of this report are implemented. Also the additional recommendations made under Section 8.0 need to be implemented.

Contents

1.0 DESCRIPTION OF BRIDGE

Bridge Name	B03858 Bridge over Spring Creek near Narrabri							
Bridge No.	B03858				**Location/ Region**		West of Narrabri / Southern Region	
Bridge Type	CCULV				**No. of Cells**	8	**Year Built**	1968
Carriage way width	7.3m				**Number of Lanes**		2	
Span/Cell No.	1	2	3	4	5	6	7	8
Span/Cell Type	Cast in Place Reinforced Concrete (RC) Type							
Span/Cell Length (m)	Each cell is of equal length of 4.57m							
						Archived Drawing Plan No.		0127 318 BC 0523

This report shall be read in conjunction with following documents from BIS,

- L2 Inspection dated 21/01/2019
- L2 Inspection dated 11/04/2017
- L3 Inspection Report dated 23/04/2004

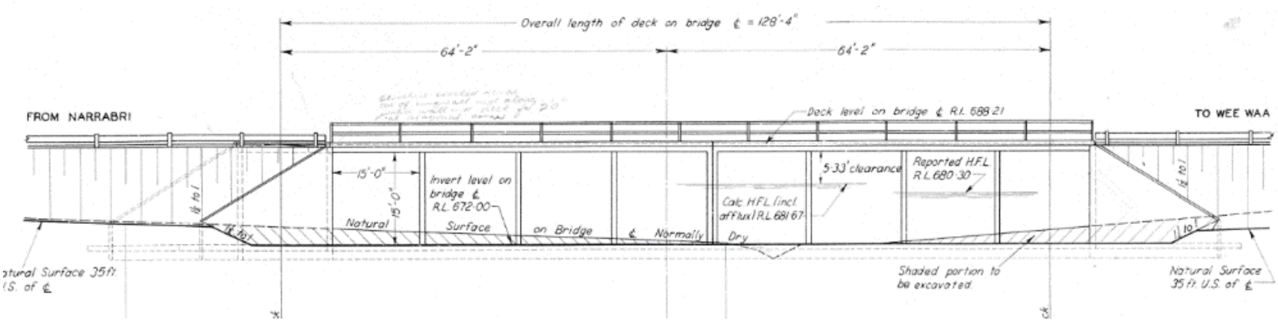


Figure 1: Elevation of the bridge

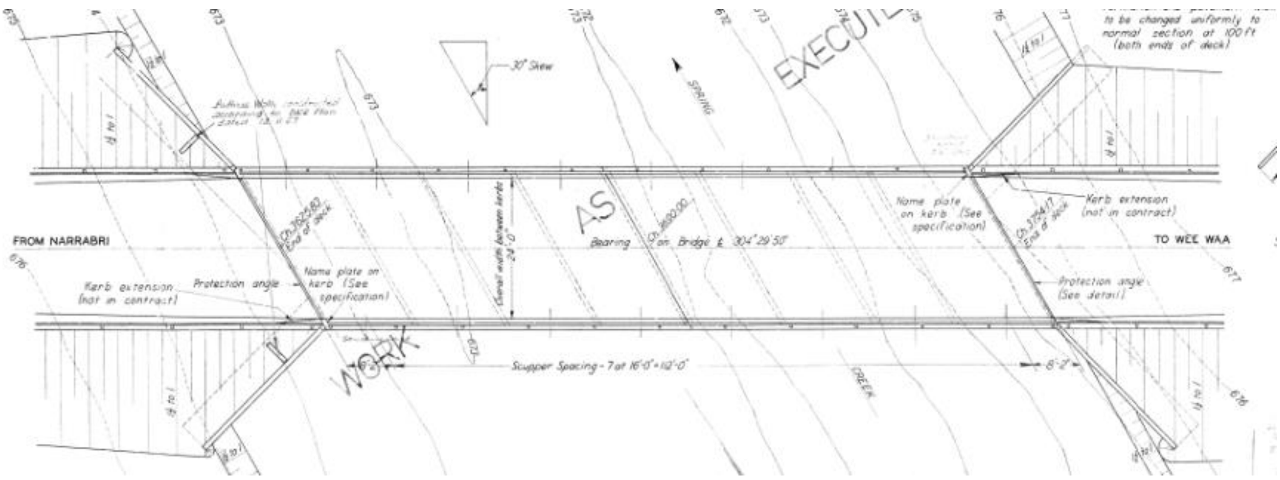


Figure 2: Bridge in plan

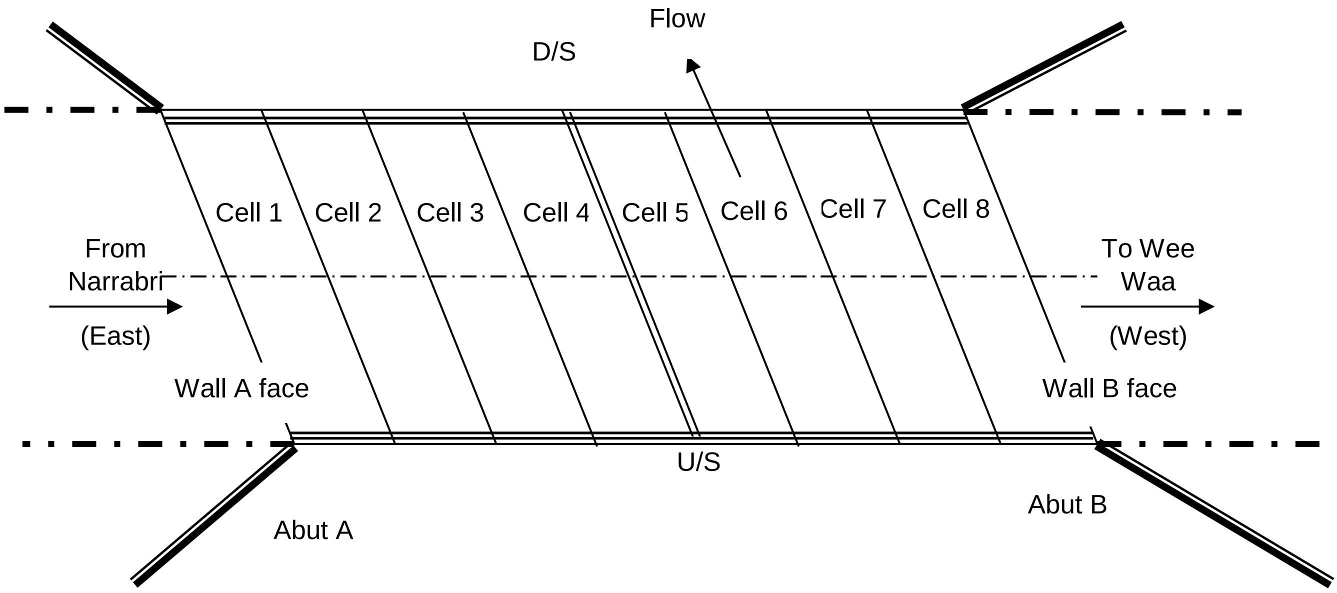


Figure 3: Plan (Schematic)

2.0 SCOPE OF WORK

Major Scope of Work	• Inspection of the major elements at close quarters. • Mapping of observed deteriorations. • Observing the bridge behaviour under normal conditions. • Photographic record of any structural defects. • Recommendations for any future strengthening repair and/ or maintenance works. • Recommendations for interim risk management strategies.

3.0 STRUCUTRAL INSPECTION

Inspection Dates	20-21/08/2019				
Inspection Personnel					
Bridge Engineering			**Regional Support Staff**		
Name		**Designation**	**Name**		**Designation**
1.	Muhammad Khattak	Project Engineer	1.	Rob Avard	Bridge Project Officer, Southern

Inspection procedures and limitations	• Below deck inspection of the bridge, where accessible, was carried out using EWP. The EWP was cherry picker type. Its usefulness is limited in terms of inspecting the deck soffit as the manoeuvrability of the cherry picker was not easy due to scour erosion on both sides of the bridge. • The cell walls and invert slab was inspected from ground level. • Above deck inspection was carried out by closing one lane for traffic at a time, during inspection. The above deck crack was covered with asphalt. • No material testing was carried out during this inspection and assessment. • No parts of the substructure located beneath ground and water level were inspected. • No engineering survey was carried out to check member deformation or bridge alignment etc.

4.0 SUMMARYOF INSPECTION FINDINGS

Abutments Walls and wing walls	Abutments walls acting as headwall are integrated with wing walls. Abutment A (Cell1 Wall A) has vertical cracks which are previously repaired and still intact *(Photo 16-18)*. There were some horizontal cracks of 0.05 to 0.1mm at 2m height from the base of the wall *(Photo 16 - 17).* The vertical cracks in the upstream side wall goes towards the soffit. These cracks had been repaired but opened again. The cracks at this location are typical with skew bridges at obtuse angle phenomena *(Photo 20)*. Wing wall at downstream (D/S) was found with cracks that were found repaired and still intact *(Photo 15).* The wing wall at upstream side was found with cracks which were repaired in the past and still found intact *(Photo 19).* Abutment B was found with vertical cracks that has been repaired in the past and still intact *(Photo 77).* The wall was found with the crack at the interface with deck soffit at downstream side which is normally due to obtuse angle phenomena *(Photo 78)*. The wing wall on upstream side *(Photo 76)* and downstream side *(Photo 75)* was found with vertical cracks, been patched repaired in the past and still intact. Both Abutment were found in Fair condition.
Cell 1	Cell1: Wall B was found with vertical cracks, sealed in the past and still intact *(Photo 21-22).* Suspected AAR type cracks were noticed at the Downstream side end *(Photo 23).* The Invert slab was found with no visible crack *(Photo 24).* The deck soffit was found with longitudinal cracks with past repaired/seal and still intact. There

	were also cracks of 0.25 to 0.3mm in deck soffit in mesh pattern *(Photo 25-26).* The cell was over all in Fair condition.
Cell 2	Wall A was found with vertical cracks, sealed and intact. This wall was also found with horizontal crack at about 700-900mm from the top. The cracks was however sealed and still intact *(Photo 27-28).* The invert slab was found with crack in centre of slab running parallel to the wall *(Photo 115).* The Wall B was found with few vertical cracks, sealed and intact *(Photo 119-120).* Both walls were found with crack at the interface with the base slab. The deck soffit was found with transverse cracks running in the direction of the traffic, sealed and still intact. However some fine transverse and longitudinal cracks of 0.05 to 0.2 were found *(Photo 32-33).* The Cell was over all in Fair condition.
Cell 3	Wall A was found with vertical cracks, sealed in the past and most of them still intact *(Photo35-36).* Wall B was also found with vertical cracks and still intact (Photo 37-38). The invert slab was found with no visible cracks *(Photo 39).* The deck soffit was found with cracks in traffic direction, sealed in the past and still intact. Some fine transverse cracks of 0.1-0.2mm also found *(Photo 40-41).* The cell was overall in Fair condition.
Cell 4	Wall A was found with vertical cracks, sealed in the past and still intact *(Photo 42-44).* Wall B was also found with vertical cracks, sealed in the past and still intact *(Photo 47).* The deck soffit was found with longitudinal cracks. Some were found sealed and still intact, however some were left ready to be sealed but not sealed. Some irregular cracks of 0.1-0.2mm were also found *(Photo 45-46).* The invert slab was found with no visible crack *(Photo 49).* The cell was overall in Fair condition.
Mid joint	The Walls of Cell 5 was found misaligned against the Cell 4. The flood forces along with soil geotechnical properties have forced the Cell 4 to rotate upward, causing differential settlement. The horizontal difference at the bottom was visibly noticed lesser as compared at the top *(Photo 3-14).* This also caused a level difference in above deck. The condition due to this movement was found as **Poor**.
Cell 5	Wall A was found with a vertical crack, sealed and intact *(Photo 51).* The wall was also found with horizontal crack at the base, sealed and intact. This wall also found with poor concrete patch in upstream side *(Photo 52).* The deck soffit was found with minor transverse cracks and longitudinal cracks, sealed and intact *(Photos 53-54).* Wall B was found with vertical and longitudinal cracks, sealed and intact *(Photos 55-56)*. The invert slab was also found with transverse crack in centre *(Photo 57).* The crack between the Invert slab & base concrete along with rotation/differential settlement made this cell rated as **Poor**.
Cell 6	Wall A was found with old vertical cracks, sealed and still intact *(Photos 58-59).* A fine crack was found extended from this old crack towards the deck soffit. The invert slab was found with transverse crack in the centre *(Photo 60).* The wall B was found with old cracks, sealed and intact *(Photo 61).* The deck soffit was found with old longitudinal cracks, sealed and intact. The deck soffit was also found with transverse cracks of 0.2mm in mesh pattern *(Photos 62-63).* The cell was overall in Fair condition.
Cell 7	Wall A was found with old vertical cracks, sealed and intact *(Photos 64, 65).* A fine crack was found extended from this old crack towards the deck soffit. Wall B was also found with old vertical cracks, sealed and some are reopen again *(Photos 67-68).* The deck soffit was also found with longitudinal cracks with some mesh pattern

	in centre *(Photos 69-70).* The invert slab was found with no visible cracks *(Photo 66).* The cell was overall in Fair condition.
Cell 8	Wall A was found with old vertical and diagonal cracks, sealed in the past and intact *(Photo 71)*. A fine crack was found extended from this old crack towards the deck soffit. The deck soffit was found with fine longitudinal cracks, some of the cracks were found sealed and still intact *(Photo 72, 73).* The invert slab was ground with no visible crack *(Photo 74).* The cell was overall in Fair condition.
Above deck	There is crack over joint above wall between Cell 3 and 4 *(Photo 82).* The deck joint 1 has level difference due to uplift/rotation of Cell 5 *(Photo 83).* The misalignment due this uplift/rotation was visible above deck in kerbs *(Photo 84 90).*
Approaches	The Abutment A Approach has ramp up to the bridge *(Photo 79-80).*
Miscellaneous	The handrail/traffic barrier was found with minor surface corrosion *(Phot 81 & 84).* The traffic barrier railing are not up to the current Australian Standard and need to be upgraded based on bridge specific risk assessment. The kerb was noticed with minor shrinkage cracks *(Photos 81).* The Upstream side was noticed with severe erosion/scour due to flood events in the past and caused erosion/scour on upstream side of the bridge *(Photos 1-6).*

4.0 ANALYTICAL ASSESSMENT

Applicable Standards, Codes, Régulations etc.	
Loading	Restricted Access Vehicles (RAV) ST45.5T(One Truck on One Lane)
Concrete	AS5100.5 – 2017, AS/RTA 5100 April 2011-Interim(Interim RTA Edition)
Other	AS5100.2 – 2017
	AS5100.7 – 2017

Material Properties							
Concrete	f_c'	17 MPa	E_c	25500 MPa	Density	2450 kg/m^3	
Steel Reinforcement	f_{sy}	345 MPa			E_s	200,000 MPa	
Mesh	f_{sy}	450 MPa			E_s	200,000 MPa	

Loading				
Super Imposed Dead Load (SDL)				
Asphaltic Concrete	Density	22	kN/m3	
Live Load				
General Access Higher Mass Limit (HML) Vehicle	ST45.5t			
Design Vehicle Loading	Not specified in the WAE drawings.			

Loading Fator and Load Combinations		
Loading Fators for Dead Load & Super Imposed Load		
Materials	Reduce Safety	Increase Satety
Concrete	1.2	0.85
Asphaltic Concrete	2	0.7
Kerb and Kerb and fence	2	0.7
Live Load Surcharge	1.8	0
Earth Pressure	1.4	0.7
Loading Fators for Live Load		
Dynamic Load Allowance (DLA)	0.3	
Live Load Factor for Rating Factor Calculation	2	

Load Combinations	
Load Combination 1	Dead Load+AC+Kerb and Fence+Live Load
Load Combination 2	Dead Load+AC+Kerb and Fence+Surchage load from traffic(AS 5100.2-2017)+Earth presssure (active)+Live Load
Load Combination 3	Dead Load+AC+Kerb and Fence+Surchage load from traffic(AS 5100.2-2017)+Earth presssure (at rest)+Live Load
Load Combination 4	Dead Load+AC+Kerb and Fence+Surchage load from traffic(5kPa)+Earth presssure (active)+Live Load
Load Combination 5	Dead Load+AC+Kerb and Fence+Surchage load from traffic(5kPa)+Earth presssure (at rest)+Live Load
Load Combination 6	Dead Load+AC+Kerb and Fence+Earth presssure (active)+Live Load
Load Combination 7	Dead Load+AC+Kerb and Fence+Earth presssure (at rest)+Live Load

Note: 5KPa is alternate surcharge load for traffic.

6.0 RESULTS AND DISCUSSION

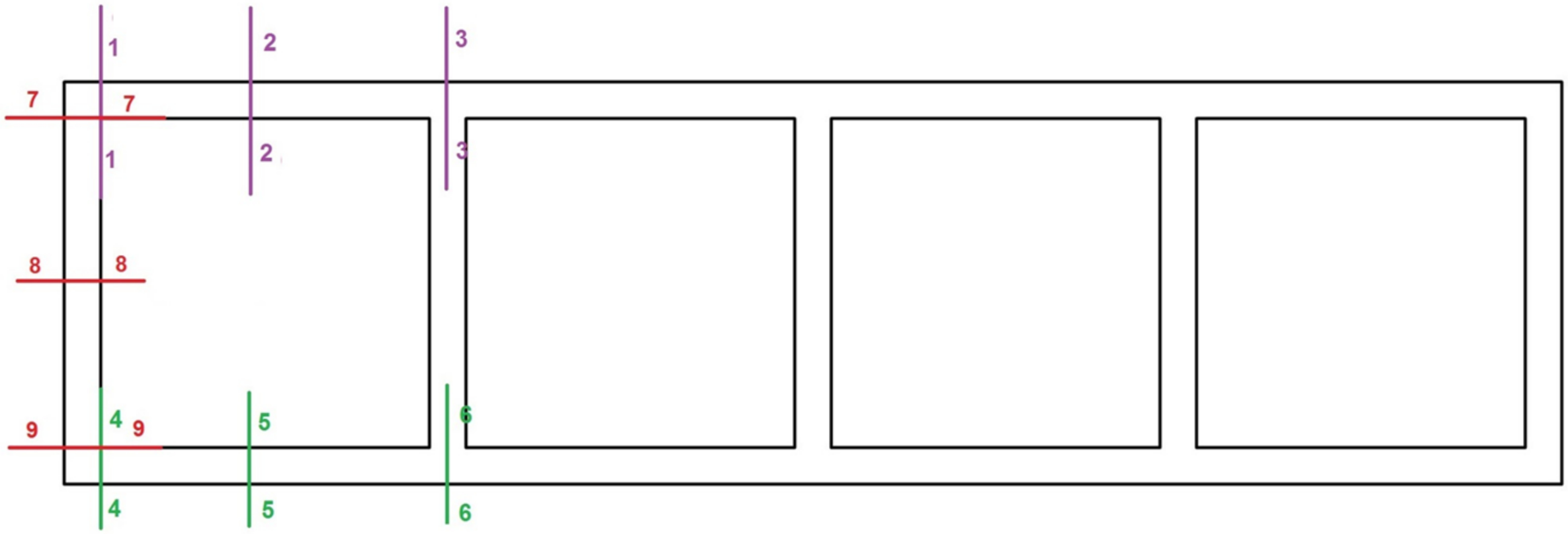


Figure 4: Critical structural analysis locations

Table 1: Moment Rating Factor Using factor 0.8

Moment Rating Factors(ST45.5)-ϕ=0.8								
Location		combination 1	combination 2	combination 3	combination 4	combination 5	combination 6	combination 7
top slab	section 1	3.4	0.64	N/A	1.3	0.30	2.0	0.98
	section 2	1.0	1.1	1.1	1.1	1.1	1.1	1.1
	section 3	1.5	1.6	1.6	1.6	1.6	1.6	1.6
base slab	section 4	2.3	N/A	N/A	0.43	N/A	0.95	N/A
	section 5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
	section 6	0.77	0.81	0.83	0.81	0.83	0.81	0.83
side wall	section 7	2.4	N/A	N/A	0.21	N/A	0.89	N/A
	section 8	43.6	15.4	5.1	21.5	11.1	28.0	17.6
	section 9	1.9	N/A	N/A	N/A	N/A	0.51	N/A

Table 2: Moment Rating Factor Using factor 0.9

Moment Rating Factors(ST45.5)-ϕ=0.9								
Location		combination 1	combination 2	combination 3	combination 4	combination 5	combination 6	combination 7
top slab	section 1	3.9	1.1	0.10	1.7	0.74	2.4	1.4
	section 2	1.2	1.3	1.3	1.3	1.3	1.3	1.3
	section 3	1.8	1.8	1.8	1.8	1.8	1.8	1.8
base slab	section 4	2.7	0.34	N/A	0.79	N/A	1.3	0.39
	section 5	4.1	4.1	4.1	4.1	4.1	4.1	4.1
	section 6	0.96	1.00	1.0	1.00	1.0	1.00	1.0
side wall	section 7	2.7	N/A	N/A	0.51	N/A	1.2	0.22
	section 8	48.7	20.6	10.2	26.6	16.3	33.1	22.8
	section 9	2.2	N/A	N/A	0.29	N/A	0.80	N/A

Note: 1, **"N/A"** indicates that the shear or moment capacity is less than action effect excluding live load.

2, one truck was loaded on one lane when calculating vehicular effects and a lane of 3m is assumed.

Table 3: Moment Rating Factor Using factor 1

Moment Rating Factors(ST45.5)-ϕ=1								
Location		combination 1	combination 2	combination 3	combination 4	combination 5	combination 6	combination 7
top slab	section 1	4.3	1.5	0.54	2.2	1.2	2.8	1.9
	section 2	1.4	1.4	1.5	1.4	1.5	1.4	1.5
	section 3	2.0	2.0	2.1	2.0	2.1	2.0	2.1
base slab	section 4	3.1	0.70	N/A	1.1	0.23	1.7	0.75
	section 5	4.6	4.6	4.6	4.6	4.6	4.6	4.6
	section 6	1.2	1.2	1.2	1.2	1.2	1.2	1.2
side wall	section 7	3.0	0.19	N/A	0.82	N/A	1.5	0.52
	section 8	53.9	25.7	15.4	31.8	21.4	38.3	27.9
	section 9	2.5	0.14	N/A	0.59	N/A	1.1	0.19

Table 4: Shear Rating Factor Using factor 0.7

Shear Rating Factors(ST45.5)-ϕ=0.7								
Location		combination 1	combination 2	combination 3	combination 4	combination 5	combination 6	combination 7
top slab	section 1	0.68	0.55	0.50	0.58	0.53	0.61	0.56
	section 3	0.53	0.57	0.59	0.57	0.59	0.57	0.59
base slab	section 4	1.3	0.74	0.50	0.86	0.62	0.99	0.76
	section 6	0.92	0.78	0.73	0.82	0.77	0.85	0.79
side wall	section 7	28.1	5.7	N/A	11.8	5.2	18.2	11.6
	section 9	15.5	N/A	N/A	0.86	N/A	4.3	N/A

Note: 1, **"N/A"** indicates that the shear or moment capacity is less than action effect excluding live load.

2, one truck was loaded on one lane when calculating vehicular effects and a lane of 3m is assumed.

Table 5: Shear Rating Factor Using factor 0.85

Shear Rating Factors(ST45.5)-ϕ=0.85								
Location		combination 1	combination 2	combination 3	combination 4	combination 5	combination 6	combination 7
top slab	section 1	0.88	0.75	0.70	0.78	0.73	0.81	0.76
	section 3	0.72	0.75	0.78	0.75	0.78	0.75	0.78
base slab	section 4	1.7	1.1	0.90	1.3	1.0	1.4	1.2
	section 6	1.3	1.1	1.1	1.2	1.1	1.2	1.1
side wall	section 7	34.0	11.6	5.0	17.8	11.2	24.1	17.5
	section 9	18.9	1.9	N/A	4.3	N/A	7.7	N/A

Table 6: Shear Rating Factor Using factor 1

Shear Rating Factors(ST45.5)-ϕ=1								
Location		combination 1	combination 2	combination 3	combination 4	combination 5	combination 6	combination 7
top slab	section 1	1.1	0.95	0.90	0.98	0.93	1.0	0.96
	section 3	0.91	0.94	0.97	0.94	0.97	0.94	0.97
base slab	section 4	2.1	1.5	1.3	1.6	1.4	1.8	1.5
	section 6	1.6	1.5	1.4	1.5	1.5	1.6	1.5
side wall	section 7	40.0	17.5	10.9	23.7	17.1	30.1	23.4
	section 9	22.4	5.3	N/A	7.7	0.22	11.1	3.7

Note: 1,**"N/A"** indicates that the shear or moment capacity is less than action effect excluding live load.

2, one truck was loaded on one lane when calculating vehicular effects and a lane of 3m is assumed.

6.1 Structural Assessment Results and Discussion

The tables in Section 6 summarise the findings, resulting from structural analysis, based on as built condition of the bridge. However, the bridge was found in overall fair condition during L3 inspection except the rotation/movement due to differential settlement at Cell 5, caused by scour/erosion of the creek/channel bed adjacent to the bridge. Different load combinations were used to analyse the structure. The results for bending moment rating factors are presented in Table 1 to 3. Similarly, the shear rating factors are presented in Table 4 to 6 using capacity reduction factors from 0.85 to 1.0.

The top deck slab has satisfactory Rating Factor (RF) for **flexure** for Higher Mass Limit (HML) ST45.5t loading without considering any earth pressure and surcharge loading under load combination 1 in Table1. However under other combinations, the rating factors was found below unity. The capacity reduction factors were altered to optimise the rating factors. The Table 3 shows that most of the bending moment rating factors for deck slab are satisfactory except for combination 3, without any capacity reduction factor (ϕ=1). The **shear** rating factor for deck slab were found significantly low in Table 4 to 5. However, they improve to an acceptable range, when the capacity reduction factor was increased to 1.0, as shown in Table 6.

Similarly the rating factors for base slab were found satisfactory under the self-weight, super imposed dead load (SDL) and live load combination. However, it shows low rating factor in both bending and shear when surcharge loading along with earth pressure were considered under different combinations as shown in Table 1 & 4 respectively. The rating factors for bending & shear improves when capacity reduction factors were increased towards unity (ϕ=1) as shown in Table 3 & 6.

In Abutment walls (side walls), Section 9 is critical as shown in Figure 6. Under normal self-weight, SDL and live load combination, it shows satisfactory rating factor for both bending and shear. However it resulted in very low rating factors when combination of surcharge loading and earth pressure along with dead load and live load were used. It doesn't improve much even when the capacity reduction factors are optimised. The base slab is therefore found inadequate due to surcharge and earth pressure loadings- which are generally considered conservative.

The L3 inspection found no sign of significant structural distress in the abutment side walls and deck soffit other than vertical cracks in the walls and longitudinal cracks in deck soffit. These cracks are assumed to be due to the spacing of transverse reinforcement, which was found slightly exceeding the minimum requirement of 300mm spacing as per the Australian Standards. Also it is found that secondary steel (transverse distribution steel) is only 18% of the main reinforcement and did not meet the minimum requirement of 30% of the main reinforcement as per AS5100.5 2004 cl 9.1.2. This inadequate secondary steel, together with shrinkage, is believed to have contributed to the longitudinal cracks in the soffit of the deck. Some of these verticals cracks in the wall are also even reported in the work as executed (WAE) drawings dated 1968. The L3 inspection found that most of these cracks were sealed and they were still found intact. However some new fine cracks were noticed in deck soffit which may need to be monitored during routine L2 inspection.

Beside the low rating factors under conservative earth pressure, the scouring in upstream side along with the suspected soil type are assumed to be contributing factors for localised settlement causing an upward/rotational movement of the Cell 5. This caused level difference above deck which was noticed in L3 inspection but not considered very alarming for at this stage. However, the scour/erosion in upstream side need to be rehabilitated to prevent further settlement causing rotational movement of the cells. The creek/channel bed requires some form of river flow stabilisation.

6.2 Previous Structural and Assessment Reports.

The L3 inspection and assessment of B3858 was also carried out on 10th February 2004 by Vijay Kodakalla & Dennis Roshan and subsequently report was issued on 23rd April 2004. This report highlighted the previous history as below;

The reinforced concrete Box culvert was built in 1968 over Spring Creek. The Spring Creek joins the Namoi River at about 2-3 km's downstream side of the culvert. The soil observed is black soil (expansive clay). Soon after construction of this culvert, there were few cracks developed in wing walls, abutment walls and also on the pier walls. No cracks were reported on the top slab. The above cracks were patched using the epoxy resins. The work as executed drawings shows the cracks. The drawings are enclosed in Appendix A.

There were major cracks on the deck and wing walls as observed during the inspections in 1978. The filling behind the abutments were identified as black soils and were replaced with free flow granular materials.

In 1979, the movements of the culverts and cracks on the walls and slabs were mapped. It is opined that the existing culvert is subject to vertical and horizontal movements. The vertical movement is about 100mm and the lateral movement to upstream side is about 35mm. The cause of cracking in the culvert members is attributed to the characteristics of the black soils. Then all the visible cracks were repaired using epoxy resins.

The outcomes of analysis, presented in the report as below:

Member	Vehicle					
	T44 Loading		B-Doubles		Semi-Trailer	
	LF	Rating	LF	Rating	LF	Rating
Deck slab	1.9 <2.0	T42	>2.0	BD 62.5	>2.0	ST 42.5
Cell Walls	2.0	T44	>2.0	BD62.5	>2.0	ST42.5

The bridge is rated as T42 in terms of T44 loading in 'as good' condition. The 'as is' condition rating is not provided in view of the serviceability problems encountered due to the excessive movements and major cracks in the culvert

The report considered three rehabilitation options. Option 1 was to replace the existing culvert with new bridge. Option 2 was to rehabilitate the existing culvert. While Option 3 was to monitor the bridge. The option 3 was recommended as a preferred option with below suggested rehabilitation measures,

- *Map all the cracks (old and new) in the top slab, bottom slab, and walls (piers, abutments and wing walls).*
- *Measure the crack widths and lengths. Record the lateral and vertical movements.*
- *'V' notch the cracks in the cells and seal with flexible epoxy as against rigid epoxy or any other standard approved methods.*
- *When the Asphaltic Concrete surface deteriorates, remove the AC surfacing, epoxy grout the cracks on top of the top slab and provide water proof membrane and then provide the Asphaltic levelling course to arrest further deterioration due to leaching.*
- *Reseal the expansion joint at the middle with suitable compression seals.*
- *Monitor and record the cracks, movements and distress annually to check, whether the culvert it is becoming unserviceable*

It was recommended in the report that use of General Access Vehicles and B-Doubles be allowed on the bridge provided that all repair works detailed above are carried out to prevent any further deterioration.

7.0 STRENGTHENING, REPAIR AND MAINTENANCE STRATEGIES

Element	Location	Strengthening	Repair/Rehabilitation	Maintenance
Cell 5 Movement	Base Slab and Wall	The base slabs of Cells 4, 5 and 6 need to be strengthened in addition to suitable underpinning.		
	Water Channel scour/erosion		The upstream side of the channel need to be reinstated/stabilised by implementing suitable scour protection/erosion controls. It is recommended to consult Geotechnical and Hydrological experts during planning, designing and implementation of these control measures.	
	Cells Movement			Regularly inspect the bridge (BIS level 2) in order to make sure that the rotation of the western half box culvert, specifically Cell 5 is not elevated. It should also be inspected soon after the each major flood event.
	Road Surface			The deck joint in above deck over Cell 4 & 5 Walls need to be monitored.
Cell walls and deck Soffit			Incomplete crack repair at Cell 4 deck soffit needs to be completed. It is also suggested to regularly monitor the repairs.	Monitor the cracks in the deck soffit for further deterioration.

Element	Location	Strengthening	Repair/Rehabilitation	Maintenance
Traffic Barrier Railing		Traffic barrier railings need to be upgraded to the current Australian Standards based on bridge specific risk assessment.		Traffic barrier railings need to be coated with suitable protective coating.
Culvert (All Cells)	Water Channel scour/erosion		Suitable Scour/erosion rehabilitation measures need to be implemented specifically at upstream side of the culvert, in consultation with Transport fNSW Engineering Services.	
	Cracks		Repair the re-opened cracks.	Monitor the cracks in the deck soffit for further deterioration.

8.0 RECOMMENDATIONS

Based on the findings from L3 inspection and subsequent analytical studies, following recommendations are made at this stage:

1. Carry out the strengthening, repair and maintenance strategies identified under Section 7.0 of this report, within the shortest practicable time frame.
2. The bridge can continue carrying the currently approved loading provided that it is monitored more frequently until the strengthening, repair and maintenance strategies identified under Section 7.0 of this report are implemented.
3. If any distress is noticed during these monitoring, risk management strategies need to be implemented with consultation from Engineering Services.
4. Carry out thorough hydrological and geotechnical investigation in consultation with Transport fNSW Engineering Services Section. This exercise will enable to establish more realistic earth pressure and surcharge forces.
5. Depend on outcome of item No.3, instruments may need to be installed to monitor the movement of abutment/wingwall and joint between cells 4 & 5.

Appendix A, Inspection Photos

Photos are to be read in conjunction with the bridge schematic diagrams available in this report. The number in bracket belongs to AE Unit archived photo records.

General Photos

Photo 1(003). General view of the bridge form Upstream side (U/S)

Photo 2 (9) General view from the upstream side

Photo 3 (20) Scouring/erosion at the upstream side

Photo 4 (19) Scouring/erosion intensity at the upstream side

Photo 5 (24) Crack in Cell 5 base slab due to upward forces by flood water and soil in upstream side (U/S)

Photoi 6 (26) close up view of the carck in base slab of Cell 5 in U/S

	
Photo 7(27) Misalignment is visible between the walls of Cell 4 & 5 due to rotational movement of the cells by flood	Photo 8 (28) Misalignment is visible between the walls of Cell 4 & 5 due to rotational movement of the cells by flood
	
Photo 9 (60) Close up view of misalignment on Upstream side	Photo 10 (63) Close up view of misalignment on Upstream side
	
Photoi 11 (68) Close up view of misalignment on Upstream side	Photo 12 (69) Close up view of misalignment on Upstream side

	
Photo 13 (73) Cell 5 invert slab and wall interface with crack reappear after sealing	Photo14 (74) Cell 5 invert slab and wall interface with crack reappear after sealing
	
Photo 15 (79)_Embankment or Wing wall_DS AbtA	Photo 16 (82)_Ladder not used due to risk assessment
	
Photo 17 (86)_Cell1_Wall A_Abt A previous cracks sealed and still intact_new fine horizontal cracks	Photo 18 (87)_Cell1A_AbtA previous cracks sealed intact_new fine horizontal cracks

	
Photo 19 (93)_Embankment's Wing wall U/S, Abt A	Photo 20 (95)_Crack at deck soffit interface with wing wall
	
Photo 21 (96)_Cell 1_Wall B, vertical cracks previously identified still intact	Photo 22 (99)_Cell 1_Wall B, vertical cracks previously identified still intact
	
Photo 23 (101)_Wall B_Cell 1_suspected AAR type cracks in Wall B	Photo 24 (104)_Cell 1 Base slab

Photo 25 (107)_Cell 1_Deck Soffit mesh/ transverse and irregular cracks

Photo 26 (105)_Cell 1_Deck Soffit mesh/ transverse and irregular cracks

Photo 27 (110)_Cell 2_Wall A cracks sealed and still intact

Photo 28 (109)_Cell 2_Wall A cracks sealed and still intact

Photo 29 (115)_Cell 2_Base slab crack in center near D/S

Photo 30 (117)_Cell 2_Wall B vertical cracks sealed and still intact

Photo 31(120)_Cell 2_Wall B vertical cracks sealed and still intact

Photo 32 (123)_Cell 2_Deck soffit diagonal crack previously sealed and still intact, minor crack 0.2mm observed

Photo 33 (125)_Cell 2_Deck soffit diagonal crack previously sealed and still intact, minor crack 0.2mm observed

Photo 34 (127)_Cell 3_G view from DS

Photo 35 (131)_Cell 3_Wall A cracks_sealed and still intact

Photo 36 (128)_Cell 3_Wall A cracks_sealed and still intact

	
Photo 37 (136)_Cell3_Wall B cracks sealed and still intact	Photo 38 (137)_Cell 3_Wall B cracks sealed and still intact
	
Photo 39 (134)_Cell 3_Wall A base slab	Photo 40 (0149)_Cell 3_deck soffit with longitudinal and irregular crack
	
Photo 41 (148)_Cell 3_deck soffit with longitudinal and irregular crack	Photo 42 (152)_Cell 4_Wall A vertical cracks sealed and still intact

Photo 43 (153)_Cell 4_Wall A vertical cracks sealed and still intact

Photo 44 (155)_Cell 4_Wall A vertical cracks sealed and still intact

Photo 45 (0157)_Cell 4_Deck soffit with longitudinal and irregular cracks

Photo 46 (161)_Cell 4_Deck soffit with longitudinal and irregular cracks

Photo 47 (0165)_Cell 4_Wall B with vertical cracks

Photo 48 (169)_Cell 4_Wall B interface with base slab no cracks, D/S

Photo 49 (0170)_Cell 4_Base slab with no visible cracks

Photo 50 (174)_Cell 4_Walls at joint DS

Photo 51 (176)_Cell 5_Wall A single vertical crack sealed and intact

Photo 52 (178)_Cell 5_Wall A, Poor concrete patch on US

Photo 53 (185)_Cell 5_Deck soffit longitudal cracks repaired and some irregular cracks

Photo 54 (187)_Cell 5_Deck soffit longitudal cracks repaired and some irregular cracks

Photo 55 (189)_Cell 5_Wall B vertical cracks sealed and intact

Photo 56 (191)_Cell 5_Wall B vertical cracks sealed and intact

Photo 57 (198)_Cell 5_Crack in base slab

Photo 58 (203)_Cell 6_Wall A vertical cracks sealed and intact

Photo 59 (206)_Cell 6_Wall A vertical cracks sealed and intact

Photo 60 (211)_Cell 6_Base slab with longitudnal

Photo 61 (213)_Cell 6_Wall B vertical crack sealed

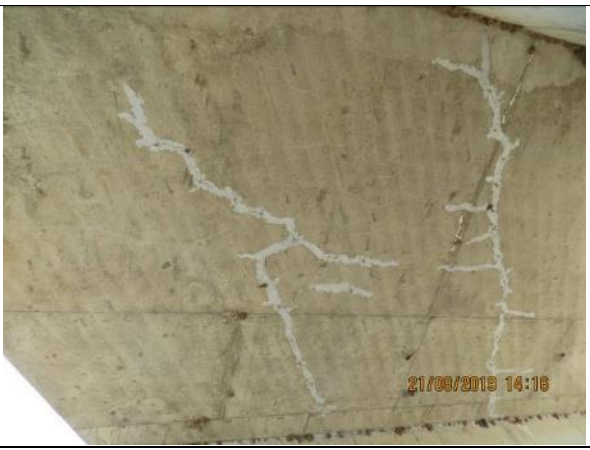


Photo 62 (221)_Cell 6_ Deck soffit, longitudinal cracks primarily sealed and still intact, traverse cracks appear in mesh pattern

Photo 63 (222)_Cell 6_Deck soffit, longitudinal cracks primarily sealed and still intact, traverse cracks appear in mesh pattern

Photo 64 (225)_Cell 7_Wall A vertical crack sealed and intact

Photo 65 (228)_Cell 7_Wall A vertical crack sealed and still intact

Photo 66 (230)_Cell 7_Base slab

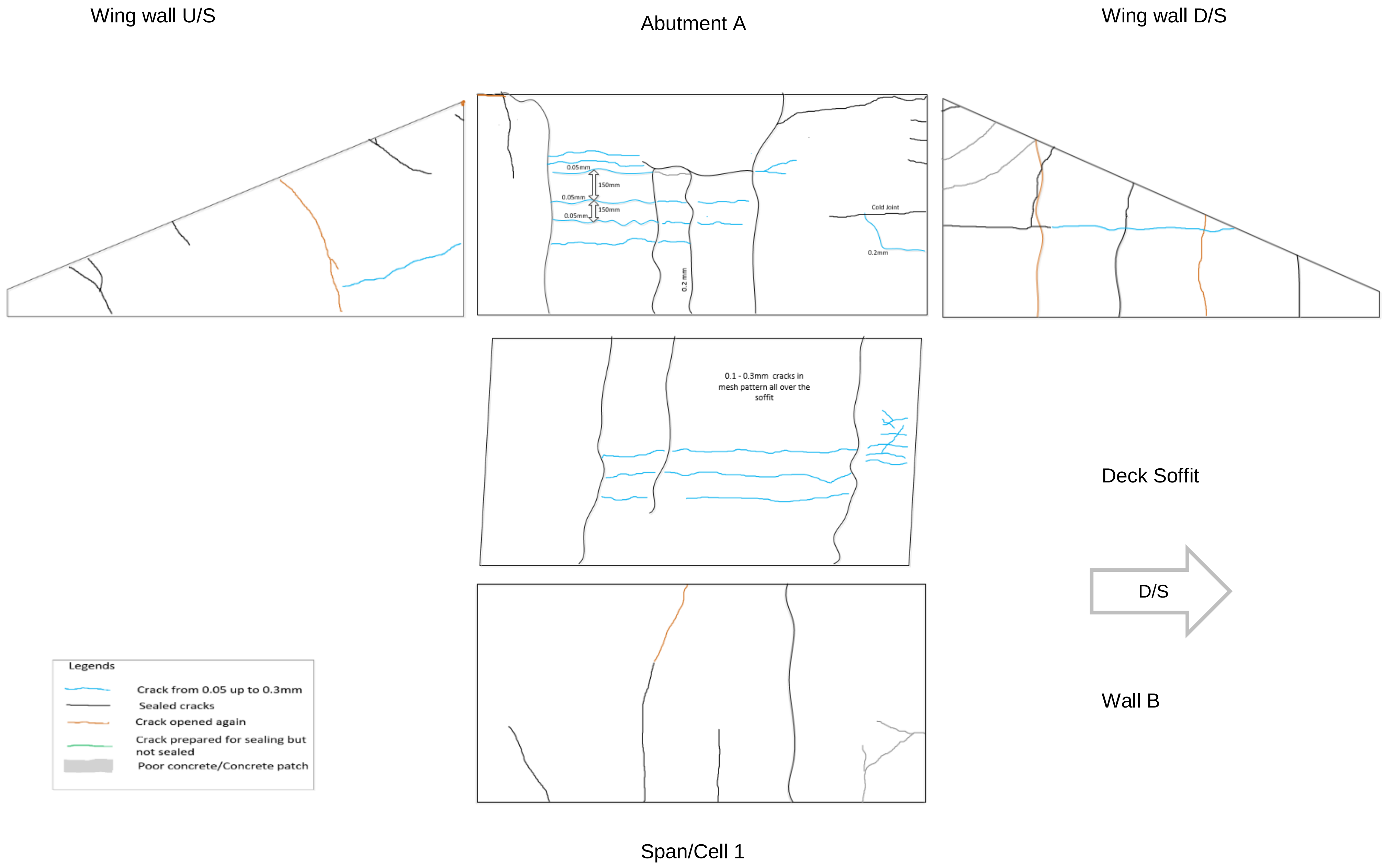
	
Photo 67 (231)_Cell 7_Wall B vertical cracks sealed and still intact	Photo 68 (232)_Cell 7_Wall B vertical cracks sealed and still intact
	
Photo 69 (241)_Cell 7_Soffit with longitudinal and irregular cracks	Photo 70 (243)_Cell 7_Soffit with longitudinal and irregular cracks
	
Photo 71 (252)_Cell 8_Wall A vertical cracks sealed and still intact	Photo 72 (255)_Cell 8_Deck soffit with longitudal crack

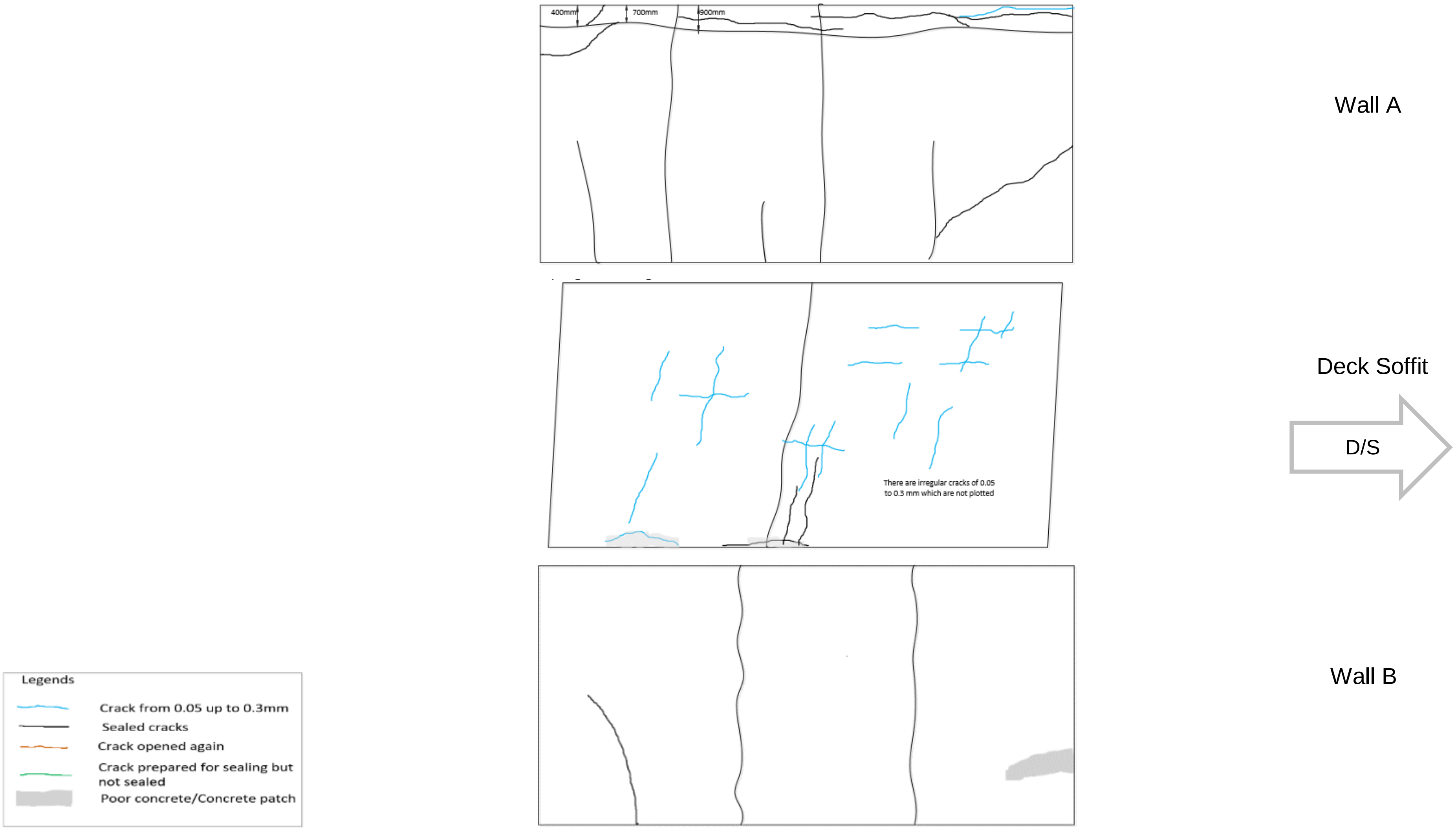
	
Photo 73 (257)_Cell 8_Deck soffit with longitudinal cracks	Photo 74 (260)_Cell 8_Base slab
	
Photo 75 (277)_Abt B DS wing wall with cracks and crack at interface with deck	Photo 76 (264)_Cell 8_Abt B US wing wall with some cracks reappearing
	
Photo 77 (270)_Cell8_AbtB_wall with vertical cracks sealed	Photo 78 (279)_AbtB DS wingwall with cracks and crack at interface with deck

	
Photo 79 (285)_Above deck joint A, hump in Abt A joint	Photo 80 (287)_Above deck joint A, hump in Abt A joint
	
Photo 81 (0293)_Shrinkage crack in DS kerb	Photo 82 (295)_Negative moment above deck crack in wall between Cell 4 and Cell 3 possibly due to joint
	
Photo 83 (304)_Joint at middle of bridge shows deviation of dip in Cell1-4	Photo 84 (306)_Joint at DS showing displacement

	
Photo 85 (327)_US handrail deviation towards DS at middle of bridge at joint	Photo 86 (329)_Joint at US kerb
	
Photo 87 (344) Kerbs misalignment at joint between Cell 4 & 5	Photo 88 (343)_G view above bridge from Abt B, shadow of handrail at US shows deviation
	
Photo 89 (0348)_Wall between Cell 4 and Cell 5_Gap decreasing down towards_Fine cracks on face of US wall	Photo 90 (356)_Wall between Cell 4 and Cell 5_Gap decreasing down towards_Fine cracks on face of US wall

Appendix B, Inspection Findings (Cracks mapping)

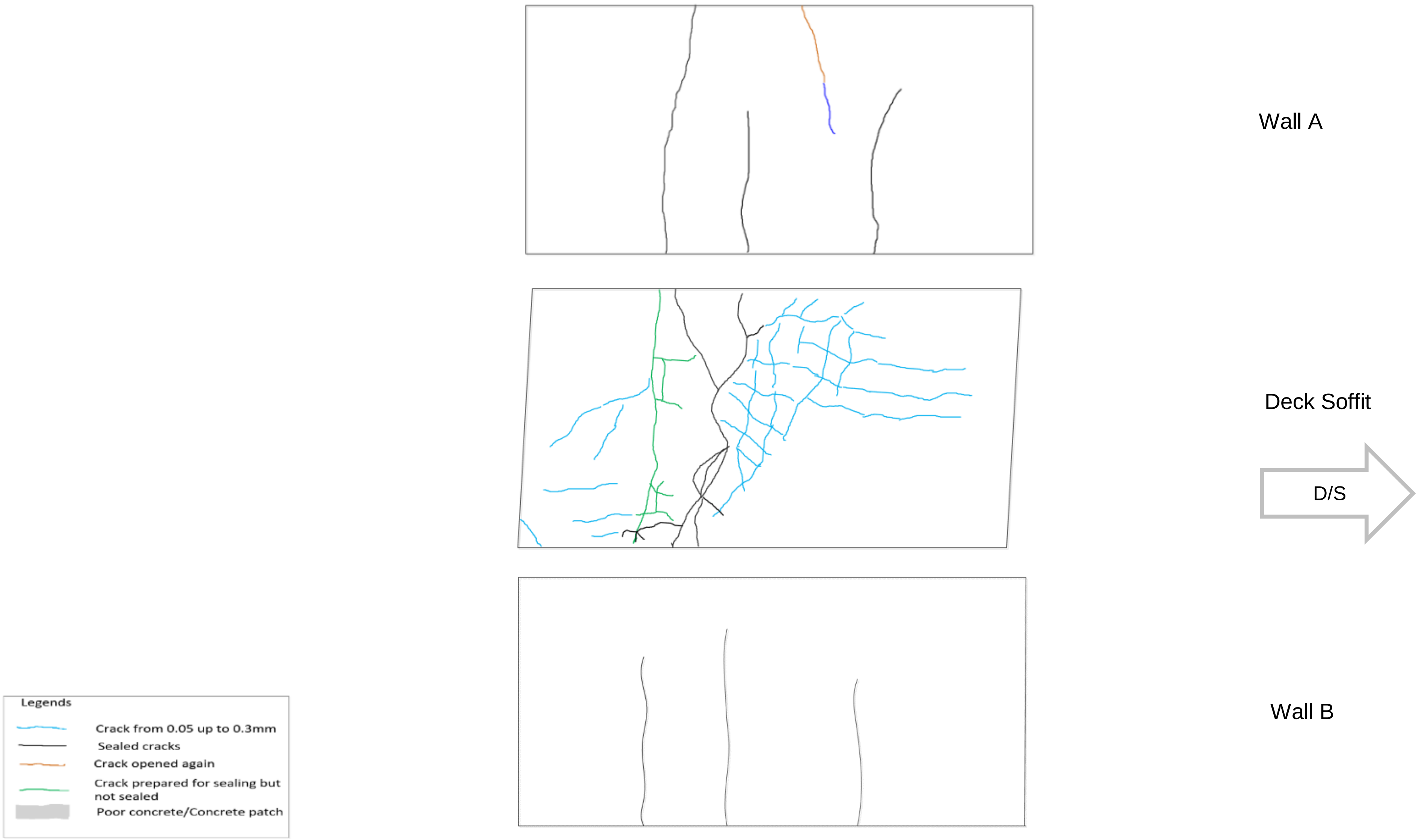

Wing wall U/S
Abutment A
Wing wall D/S
0.05mm
150mm
0.05mm
150mm
0.05mm
0.2 mm
Cold Joint
0.2mm
0.1 - 0.3mm cracks in mesh pattern all over the soffit
Deck Soffit
D/S
Wall B
Span/Cell 1
Legends
Crack from 0.05 up to 0.3mm
Sealed cracks
Crack opened again
Crack prepared for sealing but not sealed
Poor concrete/Concrete patch


400mm
700mm
900mm
Wall A
Deck Soffit
D/S
There are irregular cracks of 0.05 to 0.3 mm which are not plotted
Wall B
Legends
Crack from 0.05 up to 0.3mm
Sealed cracks
Crack opened again
Crack prepared for sealing but not sealed
Poor concrete/Concrete patch

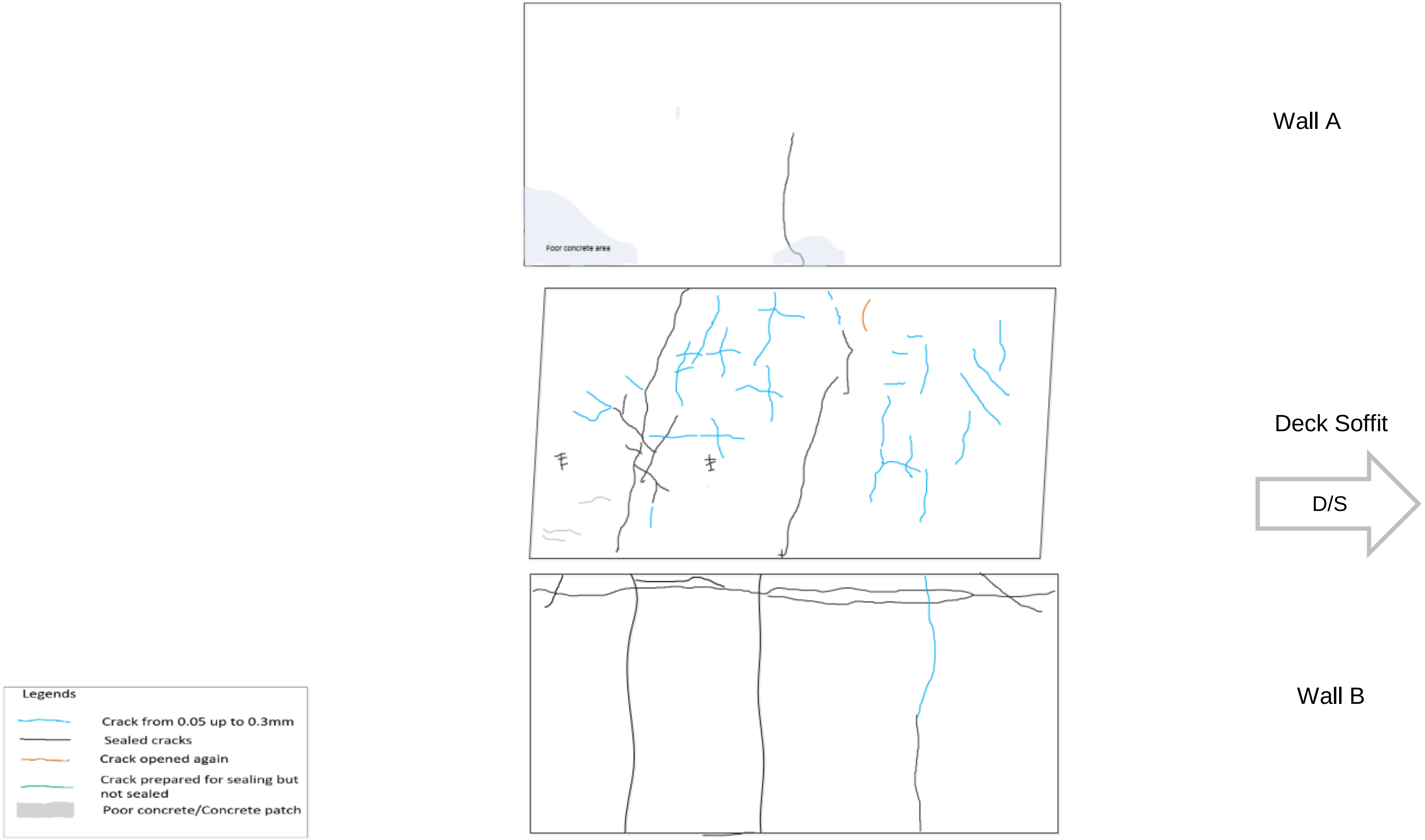
Span/Cell 2

Legends
Crack from 0.05 up to 0.3mm
Sealed cracks
Crack opened again
Crack prepared for sealing but not sealed
Poor concrete/Concrete patch
Wall A
Deck Soffit
D/S
Wall B

Span/Cell 3

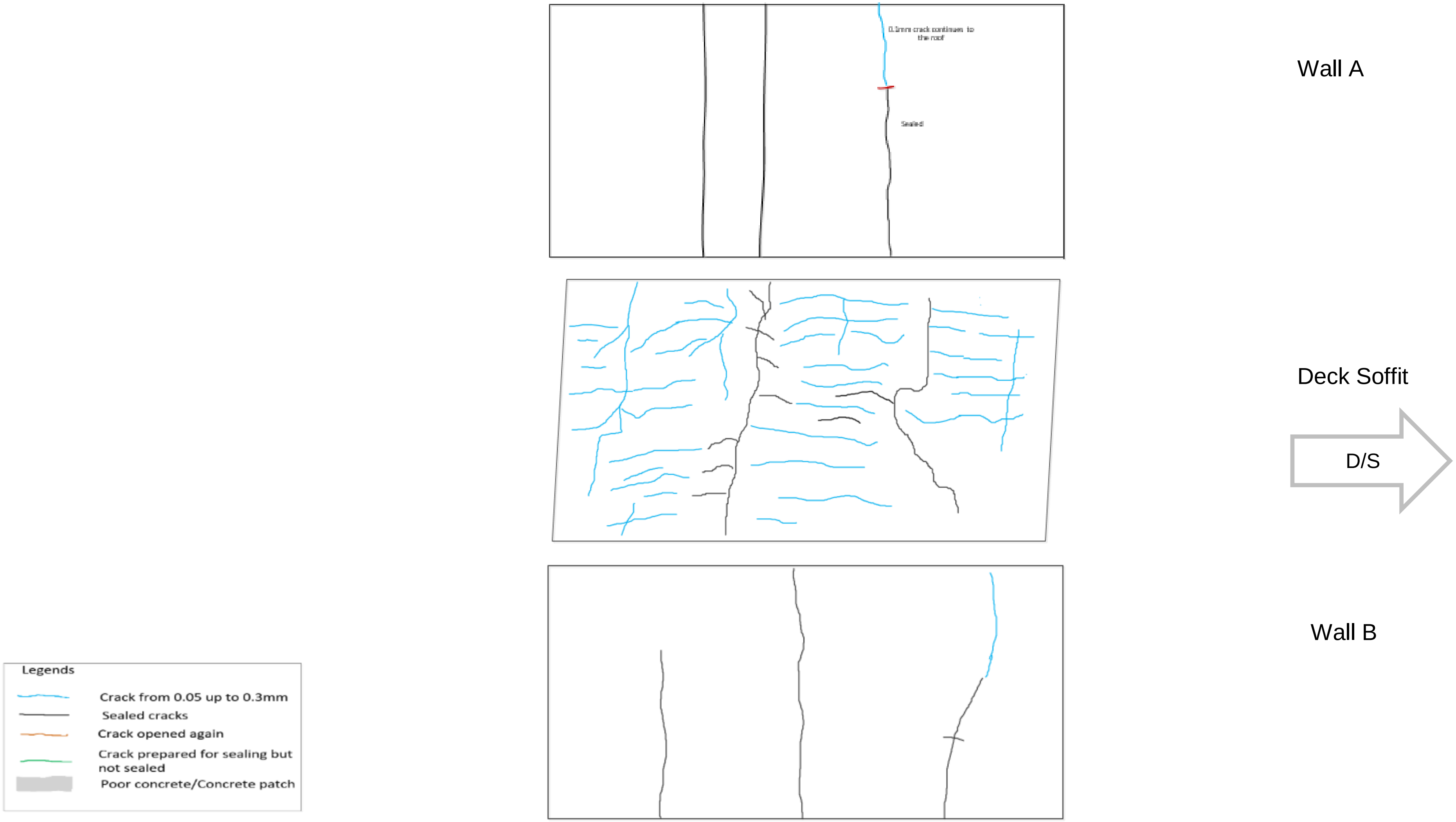

Wall A
Deck Soffit
D/S
Wall B
Legends
Crack from 0.05 up to 0.3mm
Sealed cracks
Crack opened again
Crack prepared for sealing but not sealed
Poor concrete/Concrete patch

Span/Cell 4



Poor concrete area
Wall A
Deck Soffit
D/S
Wall B
Legends
Crack from 0.05 up to 0.3mm
Sealed cracks
Crack opened again
Crack prepared for sealing but not sealed
Poor concrete/Concrete patch

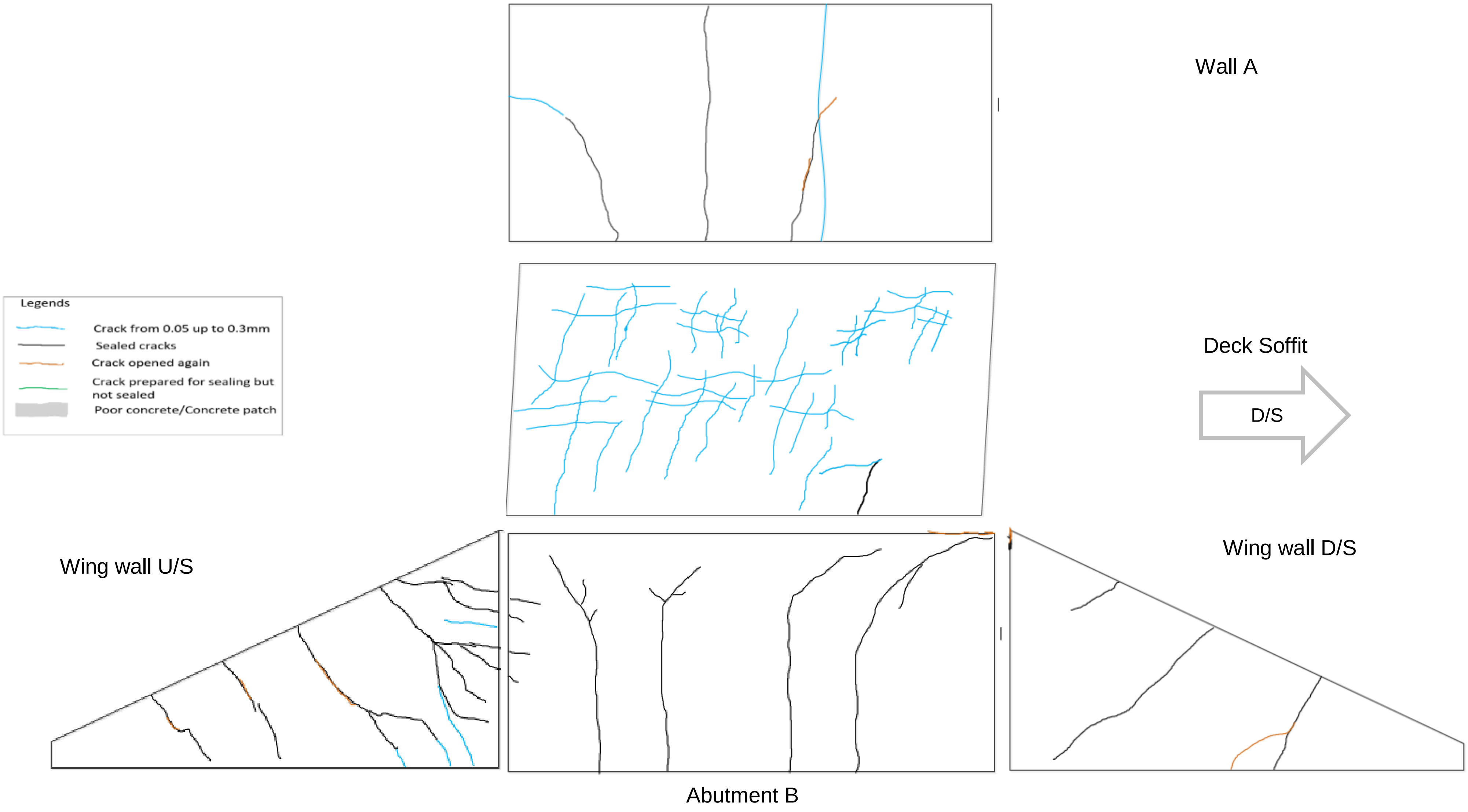
Span/Cell 5


0.1mm crack continues to the roof
Sealed
Wall A
Deck Soffit
D/S
Wall B
Legends
Crack from 0.05 up to 0.3mm
Sealed cracks
Crack opened again
Crack prepared for sealing but not sealed
Poor concrete/Concrete patch

Span/Cell 6

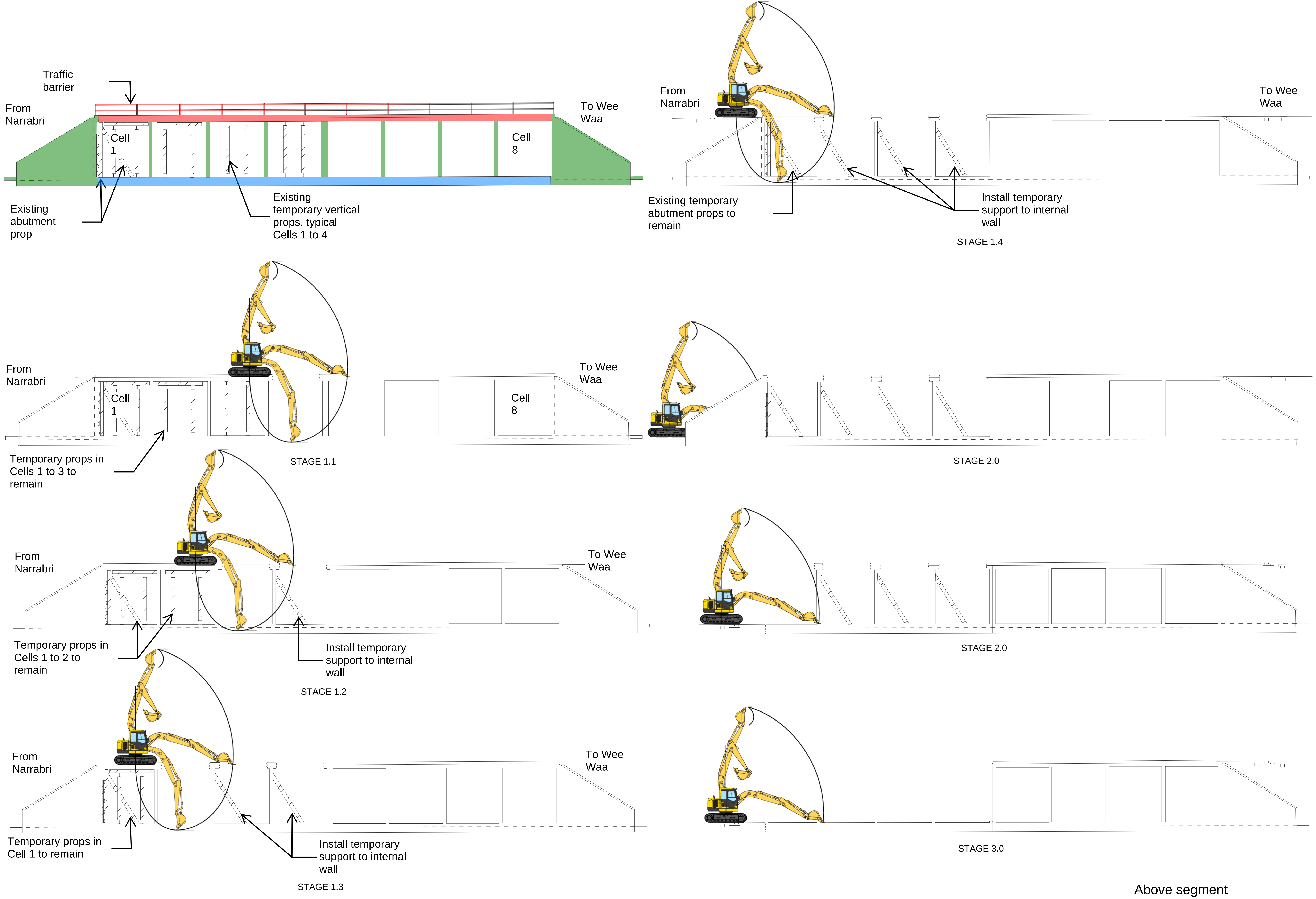
0.05 crack cotinue toward soffit
Wall A
Deck Soffit
D/S
Wall B
Legends
Crack from 0.05 up to 0.3mm
Sealed cracks
Crack opened again
Crack prepared for sealing but not sealed
Poor concrete/Concrete patch

Span/Cell 7

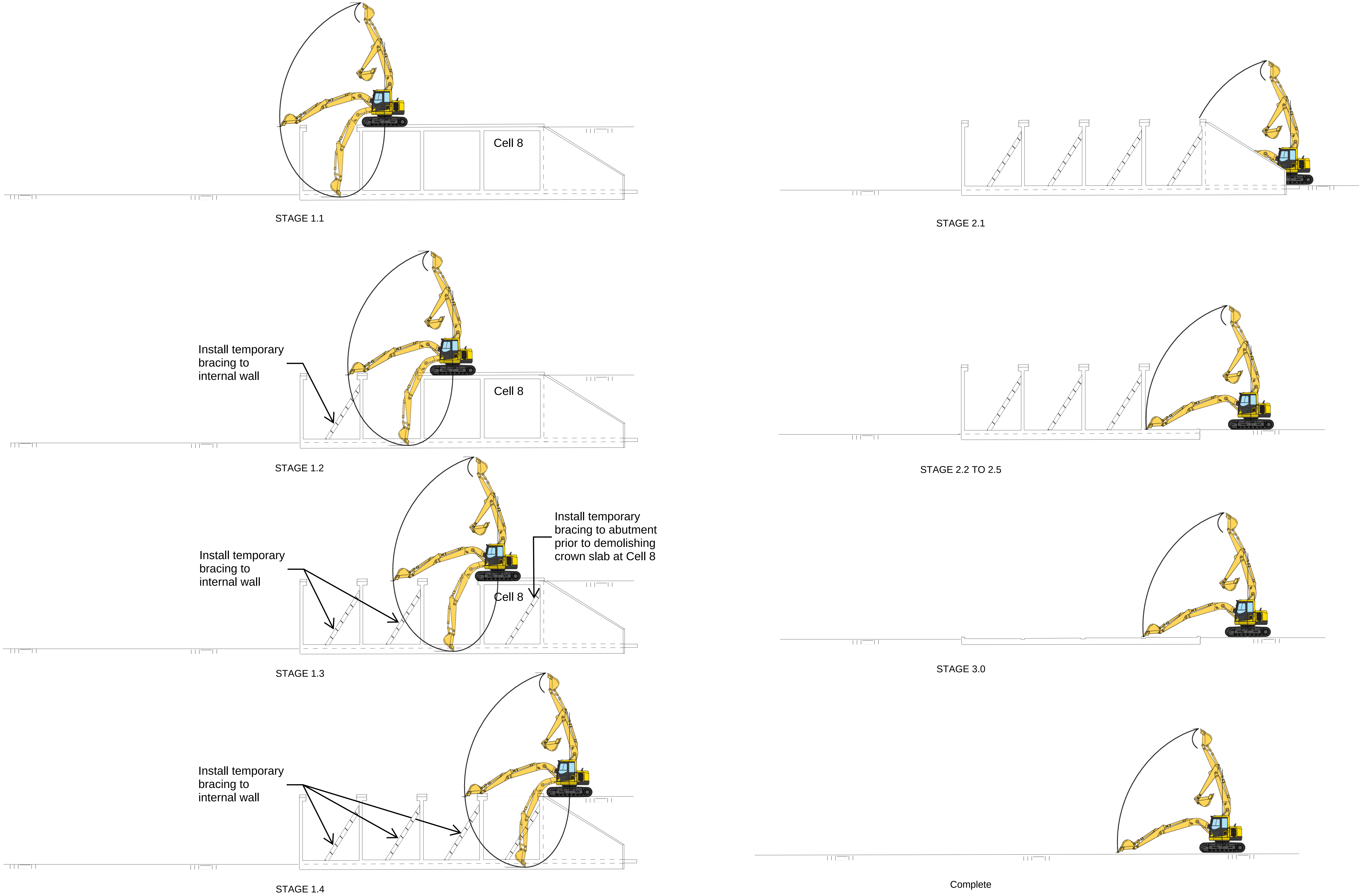

Wall A
Legends
Crack from 0.05 up to 0.3mm
Sealed cracks
Crack opened again
Crack prepared for sealing but not sealed
Poor concrete/Concrete patch
Deck Soffit
D/S
Wing wall U/S
Wing wall D/S
Abutment B

Span/Cell 8

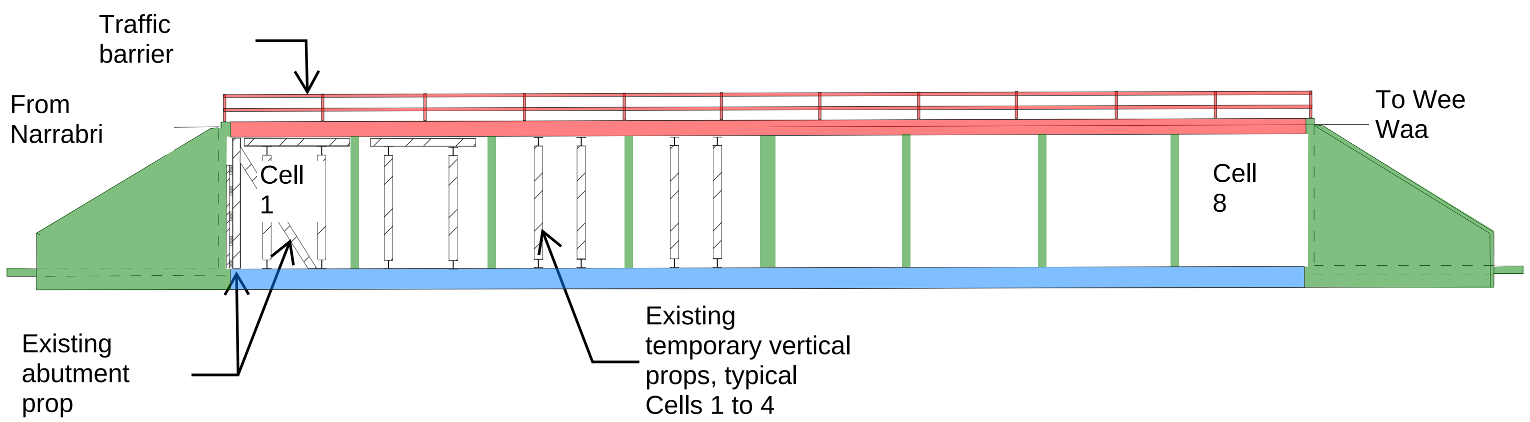
Appendix C – Demolition staging

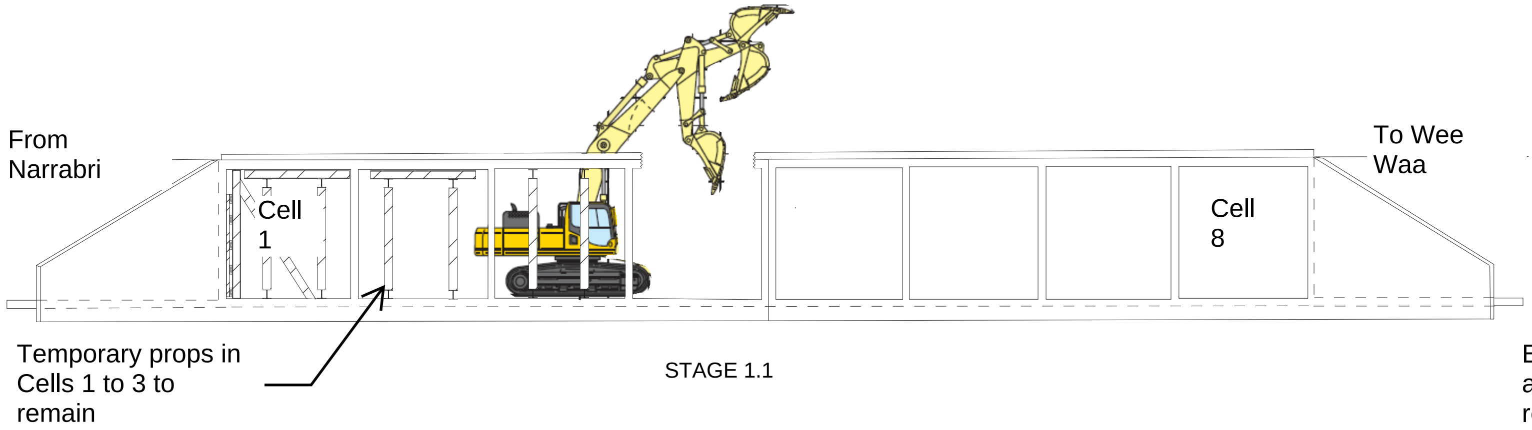


Above segment Demolition staging Cells 1 to 4

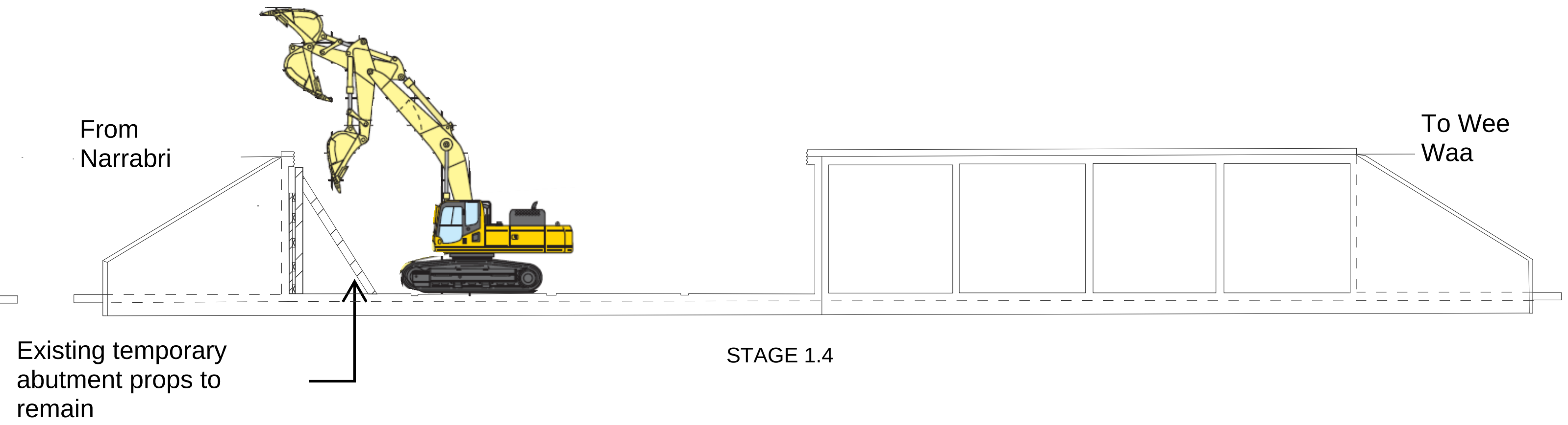


Above segment
Demolition staging
Cells 5 to 8

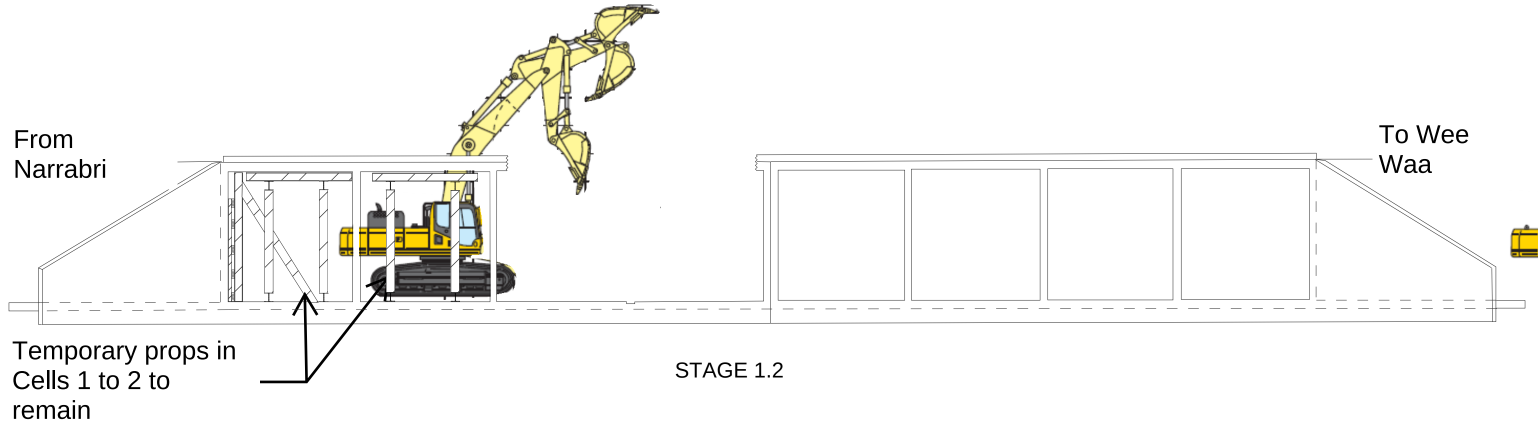




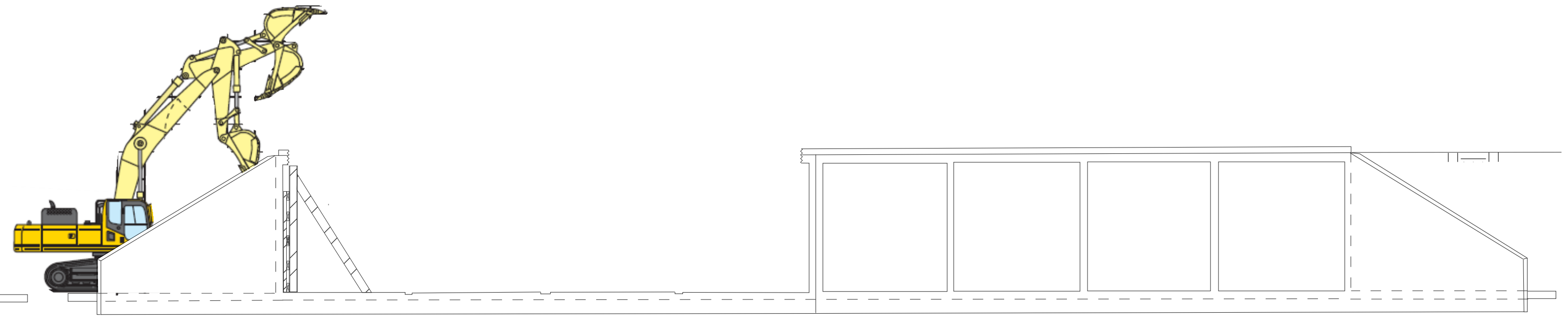
STAGE 1.1



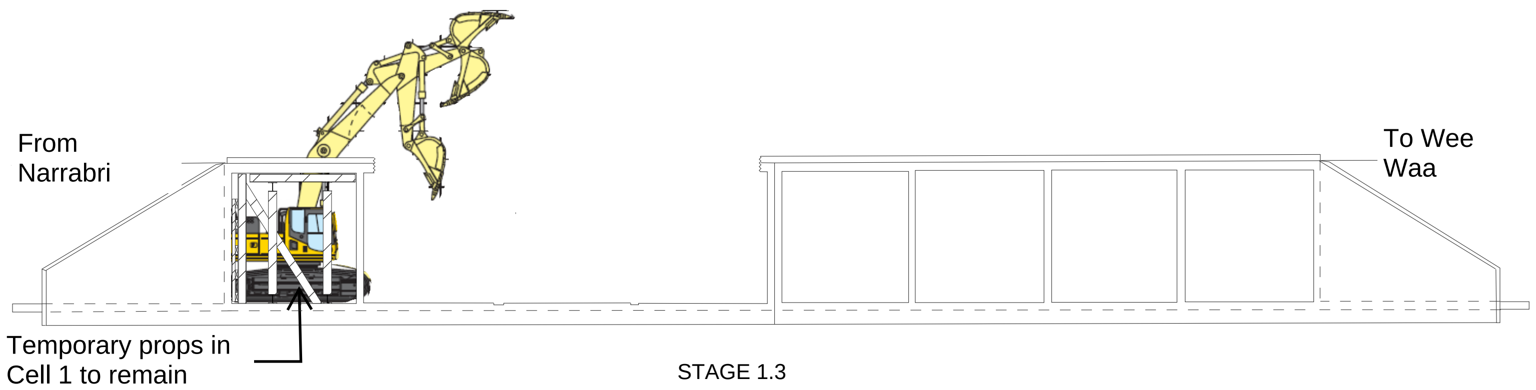
STAGE 1.4



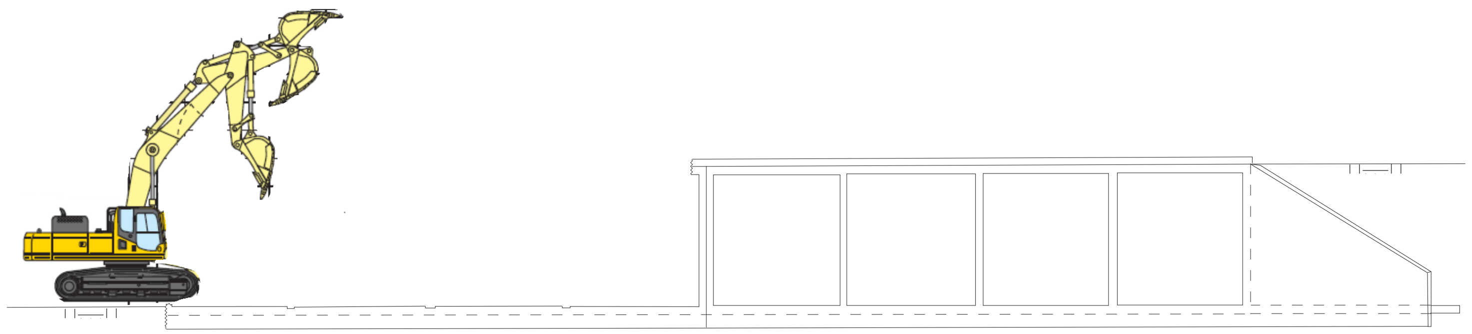
STAGE 1.2



STAGE 2.0

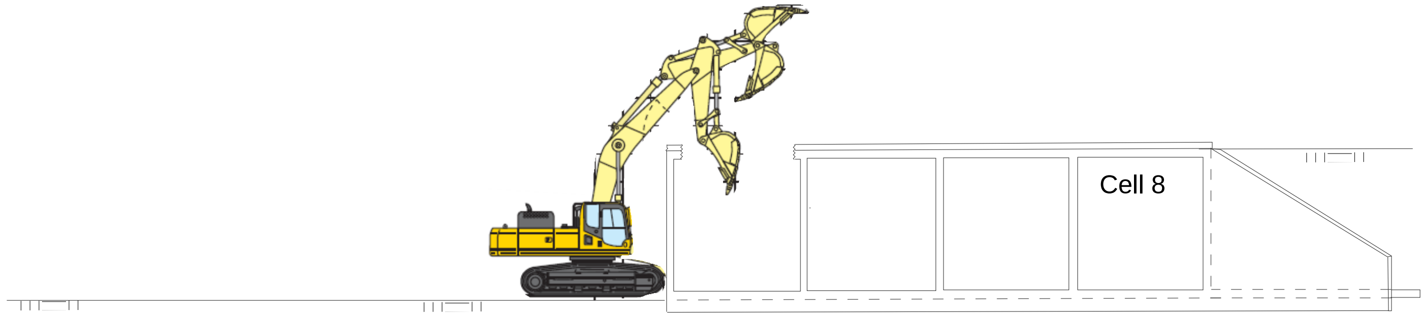


STAGE 1.3

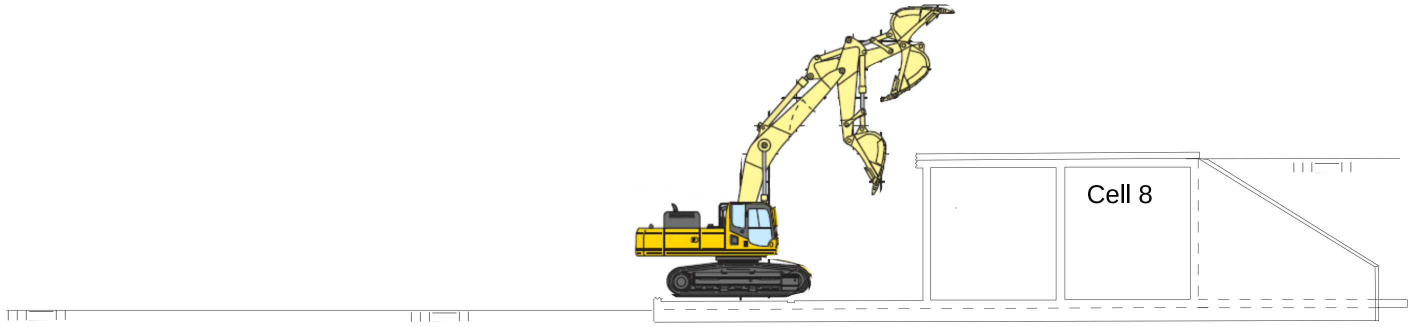


STAGE 3.0

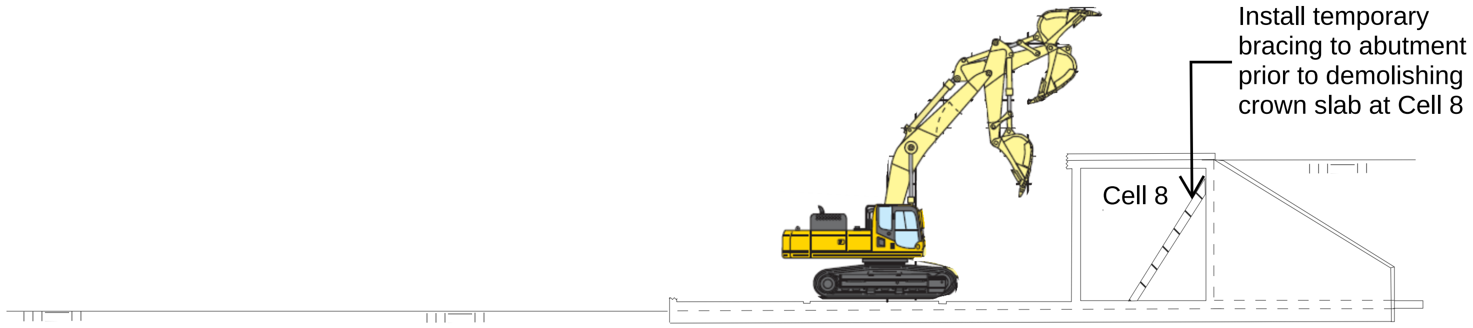
Within creek
Demolition staging
Cells 1 to 4



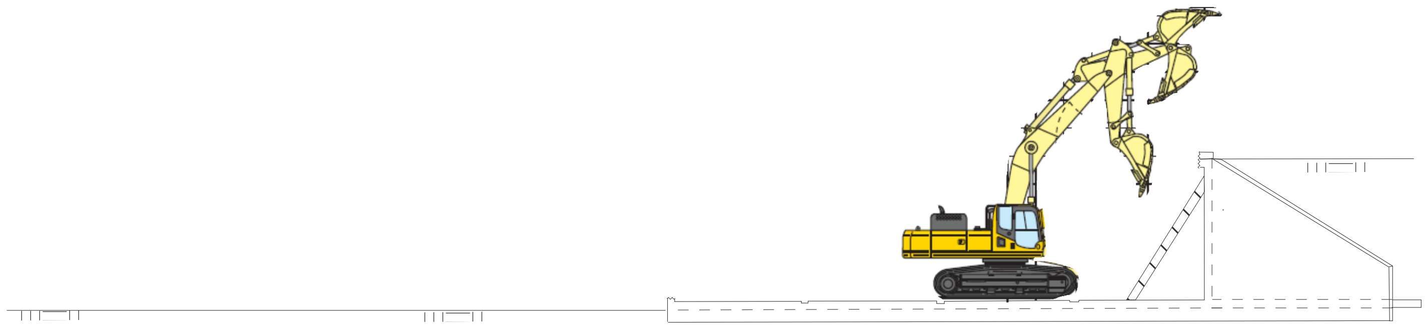
STAGE 1.1



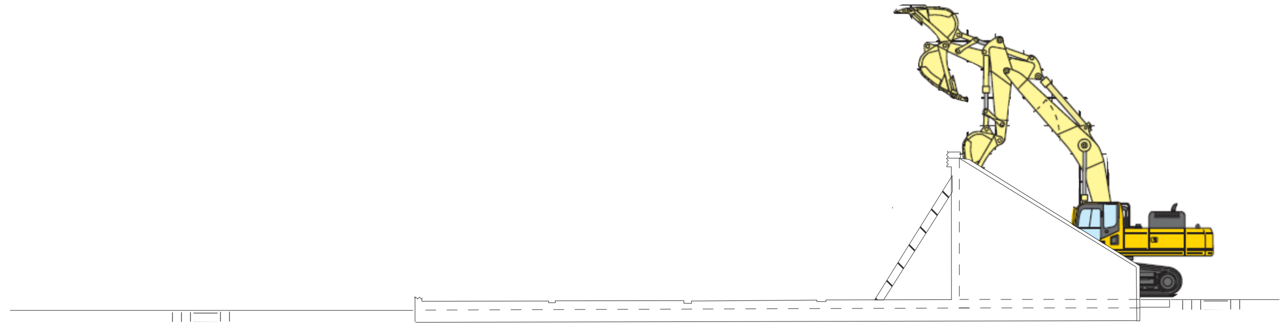
STAGE 1.2



STAGE 1.3

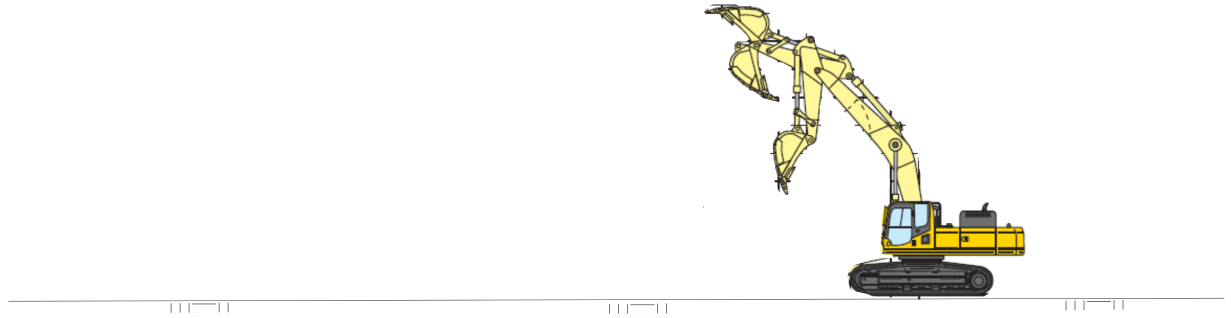


STAGE 1.4



STAGE 2.0

STAGE 3.0



Complete

Within creek
Demolition staging
Cells 5 to 8

Appendix D – Hazardous Material Survey Report

Prepared for
Transport for NSW
ABN: 76 236 371 088

AECOM

Hazardous Material Survey Report

HW29 Spring Creek Bridge B3858

11-Nov-2022

aecom.com

Delivering a better world

Hazardous Material Survey Report

HW29 Spring Creek Bridge B3858

Client: Transport for NSW

ABN: 76 236 371 088

Prepared by

AECOM Australia Pty Ltd
Awabakal and Worimi Country, 17 Warabrook Boulevard, Warabrook NSW 2304, PO Box 73, Hunter Region MC NSW 2310, Australia
T +61 2 4911 4900 F +61 2 4911 4999 www.aecom.com
ABN 20 093 846 925

11-Nov-2022

Job No.: 60692711

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 and ISO45001.

Quality Information

Document	Hazardous Material Survey Report
Ref	60692711
Date	11 November 2022
Prepared by	Aman Kaur
Reviewed by	Haley Bates

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	06-Oct-22	DRAFT - Hazardous Material Survey Report – Bridge B3858	Neil Standen	
0	13-Oct-22	FINAL DRAFT - Hazardous Material Survey Report – Bridge B3858	Neil Standen	
1	11-Nov-22	FINAL - Hazardous Material Survey Report – Bridge B3858	Neil Standen	

Glossary

Asbestos	The asbestiform varieties of mineral silicates belonging to the serpentine or amphibole groups of rock forming minerals that consist of a mixture that contains one or more of the following minerals: actinolite, amosite, anthophyllite, chrysotile, crocidolite, tremolite.
Asbestos (Friable)	Asbestos or asbestos containing material that is in a powder form or that can be crumbled, pulverised or reduced to powder by hand pressure when dry.
Asbestos (Non-friable)	Asbestos or asbestos containing material that is not friable, including material containing asbestos fibres reinforced with a bonding compound.
Asbestos containing material (ACM)	Any material or thing that, as part of its design, contains asbestos. This may include materials identified, assumed, or suspected to contain asbestos.
Asbestos dust or debris (ACD)	Dust or debris that has settled and is, or assumed to be, contaminated with asbestos.
Asbestos related work	Work involving asbestos that is permitted under the exception set out in Work Health and Safety (WHS) Regulation 419.
Class A licence	A licence that authorises the licence holder to conduct Class A (friable) asbestos removal work and Class B (non-friable) asbestos removal work.
Class B licence	A licence that authorises the licence holder to conduct Class B (non-friable) asbestos removal work only.
Competent person	A person who has acquired through training, qualification or experience the knowledge and skills of relevant asbestos removal industry practice to carry out the task.
Hazardous Materials (Hazmat)	In the context of this report hazardous materials refers to any positively identified, assumed, or suspected materials as defined in **Section 2.0**.
Hazardous Materials Register	A register that identifies assessed hazmat at the site.
Lead in paint	A paint film or component of a paint system containing a lead concentration in excess of 0.1% weight/weight (w/w).
Lead in dust	Dust containing lead in a concentration that exceeds the area specific acceptable limit for surface dust lead loadings.
Licensed asbestos assessor	A person who holds an asbestos assessor licence. This licence is required for air monitoring, conducting clearance inspections, and issuing of clearance certificates for Class A (friable) asbestos removal work.
Licensed asbestos removal work	Asbestos removal work for which a Class A or Class B asbestos removal licence is required.
NATA	National Association of Testing Authorities, Australia.
Polychlorinated Biphenyls (PCBs)	Polychlorinated biphenyl or PCB means a substance in which the biphenyl structure has chlorine atoms substituted for hydrogen atoms to varying degrees. PCBs has the chemical formula $C_{12}H_{10-n}Cl_n$ where 'n' is 1-10. Most commonly found in capacitors associated with fluorescent light fixtures.
Synthetic Mineral Fibres (SMF)	A heterogeneous group of fibrous inorganic materials manufactured into a fibrous product (e.g., glasswool, rockwool and refractory ceramic fibre).

Table of Contents

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was engaged by Transport for NSW (TfNSW) for the provision of hazardous materials consultancy services associated with demolition and bridge replacement works at Spring Creek Culvert (B3858), located on the Kamilaroi Highway 9km northwest of Narrabri, NSW 2390. AECOM carried out a hazardous materials survey (hereafter referred to as 'the survey') at the Site on 19 September 2022 to assist TfNSW in meeting its statutory obligations under the *NSW Work Health and Safety Act 2011 (WHS Act)* and *NSW Work Health and Safety Regulation 2017 (WHS Regulation).*

This report presents the findings of the survey and includes the following appendices:

- **Appendix A** Legislative Framework;
- **Appendix B** Hazardous Materials Register;
- **Appendix C** Photographic Record;
- **Appendix D** NATA Laboratory Report; and
- **Appendix E** Limitations.

2.0 Objective

The objective of the survey was to as far as practicable, identify and evaluate the presence, condition, and extent of hazardous materials at the Site, and to provide demolition specific recommendations in a user-friendly format for TfNSW.

For the purpose of this report, hazardous materials include the following:

- Asbestos containing materials (ACM);
- Lead in paint;
- Synthetic mineral fibre (SMF); and
- Polychlorinated biphenyls (PCB).

3.0 Scope of Work

The scope of work included the following:

- A review of the existing plans and Site documentation, where provided;
- A survey of the accessible areas at the Site to identify and locate hazardous materials;
  - The survey was conducted by a combination of 'destructive' and 'semi-intrusive' techniques where practicable;
- Suspected ACM and lead in paint were sampled. Samples were forwarded to a National Association of Testing Authorities (NATA) accredited laboratory for analysis and issue of NATA endorsed report;
- When sampling was not possible (i.e., lack of accessibility or risk of causing contamination), a reasonable assumption was made as to the presence or absence of a hazardous materials (ACM or lead in paint). This reasonable assumption was based on the surveyors' experience, considering factors such as age, physical appearance, and fixing method. Where possible, non-sampled materials were cross referenced to similarly sampled items and are denoted as "Similar to" in the register:
  - SMF materials were visually identified or as a result of asbestos identification analysis; and
  - Representative fluorescent light fittings were visually inspected and assessed against the *Guidelines for the identification of PCBs and Materials Containing PCBs, United Nations Environmental Programme, 1999*.

- Suspected hazardous materials were photographed where possible;
- Preparation of a hazardous materials register outlining the location, type, extent, condition, and recommendation of the identified hazardous materials; and
- Preparation of a report, including the hazardous materials register, removal recommendations (when hazardous materials are detected or assumed), photographic records and NATA laboratory report.

4.0 Site Description

Site details are outlined in **Table 1**.

Table 1: Property Details

Item	Details
Site Name	Spring Creek Culvert (B3858)
Site Address	Spring Creek Culvert(B3858) located on the Kamilaroi Highway (HW29) 9km northwest of Narrabri, NSW 2390
GPS Coordinates	Latitude: -30.263928. Longitude: 149.721391
Date of Survey	19 September 2022

5.0 Hazardous Materials Information and Methodology

The survey was conducted in accordance with the scope of works detailed in **Section 3.0** and with reference to applicable legislation in **Appendix A**. A complete list of hazardous materials identified or assumed during the Survey, including details about the identification, location, condition, and recommendation has been provided in the hazardous materials register in **Appendix B**. Photographic records and NATA endorsed reports are provided in **Appendix C** and **Appendix D** respectfully.

Hazardous materials information and the adopted methodologies for each are detailed below.

5.1 Asbestos Containing Materials

ACM are defined by the *WHS Regulation* as any material or thing that, as part of its design, contains asbestos. These forms are classified as friable and non-friable asbestos, as defined below.

- **Friable asbestos**: is in a powder form or can be crumbled, pulverised or reduced to a power by hand pressure when dry.
- **Non-friable asbestos** is any material (other than friable asbestos material) that contains asbestos.

Suspected ACMs were sampled and sent for analysis to a NATA accredited laboratory for examination as per *Australian Standard: Method for the Qualitative Identification of Asbestos in Bulk Samples (AS 4964).* The Laboratory Report (306521-[R00]) is provided in **Appendix D**.

5.2 Lead in Paint

Lead paint is defined as a paint film or component of a paint system containing lead greater than 0.1% w/w, as defined in *Australian/New Zealand Standard Guide to hazardous paint management. Part 2: Lead paint in residential, public, and commercial buildings (AS/NZS 4361.2:2017)*.

Where possible, paint samples were collected to include all coatings back to the substrate material.

Paint samples were sent to an external laboratory for analysis with reference to *US EPA Method 6010, Inductively coupled plasma-atomic emission spectrometry* to determine the quantitative concentration of lead (% w/w). The Laboratory Report (306521-[R00]) is provided in **Appendix D**.

5.3 Synthetic Mineral Fibre (SMF)

SMF materials are a heterogeneous group of fibrous inorganic materials manufactured into a fibrous product that is primarily used for insulation purposes. SMF can be classified into three groups (glasswool, rockwool and refractory ceramic fibre (RCF)), as detailed in the SafeWork *Information Guide Safe Management of Synthetic Mineral Fibres – Glasswool and Rockwool, 2015*. Glasswool and rockwool are grouped into bonded and un-bonded classifications based on the use of binding materials. The bonded form contains adhesives or cements, whereas the unbonded form contains little to no adhesives or cements.

SMF were assessed primarily by visual examination or as a result of asbestos identification analysis.

5.4 Polychlorinated Biphenyls

PCBs are chlorinated aromatic hydrocarbons, found as oil in capacitors and transformers used in electrical light fittings, electric motors, ceiling fans and dish washers. For the purpose of this survey, PCBs are limited to capacitors in light fittings.

The location of suspected PCB-containing capacitors was determined by inspecting representative light fittings throughout the Site noting and recording printed capacitor details. Capacitor details were then cross-referenced against *Identification of PCB Containing Capacitors* published by the *Australian and New Zealand Environment and Conservation Council, 1997 (ANZECC)*, and *Guidelines for the identification of PCBs and Materials Containing PCBs, United Nations Environmental Programme, 1999*.

6.0 Results

6.1 Inaccessible Areas

Specific details of inaccessible areas are outlined in the hazardous materials register presented in **Appendix B**. General areas that were inaccessible at the time of inspection included:

- Non-exposed structural material beneath concrete, road-based material etc;
- Subsurface soil, including beneath foundation slabs;
- Concealed building materials;
- Submerged materials; and
- Work at heights.

It is recommended that inaccessible areas listed in the hazardous materials register, be assumed to contain hazardous materials until proven otherwise with appropriate precaution implemented prior to demolition works.

6.2 Survey Findings

Detected or assumed hazardous materials are summarised in **Table 2**.

Table 2: Survey Findings

Summary of detected or assumed hazardous materials			
ACM	**Lead Paint**	**SMF**	**PCB**
Present	**Present**	**-**	**-**

Note:
'Present' means hazardous material identified (by laboratory analysis) or assumed (by evidence based on the surveyor's experience).
'-' means hazardous material was not identified (by laboratory analysis) or assumed (by evidence based on the surveyor's experience).

The findings included:

- ACM was detected to one (1) bulk sample (sample ID: A1) at the Site, at the time of the survey. ACM should be assumed present to the moulded fibre cement to scupper surrounds throughout which were non-friable in nature with approximately less than 10m^2 present. Some fibre cement surrounds to the scuppers were hard to access. These were completely sealed off with a new asphalt pavement layer. All moulded fibre cement surrounding scuppers, including areas where it has been sealed off should be removed prior to any demolition works.

- Lead was detected above the assessment criteria in one (1) paint sample (sample ID: L1) at the Site, at the time of the survey. The bridge had one paint system (yellow); this was found in fair condition. Although the lead content in the sample ID L2 (collected from the south rail) was below the assessment criteria 0.1% w/w, due to the homogenous nature of paint system, all the paint system should be assumed to contain lead over the assessment criteria of 0.1% w/w.
- SMF and PCBs were not identified at the Site, at the time of the survey.

A complete list of hazardous materials identified or assumed during the Survey, including details about the identification, location, condition, and recommendation has been provided in the hazardous materials register in **Appendix B**. Photographic records and NATA endorsed reports are provided in **Appendix C** and **Appendix D** respectfully.

No one section or part of a section of this report should be taken as given an overall idea of this report. Each section must be read in conjunction with the whole of this report, including all appendices.

7.0 Recommendations

The objective of the survey was to determine the presence and condition of hazardous materials and to provide demolition specific recommendations to assist TfNSW in meeting its statutory obligations under the *NSW Work Health and Safety Act 2011* and *NSW Work Health and Safety Regulation 2017*.

ACM was detected in the scupper surrounds at road level throughout the bridge sized culvert. These were found in fair condition. As a short-term mitigation, ACM located to the scupper surrounds should be encapsulated as per Section 7.1.2 if the workers and the public are potentially interacting with the material. Removal of the ACM located to the scupper surrounds should be carried out as per Section 7.1.3 before any demolition works.

Lead content exceeded 0.1% (w/w) in the sample collected from the steel traffic rail located on the upstream side of the culvert (see Photo 5). Lead content was also encountered in the sample collected from the downstream steel traffic rail however it was detected below the assessment criteria of 0.1% (w/w). The bridge is proposed for demolition, as such AECOM recommends lead paint should be addressed with demolition works as per Section 7.2.

Hazardous materials risk management strategies should be implemented where hazardous materials were identified or assumed to be present at the Site prior to the commencement of demolition works. Comments specific for each hazardous material identified or assumed during the survey are detailed in the Hazardous Materials Registers in **Appendix B**.

Non-specific recommendations for the removal of hazardous materials prior to demolition works are further discussed below. A risk assessment and methodology should be developed by the stakeholder engaged to remove / manage the hazardous materials associated with demolition works.

7.1 Asbestos

7.1.1 Mitigate

Non-friable ACM in fair condition that has a low to moderate risk of exposure can be mitigated with a combination of engineering and administrative controls. Mitigation control measures may include the ACM being enclosed, encapsulated or sealed as described below.

- **Enclose** - Placing a fixed physical barrier between the ACM and the surrounding area reducing the risk of exposure to airborne asbestos fibres from general interaction with the material (suitable for non-friable ACM where removal is not reasonably practicable and where the ACM is at risk of damage from work activities).
- **Encapsulate**– ACM is encapsulated in a resilient matrix (e.g., reinforced plastic, vinyls, resins, mastics, bitumen, flexible plaster, or cement) to prevent the release of asbestos fibres into the air (applicable if the ACM cannot be removed or enclosed).
- **Seal** – Covering the surface of the ACM with a protective coating (paint) to reduce fibre release and/or bind the fibres together (sealing is inappropriate where the process of sealing or applying paint will disturb or damage the ACM).

Mitigation control measures are interim in nature and should be supported through regular inspections by a competent person to evaluate the ongoing effectiveness of the applied controls. Removal should be considered when the applied controls are no longer effective through degradation and damage of the applied controls are observed.

The process of encapsulating and sealing ACM is considered as 'asbestos-related works' due to the direct interaction with the ACM. As such, the following should be considered when these mitigation control measures are implemented:

- Engage an appropriately licensed asbestos contractor (Class A or Class B) to undertake the works.
- The licensed asbestos contactor is to ensure they have conducted and implemented the following:
  - Notified the regulator of the licensed asbestos work.
  - Prepared a Safe Work Method Statement and Safety Management Plan.
  - Limited access to the asbestos work area (e.g., barricading, signage).
  - Provided suitable decontamination facilities or processes.
- Engage a hygienist or competent person to undertake air monitoring where asbestos-related work is being carried out, particularly if there is uncertainty as to whether the exposure standard is likely to be exceeded.

7.1.2 Remove

ACM must be removed prior to any construction, demolition, refurbishment, alteration, or maintenance works that are likely to result in the disturbance of ACM.

Any work involving the removal of ACM must be undertaken under controlled conditions, with the following considerations:

- The following licence requirements must be followed with regards to asbestos removal works:
  - **Class A Licence** - For any amount of friable ACM, asbestos containing dust and non-friable asbestos.
  - **Class B Licence** - For greater than 10 m^2 of non-friable ACM and asbestos containing dust associated with the removal of non-friable ACM.
- No licence is required for the removal of up to 10 m^2 of non-friable ACM and asbestos containing dust associated with the removal of less than 10 m^2 of non-friable ACM.
- The licensed asbestos contactor (where used as per licence requirements) is to ensure they have conducted and implemented the following:
  - Notified the regulator of the licensed asbestos removal work.
  - Prepared a Safe Work Method Statement and an Asbestos Removal Control Plan.
  - Limited access to the asbestos work area (e.g., barricading, signage).
  - Provided decontamination facilities appropriate for the type of asbestos removal works.
- For Class A licensed asbestos removal works:
  - Ensure an independent Licensed Asbestos Assessor is engaged to conduct airborne asbestos monitoring prior to, during and following any works.
  - ▪ Airborne asbestos analysis should be undertaken by a NATA Accredited laboratory.
  - Ensure an independent Licensed Asbestos Assessor conducts a clearance inspection following the Class A licensed asbestos removal works. This is undertaken to assess the adequacy of the removal works and to validate that asbestos has been removed to a satisfactory standard and that the affected areas are safe for reoccupation. This must include clearance airborne asbestos monitoring and may include soil validation sampling depending on the asbestos removal work.
- For Class B licensed asbestos removal works:

- Consider engaging an independent Licensed Asbestos Assessor or competent person to conduct airborne asbestos monitoring.
  - Airborne asbestos analysis should be undertaken by a NATA Accredited laboratory.
- Ensure an independent Licensed Asbestos Assessor or competent person conducts a clearance inspection following the Class B licensed asbestos removal works. This is undertaken to assess the adequacy of the removal works and to validate that asbestos has been removed to a satisfactory standard and that the affected areas are safe for reoccupation. This may include clearance airborne asbestos monitoring and / or soil validation sampling depending on the asbestos removal work.

- Clause 79 of the NSW *Protection of the Environment Operations (waste) Regulation 2014* requires asbestos waste transporters (transporting a minimum of 100 kilograms of asbestos waste, or 10 m^2 of asbestos waste that is asbestos sheeting, in any single load) to provide tracking information to the EPA via the WasteLocate online tool. ACM must also be disposed of at a suitably approved waste collection facility. All tipping dockets must be retained.

7.2 Lead Paint

Lead paint should be addressed during demolition works. Lead paint management should be conducted under controlled conditions in accordance with applicable legislation outlined in **Appendix A**. The following recommendations are provided when undertaking lead paint removal works.

Removal methods include:

- **Removal of lead-painted products in its entirety** – Material/structures covered in lead paint may be removed in its entirety (with lead paint in-situ) and replaced with new materials that do not contain lead paint.
- **Removal of lead paint from the structural surface** – This process involves the removal of lead paint from a structure surface only. Lead paint removal may be conducted using the following methods:
  - Wet scraping and wet sanding;
  - On site chemical stripping; and
  - Removal by heat gun and scraper.

The removal of lead paint from structural surfaces may be defined as a lead process or lead risk work based on *WHS Regulation*, *clauses 392 and 394.* As such, the following should be considered:

- Seek approval from the regulator regarding the nature of the removal works with respect to lead processes and lead risk work; and
- Where removal works are deemed a lead process or lead risk work, address relevant *WHS Regulation* clauses associated with lead processes.

The *WHS Regulation (Chapter 7)* outlines specific requirements relating to lead risk work that need to be conducted by a person conducting a business or undertaking (or the contractor engaged to do the work), including:

- Ensuring information is provided to workers about the risks and health effects when working with lead;
- Ensuring health monitoring is provided to workers before lead risk works starts and one month after starting; and
- Ensuring a lead risk work notification form is submitted at least seven (7) days before lead works commences.

Other considerations include:

- Preparation of a Safe Work Method Statement for the selected methodology;
- Limiting access to the lead paint work area (e.g., barricading, signage);

- Providing suitable decontamination facilities and processes;
- Managing lead related waste in accordance with the requirements detailed in *Protection of the Environment Operations (Waste) Regulation 2014*; and
- Schedule 1 of the NSW *Protection of the Environment Operations (waste) Regulation 2014* requires lead waste transporters to provide tracking information to the EPA via the WasteLocate online tool. Lead related waste must be disposed at a suitably approved waste collection facility. All tipping dockets must be retained.

7.3 Hazardous Materials not Detected or Assumed

As no SMF or PCBs were identified or assumed at the Site, no further actions purporting to the management of these hazardous materials are required during demolition and redevelopment works (with the exception of unexpected finds and concealed areas). Should further suspected hazardous materials be identified during demolition and redevelopment works, the unexpected finds protocol detailed in **Section 7.4** should be following prior to continuing refurbishment or demolitions works.

7.4 Unexpected Finds Protocol

When suspected hazardous materials are encountered, the following procedure protocol should be followed:

- Cease work and restricted access by isolating the area with a barrier and warning signage.
- Engage a hazardous materials consultant or equivalent specialist (e.g., licensed asbestos assessor or competent person) to undertake an assessment of the unexpected find.
  - The hazardous materials consultant or equivalent specialist (e.g., licensed asbestos assessor or competent person) should provide information following the assessment detailing the sample result, material identification, and recommendation to appropriately mitigate the find if a hazardous material is identified.
- Hazardous material removal may require the engagement of a licensed contractor and implementation of specific controls which may include air monitoring.
- If the unexpected find is deemed to be emergency asbestos removal work, a SafeWork NSW notification is not required, however the engaged asbestos removal contractor must advise SafeWork NSW within 24 hours of being advised and/or undertaking the emergency works.
- Following the removal of the hazardous material a clearance inspection may be required by a hazardous materials consultant or equivalent (e.g., licensed asbestos assessor or competent person).
- Following successful hazardous material removal works and clearance certificate (where required) remove barriers and recommence demolition and redevelopment works under normal conditions.

Appendix A

Legislative Framework

Appendix A Legislative Framework

The following legislation and guidelines have been referenced throughout the report.

Legislative Framework
Overarching Legislation applicable for all hazardous materials
• *NSW Work Health and Safety Act 2011 (WHS Act).* • *NSW Work Health and Safety Regulation 2017 (WHS Regulation).* • NSW *Protection of the Environment Operations (waste) Regulation 2014.* • *Code of Practice: Demolition Work*.
Asbestos Containing Materials
• *Code of Practice: How to Safely Remove Asbestos.* • *Code of Practice: How to Manage and Control Asbestos in the Workplace.* • *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition [NOHSC:3003(2005)].* • *Australian Standard AS 4964 - 2004, Method for the Qualitative Identification of Asbestos in Bulk Samples.*
Lead Paint
• *Australian Standard AS4361.1 – 2017, Guide to Hazardous Paint Management, Part 1: Lead and Other Hazardous Metallic Pigments in Industrial Applications*. • *Australian Standard AS4361.2 – 2017, Guide to Hazardous Paint Management, Part 2: Lead Paint in Residential, Public and Commercial Buildings*. • Relevant State/Territory specific legislation e.g., *Dept of Environment Climate Change and Water (DECCW) Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes*. • Relevant Codes of practice for working with lead including *SafeWork Australia/NIOSH (1994) National Code of Practice for the Control and Safe Use of Inorganic Lead at Work and Demolition Work.* • *US EPA Method 6010, Inductively coupled plasma-atomic emission spectrometry.*
Synthetic Mineral Fibres
• *SafeWork NSW Information Guide, Safe Management of Synthetic Mineral Fibres (SMF) Glasswool and Rockwool, 2015.* • *SafeWork Australia Guide to Handling Refractory Ceramic Fibres, 2013.*
Polychlorinated Biphenyls
• *Guidelines for the identification of PCBs and Materials Containing PCBs, United Nations Environmental Programme, 1999* • *ANZECC (1997) Identification of PCB-containing Capacitors: An information booklet for Electricians and Electrical Contractors.* • *Polychlorinated Biphenyl (PCB) Chemical Control Order 1997.* • *Polychlorinated Biphenyls Management Plan, Revised Edition April 2003.*

Appendix B

Hazardous Materials Register

Appendix B Hazardous Materials Register

Client: Roads and Maritime Services
Job Number: 60692711
Site ID: Spring Creek Bridge B3858
Address: Over Spring Creek at Crankies Plain on Kamilaroi Highway, located 9km northeast of Narrabri, NSW 2390
Survey date: 19 September 2022
Surveyor: Aman Kaur

Hazardous Materials Register

No.	Internal / External	Room/Area	Location	Material Application	Approx. Quantity	Unit	Hazmat type	Sample ID	Sample Results	Sub-Result	Friability	Photo No.	Condition	Comments and Removal Recommendations
Spring Creek Bridge B3858 over Spring Creek												**1, 2**		
1	External	Bridge deck (north)	Surrounds of the scupper throughout	Moulded compressed cement	<10	m^2	Asbestos	A1	Asbestos detected	Chrysotile	Non-Friable	3,4	Fair	If there is a likelihood of interaction with the ACM to workers or the general public, consider implementing short term mitigation control measures such as enclosing, encapsulating or sealing the ACM by a licensed asbestos removal contractor or a competent person. Removal of the ACM should be undertaken prior to any demolition or refurbishment which may affect the material in accordance with recommendations in Section 7.
1	External	Bridge deck (throughout)	Surrounds of the scupper throughout	Moulded compressed cement	<10	m^2	Asbestos	As A1	Asbestos detected	Chrysotile	Non-Friable	-	Fair	If there is a likelihood of interaction with the ACM to workers or the general public, consider implementing short term mitigation control measures such as enclosing, encapsulating or sealing the ACM by a licensed asbestos removal contractor or a competent person. Removal of the ACM should be undertaken prior to any demolition or refurbishment which may affect the material in accordance with recommendations in Section 7.
2	External	Bridge deck	Bridge rail post (north)	Yellow paint	34	lin m	Lead paint	L1	Lead detected above 0.1%w/w	0.22% w/w	-	5, 7	Fair	Lead content exceeds 0.1% w/w and is classified as lead paint. Yellow paint systems to other areas of the bridge are assumed to contain lead paint also, not just the bridge post north. Consider removal with reference to AS4361.2-2017 and the SafeWork NSW Code of Practice: Demolition Work.
3	External	Bridge deck	Bridge rail post (south)	Yellow paint	34	lin m	Lead paint	L2	Lead detected below 0.1%w/w	0.093%w/w	-	6, 8	-	Lead content does not exceed 0.1% w/w. This paint system is not classified as lead paint. However, the bridge has the same paint system throughout (yellow paint). Although the lead content in the sample collected on the south rail is below the assessment criteria 0.1% w/w, due to the homogenous nature of paint, demolition recommendations for sample ID 'L1' should be applied for the south rail post as a precaution.
4	External	Bridge	Throughout	-	-	-	SMF and PCB	-	-	-	-	-	-	SMF and PCB's were not identified at the Site, at the time of the survey.
4	External	Non exposed structural material beneath concrete, sub-surface areas, concealed building materials and any submergerd building materials.	Throughout	Inaccessible areas	-	-	-	-	-	-	-	2	-	Area was inaccessible at the time of the inspection. Potential for hazardous materials. The area should be assumed to contain hazardous materials until proved otherwise by a competent person.

Appendix C

Photographic Record

Appendix C Photographic Record

Photo 1 **Spring Creek Bridge B3858 over Spring Creek**

Photo 2 **Spring Creek Bridge B3858 over Spring Creek**

Photo 3 **Spring Creek Bridge B3858 over Spring Creek.** Sample location A1 – Moulded fibre cement to the surrounds of the scuppers (throughout).

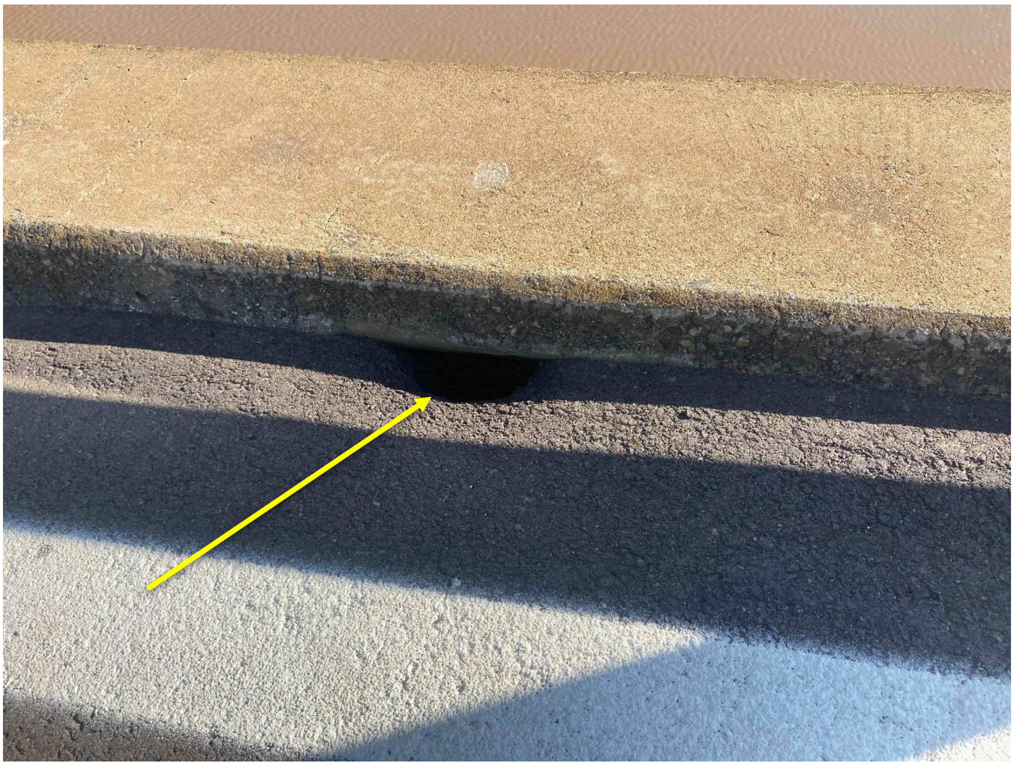


Photo 4 **Spring Creek Bridge B3858 over Spring Creek.** Some of the fibre cement surrounds to the scuppers were hard to access. These were completely sealed off with new bitumen layer. All moulded fibre cement surrounding of the scuppers, including areas where it has been sealed off be removed prior to any demolition works.

Photo 5 **Spring Creek Bridge B3858 over Spring Creek.** Sample location L1 – Yellow paint to north rail

Photo 6 **Spring Creek Bridge B3858 over Spring Creek.** Sample location L2 – Yellow paint to south rail. Although the lead content in the sample collected on the south rail is below the assessment criteria 0.1% w/w, due to the homogenous nature of paint, demolition recommendations for sample ID 'L1' should be applied for the south rail post as a precaution.

Photo 7 **Spring Creek Bridge B3858 over Spring Creek.** Yellow paint to metal rails on both ends of the bridge. Due to the homogenous nature of the paint, all yellow paint should be assumed to contain lead content exceeding the assessment criteria of 0.1%w/w. Paint was found in fair condition.

Photo 8 **Spring Creek Bridge B3858 over Spring Creek.** Yellow paint to metal rails on both ends of the bridge. Due to the homogenous nature of the paint, all yellow paint should be assumed to contain lead content exceeding the assessment criteria of 0.1%w/w. Paint was found in fair condition.

Appendix D

NATA Laboratory Report

Appendix D NATA Laboratory Report

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 306521

Client Details

Client	AECOM Australia Pty Ltd (Warabrook)
Attention	Neil Standen
Address	17 Warabrook Blvd, Warabrook, NSW, 2304

Sample Details

Your Reference	**TransportNSW - Spring Creek Bridge**
Number of Samples	1 Material, 2 Paint
Date samples received	26/09/2022
Date completed instructions received	26/09/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	04/10/2022
Date of Issue	04/10/2022

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Asbestos Approved By

Analysed by Asbestos Approved Analyst: Lucy Zhu
Authorised by Asbestos Approved Signatory: Lucy Zhu

Results Approved By

Giovanni Agosti, Group Technical Manager
Lucy Zhu, Asbestos Supervisor

Authorised By

Nancy Zhang, Laboratory Manager

Asbestos ID - materials		
Our Reference		306521-1
Your Reference	UNITS	A1
Date Sampled		21/09/2022
Type of sample		Material
Date analysed	-	29/09/2022
Mass / Dimension of Sample	-	10x5x1mm
Sample Description	-	Grey fibre cement material
Asbestos ID in materials	-	Chrysotile asbestos detected
Trace Analysis	-	[NT]

Lead in Paint			
Our Reference		306521-2	306521-3
Your Reference	UNITS	L1	L2
Date Sampled		21/09/2022	21/09/2022
Type of sample		Paint	Paint
Date prepared	-	29/09/2022	29/09/2022
Date analysed	-	30/09/2022	30/09/2022
Lead in paint	%w/w	0.22	0.093

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
Metals-020/021/022	Digestion of Paint chips/scrapings/liquids for Metals determination by ICP-AES/MS and or CV/AAS.

QUALITY CONTROL: Lead in Paint						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			29/09/2022	[NT]	[NT]	[NT]	[NT]	29/09/2022	[NT]
Date analysed	-			30/09/2022	[NT]	[NT]	[NT]	[NT]	30/09/2022	[NT]
Lead in paint	%w/w	0.005	Metals-020/021/022	<0.005	[NT]	[NT]	[NT]	[NT]	100	[NT]

Result Definitions	
NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Appendix E

Limitations

Appendix E Limitations

AECOM has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Transport for NSW and only those third parties who have been authorised in writing by AECOM to rely on the report. It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the relevant property.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

It is prepared in accordance with the agreed scope of work and for the purpose outlined in AECOM project scope with Transport for NSW (60692711) and **Section 3.0** of this report.

This report should be read in full, and no excerpts are to be taken as representative of the findings. No responsibility is accepted by AECOM for use of any part of this report in any other context.

This report is based on surveying an unfamiliar site. During the survey all reasonable efforts were made by AECOM to identify the physical presence of hazardous materials at the site. However, AECOM cannot guarantee that all hazardous materials within the site have been identified in this report or that the results contained in this report are definitive. Hazardous materials are frequently concealed within the fabric of buildings or within sealed voids, and the ability to sample is restricted by the nature and occupancy of the site. Further, the samples (where collected) are representative only of the specific locations from which they are taken. The results do not necessarily reflect conditions at any location removed from the specific points of sampling. It must always remain a possibility that hazardous materials (other than those identified within this report) may be found during any maintenance, refurbishment or demolition activity, and suitable precautions should always be taken when carrying out such activities.

In this report, we have identified or assumed the presence of hazardous materials (limited to ACM, lead in paint, SMF and PCBs), henceforth referred to as hazardous materials). Until proven otherwise, it should be assumed that any similar materials not otherwise detailed will also contain the corresponding hazardous material. The same assumption should not be made in respect of those materials which are similar to those identified in this report as not containing hazardous material.

Where this report indicates that information has been provided to AECOM by third parties, AECOM has made no independent verification of this information unless required as part of the agreed scope of work. AECOM assumes no liability for any inaccuracies in or omissions to that information.

Except as specifically stated in the report, AECOM makes no statement or representation of any kind as to the suitability of the facility for any purpose and/or the potential risk to human health and safety posed by the presence (or otherwise) of asbestos containing materials, lead containing dust or lead based paints.

The information in this report is considered to be accurate at the date of issue and is in accordance with conditions at the site on the date of inspection. Opinions and recommendations presented herein apply to the site existing at the time of our investigation and cannot necessarily apply to site changes of which AECOM is not aware and has not had the opportunity to evaluate. This document and the information contained herein should only be regarded as validly representing the site conditions at the time of the investigation unless otherwise explicitly stated in a preceding section of this report. AECOM disclaims responsibility for any changes that may have occurred after this time.

Except as required by law, no third party may use or rely on this Report unless otherwise agreed by AECOM in writing. Where such agreement is provided, AECOM will provide a letter of reliance to the agreed third party in the form required by AECOM.

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AECOM does not represent that this report is suitable for use by any third party in deciding whether to enter a transaction in relation to the property which is the subject of the report or to put that property to a particular use.

Focus Bridge Engineering Pty Ltd

Suite 21, 235 Darby Street, Cooks Hill, NSW 2300
E: mail@focusbridges.com   W: www.focusbridges.com

Job No: 220335

Rev No.	Authors	Checked		Authorised		
		Name	Signature	Name	Signature	Date
A	A.Michie	S Cruse M.Tilley	On file	M Tilley	On file	23/12/22
0	A.Michie	TfNSW	On file	M Tilley	On file	17/05/23

www.focusbridges.com

Prepared for
Transport for NSW
ABN: 18 804 239 602

Biodiversity Assessment Report

26-Apr-2023
HW29 Spring Creek Bridge Replacement

aecom.com

Delivering a better world

Biodiversity Assessment Report

Client: Transport for NSW

ABN: 18 804 239 602

Prepared by

AECOM Australia Pty Ltd
Gadigal Country, Level 21, 420 George Street, Sydney NSW 2000, PO Box Q410, QVB Post Office NSW 1230, Australia
T +61 2 8008 1700 www.aecom.com
ABN 20 093 846 925

26-Apr-2023

Job No.: 60692711

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 and ISO45001.

Quality Information

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Ref	60692711
Date	26-Apr-2023
Originator	Kai Irrgang
Checker/s	Jamie McMahon
Verifier/s	Catherine Brady

Revision History

Rev	Revision Date	Details	Approved	
			Name/Position	Signature
1	28-Nov-2022	First Draft	Jamie McMahon Technical Director	
2	12-Jan-2023	First Draft – REF changes included	Catherine Brady Technical Director	
3	06-Mar-2023	Final Draft	Catherine Brady Technical Director	
4	26-Apr-2023	Final	Catherine Brady Technical Director	

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List of Acronyms

BC Act	*Biodiversity Conservation Act 2016* (NSW)
DPE	Department of Planning and Environment
TEC	Threatened Ecological Community
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FM Act	*Fisheries Management Act 1994*
ha	Hectare
km	Kilometres
KTP	Key Threatening Process
LEP	Local Environmental Plan
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NPWS	National Parks and Wildlife Service, NSW
NSW	New South Wales
SEPP	State Environmental Planning Policy
WoNS	Weeds of National Significance

1.0 Introduction

1.1 Proposal background

Transport for NSW (Transport) proposes to replace the existing bridge sized culvert at Spring Creek (B3858) (the proposal) on the Kamilaroi Highway (HW29) located 9.5 kilometres west of Narrabri, NSW (the proposal area) (Figure 1-1 and Figure 1-2). The Kamilaroi Highway is a state road and the main connecting road from Willow Tree in the south-east to Narrabri, Walgett and Bourke in the north-west. The highway is used by local traffic and substantial volumes of agricultural and other freight vehicles.

The proposal is required to address the structural, safety and ongoing scour issues associated with the existing culvert structure, and will involve replacing the structure with a new, wider bridge which meets current design and safety standards.

AECOM Australia Pty Ltd (AECOM) has been engaged by Transport to prepare a biodiversity assessment report to identify the potential for biodiversity impacts arising from the proposal, including potential impacts upon threatened species or ecological communities.

1.2 The proposal

The existing structure is an eight cell cast in-situ reinforced concrete box culvert which was built in 1968. The culvert was constructed as two four cell modules with a total length of about 39 metres and has a reinforced concrete base slab with no piled foundations. The ground conditions throughout the waterway present as clay soil and alluvium with little to no rock.

In June 2021, following heavy rainfall, flood water penetrated beneath the base slab of the culvert and scoured beneath the structure. The water flowing under the base slab created a large void which caused one of the four cell modules to settle relative to the other and resulted in about a 250 millimetre step in the deck at the corresponding joint. The displacement in the deck of the culvert structure was rectified by placing asphalt pavement over the affected area. To support the additional load from the asphalt pavement, temporary steel propping was installed in cells 3 and 4 of the structure. The void under the culvert was filled with mass concrete in an attempt to prevent further settlement.

A 15 tonne load limit was implemented on the culvert at the end of May 2022 following an inspection by Transport where further movement and cracking was identified in the structure. This resulted in the installation of additional temporary propping in cells 1 and 2 of the culvert, as well as Abutment A. This work was completed by the end of July 2022. The additional temporary propping has allowed the 15 tonne load limit to be removed from the culvert but provides only a short term solution for the structure which is in poor condition and remains vulnerable to further deterioration from future flood events. As a result, full replacement of the existing culvert is proposed as this is the most viable cost-effective long-term solution for the site. This would involve demolition of the existing structure and construction of a new bridge at the proposal area on the existing highway alignment.

A temporary side-track has been assessed and approved under a separate Minor Works Review of Environmental Factors (MWREF) and is proposed to be constructed on the upstream side of the existing structure. The side-track would maintain safe two-lane traffic flow on the Kamilaroi Highway during both the development and construction phase of the bridge replacement proposal (refer Figure 1-2).

Key features of the proposal would include:

- Installation of creek bed and perimeter sediment controls
- Switching of traffic from the Kamilaroi Highway (HW29) on to the previously approved and constructed side-track (assessed separately under a MWREF)
- Removal of culvert scuppers and any other contaminated material prior to demolition
- Installation of temporary gravel access tracks to the waterway area downstream of the existing structure to allow construction vehicles to enter and leave the area in one direction

- Construction of rock platforms within the waterway upstream and downstream of the existing structure, including installation of temporary steel pipes within the platforms/waterway upstream and downstream of the culvert to maintain channel flow
- Adjustment of rock working platforms and temporary steel pipes, as required to suit demolition and bridge construction staging to maintain channel flow
- Clearing of vegetation and tree removal adjacent to the existing culvert abutments
- Demolition of the existing culvert structure, including excavation of the base slab and abutment areas to widen the waterway opening and accommodate the new bridge
- Adjustment of the rock working platforms within the bridge footprint and waterway to suit piling and crane access for bridge construction
- Construction of a new reinforced concrete bridge with driven steel tubular piles, reinforced concrete columns and headstocks supporting precast planks on the existing alignment, including preliminary earthworks on the road approaches as required to accommodate the wider deck
- Removal of all temporary working platforms and rock platforms from the waterway
- Installation of rock scour protection for the new bridge
- Reinstatement and revegetation of disturbed areas
- Road works to tie into the new bridge
- Commissioning of the new bridge and opening to traffic
- Removal of the side track, compound area and stockpile sites on completion.

The location of the proposal is shown in Figure 1-1 and an overview of the proposal is provided in Figure 1-2.

The new bridge would include three sets of piers within the waterway. The waterway and abutment piles would be constructed using driven steel tubular casing with reinforced concrete infills.

Figure 1-1: Location of the proposal

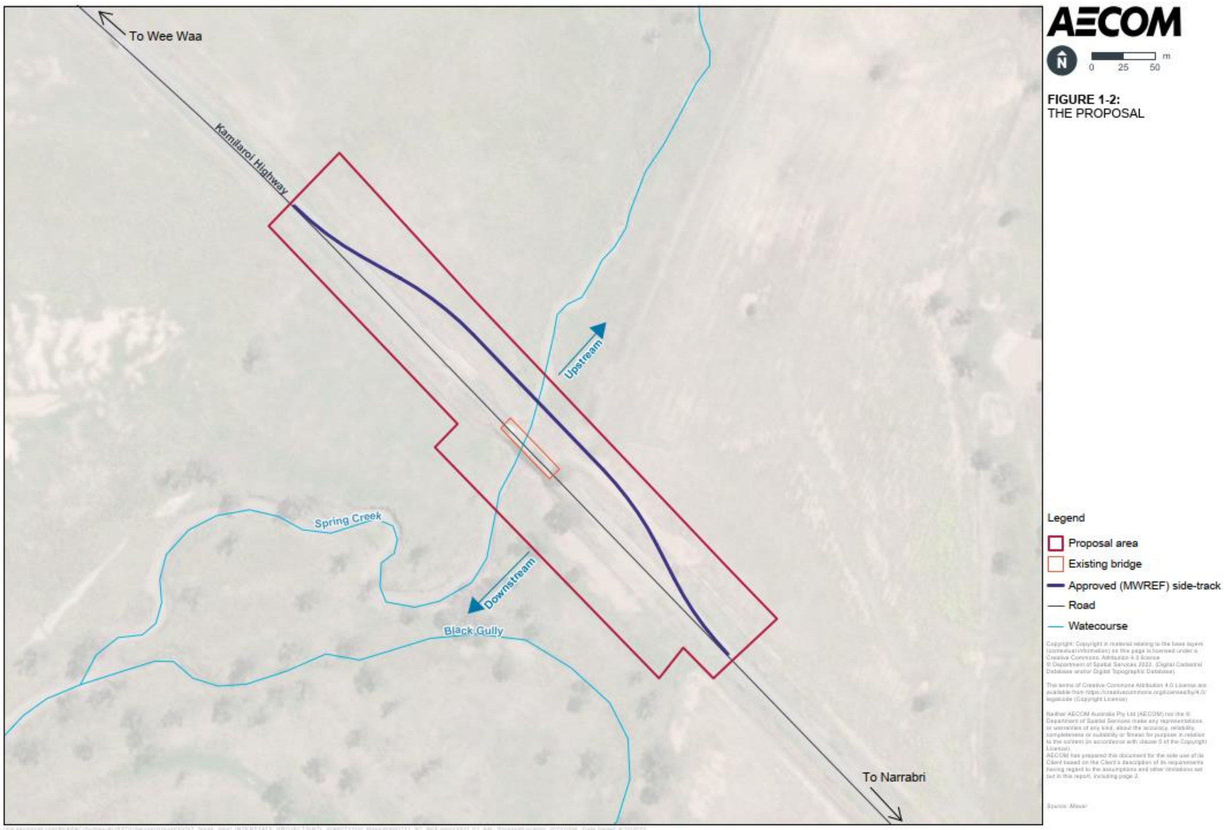


Figure 1-2: The proposal

1.3 Proposal area

The proposal is located within the Narrabri Shire Council Local Government Area (LGA), approximately 9.5 km northwest of Narrabri. The proposal area refers to the area immediately affected by the proposed construction and operation of the proposal. This includes:

- The footprint of the existing culvert structure and its approaches, which would be demolished, and upon which the new bridge would be constructed
- The widened approaches to the new bridge
- Additional areas required for construction, such as site compounds, stockpile areas, laydown areas and construction access tracks
- The footprint of the temporary side-track required to maintain safe two-lane traffic flow on the Kamilaroi Highway during construction of the proposal, located upstream of the existing culvert. Note that this has been assessed under a separate Minor Works Review of Environmental Factors (MWREF), although it’s demolition and removal has been included within the scope of this assessment.

The extent of the road corridor surrounding the proposal has also been assessed as part of the proposal area in this assessment.

1.4 Legislative context

Environmental Planning and Assessment Act 1979

A Review of Environmental Factors (REF) is prepared to satisfy Transport duties under s.5.5 of the EP&A Act to *“examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity”* and s.5.5 in making decisions on the likely significance of any environmental impacts. This biodiversity impact assessment forms part of the REF being prepared for the HW29 Spring Creek Bridge Replacement Project and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires that Commonwealth approval be obtained for certain actions and establishes an assessment and approvals system for actions that have or are likely to have, a significant impact on Matters of National Environmental Significance (MNES). MNES considered in this report include listed threatened species, populations, and ecological communities as well as migratory species protected under international agreements. Particular consideration has been given to potential impacts on threatened biota that occur or are likely to occur within the study area. Potential impacts are discussed in Section 5.0 of this report.

In September 2015, a 'strategic assessment' approval was granted by the Federal Minister in accordance with the EPBC Act. The approval applies to Transport road activities being assessed under Division 5.1 (formerly Part 5) of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species.

As a result, Transport road proposals assessed via an REF:

- Must address and consider potential impacts on EPBC Act listed threatened species, populations, ecological communities and migratory species, including application of the "avoid, minimise, mitigate and offset" hierarchy
- Do not require referral to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) for these matters, even if the activity is likely to have a significant impact
- Must use the Biodiversity Assessment Method (BAM) to calculate credits that would offset significant impacts on EPBC Act listed threatened species, populations, ecological communities and migratory species.

Assessments of impact significance are required for all relevant biodiversity values in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013).

Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) requires that the significance of the impact on threatened species, populations and threatened ecological communities is assessed using the test listed in Section 7.3 of the BC Act. Similarly, Part 7A of the *Fisheries Management Act 1994* (FM Act) requires that significance assessments are undertaken in accordance with Division 12 of the FM Act. Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the Environment Agency Head's requirements, or a biodiversity development assessment report (BDAR) must be prepared by an accredited assessor in accordance with the biodiversity assessment method (BAM) (DPIE 2020a). Potential impacts are discussed in Section 5.0 of this report.

Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) protects threatened species, populations and ecological communities of fish and marine vegetation, and other living resources of Australian waters. Species listed under this act are considered alongside those of the BC and EPBC Acts.

Under section 219 works within a waterway that may result in the temporary or permanent blockage of fish passage would require a permit from NSW Department of Primary Industries (DPI).

Section 199 of the Act requires a public authority provide the Minister for Primary Industries 21 days written notice of dredging or reclamation works, though clause 227 of the Fisheries Management (General) Regulations 2019 provide an exemption from this requirement if the works are carried out in accordance with the Code of Practice for Minor Works in NSW Waterways.

Potential impacts to aquatic environment are discussed in Section 5.1.4 and 5.2.6 of this report.

Biosecurity Act 2015

Under the *Biosecurity Act 2015*, it is a requirement to prevent, eliminate or minimise the risk posed by a prohibited matter as outlined in Schedule 2 of the Act, so far as is reasonably practicable. A priority weed is one that should be prevented, managed, controlled or eradicated in the region. Section 5.2.4 of this report considers weeds declared as priority weeds in the Narrabri LGA that occur within the proposal area.

State Environmental Planning Policy (Biodiversity and Conservation) 2021

Under the *State Environmental Planning Policy (Biodiversity and Conservation) 2021* (Biodiversity and Conservation SEPP), the proposal is considered to be within 'potential Koala habitat'. The policy aims to conserve and manage areas of natural vegetation that provide habitat for Koalas and prevent decline in populations. Potential impacts are discussed in Section 5.0 of this technical report.

State Environmental Planning Policy (Transport and Infrastructure) 2021

The *State Environmental Planning Policy (Transport and Infrastructure) 2021* (Transport and Infrastructure SEPP) aims to assist in the effective delivery of public infrastructure across the State by improving certainty and regulatory efficiency through a consistent planning assessment and approvals regime for public infrastructure and services and through the clear definition of environmental assessment and approval processes for public infrastructure and services facilities.

As the proposal is for a road infrastructure facility and is to be carried out by Transport, it can be assessed under Division 5.1 of the EP&A Act. Development consent from council is not required.

1.5 Study aims

The key aims of this study are to:

- Undertake a review of published documentation and a desktop study of flora and fauna relevant to the proposal area, identifying species and communities that may be present
- Conduct a field inspection of the proposal area, with particular attention to impacts on threatened species, populations and ecological communities listed under the BC Act and the EPBC Act
- Identify and assess likely direct impacts to flora and fauna occurring within the proposal area
- Undertake assessments of significance under the BC Act and the EPBC Act for threatened biota, where required
- Identify measures for managing impacts on threatened biota during design, construction and operation of the proposal.

2.0 Methods

2.1 Personnel

Field survey of the proposal area was undertaken on 19 September 2022 by Jamie McMahon (CEnvP Impact Assessment), a qualified and experienced ecologist from AECOM Australia.

2.2 Background research

Desktop research was undertaken prior to the commencement of the site inspection. This included database searches and a review of relevant literature to determine if targeted surveys for specific species were required. Additionally, these searches helped to identify threatened biota known or likely to occur within the proposal area.

The following databases and resources were investigated:

- Bureau of Meteorology Atlas of Groundwater Dependent Ecosystems (GDE): http://www.bom.gov.au/water/groundwater/gde/map.shtml (BoM 2022)
- NSW Department of Planning and Environment (DPE) Spatial Layer of HEVAE Vegetation Groundwater Dependent Ecosystems Value in NSW: https://datasets.seed.nsw.gov.au/dataset/hevae-vegetation-groundwater-dependent-ecosystems-in-nsw (DPE, 2022a)
- NSW DPE BioNet Database within a 5km radius of the proposal area (DPE, 2022b)
- NSW DPE, Vegetation Types Database and Threatened Species Profile Database (DPE 2022c)
- Protected Matters Report that documents all Matters of National Environmental Significance (MNES) within a 5 km radius of the proposal area. MNES include threatened species, communities and migratory species which are listed under the EPBC Act (DCCEEW 2022)
- NSW DPI – Fisheries spatial data portal (DPI 2022a)
- NSW DPI WeedWise Priority Weeds List (DPI 2022b)
- NSW DPI database for threatened species and aquatic Threatened Ecological Communities: https://www.dpi.nsw.gov.au/fishing/species-protection/what-current (DPI 2022c).

2.2.1 NSW DPE BioNet database – Threatened Flora and Fauna Records and Exotic Species

The DPE BioNet Wildlife Atlas was searched for threatened flora and fauna records from 1980 onwards. This search was undertaken using a 10 km x 10 km search area centred on the bridge. This search returned four ecological communities, four threatened fauna species and two threatened flora species listed under the BC Act.

2.2.2 Commonwealth Department of the Climate Change, Energy, Environment and Water– Protected Matters Database

The Department of Climate Change, Energy, Environment and Water (DCCEEW) Protected Matters Database was searched for MNES and other matters protected by the EPBC Act. This search utilised a 5 km radius search area centred on the proposal area.

2.2.3 NSW Department of Primary Industries WeedWise List

Priority weeds are plants that post a potentially serious threat to primary production or the natural environment. Under the *Biosecurity Act 2015* public authorities have a responsibility to prevent, manage, control or eradicate priority weeds in the region.

2.2.4 NSW Department of Primary Industries Key Fish Habitat

The DPI 'Key Fish Habitat' (KFH) includes all marine and estuarine habitats up to highest astronomical tide level (that reached by 'king' tides) and most permanent and semi-permanent freshwater habitats including rivers, creeks, lakes, lagoons, billabongs, weir pools and impoundments up to the top of the bank (DPI 2022a).

The area was reviewed for potential KFH. Spring Creek is noted to be KFH as it passes through the proposal area.

2.2.5 NSW Department of Primary Industries Threatened Aquatic Species

A search of the NSW DPI Fisheries NSW Spatial Data Portal was undertaken for the purposes of establishing threatened fish species likely to be present and/or affected by this proposal. One endangered fish population, the Murray-Darling Basin population of Eel Tailed Catfish (*Tandanus tandanus*) and one endangered fish species, the Purple Spotted Gudgeon (*Mogurnda adspersa*) were considered likely to occur within Spring Creek.

2.3 Field survey

A field survey was undertaken at the site on 19 September 2022 by Jamie McMahon (CEnvP Impact Assessment), a qualified and experienced ecologist from AECOM Australia. The survey took in both the proposal area as well as its immediate surrounds. The field survey was undertaken over approximately three hours in conjunction with Transport staff.

The survey included assessment of vegetation present, as well as opportunistic fauna sightings. No detailed fauna survey was undertaken, though an assessment of fauna habitat present within the proposal area was carried out. No in-stream aquatic survey was undertaken though aquatic conditions were noted from the bank. Biometric vegetation plots were not undertaken, though assessment of the full site was undertaken as a site walkover. Four Dusky Woodswallows (*Artamus cyanopterus cyanopterus*) were recorded foraging within the proposal area, however due to the highly mobile nature of this species and the minimal impact the proposal would have on its habitat targeted threatened fauna or flora surveys were not conducted.

Weather conditions during the field survey are summarised in Table 1. Data was drawn from the Narrabri Airport AWS (station 054038) (BoM, 2022).

Table 1: Field survey weather conditions

Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	Rainfall last 7 days (mm)
7.9	22.7	0	57.4

2.4 Vegetation assessment and mapping

Native vegetation includes trees, understory plants, groundcover and plants occurring in wetlands that are native to NSW. A plant is native to NSW if it was established in NSW before European settlement (as defined under section 1.6 of the BC Act and Part 5A 60B of the *Local Land Services Act 2013* (NSW)).

Native vegetation mapping was reviewed for the area surrounding the proposal using the NSW State Vegetation Type Map. The presence of native vegetation and plant community types was further verified by field surveys conducted on 19 September 2022.

Native vegetation within the vicinity of the proposal is shown in Figure 3-11.

2.5 Limitations

Limitations to the flora and fauna surveys, which may impact on survey results, include:

- The survey focused on particular areas where ecological risks were deemed to be greater including (but not limited to) areas of existing vegetation through which the new bridge would be constructed
- While a fauna habitat assessment was undertaken, this technique is not an adequate substitute for full fauna surveys. Fauna are capable of inhabiting sub-optimal habitat, and fragmentation, isolation or species density can all influence the presence and distribution of a particular species. Species likelihood of occurrence was informed by considering habitat characteristics and opportunistic sightings
- No in-stream aquatic survey was undertaken though aquatic conditions were noted from the bank

- Detailed Biodiversity Assessment Method (BAM) plot assessments were not undertaken, though relevant vegetation was inspected throughout the proposal area.

3.0 Existing environment

3.1 Overview

Table 2 provides an overview of the site, including relevant environmental controls and sensitivities. Photographs of the site are included in Figure 3-1 to Figure 3-10.

Table 2: Environmental controls and sensitivities

Environmental Considerations	In the study area?
Is the proposal located within a National Park?	No
Is the proposal located within land reserved or dedicated for preservation of other environmental protection purposes?	No
Is the proposal located within a World Heritage Area?	No
Is the proposal located within an Environmental Protection Zone under an environmental planning instrument?	No
Is the proposal located within land identified as a wilderness area?	No
Is the proposal located within a wetland area dedicated under the Ramsar Wetlands Convention?	No
Does the site contain critical habitat?	No
Is the area mapped as Key Fish habitat?	Yes, Spring Creek is mapped as KFH
Is the area mapped on the Biodiversity Values map?	Yes, riparian area along Spring Creek
Is the area mapped on the Native Vegetation Regulatory Map?	Yes, riparian area identified as vulnerable regulated land

Figure 3-1: Existing Spring Creek Bridge, viewed from southern bank downstream side of bridge (photo facing north)

Figure 3-2: Downstream Spring Creek, view from deck of Spring Creek Bridge (photo facing south)

Figure 3-3: Upstream Spring Creek, view from Spring Creek Bridge deck (photo facing north)

Figure 3-4: Water penetrating underneath the concrete base slab of the Spring Creek culvert structure (Transport, June 2021)

Figure 3-5: Temporary steel propping in cells 3 and 4 of the Spring Creek culvert structure (Transport, August 2021)

Figure 3-6: Dead standing tree on the northern side of Spring Creek Bridge adjacent to the existing north-western bridge approach (photo facing southeast)

Figure 3-7: Dead standing tree and pasture grasses on the southern side of Spring Creek Bridge, downstream of the bridge (photo facing south)

Figure 3-8: River red gum (*Eucalyptus camaldulensis*) on the northern side of Spring Creek Bridge along the eastern bank (photo facing west)

Figure 3-9: Woody debris and sweet clover (*Melilotus sp.*) on the northern side of Spring Creek Bridge along the eastern bank (photo facing north)

Figure 3-10: River red gums (*Eucalyptus camaldulensis*) on the southern side of Spring Creek Bridge along the eastern bank (photo facing northwest)

3.2 Landform and land use

The proposal area is located within, and adjacent to, the riparian zone of Spring Creek. Both eastern and western riparian areas are characterised by gentle slopes from the bank towards the water line. It is noted that the stream in this general region meanders, suggesting that there is a risk of future channel migration.

The landscape surrounding the proposal area is predominantly characterised by agricultural production, scattered rural residences and native vegetation. The private land adjacent to the Kamilaroi Highway consists of cleared agricultural land including access tracks and areas of isolated trees.

Agriculture in the wider area mainly comprises of cropping and grazing, with substantial areas along the nearby Namoi River subject to irrigation. These areas also include farmhouses, sheds and other infrastructure such as grain storage.

3.3 Vegetation communities and habitat

3.3.1 Terrestrial vegetation

Native vegetation mapping was reviewed for the area surrounding the proposal. The NSW State Vegetation Type Map shows areas of Plant community type (PCT) vegetation as mapped along Spring Creek, north and south of the proposal area. PCTs mapped near the proposal area are shown in Figure 3-11, and consist of the following:

- PCT 39 - Coolibah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion
- PCT 78 - River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion.

The study area also contained areas of non-native vegetation due to the agricultural land use of the surrounding area and historic invasion by exotic species. A summary of the total area of mapped PCTs within the proposal area, as well as the area of PCTs determined to be present based upon field inspection, is outlined in Table 3.

Table 3: Plant community types within the proposal area

Plant community type (PCT)	Potential threatened ecological community based on desktop searches	Area (ha)	
		Total previously mapped within proposal area	Total within proposal area based on inspection
PCT 39 – Coolibah – River Coobah – Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	Artesian Springs Ecological Community in the Great Artesian Basin (Listed BC Act, Critically Endangered) Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions (Listed BC Act, Endangered & EPBC Act, Endangered) Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Listed BC Act, Endangered)	0.13	0
PCT 78 – River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	Nil	0.27	0

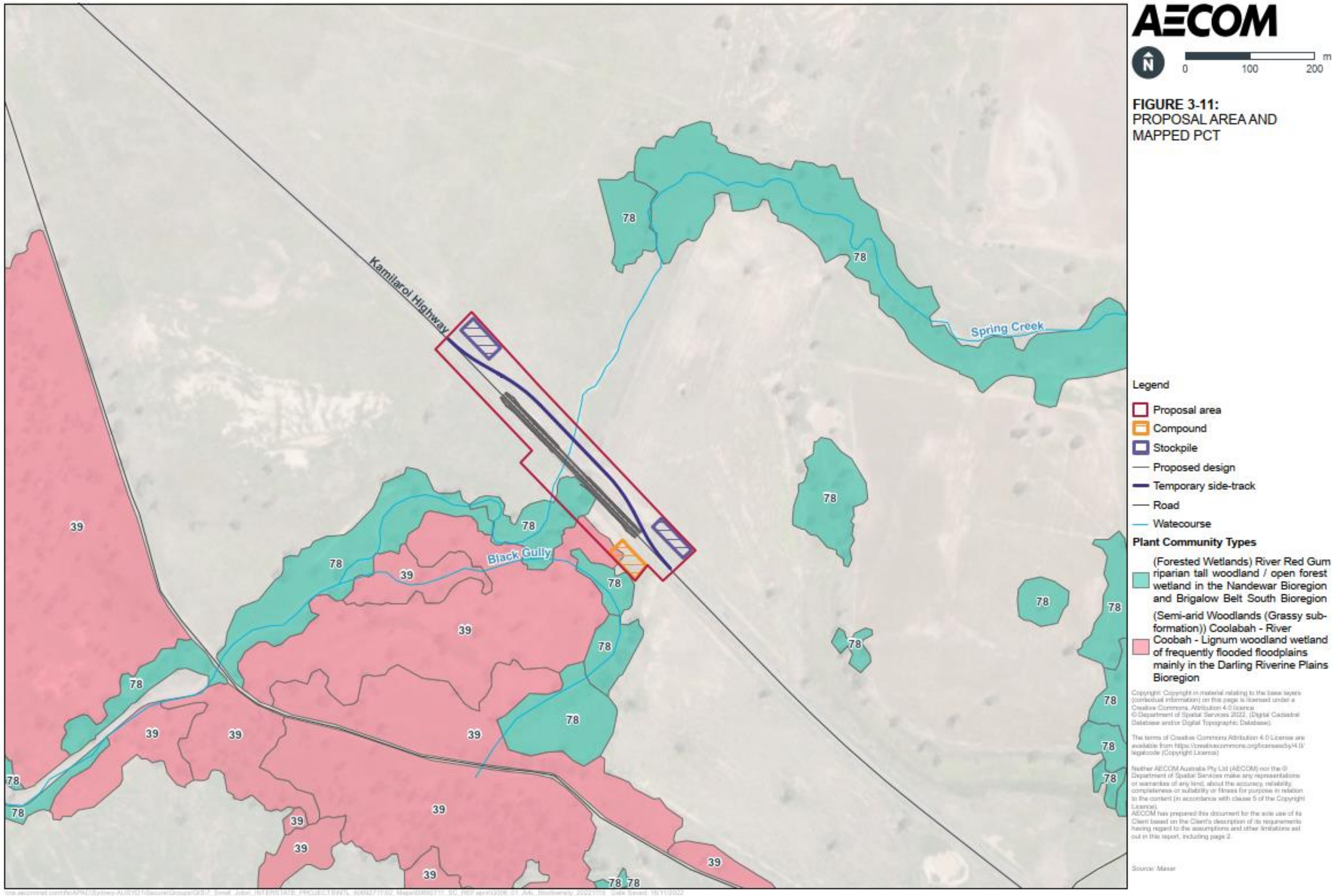


Figure 3-11: **Plant community types and vegetation zones**

PCT 39 - Coolibah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion

This community is generally characterised by open forest or woodland occurring on alluvial silty clay soils with neutral pH on floodplains of the major rivers, mainly in the Darling Riverine Plain Bioregion but with outliers in other bioregions. Canopy species generally comprise *Eucalyptus coolabah subsp. Coolabah*, *Eucalyptus camaldulensis*, *Eucalyptus largiflorens*, *Melaleuca trichostachya* and *Casuarina cristata*. The shrub layer is sparse but may contain *Acacia stenophylla*, *Geigiri parviflora*, *Rhagodia spinescens*, *Alstonia constricta* and various *Eremophila* species. This community is frequently flooded and may be subject to occasional prolonged inundation. Approximately 60% of PCT vegetation that predates 1750 has been cleared.

Field inspection of PCT 39 found that its mapped extent within the proposal area does not align with the list of the diagnostic species in the listing, and the PCT was determined to not be present within the proposal area. Vegetation within this mapped area consisted of a mix of native and exotic pasture grasses consistent with cleared areas of agricultural land within the rest of the proposal area and surrounding landscape.

PCT 78 - River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion

The community is generally characterised by tall open forest or woodland composed of *Eucalyptus camaldulensis* often with *Angophora floribunda, Eucalyptus melliodora* or *Casuarina cunninghamiana*. The shrub layer is sparse but may contain thickets of *Callistemon sieberi, Acacia deanei, Leptospermum polygalifolium, Leptospermum brachyandrum* and *Notelaea microcarpa var. microcarpa*. Small shrubs include *Swainsona galegifolia, Nyssanthes erecta* and *Maireana microphylla*. Due to its presence near rivers or creeks the ground cover is often dense and is composed of a mixture of forbs, graminoids and sedges. This community occurs on the banks of watercourses and on adjoining flats in undulating low hills or hill landscapes in the Nandewar and Brigalow Belt South Bioregions of NSW. The watercourses flood regularly. Approximately 60% of PCT vegetation predating 1750 has been cleared.

Field inspection of PCT 78 found that its mapped extent within the proposal area does not align with the list of the diagnostic species in the listing, and the PCT was determined to not be present within the proposal area. With the exception of a few *Eucalyptus camaldulensis* individuals, vegetation within this mapped area consisted of a mix of native and exotic pasture grasses consistent with cleared areas of agricultural land within the rest of the proposal area and surrounding landscape.

3.3.2 Fauna habitat

The immediate area surrounding the proposal is representative of the broader regional landscape, characterised by broad scale agricultural production. Fauna habitat within these areas is minimal, with the majority of these areas being regularly cultivated and/or grazed. Immediate fauna habitat features within the proposal area include four mature *Eucalyptus camaldulensis* on the eastern bank of the creek. Two dead standing trees are located within the proposal area, one on the western bank of the creek, north of the Kamilaroi Highway and one on the same bank south of the Highway (see Figure 3-6 and Figure 3-7). Logs and other woody debris can be found on the eastern bank north of the Kamilaroi Highway (see Figure 3-9). Vegetation within the roadside reserve is largely comprised of native and exotic pasture grasses, and other weedy vegetation.

No evidence of microbat occupation was found during the field survey. This does not rule out the possibility of individuals being present in other inaccessible parts of the bridge or future occupation at some stage between the survey and bridge demolition. The creek itself was not surveyed, though was observed to have heavily sediment-laden water. No branches or logs were observable within the creek itself. DPI mapping lists Spring Creek as being ‘Fair’ on the Freshwater Fish Community Status mapping (Figure 3-14).

Beyond the proposal area, fauna habitat can be generally categorised according to location:

- South of the Kamilaroi Highway on the eastern side of Spring Creek: the eastern side of the bank includes small stands of *Eucalyptus camaldulensis* among both native and exotic pasture grasses. Some of these trees were observed to contain tree hollows about 5-10cm in diameter, with three in total identified in trees beyond the proposal area during site inspection. For about 400 m beyond the riparian area on the eastern side of Spring Creek, the land is characterised by cleared agricultural land dotted with isolated paddock trees, before meeting an area of sparse open woodland about 24 ha in area. This area is mapped as PCT 39 and is suspected to contain a mix of *E. coolabah, E. camaldulensis and E. largiflorens*. Beyond the open woodland, the land is extensively cleared for agricultural purposes for about 800 m up to the riparian area of Narrabri Creek. Two farm dams each around 900 m in area are located in this cleared area

- South of the Kamilaroi Highway on the western side of Spring Creek: the western side of the bank is generally cleared of vegetation and consists of isolated trees and native and exotic pasture grasses along the riparian zone. For about 1000 m along the Kamilaroi Highway, the land is extensively cleared with little to no vegetation within about a 400 m corridor. Further west of this cleared area exists an area of sparse open woodland approximately 100 ha in area, mapped as PCT 39, suspected to contain a mix of *E. coolabah, E. camaldulensis and E. largiflorens*. Two farm dams each around 1000 m in area are located on the south-western margin of this wooded area
- North of the Kamilaroi Highway: this area is largely characterised by extensively cleared areas of agricultural land with isolated paddock trees. A large gap in riparian vegetation of about 350 m exists between the bridge and the next sparsely vegetated area upstream, mapped as PCT 78. This riparian area is suspected to contain *E. camaldulensis, Angophora floribunda* and *Casuarina cunninghamiana*. The large areas of cleared agricultural land within this are dotted with three small farm dams, each around 300 m^2 in area.

3.3.3 Priority weeds

Priority weeds are plants classified under the *Biosecurity Act 2015* as presenting a biosecurity risk to the State or a particular region. No priority weeds listed for the Narrabri Shire LGA were recorded.

Additional exotic species present in the study area includes exotic species, African boxthorn (*Lycium ferocissimum*). This species is categorised as ‘manage’ under the *Biosecurity Act 2015*.

3.4 Threatened ecological communities

A search of the NSW Bionet Atlas and the Commonwealth Protected Matters Search Tool identified four Threatened Ecological Communities (TECs) present within a 5 km search area cantered on the proposal area. Of the listed TECs, three were associated with PCTs which were mapped near the proposal area. These include:

- Artesian Springs Ecological Community in the Great Artesian Basin (Listed BC Act, Critically Endangered)
- Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions (Listed BC Act, Endangered & EPBC Act, Endangered)
- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Listed BC Act, Endangered).

During the survey particularly attention was paid to areas that were indicated as comprising part of a TEC. In this case one of the two native PCTs present were identified by database searches as having the potential to comprise TECs. Three of these were listed under the BC Act and one was also listed under the EPBC Act.

As the PCTs associated with these TECs was not considered to be present within the proposal area following field survey, no TECs are considered likely to be affected by the proposal.

3.5 Groundwater dependent ecosystems

According to the Groundwater Dependent Ecosystems Atlas (Bureau of Meteorology 2022), the majority of the proposal area is located on land considered low potential Groundwater Dependent Ecosystem (GDE). Areas of vegetation on the eastern side of Spring Creek, south of the Kamilaroi Highway are mapped as high potential GDE (Figure 3-12).

No known, low, medium or high potential aquatic GDEs are within the vicinity of the proposal. One medium probability aquatic GDE is mapped along Bohena Creek about 1.65 kilometres west of the proposal.

According to NSW DPE High Ecological Value Aquatic Ecosystems (HEVAE) mapping, areas of mapped PCT 39 within the proposal area are considered very high probability GDE, while areas mapped as PCT 78 within the proposal area are considered as being high potential to occur. As discussed in Section 3.3.1, these PCTs were determined to not be present in the proposal area based upon field inspection.

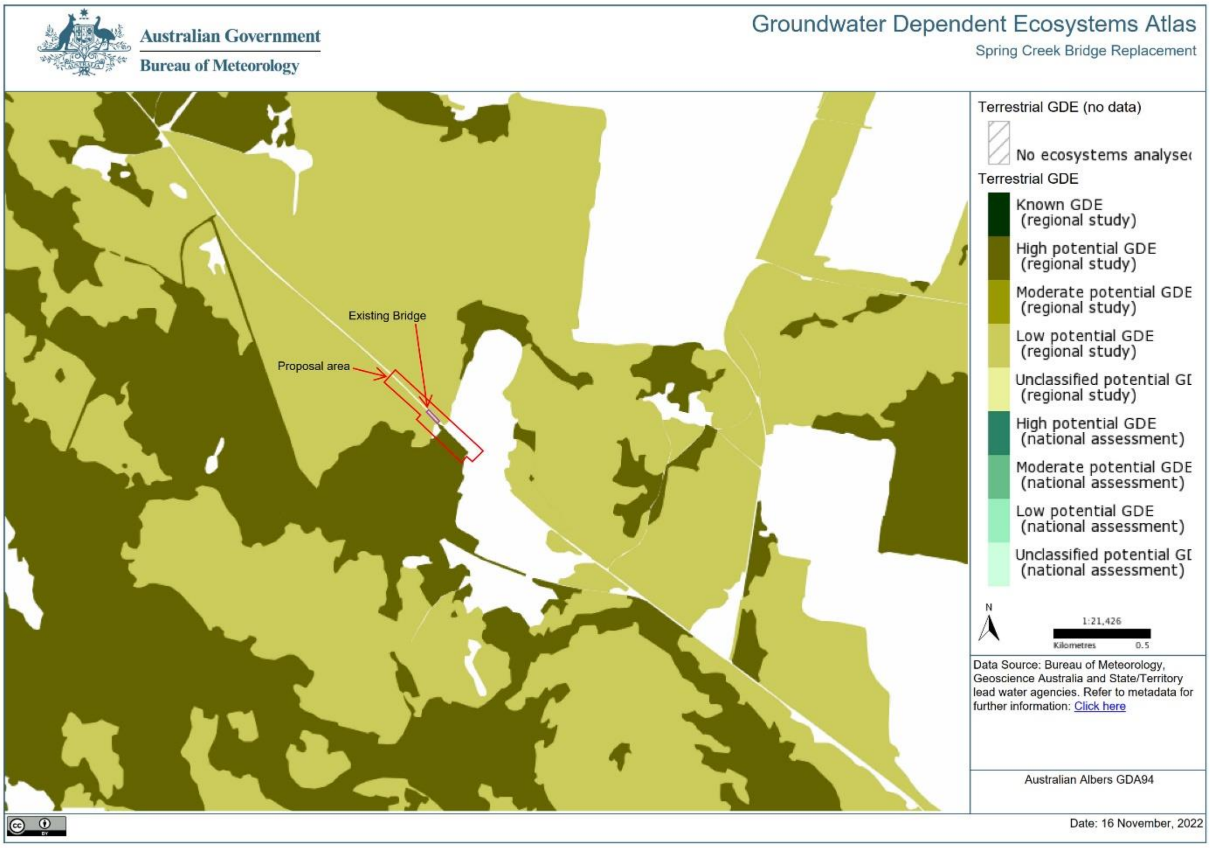


Figure 3-12: Groundwater dependent ecosystems near the proposal area

3.6 Threatened species

A search of the NSW Bionet Atlas and the Commonwealth Protected Matters Search Tool indicated the potential for 25 threatened and 9 migratory species to be present within a 5 km radius of the proposal. This includes highly mobile species such as Regent Honeyeater, Corben's Long-eared Bat and Grey-headed Flying-fox, as well as less mobile species such as Five-clawed Worm-skink and Pink-tailed Worm-lizard. Threatened plants in the area include Five-finger Panic Grass, Bluegrass and Spiny Pepper-cress.

Several records of Five-finger Panic Grass (*Digitaria porrecta*) were identified along the Kamilaroi Highway and along Bald Hill Road, 4 to 6 km from the proposal area. One record of a Black-Necked Stork (*Ephippiorhynchus asiaticus*) was identified about 4.7 km south of the proposal (Figure 3-13). No other records or sighting of any threatened species were located within the immediate vicinity of the proposal area.

Whilst none of these species were recorded during the site inspection, there remains the potential that threatened flora species may be present or that this area may be used by one or more of these mobile fauna species for shelter or foraging on an opportunistic or casual basis. The bridge structure itself was searched for signs of habitation by microbats. No immediate evidence of microbat presence was found within or surrounding the bridge structure.

During the site inspection, around four Dusky Woodswallow (*Artamus cyanopterus cyanopterus*) were observed foraging on the ground within the proposal area. Dusky Woodswallow are listed as vulnerable under the BC Act.

Figure 3-13: Bionet threatened species records

3.7 Aquatic environment

Spring Creek Bridge crosses Spring Creek, which is a fourth order stream part of the Lower Namoi River Catchment. Spring Creek is listed as Key Fish Habitat by DPI Fisheries. A search of the NSW DPI Fisheries Spatial Data Portal identified the creek through this area as “Fair” freshwater fish community status (Figure 3-14).

Review of threatened fish habitat mapping (DPI 2022) indicated the potential for the following species to be present within Spring Creek as shown on Figure 3-15 and Figure 3-16:

- Purple Spotted Gudgeon (*Mogurnda adspersa*)
- Eel Tailed Catfish (*Tandanus tandanus*).

As outlined in Section 3.3.2, water within the creek was observed to be heavily sediment-laden. No branches or logs were observable within the creek itself.

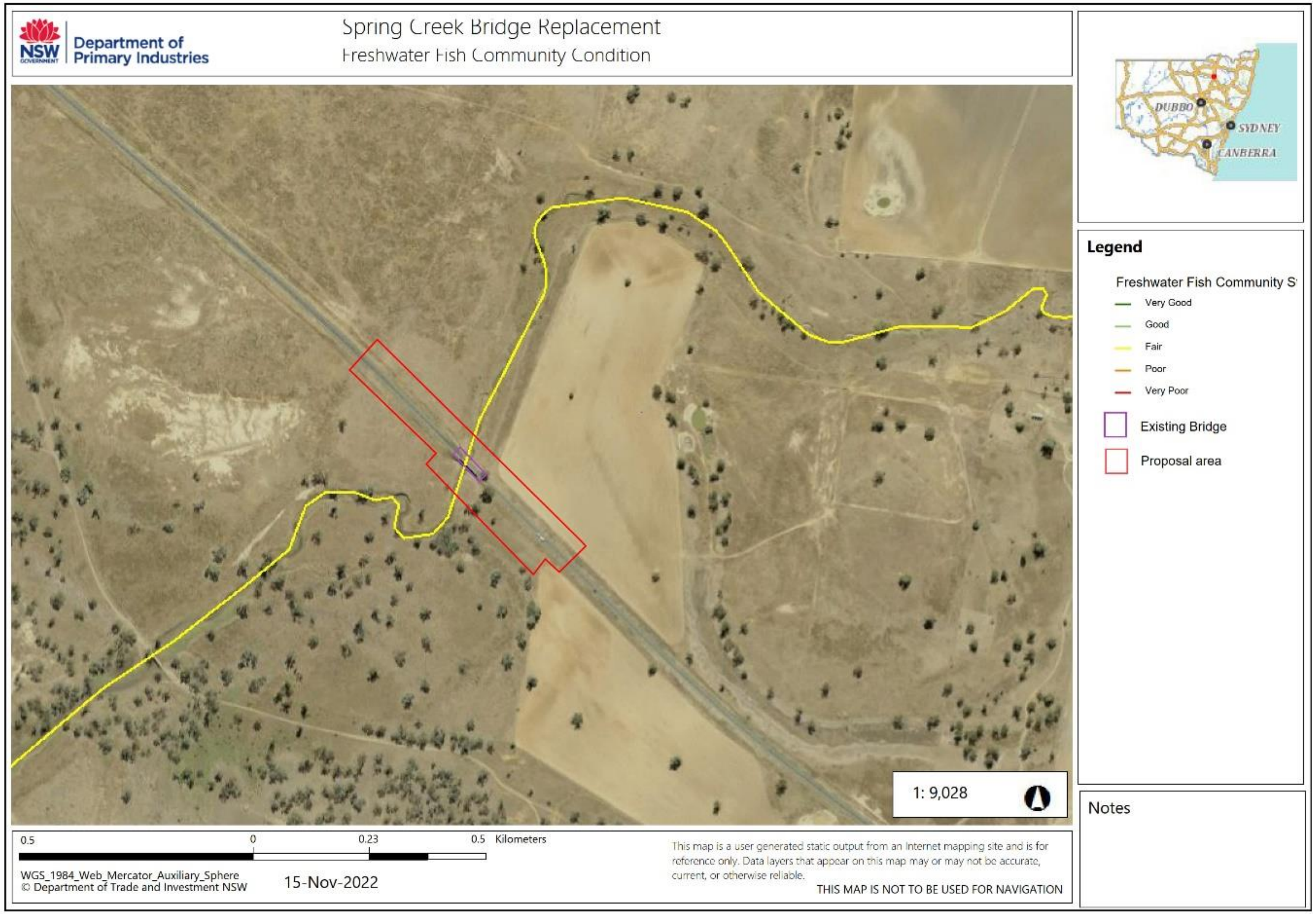


Figure 3-14: Spring Creek Freshwater Fish Community Condition

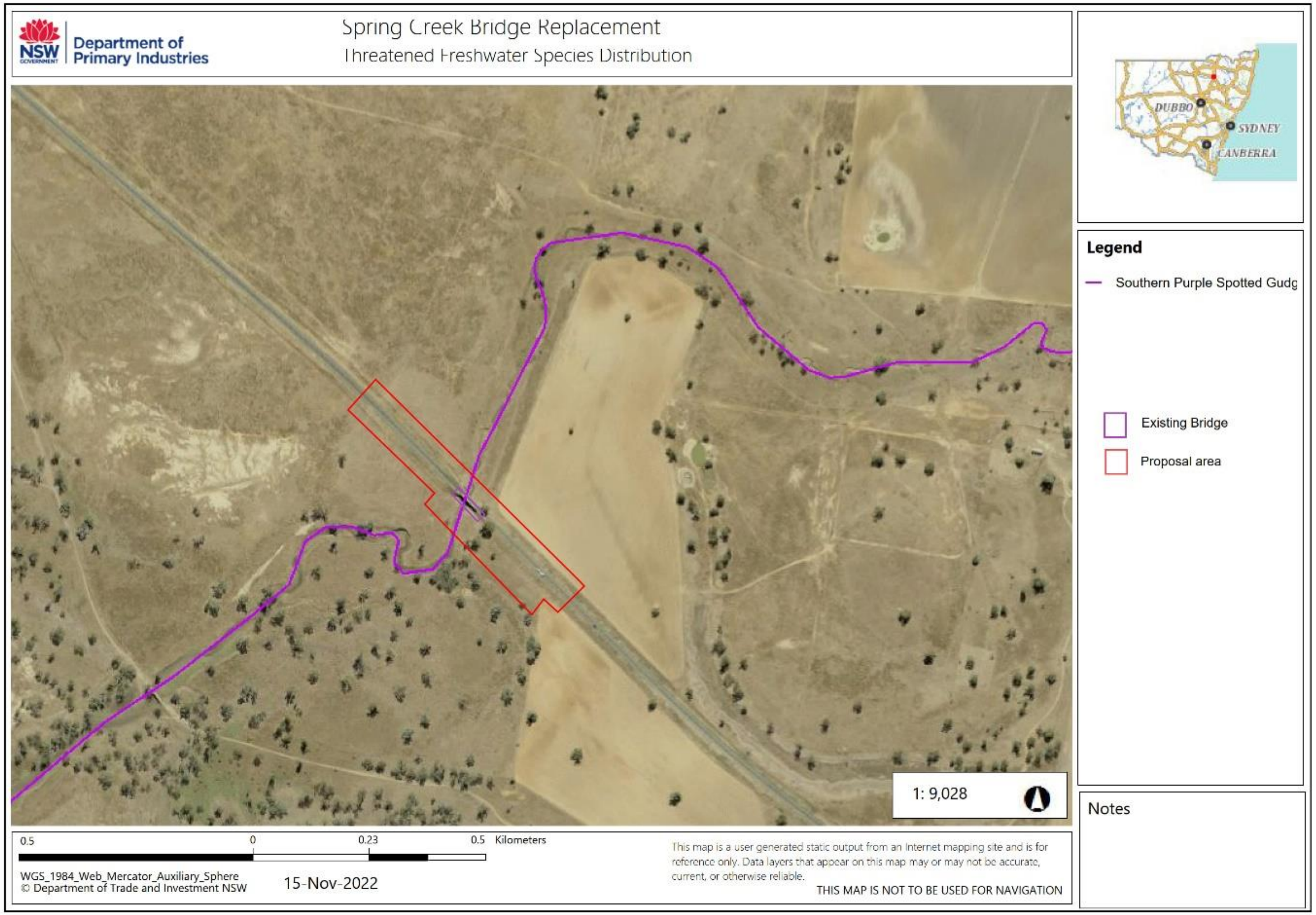


Figure 3-15: Spring Creek Southern Purple Spotted Gudgeon Distribution

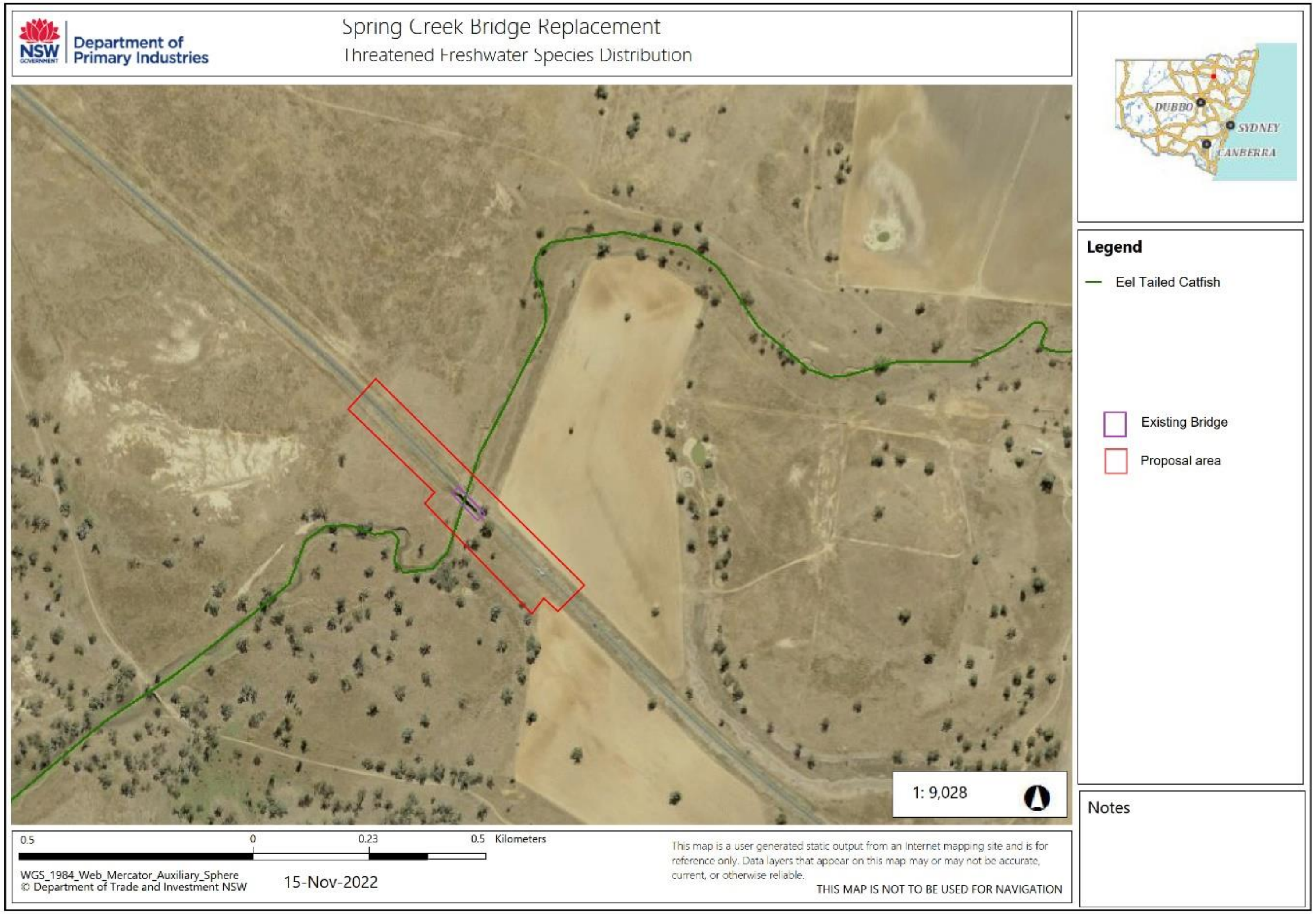


Figure 3-16: Spring Creek Eel Tailed Catfish Distribution

3.8 Areas of outstanding biodiversity value

None of the land in or around the proposal area is listed as an area of outstanding biodiversity value.

3.9 Wildlife connectivity corridors

The proposal is largely surrounded by agricultural land. As such wildlife connectivity is patchy, with substantial areas of land that is completely, or nearly completely, cleared of remnant native vegetation. The remainder of vegetation in the general area is generally limited to riparian vegetation and scattered and isolated paddock trees.

3.10 EPBC Matters of National Environmental Significance

The Protected Matters Search Tool (PMST) identified the following TECs as potentially occurring within the proposal area:

- Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions.

As the PCT associated with this TEC was not considered to be present within the proposal area following field survey, this TEC is not considered likely to be affected by the proposal.

No threatened or migratory species listed under the EPBC Act were recorded during the surveys. Some threatened and/or migratory species may utilise habitat within the study area for foraging or movement on occasion, however, it is noted abundant and better-quality habitat is located within the broader locality.

4.0 Avoidance and minimisation

A key part of Transport's management of biodiversity for this proposal is the application of the 'avoid, minimise, mitigate and offset' hierarchy as follows:

1. Avoid and minimise impacts
2. Mitigate impacts
3. Offset impacts in accordance with Transport guidelines.

This section of the BAR demonstrates the efforts taken to avoid and minimise impacts on biodiversity values.

Key actions taken to avoid and minimise ecological impacts are outlined below:

- Avoid:
  - The overall footprint of the proposal has been selected to minimise the amount of clearing required. This has included the avoidance of existing riparian vegetation along Spring Creek adjacent to the proposal area
  - The location of the new bridge has been selected to be on the same alignment as the existing bridge to avoid new permanent impacts on habitat upstream or downstream of the alignment
  - The proposed ancillary facilities are to be located within areas already cleared of vegetation
  - The design of the new bridge has been selected to enable the removal of the existing box culvert structure. This includes the removal of the base slabs and the return of the creek bed to a more natural state.
- Minimise:
  - The extent of vegetation clearing has been reduced to the minimum to enable the proposal to be constructed safely and efficiently
  - The amount of rock platform within the creek bed has been minimised as far as practical in order to allow the proposal to be constructed safely
  - The extent of piers and footings within the channel of Spring Creek have been minimised as far as possible to reduce the degree of potential blocking of fish passage.

5.0 Potential impacts

Potential impacts associated with the proposal are detailed below and have been assessed with consideration of both direct and indirect effects, and the resulting change to the biophysical and ecological processes that establish and support the biodiversity values of the proposal area. For this proposal, these direct and indirect impacts are a result of changes to the biophysical environment that ultimately result in changes to biodiversity, i.e. vegetation, landform and soils.

The potential impacts identified in this chapter consider:

- Direct and indirect impacts to biodiversity
- The scale (local and regional), timing, frequency and duration of activities that may result in impacts during construction and operational phases of the proposal
- The significance of the impact, including reasoning from the assessments of significance
- Other anthropogenic activities that influence cumulative impacts to biodiversity in the area.

5.1 Construction direct impacts

5.1.1 Removal of native vegetation

As discussed in Section 3.3.1, the PCTs mapped within the proposal area were determined to not be present in the proposal area based upon field inspection. Vegetation within these areas consisted of a mix of native and exotic pasture grasses, with the exception of four *Eucalyptus camaldulensis* located on the eastern bank of the Kamilaroi Highway within the proposal area. The total area of vegetation to be removed for the construction of the proposal, including non-native vegetation, is approximately 4.3 ha.

As no coherent PCTs were determined to be present within the proposal area, no areas of vegetation to be removed for the proposal are considered to form a part of a TEC.

Around four *Eucalyptus camaldulensis* are located within the proposal area. Only two of these trees directly adjacent the existing bridge would be removed as part of the proposal. All efforts would be taken to avoid the removal of other trees within the proposal area during construction.

Based on the degree of vegetation removal required, the context of the surrounding lands, and the safeguards proposed, the overall impact associated with vegetation loss within and around the bridge would be minor and is not considered to be significant.

5.1.2 Removal of threatened fauna habitat

As outlined above, the proposal would include the removal of a mix of native and non-native vegetation in the form of native and exotic pasture grasses. Only a few scattered trees are present in the proposal area and only two of these trees would need to be removed during construction. The dead standing tree on the northern side of Spring Bridge along the western bank would likely require removal during construction (Figure 3-6).

Some woody debris exists on the northern side of Spring Creek Bridge (Figure 3-9) which could serve as potential habitat for small native fauna. Removal of this debris is unlikely to significantly affect the availability of fauna habitat in the area as similar habitats are available in the area. Vegetation within the proposal area on the roadside along the Kamilaroi Highway consists primarily of disturbed native and non-native grasses and removal of this vegetation would not likely result in significant impact to fauna.

Given the extensively cleared landscape and no remnant hollow bearing trees observed within the proposal area, it is recommended that safeguards are implemented as part of construction to ameliorate impacts. This includes the retention of mature trees wherever possible.

The use of machinery and other equipment during construction can increase the risk of accidental spills of fuels, lubricants or paints which can affect the health of the terrestrial and aquatic ecosystems. Construction machinery and vehicles can also disperse weeds throughout the proposal area and can transport aquatic weeds if used in wet areas prior to entering the site. These impacts can be managed through the implementation of sufficient safeguards and are considered to be minor.

Construction of the proposal would require demolition of the existing bridge. As outlined above, the existing bridge was inspected and is not considered to be a significant habitat for microbats. On this basis the removal of the existing bridge is not expected to result in a significant impact upon threatened or non-threatened microbat habitat.

Provided that management measures outlined in Section 7.0 are adequately implemented, and that works within the creek bed are minimised, it is considered the proposal would not result in a significant impact on terrestrial or aquatic habitats.

5.1.3 Threatened species and ecological communities

During the site inspection, around four Dusky Woodswallows (*Artamus cyanopterus cyanopterus*) were recorded foraging on the ground within the proposal area. The removal of two *Eucalyptus camaldulensis* required as part of the proposal may potentially reduce nesting and roosting habitat for this species. Given the presence of larger stands of *Eucalyptus camaldulensis* both upstream and downstream of the proposal and the minimal vegetation clearance required, this impact is not expected to be significant.

No threatened aquatic species were recorded in the proposal area during the site inspection. Suitable habitat was identified, as was determinable without entering the creek, for the following species:

- Eel Tailed Catfish (*Tandanus tandanus*) – slow-flowing areas with cobble and gravel beds. This species is often found around undercut banks
- Purple-Spotted Gudgeon (*Mogurnda adspersa*) – slow-flowing waters with overhanging bank vegetation and snags.

Tests of Significance (ToS) have been prepared for the above species in accordance with s220ZZ of the FM Act (Appendix B). These assessments concluded the proposal would not have a significant impact on these species as the proposal is unlikely to place a local occurrence of any of these species at risk of extinction.

No threatened fauna species were recorded in the proposal area during the site inspection, though suitable potential habitat for the following species was present:

- Grey Falcon (*Falco hypoleucos*) – Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey.

One record of threatened fauna was also identified about 4.7 km south of the proposal:

- Black-Necked Stork (*Ephippiorhynchus asiaticus*) - Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.

Tests of Significance (ToS) have been prepared for the above species in accordance with the s7.3 of the BC Act (Appendix B). These ToS concluded the proposal would not have a significant impact on these species as the proposal is unlikely to place a local occurrence of any of these species at risk of extinction.

No TECs were determined to be present within the proposal area.

5.1.4 Aquatic impacts

Construction of the proposal would require several activities that have the potential to result in impacts upon the aquatic environment of Spring Creek. These include:

- Construction of temporary rock platforms – platforms would be constructed within the waterway upstream and downstream of Spring Creek Bridge to facilitate access to the centre of the waterway for the purposes of demolition of the existing structure and construction of the new bridge. The placement of these platforms would directly temporarily occupy areas of the creek bed with the potential to restrict flow and fish passage through the proposal area. Temporary steel pipes would be installed within the platforms in the waterway area upstream and downstream of the bridge to provide water and fish passage.
- Permanent bridge piers – The new bridge would include three sets of piers within the waterway. The piles would be constructed using driven steel tubular casing with reinforced concrete infills. The reinforced concrete columns and headstocks would then be constructed in-situ. The proposed bridge piers would be placed in the waterway in a manner that generally improves waterflow and fish passage compared to the existing box culvert structure. As such the operational proposal is not expected to result in any additional adverse impact upon the cross-sectional area of the waterway than is currently present. The existing culvert base slab would be removed to 0.5 metres below existing creek bed level as part of the demolition of the existing structure.
- Increased sediment loads within the waterway – the creek was noted to have a high sediment load from visual observations during the site inspection, likely to be a result of widespread agricultural practices in the region and concurrent local flooding. Whilst the proposal has the potential to result in increased sedimentation risks to the waterway this would be managed through the implementation of standard soil and water safeguards outlined in Section 7.0. As such this impact is not expected to be significant.
- Spills - during construction there is the potential for substances associated with the works such as oil, petrol, paint, solvents and other materials to be spilled and enter the waterway. The risk of such events would be managed through the implementation of standard safeguards as outlined in Section 7.0.

- Underwater noise – the noise of piling in the creek bed is likely to result in direct disturbance of aquatic fauna, particularly fish. Given the energy of the piling hammer this has the potential to result in temporary or permanent disturbance for fish or even mortality for those in close proximity. In order to manage this risk it is proposed that all piling commence with a 'soft start' approach to provide an opportunity for fish to disperse.

In addition to the impacts outlined above the consequences of aquatic impacts have been considered as per NSW DPI's *Policy and guidelines for fish habitat conservation and management* (the fish habitat guideline). This document outlines the general approach to assessing impacts to key fish habitat arising from development within and near waterways in NSW. Based on the criteria outlined in this document Spring Creek is considered to be 'Type 2 – Moderately sensitive Key Fish Habitat' as well as 'Class 2 – moderate key fish habitat' (Table 4).

Table 4: Habitat and waterway classification – Spring Creek

Characteristic	Classification	Reasoning
Habitat sensitivity	TYPE 2 – Moderately sensitive key fish habitat	Freshwater habitats and brackish wetlands, lakes and lagoons other than those defined in TYPE 1
Waterway classification	CLASS 2 - Moderate key fish habitat	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanent to permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present.

As per the requirements of the fish habitat guideline an aquatic habitat assessment has been undertaken (Table 5).

Table 5: Aquatic habitat assessment

Question	Response
What are the geomorphic characteristics of the waterway?	Spring Creek through this location is approximately 12 m wide inside a non-incised channel approximately 0.7 m deep compared to the surrounding land. The creek through this area is moderately meandering.
Is it a gully, intermittent stream or major river? Does is it have deep pools or in-stream gravel beds? Is it a wetland? Does the watercourse connect with other watercourses upstream or downstream? What is the slope/gradient?	Spring Creek is an intermittent tributary of the Namoi River. It is meandering. There are no pools or other adjacent elements of lower flow habitat in this particular stretch. The gradient is shallow, consistent with the relatively flat surrounding topography.
Is it mapped as key fish habitat?	Yes
What is the flow regime of the watercourse (e.g. is it an intermittent or permanently flowing stream? What is the range of water velocity of the flow? What are the maximum and minimum or percentile flows (in megalitres/day) for the watercourse?)	The creek flows intermittently. Water velocity is likely to significantly vary on a seasonal basis. During the site inspection it was observed to be standing. The total daily flow is not known.
What are the local wave and current regimes?	The creek is not subject to waves or tides.
Describe the water quality (e.g. discolouration, sedimentation, turbidity, pH, dissolved oxygen, nutrients)	The water was observed to be a khaki to brown colour during the inspection. Quantitative water quality data was not available.
What types of surrounding land use are present (e.g. agricultural, urban, aquaculture)?	Surrounding land uses are predominately agricultural, with some remnant vegetation in places.

Question	Response
What is the condition of riparian vegetation (i.e. present or absent. Are the species native or exotic? Is the density of vegetation thick or sparse?)	In this stretch riparian vegetation is largely comprised of pasture grasses from adjacent paddocks and agricultural land use. Four *Eucalyptus camaldulensis* are located on the eastern bank of Spring Creek within the proposal area. Otherwise, vegetation on the banks is typical of the remainder of Spring Creek in this area, being mostly native and exotic grasses with minor stands of *E. camaldulensis* and *Allocasuarina luehmannii*.
What is the condition of freshwater aquatic vegetation (i.e. present or absent. Are the species native or exotic? Is the density thick or sparse? Is it continuous or sparse in coverage? What is the aerial extent of major vegetation types? Is the vegetation healthy or degraded?)	It was not possible to inspect the nature of underwater freshwater vegetation during the site visit. No substantial vegetation was observed on the surface due to recent flooding. Given the intermittent nature of the creek, it is likely that aquatic vegetation would be limited.
What is the condition of marine vegetation (i.e. information on type, species, shoot density and/or percentage cover, Is the vegetation continuous or sparse in coverage? What is the aerial extent? Is the vegetation healthy or degraded? Is wrack (dead seagrass or macroalgae) present?)	The site is not a marine location.
Are there wetlands nearby (including freshwater wetlands and saltmarsh) (i.e. are the wetlands protected under any legislation (e.g. SEPP (Resilience and Hazard), Ramsar wetlands)? Are the wetlands in a healthy or degraded condition?)	No wetlands were observed in the immediate vicinity of the subject stretch of creek.
What is the substrate type (e.g. rock, sand, gravel, silt, coral reef)?	Based upon the high degree of background turbidity the substrate is expected to be highly silty.
Are there refuge areas present (e.g. adjacent wetlands, upstream pools)?	No refuge areas were observed in this stretch of Spring Creek.
Are there spawning areas present (e.g. gravel beds, snags, reed beds, saltmarshes)?	It was noted that the creek in this location did not have any snags present (tree branches poking above the water near the banks). This situation was observed both upstream and downstream of the proposal area. The creek bed was observed to contain areas of gravel mixed among the silt and mud but no defined gravel beds. No reed beds or saltmarshes were observed.
Are there natural or artificial barriers to fish passage upstream and downstream (e.g. waterfalls, cascades, weirs, dams, floodgates, road crossings)?	The only artificial barrier to fish passage in the general vicinity of the proposal area is the existing box culvert structure.
What types of migratory fish or other aquatic species likely to inhabit the areas (based on known distribution range within the scientific literature)?	There are no migratory aquatic species recorded likely to inhabit the area.
What is the timing of construction in relation to any fish migration seasons?	The timing of construction is not currently known.
What is the timing of construction in relation to flow conditions relative to expected wet seasons?	The timing of construction is not currently known.

Question	Response
Are there any listed threatened or protected aquatic species or 'critical habitat' under the FM Act and EPBC Act present?	A protected matters search indicates the potential for the creek in this location to be habitat for Murray Cod. DPI threatened fish maps indicate the potential for the following species to be present: • Eel Tailed Catfish (*Tandanus tandanus*) • Southern Purple-Spotted Gudgeon (*Mogurnda adspersa*).

As the installation of temporary steel pipes within the waterway would provide water flow and fish passage that would otherwise be obstructed by construction of the temporary rock platforms, it is not necessary to obtain a permit for the obstruction of fish passage from the Minister for Primary Industries in order to operate the proposal as per section 219 of the *Fisheries Management Act 1994.* Transport must undertake the works in accordance with the Code of Practice for Minor Works in NSW Waterways, or alternatively, provide written notification to the Minister 21 days prior to carrying out dredging or reclamation work within the creek.

5.1.5 Injury and mortality

During construction the proposal would involve the movement of plant and machinery. Although the existing road already poses a threat to native fauna for injury and mortality, it is likely that the risk would be higher during construction, particularly during any required vegetation clearing when fauna would be forced to move. This would be somewhat mitigated by the generally slower speed of construction vehicles and machinery, as well as general traffic during construction.

During construction it would be necessary to remove mature vegetation in the form of two *Eucalyptus camaldulensis* to facilitate the proposal. This has the potential to displace native animals utilising potentially unidentified nest hollows and other habitat features within the trees such as flaking bark. However, with the implementation of the mitigation measures in Section 7.0, the potential impacts are considered manageable.

5.1.6 Groundwater dependent ecosystems

The new bridge requires three sets of piers within the waterway. The waterway and abutment piles would be constructed using driven steel tubular casing with reinforced concrete infills. This may involve pump out of infiltrating groundwater in order to set the concrete which is expected to result in a negligible impact on the groundwater and associated GDEs.

5.2 Indirect and operational impacts

5.2.1 Edge effects on adjacent native vegetation and habitat

Construction activities including earthworks and movement of soil risk spreading weeds and pathogens into unaffected areas. The proposal area currently contains invasive forbs such as Buchan Weed, Sweet Clover, Sow Thistle, Patterson's Curse and Black Nightshade which may establish in newly cleared areas and contribute to edge effects encroaching into the surrounding vegetation. No pathogens were identified within the proposal area, though these could be imported from machinery, soil and vehicles. Given the safeguards and mitigation measures proposed, this impact is not anticipated to be significant.

5.2.2 Wildlife connectivity and habitat fragmentation

The proposal would result in the clearing of approximately 4.3 ha of vegetation consisting of a mix of native and exotic pasture grasses and two *Eucalyptus camaldulensis*.

Construction of the widened approaches to the new bridge, demolition and removal of the temporary diversion track and additional areas required for construction, site compounds, stockpile and laydown areas and construction accesses would require clearing of localised vegetation adjacent the Kamilaroi Highway and existing bridge. Canopy vegetation in this location is largely restricted to four *Eucalyptus camaldulensis* located on the eastern bank of the creek, in an area mapped as PCT 78 River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion. Two *E. camaldulensis* individuals would be removed for the proposal. In the east of the proposal area and south of the Kamilaroi Highway, construction of the widened approaches to the new bridge would require clearing of areas mapped as PCT 39 Coolibah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion. Upon site inspection, these areas were found to mostly consist of a mix of low condition native and exotic grasses, and both PCT 78 and PCT 39 were determined not to be present within the proposal area.

Removal of *Eucalyptus camaldulensis* would expand the gap in riparian vegetation by approximately 50 m. Whilst this corridor is already, to some degree, interrupted by the existing bridge and approximately 350 m of cleared riparian areas north of the proposal, this gap would be expanded to facilitate construction and demolition access, as well as ongoing maintenance. In the context of the broader regional landscape which has been subject to significant historic clearing for agriculture the riparian corridor takes on an increased importance for fauna movement. Whilst the degree of disruption to this corridor is not expected to fragment local populations or threatened species to the point that they are split into two or more disconnected populations, measures are recommended to mitigate this impact in the long term. These include the absolute minimisation of vegetation removal to facilitate construction, as well as the revegetation of this corridor post-construction to close this gap as swiftly as possible.

As outlined above, impacts to connectivity arising from the proposal may be mitigated through prudent avoidance and/or rehabilitation of adjacent and nearby areas. It is recommended that the existing riparian zone and temporary diversion track be rehabilitated as part of the proposal, including removal of the temporary pavement and revegetation with appropriate species.

5.2.3 Injury and mortality

Construction of the widened approaches to the new bridge would not increase traffic speeds but would slightly increase the distance of travel for fauna crossing the highway. This increased distance would increase the time spent crossing and would increase the chances of vehicle strike, particularly for ground-dwelling species. However, given the limited extent of existing vegetation in the road reserve and the absence of connectivity north of the highway to the creek, the desire for such crossing is expected to be minimal. On this basis the increased likelihood of injury or mortality is not expected to be significant.

5.2.4 Invasion and spread of weeds

The movement of vehicles and personnel into and throughout the proposal area has the potential to facilitate the spread of weeds. With the implementation of appropriate safeguards and measures, the overall weed impact associated with the construction phase of this proposal would likely be minor.

The operation of the proposal would not present any additional or ongoing risk in terms of the spread of weeds.

5.2.5 Invasion and pests and pathogens

The proposal area is likely to be utilised by a range of vertebrate pest species. Impacts from pest species are likely to include ongoing grazing and predation on small to medium native fauna. The proposal is unlikely to alter the occurrence of pest species in and around the site, either positively or negatively, due to the localised nature of the works. As such the overall impact in this regard is considered to be neutral with respect to the existing scenario.

As with weeds, the proposal has the potential to spread pathogens into the proposal area. This may include plant diseases such as myrtle rust and phytophthora fungus, or animal disease such as chytrid fungus, which affects amphibians.

The scope of the site inspection was not broad enough to be able to identify the presence of any plant pathogens in the area, though no immediate signs of poor plant health or dieback were present. Similarly, no detailed fauna survey was undertaken so the presence of chytrid could not be confirmed. Assuming that none of these pathogens are currently present, the risk of the introduction of such pathogens is expected to be low.

5.2.6 Changes to hydrology

The proposal would involve the installation of temporary in-stream structures, including temporary construction working platforms and temporary access tracks for construction and demolition access.

These structures would be placed in the waterway with pipe culverts ensuring surface water flow and providing some level of flood resistance. These structures can potentially detain water, increasing inundation. However, given the morphology of the waterway channel, it is unlikely they would greatly alter water flow in the event of flooding.

The new bridge would provide an increased flood immunity to the existing bridge during operation. The preferred design would result in a 64 metre wide channel as the abutments would be set back to accommodate a longer deck length, resulting in an increased lateral extent of available water passage under the bridge.

5.2.7 Noise, light, dust and vibration

There is the potential for some resident native fauna to temporarily avoid habitats within and directly adjacent to the proposal area during construction due to the presence of people, vehicles, noise and light.

During construction it would be necessary to drive tubular steel casing to construct the new bridge piers and abutments. The installation of the piles is likely to result in increased noise, which may result in direct disturbance to some fauna, particularly aquatic fauna within the waterway. This impact is not likely to be substantial however given that piling would include a soft start procedure and would not be a continuous process during the work shift. It is also noted that this area is subject to somewhat elevated noise levels associated with vehicle use of the existing bridge by heavy and light vehicles.

Given construction would be only carried out between 7am and 6pm (Monday to Friday) and 8am to 5pm on a Saturday, the potential for disruption to nocturnal species would be reduced. Despite this, mitigation measures are recommended to reduce the potential of adversely impacting nocturnal species. These measures are outlined in Section 7.0. No additional noise, light, dust and vibration impacts are expected during operation of the proposal.

5.3 Cumulative impacts

No other similar projects, road or otherwise, are known to be planned for this area. As such there would be no known cumulative development impacts arising from this proposal.

The removal of vegetation, and associated habitat, associated with the proposal would contribute to the overall and ongoing reduction in available habitat and resources available for native species generally. This impact is considered to be negligible however given the scale of the proposed works, and the relatively minor amount of vegetation and aquatic habitat affected.

6.0 Key threatening processes

6.1 BC Act

The following key threatening processes listed under the BC Act are considered relevant to the proposal:

- Clearing of native vegetation

The proposal would result in the clearing of a small amount of native vegetation to facilitate the construction of the new bridge as well as demolition of the existing bridge. The vegetation in this area is generally low quality and highly modified, consisting of a mix of native and exotic pasture grasses.

- Invasion of native plant communities by exotic perennial grasses

Exotic perennial grasses and other environmental weeds exist within the study area and can benefit from disturbance to natural vegetation. Weed management at the site would help prevent these species from spreading within or between sites.

- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis

Chytridiomycosis is a fatal disease of amphibians and is caused by the chytrid *Batrachochytrium dendrobatids*. Management measures are recommended to address contributing to this Key Threatened Process (KTP).

6.2 FM Act

The following key threatening processes listed under the FM Act are considered relevant to the proposal:

- *Degradation of native riparian vegetation along New South Wales water courses*

The proposal would result in the clearing of riparian vegetation, namely two *Eucalyptus camaldulensis* individuals, to facilitate the construction of the new bridge as well as demolition of the existing bridge. Riparian vegetation is relatively consistent along the banks of Spring Creek for hundreds of kilometres upstream and downstream, with the proposal limited to removal of about 0.15 ha hectares of riparian vegetation, consisting primarily of a mix of native and exotic pasture grasses.

- *Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams*

The proposal would involve the construction of temporary rock platforms in the waterway. This would alter the natural flow of the creek for the duration of the new bridge construction period. Steel pipes would be installed within the rock platforms to allow the central section of the stream to remain open during this period. This would limit the impact of the rock platform on natural flows, and the removal of the platform following completion of the new bridge would restore flows to that prior to the platform construction. The installation of three sets of piers within the waterway would have a negligible impact on the current flow of the creek as their profile would be the same or less than the existing structure. Additionally, the removal of the existing structure would contribute towards ameliorating the impacts to natural flow due to the proposal.

6.3 EPBC Act

Relevant key threatening processes listed under the EPBC Act are:

- Land clearance
- Novel biota and their impact on biodiversity
- Infection of amphibians with chytrid fungus resulting in chytridiomycosis.

The impact of clearing of vegetation is outlined within this document. The scale of the proposed clearing is considered minor, and further opportunities would be investigated during subsequent stages of development to reduce this impact further.

The other two KTPs are considered minor based on the limited physical scale of the proposal and would be managed during construction and operation through the application of relevant measures.

7.0 Mitigation

Within the context of ongoing use of the proposal area as an active road, and to the extent that is safe and practicable, consideration should be given to implementing the management measures described in Table 6 to protect and enhance existing ecological assets and values.

Offset measures have not been proposed as part of the proposal. Though the riparian area along Spring Creek is mapped on the Biodiversity Values Map, the area of native vegetation being cleared for the proposal is below the 0.25 ha threshold for clearing of native vegetation above which the Biodiversity Assessment Method and offset scheme apply.

The management measures provided are broadly listed in order of priority for managing ecological values.

Table 6: Proposed mitigation measures

Impact	Ref	Management measure
General	G1	Investigate measures to further avoid and minimise the construction footprint and native vegetation or habitat removal during detailed design and implement where practicable and feasible.
Aquatic impacts	A1	Use sediment and erosion controls for in-stream works to avoid impacts on water quality and fish passage e.g. erosion fencing, stockpile covers and silt curtains
	A2	Undertake work in accordance with the Code of Practice for Minor Works in NSW Waterways (Roads and Maritime Services, 2014)
	A3	Restrict works to periods of normal flow (i.e. no work during flood periods)
	A4	Place stockpiles in designated stockpile locations such that they are not subject to a 1 in 10 year flood event i.e. at top of banks
	A5	Replace/add snags into the waterway post-construction where practicable so as to replicate the pre-construction condition
	A6	Rehabilitate vegetation within the riparian zone upon completion of construction including revegetation with local native species e.g. *E. camaldulensis*
	A7	Aquatic habitat shall be protected in accordance with *Guide 10: Aquatic habitats and riparian zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 Standard precautions and mitigation measures of the *Policy and guidelines for fish habitat conservation and management Update 2013* (DPI 2013).
Vegetation removal	B1	All vegetation removal should be limited to the minimum extent necessary to construct the bridge and approaches, and demolition and removal of the temporary diversion track.
	B2	Prior to the commencement of any works, a physical clearing boundary is to be demarcated and implemented. The demarcation of the exclusion zone will be in accordance with *Biodiversity Guidelines – Protecting and Managing Biodiversity on RTA Projects: Guide 2: exclusion zones* (RTA 2011).
	B3	A 'Clearing and Grubbing Plan' should be developed in accordance with *Guide 4 (clearing of vegetation)* of the Transport for NSW *Biodiversity Guidelines* (RTA 2011). This will include best practice methods for the removal of woody vegetation and non-woody vegetation.
	B4	As mature trees with a DBH >40 cm diameter are proposed to be cleared, an ecologist or Transport Environmental Officer must be onsite to undertake a pre-clearance survey prior to and whilst the tree/s are being removed (see *Biodiversity Guidelines – Protecting and Managing*

Impact	Ref	Management measure
		Biodiversity on RTA Projects: Guide 1 Pre-clearing Process and *Guide 4 Clearing of vegetation and removal of bushrock* (RTA 2011).
	B5	Within the riparian area, the sections of felled trees including hollows should be placed on the ground to provide habitat for ground-dwelling fauna, where practicable.
Protection of native flora	C1	If unexpected threatened flora species are discovered, stop works immediately and follow the *Biodiversity Guidelines – Protecting and Managing Biodiversity on RTA Projects: Guide 1 (Pre-clearing process)* (RTA 2011).
Protection of fauna and habitat	D1	Construction of the new bridge should include the rehabilitation of the temporary side track upon removal. This should include removal of the existing pavement and tilling to allow the regeneration of native plants.
	D2	Transport should contribute to the Transport Conservation Fund in accordance with the Tree and Hollow Replacement Guidelines (Transport for NSW, 2022). Fund contributions are detailed in Table 2-2 of the Guidelines.
	D3	If unexpected threatened flora species are discovered, stop works immediately and follow the *Biodiversity Guidelines – Protecting and Managing Biodiversity on RTA Projects: Guide 1 (Pre-clearing process)* (RTA 2011)
	D4	WIRES should be consulted if any injured fauna are encountered.
	D5	If it is perceived that significant impacts are occurring to aquatic environments within the vicinity of the work area (e.g. spill of any chemicals), works at that location should cease and Transport environment branch should be contacted for further advice.
	D6	To minimise the risk of injury or mortality to fauna and their young the following measures are recommended: • All clearing is to follow the RTA biodiversity guidelines with respect to the pre-clearing process, including the capture and relocation (by licenced wildlife carers or ecologists) of fauna that have the potential to be disturbed as a result of clearing activities • Vegetation removal is to be undertaken as per Guide 4 of the RTA biodiversity guidelines, including the implementation of staged clearing.
	D7	Routine corridor maintenance should be carried out to manage mid-storey vegetation on road batters to reduce congregation of wildlife and improve sight lines for motorists during operation.
Weeds and disease	E1	Vehicles should be inspected prior to arrival on site to minimise the spread of weeds or disease.
	E2	Weeds will be managed in accordance with the Transport's standard weed management measures.
Offsite impacts	O1	Reduce the potential for off-site impacts arising from sedimentation, dust, and noise through the implementation of a Construction Environment Management Plan (CEMP). The CEMP should seek to retain any native vegetation present within and around the proposal area wherever possible. The CEMP should include erosion and sediment controls in accordance with *Managing urban stormwater: soils and construction* (the Blue Book).

Impact	Ref	Management measure
Waste	F1	All waste material and rubbish associated with the proposal, particularly chemicals, are to be removed from site and properly disposed of.

8.0 Offsets and other measures

8.1 Preliminary tree and hollow replacement estimates

Table 7 provides an estimate of the preliminary tree and hollow replacement requirements for tree removal as a result of the proposal, based on the Tree and Hollow Replacement Guidelines (Transport for NSW, 2022).

Table 7: Preliminary estimates of trees and hollow replacement requirements

Category	Estimated No. impacted		Replacement requirement per tree/hollow removed[1]		Estimated number to be replaced[2]		Estimated equivalent payment to Transport conservation fund[2]
	Native trees	Amenity trees	Planting required	Contribution required	Native trees	Amenity trees	
Very large tree (DBH ≥100cm)			Plant minimum 16 trees	$2,500			
Large tree (DBH ≥50 to <100cm)	2		Plant minimum 8 trees	$1,000	16		$2000
Medium tree (DBH ≥20 to <50 cm)			Plant minimum 4 trees	$500			
Small tree (DBH ≥ 5cm to <20 cm)			Plant minimum 2 trees	$125			
Hollow			Provide 3 artificial hollows for every occupied hollow removed*	$500			
Totals					16		$2000

NOTE 1: As per the Transport Tree and Hollow Replacement Guidelines

NOTE 2: An equivalent payment to the Transport Conservation Fund can be used where replanting is not feasible or fully achievable within the project boundary or adjacent land.

9.0 Conclusion

9.1 Overview of key findings

Land around the proposal area is largely characterised by cleared agricultural land with isolated paddock trees and sections of sparse open woodland, and riparian vegetation along Spring Creek. Within the proposal area, habitat features of note include four mature *Eucalyptus camaldulensis*. Two dead standing trees are located within the proposal area, along with logs and other woody debris on the eastern bank north of the Kamilaroi Highway. Vegetation within the roadside reserve is largely comprised of native and exotic pasture grasses, and other weedy vegetation. No branches or logs were observed within Spring Creek though it is noted the creek bed did contain scattered gravel and rocks among the sediment laden bottom.

The proposal would remove up to 4.3 ha of vegetation consisting mainly of exotic pasture grasses, and two *E. camaldulensis* adjacent the existing bridge. The proposal area does not contain any substantial habitat for threatened flora. Around four Dusky Woodswallows were recorded during the site inspection, foraging on the ground within the proposal area. Though the removal of two *E. camaldulensis* may potentially reduce the roosting habitat for this species, this impact is not expected to be significant. Desktop searches identified four threatened species, including two aquatic species, with the potential to occur within the proposal area. ToS were undertaken to assess the potential for a significant impact upon these species. The assessments concluded that such an impact was unlikely.

No TECs were recorded within the proposal area.

Based on the limited area of vegetation clearing required and the implementation of the recommended safeguards, the overall impact of the proposal upon threatened and non-threatened biodiversity, including ecological communities, is considered to be low. Despite this, compensatory mitigation measures are proposed including the rehabilitation of disturbed or disused parts of the proposal area.

9.2 Recommendations

The proposal is recommended to proceed subject to the implementation of the safeguards provided.

10.0 References

Bureau of Meteorology Atlas of Groundwater Dependent Ecosystems (GDE): http://www.bom.gov.au/water/groundwater/gde/map.shtml. (BoM 2022)

Department of Climate Change, Energy, Environment and Water (DCEEW), 2022, Protected Matters Search Tool

NSW Department of Planning and Environment (DPE), 2022a, Spatial Layer of HEVAE Vegetation Groundwater Dependent Ecosystems Value in NSW: https://datasets.seed.nsw.gov.au/dataset/hevae-vegetation-groundwater-dependent-ecosystems-in-nsw

NSW Department of Planning and Environment (DPE), 2022b, BioNet database

NSW Department of Planning and Environment (DPE), 2022c, Vegetation Types Database and Threatened Species Profile Database

NSW Department of Primary Industries (DPI), 2022a, Fisheries spatial data portal

NSW Department of Primary Industries (DPI), 2022b, WeedWise Priority Weeds List

NSW Department of Primary Industries (DPI), 2022c, database for threatened species and aquatic TECs: https://www.dpi.nsw.gov.au/fishing/species-protection/what-current

Roads and Traffic Authority (RTA), 2011a, *Biodiversity Guidelines – Protecting and Managing Biodiversity on RTA Projects: Guide 2: exclusion zones*

Roads and Traffic Authority (RTA), 2011b, *Guide 4 (clearing of vegetation)* of the Transport for NSW *Biodiversity Guidelines*

Appendix A

Flora and fauna with the potential to occur within the study area

Appendix A Flora and fauna with the potential to occur within the study area

NOTE: The list of threatened species, populations, or ecological communities which may be affected directly or indirectly by the proposal is derived from searches of the following databases as well as on ground survey conducted September 2022:

NSW Office of Environment and Heritage Atlas of NSW Wildlife Database (OEH 2015)

NSW Office of Environment and Heritage Endangered Ecological Community and Threatened Species Profiles (OEH 2013)

NSW Flora Online Search – Rare or Threatened Australian Plants (ROTAP) species (The Royal Botanic Gardens and Domain Trust 2013)

NSW Department of Primary Industries: Fishing and Aquaculture – Profiles for species, populations and ecological communities (NSW Government 2005)

Protected Matters Report documenting all Matters of National Environmental Significance within 5 km of site (Commonwealth Department of the Environment 2015).

The likelihood of occurrence is based on the risk matrix in Appendix F.

V = Vulnerable, **E** = Endangered, **CE** = Critically Endangered, **M** = Migratory

Species name	Common name	FM Act	BC Act	EPBC Act	Habitat association	Likelihood of occurrence within the proposal site
Birds						
Ephippiorhynchus asiaticus	Black-necked Stork		E		Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	High
Calidris ferruginea	Curlew Sandpiper		E	CE, M	Curlew Sandpiper generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed.	Low
Anthochaera phrygia	Regent Honeyeater		CE	CE	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have substantially large numbers of mature trees, high canopy cover and abundance of mistletoes. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast. Birds are occasionally seen on the south coast. In the last 10 years Regent Honeyeaters have been recorded in urban areas around Albury where woodlands tree species such as Mugga Ironbark and Yellow Box were planted 20 years ago.	Low
Botaurus poiciloptilus	Australasian Bittern		E	E	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (Typha spp.) and spikerushes (Eleocharis spp.). Hides during the day amongst dense reeds or rushes and feed mainly at night.	Low
Rostratula australis	Painted Snipe (Australian subspecies)		E	E, M	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves.	Low

Species name	Common name	FM Act	BC Act	EPBC Act	Habitat association	Likelihood of occurrence within the proposal site
					Forages nocturnally on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter.	
Hirundapus caudacutus	White-throated Needletail			M	Aerial space over a variety of habitat types, but prefers to forage over treed habitats as these would provide a greater abundance of insect prey; often forage on the edge of low pressure systems and may follow these systems ; breeds in Asia.	Low
Polytelis swainsonii	Superb Parrot		V	V	Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakey's Red Gum, Yellow Box, Apple Box and Red Box. Nest in small colonies, often with more than one nest in a single tree.	Low
Leipoa ocellata	Malleefowl		E	V	Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300 - 450 mm mean annual rainfall) areas. Utilises mallee with a spinifex understorey, but usually at lower densities than in areas with a shrub understorey. Less frequently found in other eucalypt woodlands, such as Inland Grey Box, Ironbark or Bimble Box Woodlands with thick understorey, or in other woodlands such dominated by Mulga or native Cypress Pine species. Prefers areas of light sandy to sandy loam soils and habitats with a dense but discontinuous canopy and dense and diverse shrub and herb layers.	Low
Calyptorhynchus lathami	Glossy Black-Cockatoo		V	V	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of she-oak occur. Black She-oak (*Allocasuarina littoralis*) and Forest She-oak (*A. torulosa*) are important foods. Inland populations feed on a wide range of she-oaks, including Drooping She-oak, *Allocasuaraina diminuta*, and *A. gymnathera*. Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping She-oak, but also recorded in open woodlands dominated by Belah (*Casuarina cristata*).	Low

Species name	Common name	FM Act	BC Act	EPBC Act	Habitat association	Likelihood of occurrence within the proposal site
Falco hypoleucos	Grey Falcon		E		Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey.	Medium
Grantiella picta	Painted Honeyeater		V	V	Inhabits Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus *Amyema*. Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nesst from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.	Low
Mammals						
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat		V		Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn.	Low
Phascolarctos cinereus	Koala		V	V	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees, but will descend and traverse open ground to move between trees. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.	Low
Chalinolobus dwyeri	Large-eared Pied Bat		V	V	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to	Low

Species name	Common name	FM Act	BC Act	EPBC Act	Habitat association	Likelihood of occurrence within the proposal site
					January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies.	
Nyctophilus corbeni	Corben's Long-eared Bat		V	V	Inhabits a variety of vegetation types, including mallee, bulloke, *Allocasuarina leuhmanni* and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark	Low
Pteropus poliocephalus	Grey-headed Flying-fox		V	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	Low
Reptiles						
Hemiaspis damelii	Grey Snake			E	In the Lowbidgee floodplain region of NSW it has been recorded exclusively from the margins of ephemeral wetlands within River Red Gum *Eucalyptus camuldulensis* and Black Box *E. largiflorens* vegetation communities and from Tangled Lignum *Duma florulenta* swamps. In recent times, Grey Snakes in the Lowbidgee region have only been sighted from wetlands that have received environmental water flows. No snakes have been detected from dry phase wetlands suggesting its detectability may be related to wetland inundation regimes as well as suitable weather conditions.	Low
Aprasia parapulchella	Pink-tailed Legless Lizard		V	V	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks; the burrows have been constructed by and are often still inhabited by small black ants and termites.	Low

Species name	Common name	FM Act	BC Act	EPBC Act	Habitat association	Likelihood of occurrence within the proposal site
Anomalopus mackayi	Five-clawed Worm-skink		E	V	Close to or on the lower slopes of slight rises in grassy White Box woodland on moist black soils, and River Red Gum-Coolibah-Bimble Box woodland on deep cracking loose clay soils. May also occur in grassland areas and open paddocks with scattered trees. Live in permanent deep tunnel-like burrows and deep soil cracks, coming close to the surface under fallen timber and litter, especially partially buried logs.	Low
Fish						
Maccullochella peelii	Murray Cod			V	The Murray Cod utilises a diverse range of habitats from clear rocky streams, such as those found in the upper western slopes of NSW (including the ACT), to slow-flowing, turbid lowland rivers and billabongs. Preferred microhabitat consists of complex structural features in streams such as large rocks, snags (pieces of large submerged woody debris), overhanging stream banks and vegetation, tree stumps, logs, branches and other woody structures.	Low
Flora						
Lepidium aschersonii	Spiny Peppercress		V	V	Found on ridges of gilgai clays dominated by Brigalow (*Acacia harpophylla*), Belah (*Casuarina cristata*), Buloke (*Allocasuarina luehmanii*) and Grey Box (*Eucalyptus microcarpa*). In the south has been recorded growing in Bull Mallee (*Eucalyptus behriana*). Often the understorey is dominated by introduced plants. The species grows as a a component of the ground flora, in grey loamy clays. Vegetation structure varies from open to dense, with sparse grassy understorey and occasional heavy litter. Flowers from spring to autumn.	Low
Swainsona murrayana	Slender Darling Pea		V	V	The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with *Maireana* species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated.	Low
Dichanthium setosum	Bluegrass		V	V	Flowering time is mostly in summer. Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately	Medium

Species name	Common name	FM Act	BC Act	EPBC Act	Habitat association	Likelihood of occurrence within the proposal site
					disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. (Often collected from disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched). Associated species include *Eucalyptus albens, Eucalyptus melanophloia, Eucalyptus melliodora, Eucalyptus viminalis, Myoporum debile, Aristida ramosa, Themeda triandra, Poa sieberiana, Bothriochloa ambigua, Medicago minima, Leptorhynchos squamatus, Lomandra aff. longifolia, Ajuga australis, Calotis hispidula and Austrodanthonia, Dichopogon, Brachyscome, Vittadinia, Wahlenbergia* and *Psoralea* species. Locally common or found as scattered clumps in broader populations.	
Digitaria porrecta	Finger Panic Grass		E		In NSW, the most frequently recorded associated tree species are *Eucalyptus albens* and *Acacia pendula. Common* associated grasses and forbs in NSW sites include *Austrostipa aristiglumis, Enteropogon acicularis, Cyperus bifax, Hibiscus trionum* and *Neptunia gracilis*. Flowering season is summer or late summer from mid-January to late February, with seeds maturing and falling from the plant soon after. Native grassland, woodlands or open forest with a grassy understorey, on richer soils. Often found along roadsides and travelling stock routes where there is light grazing and occasional fire.	High
Lepidium monoplocoides	Winged Peppercress		E	E	Occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with a mean annual rainfall of around 300-500 mm. Predominant vegetation is usually an open woodland dominated by *Allocasuarina luehmannii* (Bulloak) and/or eucalypts, particularly *Eucalyptus largiflorens* (Black Box) or *Eucalyptus populnea* (Poplar Box). The field layer of the surrounding woodland is dominated by tussock grasses. Recorded in a wetland-grassland community comprising *Eragrostis australasicus, Agrostis avenacea, Austrodanthonia duttoniana, Homopholis proluta, Myriophyllum crispatum, Utricularia dichotoma* and *Pycnosorus globosus*, on waterlogged grey-brown clay. Also recorded from a *Maireana pyramidata* shrubland.	Low

Species name	Common name	FM Act	BC Act	EPBC Act	Habitat association	Likelihood of occurrence within the proposal site
Vincetoxicum forsteri	Vincetoxicum forsteri (syn. Tylophora linearis)		V	E	Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla* and *Allocasuarina luehmannii*. Also grows in association with *Acacia hakeoides, Acacia lineata, Melaleuca uncinata, Myoporum* species and Casuarina species. Flowers in spring, with flowers recorded in November or May with fruiting probably 2 to 3 months later.	Low
Cadellia pentastylis	Ooline		V	V	Appears to flower spasmodically, during a general flowering period of October to January. Forms a closed or open canopy mixing with eucalypt and cypress pine species. There appears to be a strong correlation between the presence of Ooline and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sandy loam surface layer, grading from a light clay to a medium clay with depth. The total area occupied by Ooline is only about 1200 hectares, with remaining populations in NSW still threatened to various degrees by clearing for agriculture and grazing pressures.	Low
Androcalva procumbens	Androcalva procumbens (syn. Rulingia procumbens, Commersonia procumbens)		V	V	Grows in sandy sites, often along roadsides. Recorded in *Eucalyptus dealbata* and *Eucalyptus sideroxylon* communities, *Melaleuca uncinata* scrub, under mallee eucalypts with a *Calytrix tetragona* understorey, and in a recently burnt Ironbark and Callitris area. Also in *Eucalyptus fibrosa subsp. nubila*, *Eucalyptus dealbata*, *Eucalyptus albens* and *Callitris glaucophylla* woodlands north of Dubbo. Other associated species include *Acacia triptera, Callitris endlicheri, Eucalyptus melliodora, Allocasuarina diminuta, Philotheca salsolifolia, Xanthorrhoea species, Exocarpos cupressiformis, Leptospermum parvifolium* and *Kunzea parvifolia*. The species is often found as a pioneer species of disturbed habitats. It has been recorded colonising disturbed areas such as roadsides, the edges of quarries and gravel stockpiles and a recently cleared easement under power lines.	Low
Thesium australe	Austral Toadflax		V	V	Suitable habitat for this species includes grassland and grassy woodland, often in damp sites.	Low

Appendix B

FM Act and BC Act Tests of Significance

Appendix B Assessment of Significance

Fisheries Management Act 1994

Under the *Fisheries Management Act 1994* (FM Act), the threatened species 'assessment of significance' is also used to determine if an action is likely to significantly affect threatened species or ecological communities as identified in the FM Act. Assessments of significance were carried out for the purposes of this assessment on the following:

Fish species:

- **Southern Purple-Spotted Gudgeon (*Mogurnda adspersa*)**

Threatened populations:

- **Murray Darling Population of the Eel-Tailed Catfish (*Tandanus tandanus*)**

These tests are provided below.

Fish Species and threatened populations: Southern Purple-Spotted Gudgeon (Mogurnda adspersa), and Murray Darling Population of the Eel-Tailed Catfish (Tandanus tandanus).

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
These species were not recorded during the site survey but have been assumed to be present for the purposes of this assessment. Given the broad-ranging mobility of these species it is difficult to isolate any one area as being a separate population. As such it is not clear whether individuals potentially using this area would be part of a viable local population. Despite this it has been assumed that the local population of this species (to whatever extent it is present) is viable for the purposes of this assessment. The proposal would disturb up to 0.15 ha of riparian area and extent of works. This would occur within the context of the Murray Darling Bains North river system, including riparian habitat, extending southwest towards the Namoi River and associated tributaries for hundreds of kilometres. The proposal would result in direct disturbance to the creek bed with adjustment of rock platform and temporary steel pipes, as required to suit demolition and bridge construction staging. No substantial snags from fallen riparian vegetation were identified within the proposal area during field assessment. Though the creek bed was observed to contain some scattered gravel and rocks, no defined gravel bed was identified and no rocks larger than 500 mm were observed. As such the proposal would not reduce habitat for these species Placement of in stream structures may pose a local restriction on movement and accessibility to breeding sites along the waterway. However, as the central section of the stream would remain open during the entirety of works, and the placement of these structures would be temporary, it is not considered likely this would affect the viability of local populations. Additionally, the streams morphology appears typical of the streams of the area and is consistent through the extent of waterway in the area of the proposal and likely extends for a substantial distance both upstream and downstream. It is not considered likely that the proposal would limit the availability of gravel beds, snags, aquatic vegetation or other breeding areas, or result in other restrictions upon this species such that the local population of these species may be placed at risk of extinction. Similarly, the proposal is unlikely to significantly disrupt or remove the availability of foraging resources during construction or operation.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction
The Eel-Tailed Catfish was not recorded during the site survey but has been assumed to be present for the purposes of this assessment. The Eel-Tailed Catfish assumed to be present within the proposal area is part of the Murray Darling Population, which is predicted to occur within Spring Creek at the location of the proposal. The proposal is located in the central area of the indicative distribution of this population within the Northern Murray-Darling Basin river system, including several tributaries. It has been assumed that the local population of this species (to whatever extent it is present) is viable for the purposes of this assessment. Increase in silt and sediment smothering eggs and nests and removal of woody debris from the waterway would affect the life cycle of the species. In the context of runoff from the large extents of agricultural land surrounding the creek, the degree to which the proposal would result in silt and sedimentation impacts would likely not be significant given the mitigation measures recommended. No snags were identified within the proposal area. If snags are to be encountered during construction and require removal, these would be replaced in the waterway where practicable, reducing this impact. Due to this, the proposal is not considered likely to impact the viability of any local populations due to interference with life cycle of these species.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: **i. is likely to have an adverse effect on the extent of the ecologicalcommunity such that its local occurrence is likely to be placed at risk of extinction, or** **ii. is likely to substantially or adversely modify the composition of the ecological community substantially and adversely such that its local occurrence is likely to be placed at risk of extinction.**
i. N/A ii. N/A

d) in relation to the habitat of a threatened species or ecological community: **i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and** **ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and** **iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**
i. The proposal would affect up to 0.09 ha of habitat for these species with about 350 m^2 of the waterway directly affected by the rock platform and piers. The rock platforms would be removed upon completion of the construction phase. This is less than 0.01 percent of the creek habitat available within the broader region. ii. The placement of the rock platform in Spring Creek may result in a temporary barrier to movement for some species which shelter in areas such as snags and overhanging vegetation such as the Eel-Tailed Catfish and Purple Spotted Gudgeon. This would be minimised by the maintenance of a passage in the central section of the creek between the platform and be negated upon removal of the rock platform following construction. The stream habitat appears to be consistent both upstream and downstream of the stream, and noting the highly mobile nature of these species, this impact would not be expected to isolate any habitat from other areas. iii. The habitat to be removed within Spring Creek is ideal habitat for these species, though it is noted that this same habitat in similar condition extends in both directions along the creek. As the rock platform would be removed upon completion of construction of the new bridge,

d) in relation to the habitat of a threatened species or ecological community: i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality
the long term impacts of the proposal would be restricted to damage to the creek bed from occupation of the rock platform, which would recover over time, and removal of habitat in the areas occupied by the new piers. Due to this, the proposal is not anticipated to have a significant impact on the long-term survival of any local populations.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)
The proposal would not affect any area of critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan
There is one threat abatement plan which applies to this ecological community, and is listed below: • Threat Abatement Plan: Removal of large woody debris from NSW rivers and streams While no snags were identified in the proposal area, there is the potential for snags to be encountered during construction which may require removal. Removal of snags is identified in the Threat Abatement Plan: Removal of large woody debris from NSW rivers and streams. This would be limited to the area surrounding the new bridge construction and existing bridge and mitigated by the recommendation of relocation of snags removed from the creek downstream. Additionally, the presence of large woody debris in the waterway upstream and downstream from the proposal area is consistent to that within the proposal area and would not be affected. Due to this, the proposal would not significantly affect the presence of large woody debris in the locality and would therefore would not be inconsistent with this plan.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process
As outlined in section 6.0, the proposal may contribute to the following KTPs: • Degradation of native riparian vegetation along New South Wales water courses • Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams. Mitigation measures are proposed to control each of these KTPs. Provided these are adequately implemented the effect of these KTPs is not expected to be significant.

Conclusion
The Proposal would affect up to about 0.14 ha of waterway and 0.15 ha of riparian vegetation within the riparian channel. This would occur within the context of the consistent habitat within the local waterway and larger Norther Murray Darling Basin habitat extending in both directions for hundreds of kilometres. Whilst the proposal would result in the disturbance of creek bed, remove riparian and waterway habitat and reduce the water quality within the proposal area, this impact is not considered to be significant in the context of the larger creek and riparian habitat and the mobility of the species affected. It is also noted that the proposal would include provision for the rehabilitation of the riparian area and removal of the rock platform on completion of construction.

Biodiversity Conservation Act 2016

Under the *Biodiversity Conservation Act 2016*, the threatened species 'test of significance' is used to determine if a development or activity is likely to significantly affect threatened species or ecological communities, or their habitats. It is sometimes also referred to as the 'five-part test'. A five-part test was carried out for the purposes of this assessment on the following:

- **Grey Falcon (Falco hypoleucos)**
- **Black-Necked Stork (Ephippiorhynchus asiaticus).**

These tests are provided below.

Grey Falcon (Falco hypoleucos)

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
This species was not recorded during the site survey but has been assumed to be present for the purposes of this assessment. Grey Falcons are restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions. They prey on birds, especially parrots and pigeons, using high speed chases and stoops; reptiles and mammals are also taken. Like other falcons, the Grey Falcon utilises old nests of other birds of prey and ravens, usually living in higher eucalypt trees near water or a watercourse. The proposal would remove up to 4.3 ha of vegetation predominantly consisting of native and exotic pasture grasses along the riparian zone and along the roadside, along with the removal of two mature *Eucalyptus camaldulensis* within an area mapped as PCT 78 River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion. As stated in Section 3.3.1, PCT 78 was determined not to be present within the proposal area following field inspection. Removal of this vegetation would also occur within the context of larger areas of PCT 78 both upstream and downstream of the proposal area, which contain multiple *E. camaldulensis*. The removal of the above vegetation would directly reduce the available foraging and roosting/nesting habitat for these species. Whilst this would inevitably result in an adverse impact on any local populations of this species, such an impact is not expected to be such that any local population(s) would be placed at risk of extinction, noting the context of larger areas of PCT 78 both upstream and downstream of the proposal area.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
i. N/A ii. N/A

c) in relation to the habitat of a threatened species or ecological community: **iii. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and** **iv. whether an area of habitat is likely to become fragmented or isolated from other areas as a result of the proposed development or activity, and** **v. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality**
iii. The proposal would affect up to 0.15 ha of habitat for these species. This is less than 0.01 percent of native forest habitat available within the broader region.

c) in relation to the habitat of a threatened species or ecological community: iii. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and iv. whether an area of habitat is likely to become fragmented or isolated from other areas as a result of the proposed development or activity, and v. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
iv. The removal of vegetation along Spring Creek would inevitably result in a break in vegetation along the riparian zone where the new bridge would be constructed, leading to a degree of fragmentation of habitat. v. Most intact and remnant vegetation within the region is likely to have a degree of importance to these species in the context of the extensive historical land clearing that has occurred for agricultural activity. Noting that this species was not recorded during the site visit and noting its extensive distribution, the habitat proposed to be removed is not considered critical to the long-term survival of these species.

d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either direct of indirectly)
The proposal would not affect any Area of Outstanding Biodiversity Value.

e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
As outlined in section 6.0, the proposal may contribute to the following KTPs: • Clearing of native vegetation • Invasion of native plant communities by exotic perennial grasses • Infection of frogs by amphibian chytrid causing the disease chytridiomycosis. Mitigation measures are proposed to control each of these KTPs. Provided these are adequately implemented the effect of these KTPs is not expected to be significant.

Conclusion
The proposal would clear up to 0.15 ha of habitat for these species in the context of partially contiguous habitat along Spring Creek, as well as remnant vegetation to the southeast. Whilst the proposal would locally increase fragmentation and remove some potential foraging and/or roosting habitat, this impact is not considered to be significant in the context of the remaining nearby vegetation and the broad home ranges of these species. It is also noted that the proposal would include provision for the rehabilitation and revegetation of exposed earthworks and batter works during construction.

Black-Necked Stork (*Ephippiorhynchus asiaticus*)

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
This species was not recorded during the site survey but has been assumed to be present for the purposes of this assessment. Black-Necked Storks inhabit floodplain wetlands of the major coastal rivers, along with other minor floodplains, coastal sandplain wetlands and estuaries. They build nests high in tall trees close to water. The proposal would remove up to 4.3 ha of vegetation predominantly consisting of native and exotic pasture grasses, including the removal of two mature *Eucalyptus camaldulensis* within an area mapped as PCT 78 River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion. As stated in Section 3.3.1, PCT 78 was determined not to be present within the proposal area following field inspection. Removal of this vegetation would also occur within the context of larger areas of PCT 78 both upstream and downstream of the proposal area, which contain multiple *E. camaldulensis*. The removal of the above vegetation would directly reduce the available roosting/nesting habitat for these species. Whilst this would inevitably result in an adverse impact on any local populations of this species, such an impact is not expected to be such that any local population(s) would be placed at risk of extinction, noting the context of larger areas of PCT 78 both upstream and downstream of the proposal area.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **vi. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **vii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
vi. N/A vii. N/A

c) in relation to the habitat of a threatened species or ecological community: **viii. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and** **ix. whether an area of habitat is likely to become fragmented or isolated from other areas as a result of the proposed development or activity, and** **x. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality**
viii. The proposal would affect up to 0.15 ha of habitat for these species. This is less than 0.01 percent of native forest habitat available within the broader region. ix. The removal of vegetation along Spring Creek would inevitably result in a break in vegetation along the riparian zone where the new bridge would be constructed, leading to a degree of fragmentation of habitat. x. Most intact and remnant vegetation within the region is likely to have a degree of importance to these species in the context of the extensive historical land clearing that has occurred for agricultural activity. Noting that this species was not recorded during the site visit and noting its extensive distribution, the habitat proposed to be removed is not considered critical to the long-term survival of these species.

d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either direct of indirectly)
The proposal would not affect any Area of Outstanding Biodiversity Value.

e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
As outlined in section 6.0, the proposal may contribute to the following KTPs: • Clearing of native vegetation • Invasion of native plant communities by exotic perennial grasses • Infection of frogs by amphibian chytrid causing the disease chytridiomycosis. Mitigation measures are proposed to control each of these KTPs. Provided these are adequately implemented the effect of these KTPs is not expected to be significant.

Conclusion
The proposal would clear up to 0.15 ha of habitat for these species in the context of partially contiguous habitat along Spring Creek, as well as remnant vegetation to the southeast. Whilst the proposal would locally increase fragmentation and remove some potential foraging and/or roosting habitat, this impact is not considered to be significant in the context of the remaining nearby vegetation and the broad home ranges of these species. It is also noted that the proposal would include provision for the rehabilitation and revegetation of exposed earthworks and batter works during construction.

14th October 2022

Adrienne Pierini
Project/Contract Manager
Project Services West | Network and Assets
Regional and Outer Metropolitan
Transport for NSW

Dear Adrienne,

Preliminary assessment results for HW29 Spring Creek Replacement Bridge, based on Stage 1 of the *Procedure for Aboriginal cultural heritage consultation and investigation.*

The project, as described in the Stage 1 assessment checklist, was assessed as being unlikely to have an impact on Aboriginal cultural heritage.

The assessment is based on the following due diligence considerations:

- The project is unlikely to harm known Aboriginal objects or places.
- The AHIMS search did not indicate moderate to high concentrations of Aboriginal objects or places in the study area.
- The study area does not contain landscape features that indicate the presence of Aboriginal objects, based on the Office of Environment and Heritage's *Due diligence Code of Practice for the Protection of Aboriginal objects in NSW* and the Roads and Maritime Services' procedure.
- The cultural heritage potential of the study area appears to be reduced due to past disturbance.

Your project may proceed in accordance with the environmental impact assessment process, as relevant, and all other relevant approvals.

If the scope of your project changes, you must contact me and your regional environmental staff to reassess any potential impacts on Aboriginal cultural heritage.

If any potential Aboriginal objects (including skeletal remains) are discovered during the course of the project, all works in the vicinity of the find must cease. Follow the steps outlined in the Roads and Maritime Services' *Unexpected Archaeological Finds Procedure*.

For further assistance in this matter do not hesitate to contact me.

Yours sincerely

Mike Nolan –
Aboriginal Community Heritage Partner - West Region
Public Affairs and Marketing
Customer Strategy and Technology

AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : 60692711

Client Service ID : 724212

AECOM Australia Pty Ltd - Newcastle

Date: 19 October 2022

17 Warabrook Boulevard
Newcastle New South Wales 2304

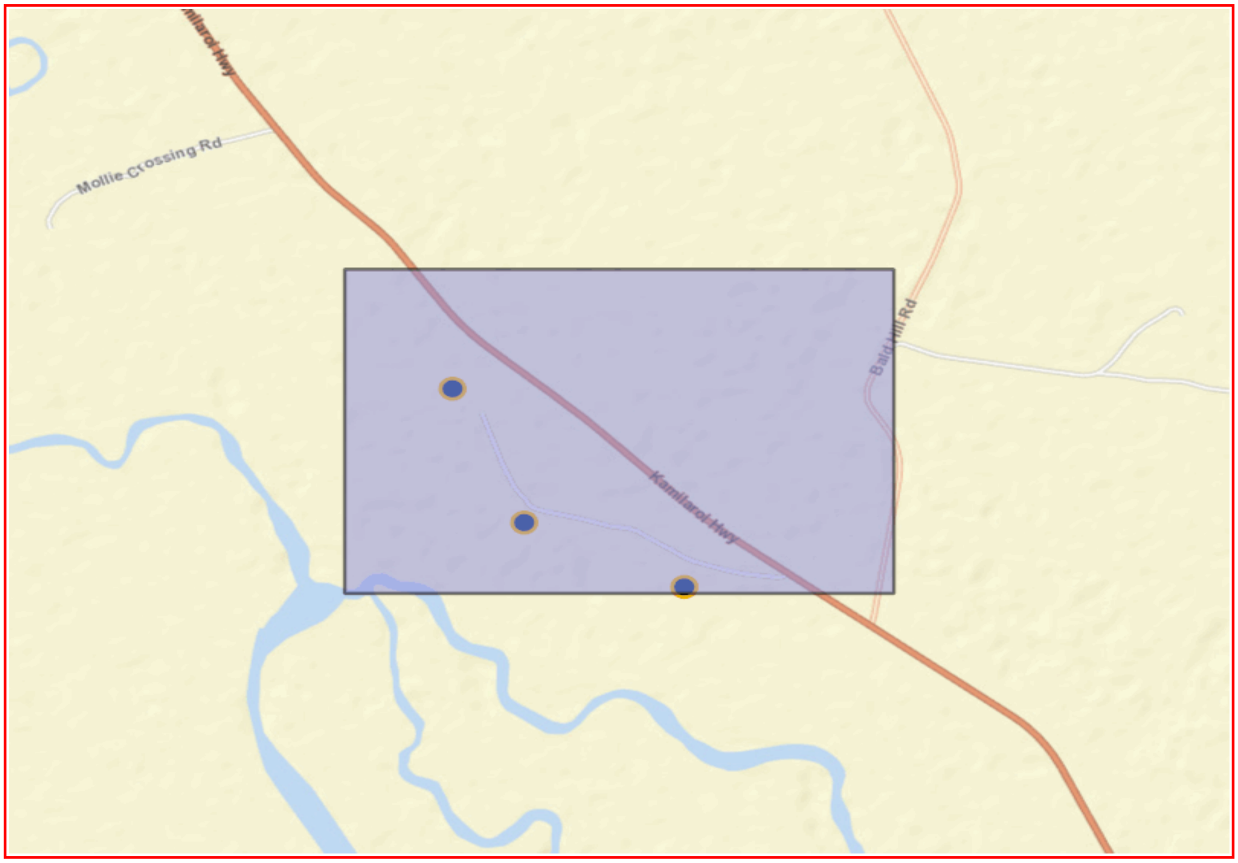
Attention: Heather Mylan

Email: heather.mylan@aecom.com

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -30.2719, 149.7055 - Lat, Long To : -30.2534, 149.7364, conducted by Heather Mylan on 19 October 2022.

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:

3	**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.

26 October 2022

NSW State Emergency Service
PO Box 6126
WOLLONGONG NSW 2500

To Whom it May Concern

Consultation regarding proposed HW29 Spring Creek Bridge Replacement

Transport for NSW is proposing to replace Spring Creek Bridge, which is located on the Kamilaroi Highway (HW29) approximately 9.5 km west of Narrabri.

The objectives of the proposal are to replace the existing eight cell cast in-situ reinforced concrete box culvert structure, which is narrow and in poor condition, with a new wider reinforced concrete bridge capable of carrying higher mass traffic loads and which is compliant with current design standards.

A review of environmental factors (REF) is currently being prepared to assess the likely impacts of the proposal under Division 5.1 of the *Environmental Planning and Assessment Act 1979.* Transport for NSW invites your organisation to comment and advise of any interests or concerns relating to the proposal. Comments received will be considered in the REF.

Under section 2.13 of SEPP (Transport and Infrastructure), Transport for NSW is required to undertake consultation with the State Emergency Service for development with impacts on flood liable land under relevant provisions including Division 17 (Roads and traffic).

It has been determined that this proposal is located within the Lower Namoi Valley Floodplain and therefore may impact flood liable land.

A Flood Contingency Management Plan would be prepared to reduce any risks associated with flooding during construction.

An outline of the proposal (including preliminary hydraulic investigation) is attached to this letter as well as a copy of the concept design drawings for the proposed bridge and road approaches.

It would be appreciated if you could provide any comments on this proposal by **Wednesday 23 November 2022.**

Transport for NSW would be pleased to provide further information if required. In this regard I may be contacted on my mobile (0429 723 668) or by email (adrienne.pierini@transport.nsw.gov.au).

Yours Faithfully,

Adrienne Pierini
Project/Contract Manager
Transport for NSW

26 October 2022

Robert Williams
General Manager
Narrabri Shire Council
PO Box 261
NARRABRI NSW 2390

Dear Robert

Consultation regarding proposed HW29 Spring Creek Bridge Replacement

Transport for NSW is proposing to replace Spring Creek Bridge, which is located on the Kamilaroi Highway (HW29) approximately 9.5 km west of Narrabri.

The objectives of the proposal are to replace the existing eight cell cast in-situ reinforced concrete box culvert structure, which is narrow and in poor condition, with a new wider reinforced concrete bridge capable of carrying higher mass traffic loads and which is compliant with current design standards.

A review of environmental factors (REF) is currently being prepared to assess the likely impacts of the proposal under Division 5.1 of the *Environmental Planning and Assessment Act 1979.* Transport for NSW invites your organisation to comment and advise of any interests or concerns relating to the proposal. Comments received will be considered in the REF.

Under Section 2.12 of SEPP (Transport and Infrastructure), Transport for NSW is required to undertake consultation with Council where proposed activities on flood liable land may impact flood patterns other than to a minor extent. It has been determined that this proposal is located within the Lower Namoi Valley Floodplain and may impact flood patterns to more than a minor extent.

An outline of the proposal (including preliminary hydraulic investigation) is attached to this letter as well as a copy of the concept design drawings for the proposed bridge and road approaches.

It would be appreciated if you could provide any comments on this proposal by **Wednesday 23 November 2022.**

Transport for NSW would be pleased to provide further information if required. In this regard I may be contacted on my mobile (0429 723 668) or by email (adrienne.pierini@transport.nsw.gov.au).

Yours Faithfully,

Adrienne Pierini
Project/Contract Manager
Transport for NSW

26 October 2022

Andrew George
Chief Executive Officer
Water NSW
Level 14 169 Macquarie Street
PO Box 398
PARRAMATTA NSW 2124

Dear Andrew

Invitation to comment – proposed HW29 Spring Creek Bridge Replacement

Transport for NSW is proposing to replace Spring Creek Bridge, which is located on the Kamilaroi Highway (HW29) approximately 9.5 km west of Narrabri. A review of environmental factors (REF) is currently being prepared to assess the likely impacts of the proposal under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Transport for NSW invites your organisation to comment and advise of any interests, concerns or statutory requirements relating to the proposal. Comments received will be considered in the REF.

The objectives of the proposal are to replace the existing eight cell cast in-situ reinforced concrete box culvert structure, which is narrow and in poor condition, with a new wider reinforced concrete bridge capable of carrying higher mass traffic loads and which is compliant with current design standards.

The works would be undertaken adjacent to and within the waterway of Spring Creek. To assist in your response, please find attached details of the proposal and concept design drawings of the proposed bridge and road approaches.

To enable consideration of your comments in the REF, a written response would be appreciated by **Wednesday 23 November 2022**.

Transport for NSW would be pleased to provide further information if required. In this regard I may be contacted on my mobile (0429 723 668) or by email (adrienne.pierini@transport.nsw.gov.au).

Yours Faithfully,

Adrienne Pierini
Project/Contract Manager
Transport for NSW

26 October 2022

Grant Barnes
Chief Regulatory Officer
Natural Resources Access Regulator
Locked Bag 5022
PARRAMATTA NSW 2124

Dear Grant

Invitation to comment – proposed HW29 Spring Creek Bridge Replacement

Transport for NSW is proposing to replace Spring Creek Bridge, which is located on the Kamilaroi Highway (HW29) approximately 9.5 km west of Narrabri. A review of environmental factors (REF) is currently being prepared to assess the likely impacts of the proposal under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Transport for NSW invites your organisation to comment and advise of any interests, concerns or statutory requirements relating to the proposal. Comments received will be considered in the REF.

The objectives of the proposal are to replace the existing eight cell cast in-situ reinforced concrete box culvert structure, which is narrow and in poor condition, with a new wider reinforced concrete bridge capable of carrying higher mass traffic loads and which is compliant with current design standards.

The works would be undertaken adjacent to and within the waterway of Spring Creek. To assist in your response, please find attached details of the proposal and concept design drawings of the proposed bridge and road approaches.

To enable consideration of your comments in the REF, a written response would be appreciated by **Wednesday 23 November 2022**.

Transport for NSW would be pleased to provide further information if required. In this regard I may be contacted on my mobile (0429 723 668) or by email (adrienne.pierini@transport.nsw.gov.au).

Yours Faithfully,

Adrienne Pierini
Project/Contract Manager
Transport for NSW

Transport for NSW

26 October 2022

Chief Executive Officer NSW Water Sector
NSW Department of Planning & Environment - Water
Locked Bag 5022
PARRAMATTA NSW 2124

To Whom it May Concern

Invitation to comment – proposed HW29 Spring Creek Bridge Replacement

Transport for NSW is proposing to replace Spring Creek Bridge, which is located on the Kamilaroi Highway (HW29) approximately 9.5 km west of Narrabri. A review of environmental factors (REF) is currently being prepared to assess the likely impacts of the proposal under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Transport for NSW invites your organisation to comment and advise of any interests, concerns or statutory requirements relating to the proposal. Comments received will be considered in the REF.

The objectives of the proposal are to replace the existing eight cell cast in-situ reinforced concrete box culvert structure, which is narrow and in poor condition, with a new wider reinforced concrete bridge capable of carrying higher mass traffic loads and which is compliant with current design standards.

The works would be undertaken adjacent to and within the waterway of Spring Creek. To assist in your response, please find attached details of the proposal and concept design drawings of the proposed bridge and road approaches.

To enable consideration of your comments in the REF, a written response would be appreciated by **Wednesday 23 November 2022**.

Transport for NSW would be pleased to provide further information if required. In this regard I may be contacted on my mobile (0429 723 668) or by email (adrienne.pierini@transport.nsw.gov.au).

Yours Faithfully,

Adrienne Pierini
Project/Contract Manager
Transport for NSW

26 October 2022

David Ward
Senior Fisheries Manager
DPI Fisheries – Freshwater Environment
Department of Primary Industries
4 Marsden Park Road
CALALA NSW 2340

Dear David

Invitation to comment – proposed HW29 Spring Creek Bridge Replacement

Transport for NSW is proposing to replace Spring Creek Bridge, which is located on the Kamilaroi Highway (HW29) approximately 9.5 km west of Narrabri. A review of environmental factors (REF) is currently being prepared to assess the likely impacts of the proposal under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Transport for NSW invites your organisation to comment and advise of any interests, concerns or statutory requirements relating to the proposal. Comments received will be considered in the REF.

The objectives of the proposal are to replace the existing eight cell cast in-situ reinforced concrete box culvert structure, which is narrow and in poor condition, with a new wider reinforced concrete bridge capable of carrying higher mass traffic loads and which is compliant with current design standards.

The works would be undertaken adjacent to and within the waterway of Spring Creek. To assist in your response, please find attached details of the proposal and concept design drawings of the proposed bridge and road approaches.

To enable consideration of your comments in the REF, a written response would be appreciated by **Wednesday 23 November 2022**.

Transport for NSW would be pleased to provide further information if required. In this regard I may be contacted on my mobile (0429 723 668) or by email (adrienne.pierini@transport.nsw.gov.au).

Yours Faithfully,

Adrienne Pierini
Project/Contract Manager
Transport for NSW

Our Reference: 2019803 EC:SR
Contact Name: Eloise Chaplain

NARRABRI SHIRE
DISCOVER THE POTENTIAL

explore NARRABRI region

Ms Adrienne Pierini

Transport for NSW
28 Hampden Street
Dubbo NSW 2830

Via Email: Adrienne.Pierini@transport.nsw.gov.au

Monday, 31 October 2022

Re: HW29 Spring Creek Bridge Replacement

Dear Ms Pierini,

I am writing to you in response to your email received 26 October 2022 and would like to thank you for reaching out.

Narrabri Shire Council has reviewed the documentation for the proposed Spring Creek Bridge replacement on the Kamilaroi Highway.

Based on the options provided in the hydraulic report, option 1 would be our preferred option as to minimise the impact to surrounding properties. Council would also like noted that the design has incorporated the outputs of hydraulic modelling to ensure there are no adverse effects to current flood behaviour. No adverse afflux should be created in respect of any nearby Council-managed infrastructure assets or residential properties.

An Aboriginal cultural heritage assessment should be undertaken as part of the assessment process and be incorporated into the final Review of Environmental Factors (REF).

Should you require any further information please do not hesitate to contact Council's Customer Service Team on 02 6799 6866.

Yours faithfully,

Eloise Chaplain
Director | Infrastructure Delivery

Narrabri Shire Council
46 - 48 Maitland Street
PO Box 261, Narrabri NSW 2390

P. (02) 6799 6866
F. (02) 6799 6888

E. council@narrabri.nsw.gov.au
www.narrabri.nsw.gov.au

NSW STATE EMERGENCY SERVICE

Our Ref: ID 1769

23 November 2022

Adrienne Pierini
Transport for NSW
28 Hampden Street
Dubbo NSW 2830

email: Adrienne.Pierini@transport.nsw.gov.au
cc: craig.ronan@ses.nsw.gov.au

Dear Adrienne,

Notification under section 2.13 of the State Environmental Planning Policy (Transport and Infrastructure) 2021 in relation to the proposed Highway 29 Spring Creek Bridge Replacement

Thank you for the notification under section 2.13 of the *State Environmental Planning Policy (Transport and Infrastructure) 2021* in relation to the proposed upgrade of Highway 29 Spring Creek Bridge Replacement, Narrabri. It is understood that the proposed works include replacing the existing bridge structure with a new wider reinforced concrete bridge, with potential short-term waterway impacts during construction.

The NSW State Emergency Service (NSW SES) is the agency responsible for dealing with floods, storms and tsunami in NSW. This role includes, planning for, responding to and coordinating the initial recovery from floods. As such, the NSW SES has an interest in the public safety aspects of the development of flood prone land, particularly the potential for changes to land use to either exacerbate existing flood risk or create new flood risk for communities in NSW.

The NSW SES has reviewed the proposed upgrade and the flood risk information (e.g. Local Flood Plan, Narrabri Flood Study: Namoi River, Mulgate Creek and Long Gully 2016, etc.) available to the NSW SES, and note that the proposed works are located within the 20% AEP flood extent. The NSW SES also note that the height of the soffit of the proposed bridge appears to be at the height of the 2000-year design flood level. In addition, this may be impacted as frequently as a 100 year design flood if debris greater than 0.9m in height is present, as noted from the attached Concept Bridge and Road Design.

The proposed works appear to have minimal impact to the NSW SES response operations, however any improvements that can make to reduce any flood risk will benefit the current and future community. Based on this review, the NSW SES provides the following advice:

- consider the impact of flooding on the infrastructure, up to and including the Probable Maximum Flood (PMF) level.

- pursue, if relevant, site design and stormwater management that minimises any risk to the community.
- ensure workers and people using the site during and after the upgrades are aware of the flood risk, for example by using signage.

In addition, if the construction phase of the upgrades causes disruption to the operation of local roads, this may impact the ability for emergency vehicles to use these routes. The NSW SES requests that notification be provided where there are likely to be significant delays in the operation of the roads affected by the upgrades.

Please feel free to contact Claire Flashman via email at rra@ses.nsw.gov.au should you wish to discuss any of the matters raised in this correspondence. The NSW SES would also be interested in receiving future correspondence regarding the outcome of this referral via this email address.

Yours Sincerely

Elspeth O'Shannessy
Planning Coordinator, Emergency Risk Management
NSW State Emergency Service

DPI Fisheries
Department of Regional NSW

Our Ref: C22/682 FE22/1052

27 October 2022

Adrienne Pierini
Transport for NSW
28 Hampden Street
DUBBO NSW 2830

Re: HW29 Spring Creek Bridge Replacement – Request for Comments DPI Fisheries

Thank you for providing notification on the 26th October 2022, seeking comment on the proposed works from DPI Fisheries, a division of NSW Department of Primary Industries (DPI).

DPI Fisheries is responsible for ensuring that fish stocks are conserved and that there is no net loss of key fish habitats upon which they depend. To achieve this, DPI Fisheries ensures that developments comply with the requirements of the *Fisheries Management Act 1994* (namely the aquatic habitat protection and threatened species conservation provisions in Parts 7 and 7A of the Act, respectively), and the associated *Policy and Guidelines for Fish Habitat Conservation and Management (2013)*. In addition, DPI Fisheries is responsible for ensuring the sustainable management of commercial, recreational and Aboriginal cultural fishing, aquaculture, marine parks and aquatic reserves within NSW.

A permit may be required to temporarily or permanently block fish passage under section 219 of the Act. Such works may include the bunding of waterways during bridge or sidetrack construction, use of silt fences across waterways and other similar works. The REF should describe the type, extent and duration of such works at Spring Creek.

Specifically, DPI Fisheries requests that the following issues are addressed in the REF for the proposed works;

1. **Blockages to fish Passage** - DPI Fisheries requests that the REF needs to consider whether any the works may result in the temporary blockage of fish passage within the waterway. If so, details on proposed design and construction methods, likely duration of installation or removal methods should be outlined within the REF. The publication *Policy and Guidelines for Aquatic Habitat Management and Fish Conservation (2013)* on the website outlines important considerations when designing or constructing waterway crossings, and includes a summary table of Classification of Waterways for Fish Passage.

2. **Maintenance or Improvement to the Cross-sectional Area of a Waterway** – The REF should describe the proposed works in relation to the cross-sectional area of the waterway, A description of the need for the proposed works, and the likely construction methods should be provided. DPI Fisheries requests that constriction of waterways with the use of scour protection within the bed of waterways be avoided where possible, as such works are likely to have a detrimental impact on floodwater velocities which can have significant impacts on fish and fish habitat.

3. **Damage to Riparian Vegetation** - DPI Fisheries seeks information on any damage to riparian vegetation that may occur, noting that *Degradation of Riparian Vegetation along Watercourses* is listed as a Key Threatening Process under the FM Act.

4. **Bank Stabilisation and Rehabilitation** – DPI Fisheries seeks information on any destabilisation of the banks with heavy machinery or damage to the bed or banks. DPI Fisheries requests that any bed and bank rehabilitation works be completed immediately after the completion of works. Proposals to ensure replacement of aquatic and riparian vegetation with native/endemic species are encouraged.

5. **Removal, realignment of snags -** DPI Fisheries requests information on any proposal to remove, realign or relocate snags (large woody debris) during bridge construction. Proposed works should be outlined within the REF. Snags should not be removed, realigned or relocated without first contacting DPI Fisheries. NSW. Note: that the *removal of large woody debris* is listed as a Key Threatening Process under the FM Act.

6. **Threatened species, populations, and ecological communities** – The proposal should include a threatened aquatic species assessment (as per part 7A *Fisheries Management Act* 1994) to address whether there are likely to be any significant impacts on listed threatened species, populations or ecological communities listed under the *Fisheries Management Act 1994*. Threatened fish species mapping distributions are available at: https://www.dpi.nsw.gov.au/fishing/threatened-species/what-current/threatened-species-distributions-in-nsw

If you have any queries do not hesitate to call me on 6763 1255 or 0429 908 856.
Yours sincerely

D. Ward.

David Ward
Fisheries Manager (Tamworth)

Contact: *Alison Kniha*
Telephone: *0407 088 372*
Our ref: *D2022/152771*

10 November 2022

Adrienne Pierini
Project / Contract Manager
Transport for NSW
PO Box 39
DUBBO NSW 2830

By email: Adrienne.Pierini@transport.nsw.gov.au

Dear Ms Pierini,

Proposed HW29 Spring Creek Bridge Replacement

I refer to your letter dated 26 October 2022 inviting WaterNSW to provide comments for consideration in the Review of Environmental Factors (REF) for the above proposal.

WaterNSW notes that while the bridge itself is within the road reserve, certain works are proposed for adjoining land under the ownership and management of WaterNSW, including a temporary gravel access track on the downstream side. A side track and associated facilities are also being established on the upstream side under a separate Minor Works REF (TfNSW; July 2022) that impact WaterNSW lands.

For the proposed bridge replacement, WaterNSW provides the following comments for consideration in the REF:

- WaterNSW owns and manages land to be partially occupied, as well as the downstream Mollee Weir on a regulated water source (Lower Namoi).
- TfNSW should note that this area is particularly susceptible to gully erosion and this should be accounted for in the design and construction methodology.
- We note the bridge is designed to a 1:200 year flood and rated for higher mass load vehicles. WaterNSW has no issue with the concept design.
- Adequate mitigation measures must be included in the REF to address impacts to water quality and flooding risk. The works must be carried out in a manner that will prevent or minimise impacts on water quality, environmental damage and fire.
  - Appropriate and adequate dust suppression measures must be undertaken to prevent dust and windblown debris leaving the project site.
  - Effective erosion and sediment controls, designed, installed and maintained in accordance with Landcom's 2004 'Blue Book', must be installed prior to construction and be regularly maintained and retained until works have been completed and the ground surface stabilised or groundcover re-established.
- The proposal has the potential to introduce a biosecurity risk through facilitating the spread of pests, weeds and diseases onto or within different properties, and downstream. Mitigation measures to prevent this spread should be included in the REF.

- Prior to construction, a dilapidation report/ condition assessment, identifying the condition of WaterNSW lands must be completed. This assessment must be replicated on completion of the works, with the lands restored to pre-development condition.
- If any cultural heritage site or artefact (as defined by the *National Parks and Wildlife Act 1974* or *Heritage Act 1977*) is identified during the works on WaterNSW land, work must stop immediately at the location to ensure no further harm to the object. TfNSW must immediately report the find to WaterNSW and the regulator in accordance with legislation. Works are not permitted to recommence in the vicinity of the find until any required approvals have been granted by the regulator. In the event that skeletal remains are encountered, the area must be secured to prevent unauthorised access and TfNSW must immediately contact NSW Police and WaterNSW.
- If any contamination or hazardous materials are encountered on WaterNSW lands, works must stop immediately until a qualified environmental specialist has been contacted and conducted a thorough assessment. If the contamination is confirmed, and if remediation is required, all works must cease in the vicinity of the contamination and WaterNSW notified immediately. Where remediation work is required, the written approval of WaterNSW is required prior to implementation. A clearance certificate must be provided to WaterNSW prior to works recommencing.
- In the event of spill the following procedure is to be followed (as a minimum):
  - Mechanical means are to be used to collect as much of the spilled material as possible and to apply an appropriate absorbent spill product to capture the balance.
  - Appropriate bunding or other physical measures are to be used to prevent spilt liquids and subsequent run off from entering the waterway.
  - Solvents and or water are not to be used to dilute the spill.
  - Materials used to collect or contain the spill are to be removed from the site.
- Any damage to WaterNSW land and/or associated infrastructure caused at any stage must be repaired by TfNSW, or all reasonable costs should be paid associated with repairing the damage, in a timely manner and to the satisfaction of WaterNSW.
- All waste generated from the works must be removed off site and disposed of at a licenced waste facility.
- All incidents that affect or could affect WaterNSW lands shall be reported to WaterNSW on the 24-hour Incident Notification Number 1800 061 069 as a matter of urgency.

WaterNSW would appreciate receiving a copy of the final REF for our records. It is expected that WaterNSW be notified at least 2 weeks prior to construction commencing and at completion of use of WaterNSW land.

If you have any questions regarding this letter, please contact me at alison.kniha@waternsw.com.au.

Yours sincerely

ALISON KNIHA
Catchment Protection Planning Manager

HW29 Spring Creek Bridge Replacement

APPENDIX

C

HYDROLOGY MEMO

Technical Memorandum

To	Long Bai	From	Anthony Densten
CC		Date	5th September 2022
Project	Spring Creek Bridge Assessment	Location/Time	
Subject	Final Hydrology and Hydraulic Assessment Memo (304100824-HY-MEM-0001)		
Action Required	Action required from recipient	Attachments	

Overview

Stantec has been commissioned to assess the options for upgrade of Spring Creek crossing north of Narrabri township. The existing cross drainage structure (Reinforced Box Culverts) has been undermined and continual erosion issues have seen the road surface impacted by settlement and local erosion areas.

Our initial hydraulic review of the area has identified the following:

- A steep gradient across the area (1 in 60) within the main channel.
- An upstream storage and low-lying area that results in ponding behind the roadway.
- An existing 40m opening between abutments.
- A more defined channel downstream and evidence of scour within the main channel from culvert outflows.
- A constrained outlet that opens out to a larger floodplain of the adjacent Narrabri Creek
- An upstream flow constraint nominally 1.7km upstream.
- Flow appears to be skewed at 20 degrees to the main bridge.
- The downstream area is very flat with significant floodplain storage available between the bridge and the Narrabri Creek

A Figure showing the general layout and topography of the area is presented in Figure 1.

Preliminary options assessment for the crossing upgrade was undertaken prior to selection of the preferred design arrangement.

The proposed bridge has dedicated abutments and standard beam and headstock. For the purposes of more detailed investigations the following bridge base dimensions have been adopted.

- No of Spans – 4
- Span width – 16000mm
- Bridge road height – 209.7mRL
- Beam and Road Depth – 1.005m (Obvert of 208.695mRL)
- Pier diameter - 900mm.
- Headstock Width – 1400mm
- Headstock Depth – 1350mm

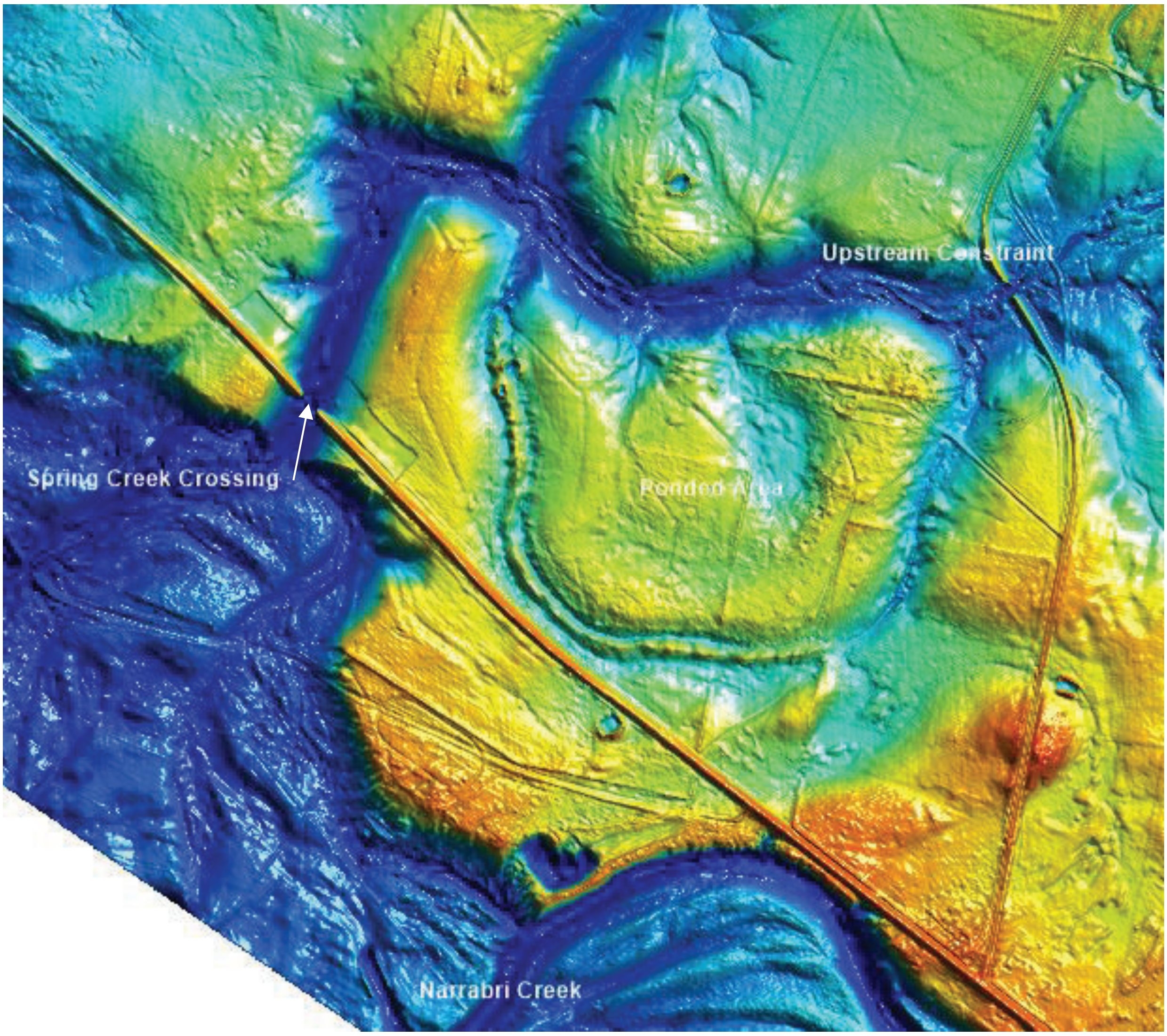


Figure 1-1 Area Layout and Topography

Hydrology

The previous Options assessment provided details of the 1% AEP flows expected at the Spring Creek crossing (nominally 865m3/s).

Our review of the Regional Flood Frequency Assessment for this area has identified a significantly lower flow rate as follows:

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AEP (%)	Discharge (m^3/s)	Lower Confidence Limit (5%) (m^3/s)	Upper Confidence Limit (95%) (m^3/s)
50	36.2	14.4	90.9
20	89.3	37.2	214
10	145	60.0	350
5	217	87.9	538
2	344	134	888
1	469	177	1260

Figure 2 – RFFE Output

Review of the above generally indicates a Peak 1% AEP flow rate for this location of approximately 470m3/s which is 55% of the original flow. A details XPRafts model was developed for this catchment area that made allowance for routing, losses and local area hydrographs and were run in accordance with ARR19 parameters with outcomes as follows:

- 5% AEP Peak Flow Rate at the crossing of $365m^3/s$
- 1% AEP Peak Flowrate at the crossing location of $488m^3/s$
- 0.05% (1 in 2000) peak flow rate of $770m^3/s$

Note that the model was run for the full $202km^2$ area and had a 0mm initial loss and 2.5mm/hr continuous loss and appeared to provide good correspondence with the estimated RFFE.

Critical events for the different durations were as follows:

- 5% AEP 6hr storm duration – TP01
- 1% AEP 3hr storm duration – TP07
- 0.05% AEP 9hr storm duration – TP03.

On the basis of hydrological modelling outcomes, the reduced 1% AEP flow rate was adopted in preference to the previously defined estimates. Current modelling was unable to replicate the initial flows to the magnitude required as part of original options investigations.

In undertaking 2D design assessment the large storage capacity of the system upstream of the bridge has resulted in further significant routing and reduction in flows at the bridge crossing. Design flows through the bridge have been assessed in the next section.

Hydraulics

A 2D flood model has been developed using HecRAS 2D to allow for estimation of peak flow velocity and scour assessment about the bridge area.

The 2D model has been set-up for the existing and design bridge configuration to estimate the expected flow velocity and performance of the options under 1% AEP and 0.05% AEP flow conditions.

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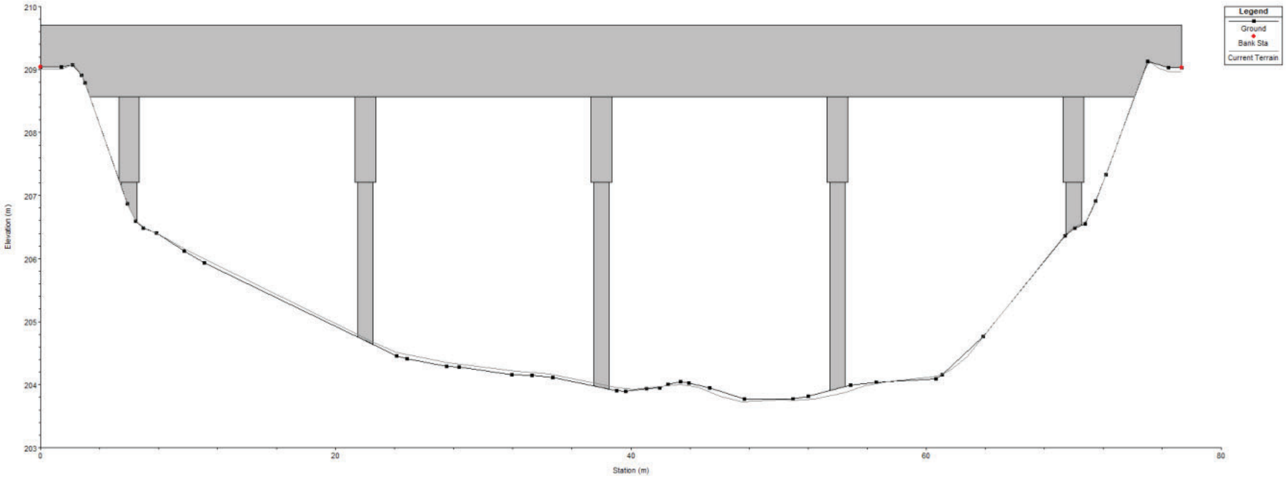
Review of the area has generally indicated a sandy creek bed with limited riparian vegetations and as such the Manning's Roughness adopted was 0.035 for the main flow areas.

A major consideration for flood modelling is the potential for the downstream Narrabri Creek backwater to potentially impact the conveyance of the existing bridges. An initial assessment with a water level set at 207m AHD, in line with the regional Narrabri Creek Flood Study, has showed the bridge to retain flood immunity for the 1% AEP.

For velocity assessment no downstream flood level has been adopted as this results in the highest local flow velocity through the system.

The bridges have been modelled as defined and are presented below in Figure 3.



Preferred Bridge Arrangement – 4 X 16m span

Review of the flow direction and skew has indicated that the flow through the bridge has been estimated to have a 26 degree angle to the pier alignment.

Given the bridge width of 11m, the average spacing between the piers is as follows:

- Approx. 2.8m spacing with a nominal 1.9 m gap (in direction of flow) between each pier and an associated 400mm flow gap.

Review of the outcomes of 2D modelling has indicated a significant reduction and revision of the flow expected through the actual bridge opening and that due to the increased flow area for the proposed bridge and the large storage potential upstream this reduction is significant as follows:

Table 1-1 Hydrology and 2D Flow Comparison at Bridge

Scenario	Hydrology Inflow		Bridge Outflow		Flow Reduction	
AEP Event	1% AEP	0.05% AEP	1% AEP	0.05% AEP	1% AEP	0.05% AEP
Existing	488	770	324	356	34%	47%
Proposed Bridge			410	495	27%	36%

Outcomes have indicated an increased flow rate expected through the proposed bridge due to the enlargement of the waterway flow area.

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Initial modelling assessment with the adopted water level downstream has indicated that water levels for all events are generally below the bridge obvert for the 1% AEP event.

The proposed bridge configurations all provide flood immunity to a level greater than the 0.05% AEP event. As flow events become more extreme, overland runoff tends to overtop the road deck to the west of the bridge (Wee Waa direction), where road levels sit below 208m AHD and culverts along the road allow for convergence as well.

The 2D model for the entire area has been used to define the expected afflux about the area compared to the existing arrangement with modelled outcomes presented in Figure 1-2 for 5% AEP and Figure 1-2 for 1% AEP afflux and Figure 1-3 for the 0.05% AEP.

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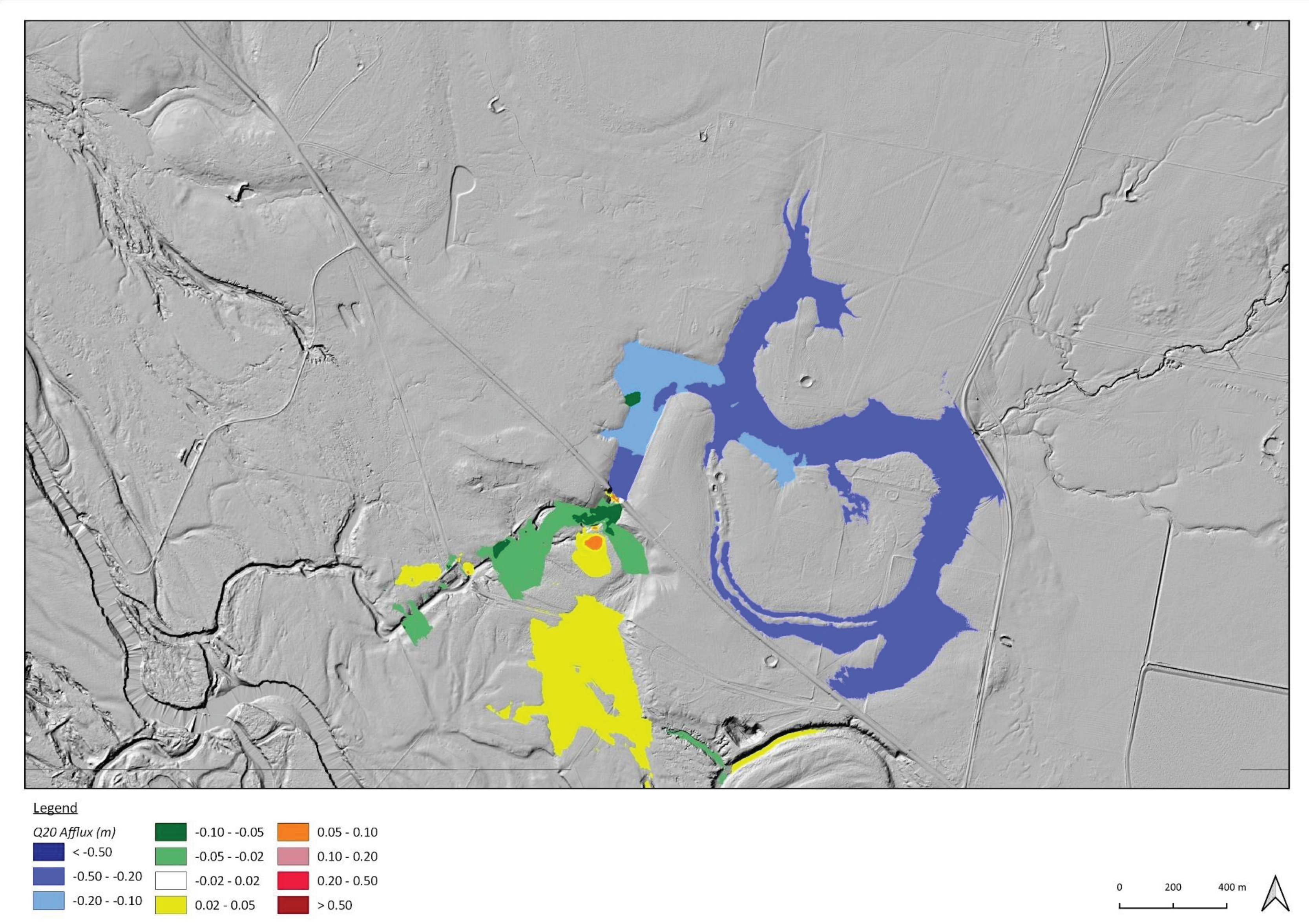
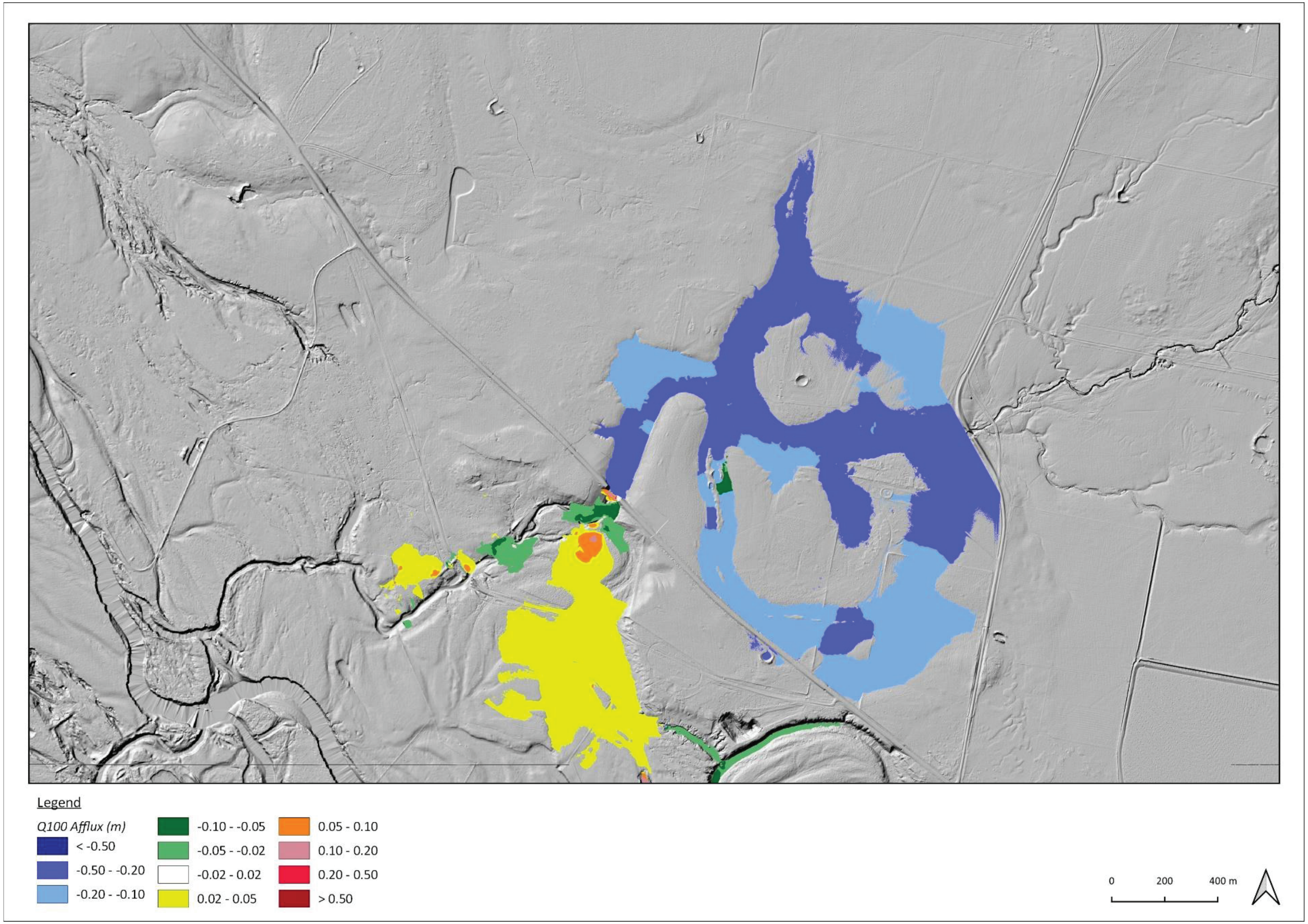


Figure 1-2 20% AEP 2D Afflux Assessment



Legend
Q100 Afflux (m)
< -0.50
-0.50 - -0.20
-0.20 - -0.10
-0.10 - -0.05
-0.05 - -0.02
-0.02 - 0.02
0.02 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.50
> 0.50
0
200
400 m

Figure 1-3 1% AEP 2D Afflux Assessment

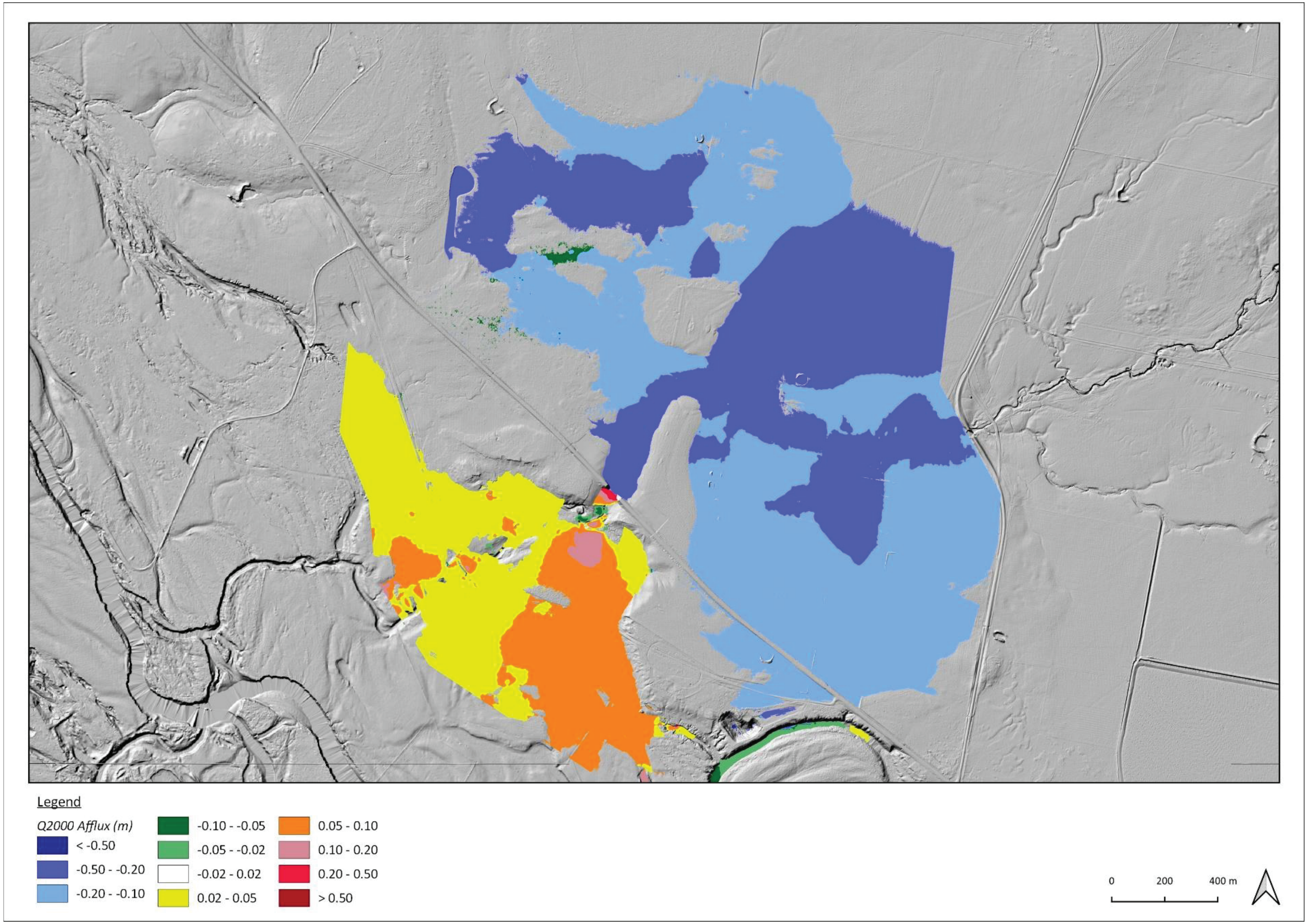


Figure 1-4 0.05% AEP 2D Afflux Assessment

Review of the outcomes generally indicates the following:

- For the preferred bridge arrangement there is a 700mm reduction in upstream water level for the 1% AEP event associated with the increased flow area under the bridge.
- There appears to be limited downstream (20 to 50mm) afflux due to the ponded nature of flows in this location and the sudden widening of the waterway downstream.
- The model was run without tailwater levels associated with Narrabri creek and in general the modelled downstream afflux would be drowned out by the expected 1% AEP creek levels that are nominally 207mAHD.

A re-alignment of piers to account for flow skew or further reshaping of the waterway beneath the bridge would see the majority of afflux reduced further and potentially removed.

A nominal cross section comparison across the bridge between the existing culvert arrangement and the smoothed design surface beneath the bridge is presented in Figure 1-5.

The reprofiling generally involves the following:

- Inclusion of a 1.5:1 abutment slope down to a 1m wide bench required for maintenance.
- A nominal 1V:3H to 1V:4H slope downstream of the bench on the western abutment area.
- A nominal 1V:6H to 1V:9H slope downstream of the bench on the eastern abutment area
- The reshaping and excavation of the area to reprofile the channel below the bench to match existing.
- The excavation requirement is nominally 1,500m^3 of material removed.

Note that there has been no reduction in flow area for the proposed waterway reshaping and flow area is expected to increase.

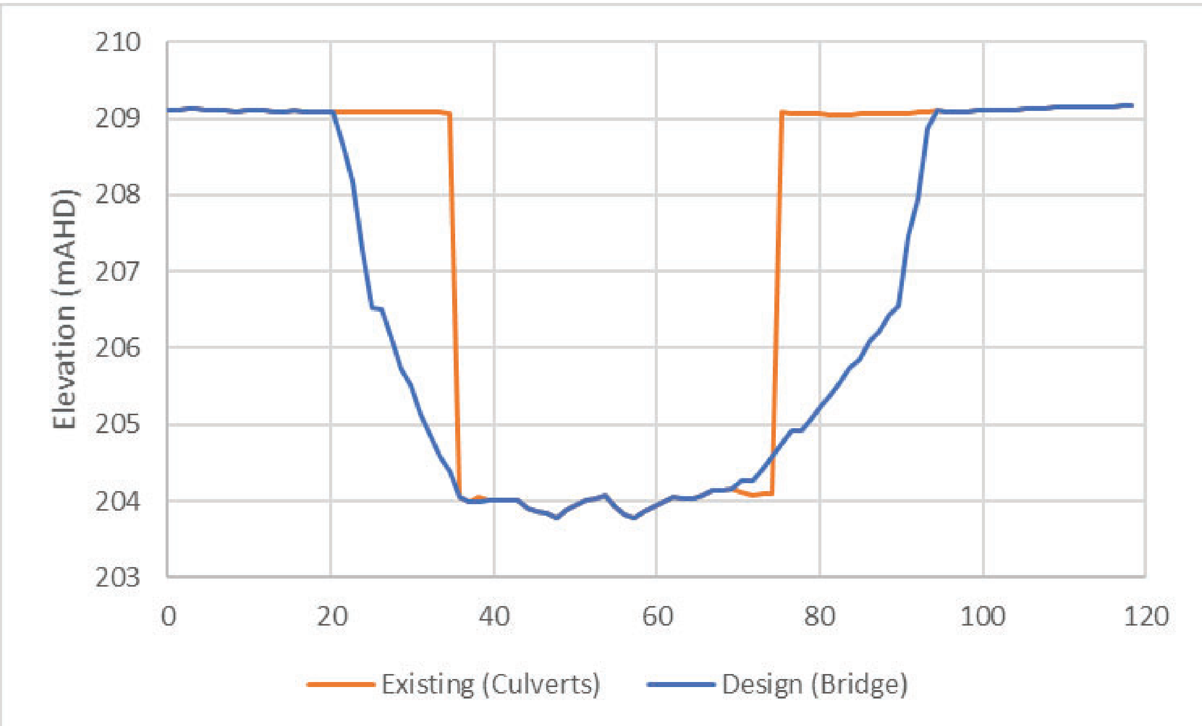


Figure 1-5 Bridge Location existing and Design Cross Section

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The nominal extent of excavation required for the abutments for the preferred bridge option is presented in Figure 1-6.

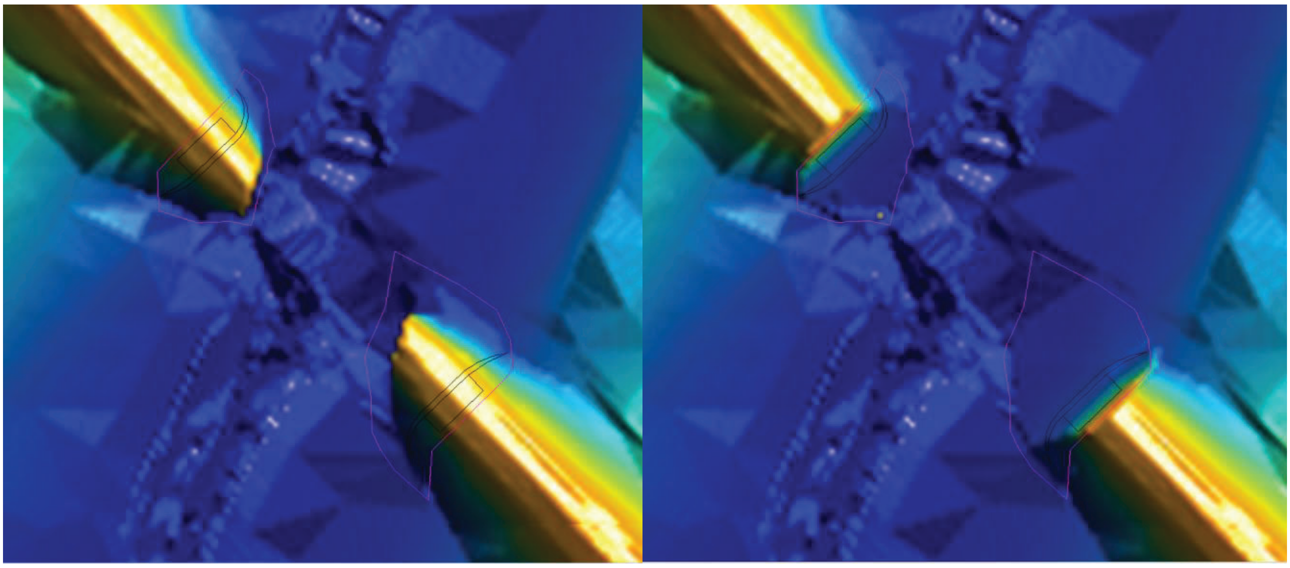

Figure 1-6 Extent of Excavation for proposed bridge

Note that the bridge location has been defined based on TfNSW alignment and chainages and review of channel reshaping has indicated potential shift (10m north west) to better match required excavation slopes (i.e. both sides at 1V:6H).

Summary outcomes of 2D modelling about the Bridge location are presented below

Table 1-2 2D Hydraulic Performance at Bridge

AEP Event	5% AEP	1% AEP	0.05% AEP
Flood Level (mRL)	207.2	207.4	207.81
Max Flow Velocity (m/s)	3.2	3.3	4.0

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Scour Protection

An initial 1D scour assessment has been undertaken based on the provided material classification from the existing boreholes. Borehole data has classified the classification of the soil which has been converted to a representative particle size using the following:

PARTICLE SIZE DEFINITIONS

Fraction	Components	Subdivision	Size* mm
Oversize	BOULDERS		>200
	COBBLES		63–200
Coarse grained soil	GRAVEL	Coarse	19–63
		Medium	6.7–19
		Fine	2.36–6.7
	SAND	Coarse	0.6–2.36
		Medium	0.21–0.6
		Fine	0.075–0.21
Fine grained soil	SILT		0.002–0.075
	CLAY		<0.002

* These sizes correspond approximately to standard sieve sizes.

A summary of the borehole data is provided below in Table 2 and includes a preliminary assessment of the expected D_{50} at each location. Note that we have assumed that all clay is generally non-cohesive and potentially highly erodible.

Table 2 – Existing borehole data

Borehole	Location	Comment	Adopted D_{50}
BH01	Narrabri Abutment	• Generally sandy silty clay or sand and gravels to 7m	0.20
BH02	Wee Waa Abutment	• Sand and Sandy Clay to 1.8m • Clay Medium Plasticity to 7m • Sand to 14m	0.25
BH03	Base of Creek	• Clay and Silty Clay to 4m • Sand to 14m	0.05

Review of the scour assessment outcomes generally indicates the scour performance outlined in Table 3.

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Table 1-3 1D Scour Assessment Outcomes (1% AEP)

Scour Type	1% AEP Scour Depth (m)	0.05% AEP Scour Depth
Contraction and Pier	3.25	5.0
Abutment	Left 0.00 Right 0.75	Left 0.00 Right 0.75

Scour depths have greatly reduced on the abutments compared to previous review on the basis that flow velocity about the abutments have been reduced and the skewness of the bridge generally indicates potential scour on the right embankment only.

A detailed 2D hydraulic sediment transport model was also developed to confirm the appropriateness of these values using a rating of the material classification from BH03 in the creek bed. Assessment was undertaken at a finer resolution about the piers and allowed for a finer grid in critical scour areas.

Outcomes are presented in Figure 1-4 for the Option 1 assessment.

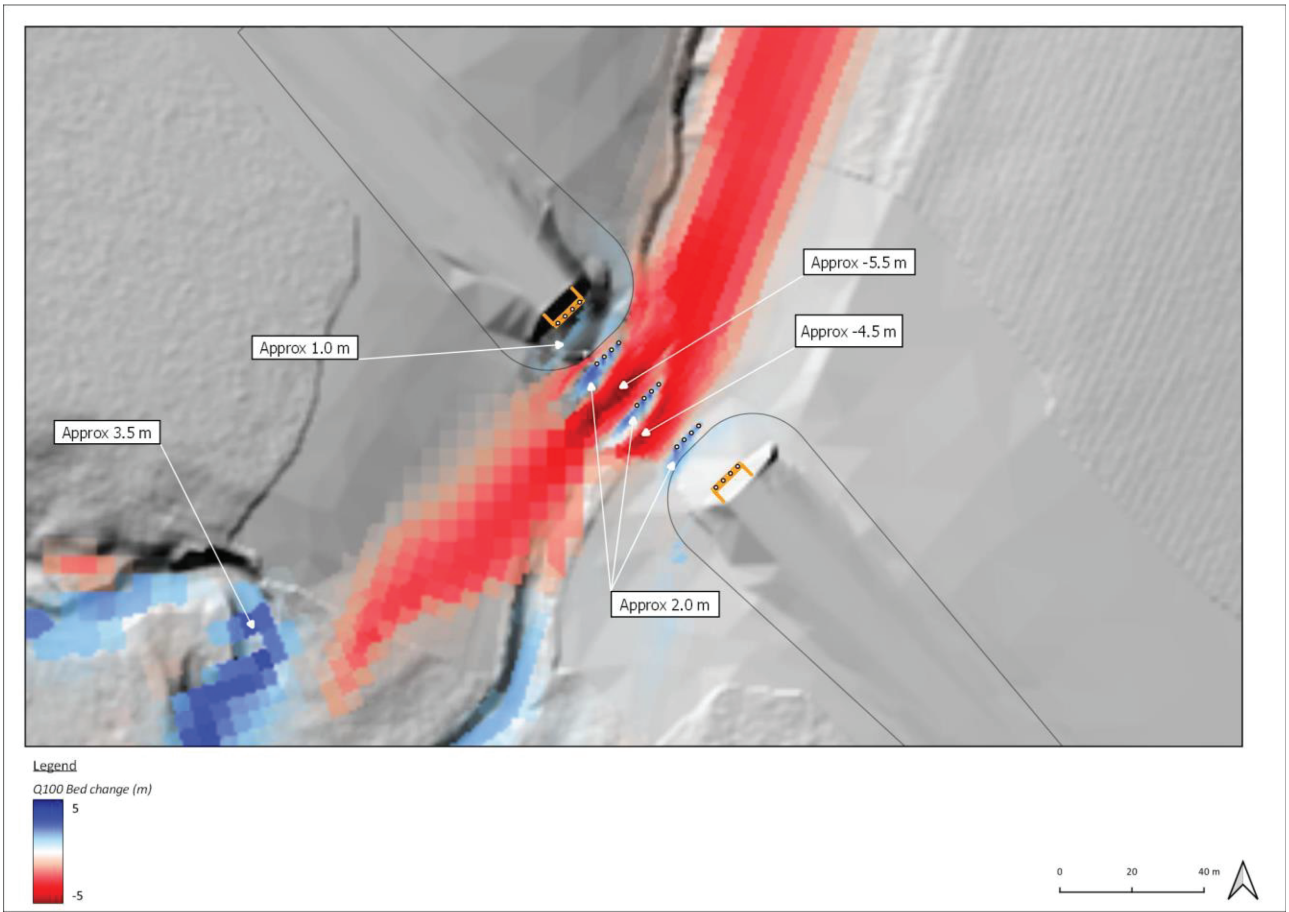

Figure 1-7 2D Scour Assessment Outcomes

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Review of the above indicates an abutment scour depth ranging from 1 - 2 m and scour about the piers ranging from 4 – 5m and some accumulation of material to a nominal 2m depth. These outcomes remain consistent with the outcome of the 1D assessment and generally indicate the need for bank scour protection and pier design that considers potential scour depth.

The 2D modelling outcomes have also indicated a potential increase in bed levels associated with settlement of material within localised eddies about the piers. This is in general in keeping with our expectations about bridge pier scour where material actually accumulates in slower moving water about the piers and scours out the areas between the piers. The accumulated area is in general located in the downstream flow shadow which is impacted by the skew of the bridge pier to the flow direction.

The 2D assessment also allowed for better definition of the flow velocity expected across the waterway with the velocity profile presented in Figure 1-8 for upstream, through channel and immediately downstream.

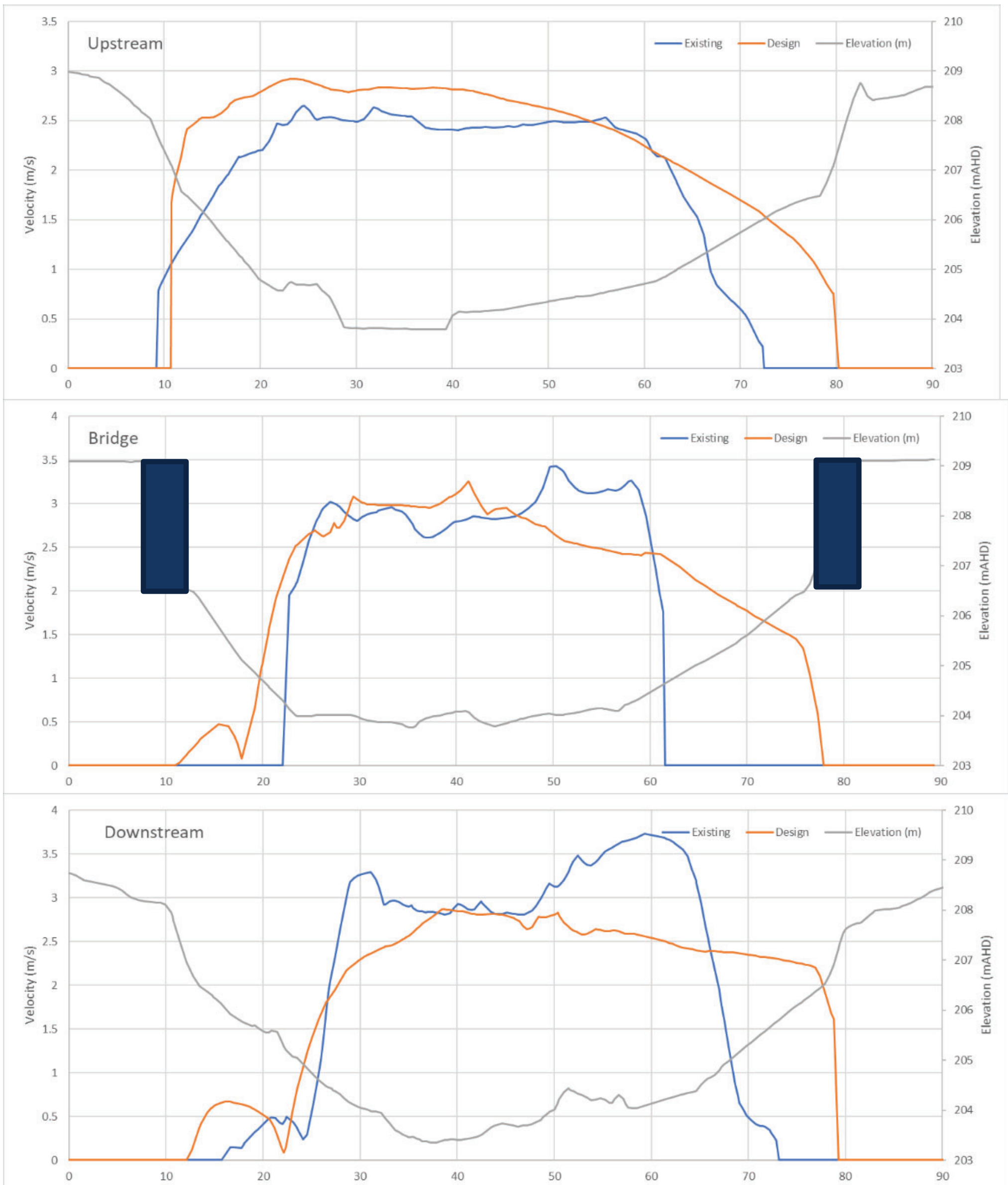

Figure 1-8 1% AEP Flow Velocity Profile across waterway

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Review of the above generally indicates the following:

- A shifting focus on velocity on abutments with an increasing profile across the right abutment and decreasing profile across the left abutment primarily due to the skew of the bridge and piers.
- A maximum flow velocity through the bridge area of around 3m/s

A summary of the main abutment velocity expected is presented in Table 1-4.

Table 1-4 1% AEP Velocity on Abutment and Excavated Slope

Location	Velocity (m/s)			
	Abutments		Excavated Slope	
	Left	Right	Left	Right
Upstream	2	0.75	2.8	2.2
Bridge	0.5	1.4	1.8	1.8
Downstream	0.65	2.2	1.5	2.4

Review of the flow depth and requirement for rock protection for the 1% AEP event generally indicates that the 1.5:1 abutment above the bench are generally outside of the 1% AEP flow area and that facing rock D_{50} = 250mm is appropriate for this area above level 207.2mAHD.

Downstream of the bench the cut batters that extend to natural surface are at a different side slope for the left and right banks (1V:4H and 1V:9H) and the requirements for rock protection vary as follows:

Table 1-5 Rock Protection Sizing

Location	D (mm)	
	Left	Right
Upstream	450	350
Downstream	350	350

Rock protection at these sizes to be provided below 1% AEP flood level (207.5mAHD) within the nominated extents of excavation (1,100m^2) and as required across the base of the channel about the piers.

The larger rock requirement on the left (western abutment) is mainly due to the skew and higher velocity of flow expected at this location (>2.5m/s).

To	Action		Date

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Construction Noise Assessment – Spring Creek Bridge

1. Proposal details

1.1 Introduction

Transport for NSW (Transport) are proposing to replace the existing bridge sized culvert over Spring Creek (bridge number B3858) on the Kamilaroi Highway, 9.5 km west of Narrabri, NSW.

The existing culvert structure is an eight cell reinforced concrete box culvert which was built in 1968. Each cell spans 4.6 m and has a height of 4.6 m. The culvert is 8.4 m wide and 39 m long. The culvert is founded on a reinforced concrete base slab with no pier supports. The ground conditions throughout the waterway are clay soil and alluvium with little to no rock.

Following heavy rainfall in June 2021, water penetrated below the base slab, causing a void which led to settlement of one of the four cell culvert modules relative to the other. Whilst repair works were completed in July-August 2021, recent inspections by Transport identified further settlement and structural cracking. Additional propping has now been installed to stabilise the structure and allow time to develop and construct a replacement bridge.

1.2 Duration of works

Works are anticipated to take up to 18 months. Works will be completed during the day.

1.3 Proposed activities and/or equipment. Identify the noisiest activity/plant

Proposed construction methodology:

- Site establishment
- Kamilaroi Highway (HW29) traffic to be diverted onto an upstream side-track.
- Removal of asbestos culvert scuppers and any other contaminated material prior to demolition
- Installation of gravel access tracks, rock platforms and temporary steel pipes within the waterway upstream and downstream of the culvert
- Vegetation clearance and tree removal
- Bridge demolition (combination of saw cutting techniques and/or a hydraulic breaker mounted on a 32 t excavator). Concrete to broken up on site using a pulveriser/jaw attachment on a 32 t excavator. Equipment to be used includes: excavator 12-32 t, hydraulic breaker (excavator mounted), concrete road saw, concrete wall saw, air powered hand jack hammer 35-40 kg, demolition saw handheld, cranes 50-250 t, oxy cutting equipment, tippers, heavy haulage trucks
- Excavation of culvert abutment and adjustment of rock working platforms within the bridge footprint and waterway to allow piling and crane access for bridge construction. Equipment to be used includes: excavator 12-32 t, material transport, heavy haulage equipment, heavy rigid trucks
- Construction of waterway and abutment piles using driven steel tubular casing (1,050 mm diameter with 9 t hammer) with reinforced concrete infills. Temporary working platforms may also need constructing at the two abutment locations. Equipment to be used includes: excavator 12-32 t, heavy haulage equipment, pile driving rig 50-80 t, crane 50-100 t, hydraulic vibrating hammer 4-5 t (crane mounted), hydraulic impact hammer 5-9 t crane or rig mounted, portable welding equipment, electric power tools (grinders etc.), concrete pump, concrete agitators (trucks), concrete vibrators x 2, water pump flex drive x 2

- Construction of in-situ reinforced concrete piers, headstocks and abutments and backfilling behind abutments using granular fill or stabilised sand. Equipment to be used includes: crane 25-50 t, excavator 12-20 t, portable welding equipment, electric power tools (grinder, metal and timber cut off saw, electric hand saw, hammer drill etc.), concrete vibrator x 2, water pump standard 2”, concrete pump, concrete agitators (trucks), air powered jack hammer, air compressor to clean out formwork, air powered scabbler
- Excavation and installation of scour protection rock in front of bridge abutments. Installation of spaced planks for spans 1 to 4. Working platforms may need to be installed for craneage at the top of the creek bank and/or behind the bridge abutments on the existing Kamilaroi Highway (HW29) alignment. Equipment to be used includes: transport equipment, cranes 50-200 t, and portable welding equipment. Construction of crane working platforms will involve 32 t excavator with heavy rigid tip trucks
- Construction of deck slabs and parapets and construction of approach slabs behind bridge abutments - Equipment to be used includes: cranes 25-50 t, portable welding equipment, electric power tools (Grinder, metal and timber cut off saw, electric hand saw, hammer drill etc.), concrete vibrator x 3, motorised vibration screed, water pump standard 2”, concrete pump, concrete agitators (trucks), air compressor to clean out formwork, air powered scabbler
- Demobilisation
- Bulk earthworks & final roadworks construction. Equipment to be used includes: Heavy rigid or Semi-trailer tippers, 20-30 t Excavator, Rigid trucks, 12’ Grader, Heavy rigid watercart x 2, 16-21 t rubber tyre roller/padfoot roller/smooth drum roller, 300-500 HP soil stabiliser, stabilising agent spreader truck, franna crane, concrete trucks, concrete vibrators and front end loader, Sealing works will involve bitumen truck, aggregate trucks, tractor with broom attachment and rubber tyre rollers x 2.
- Open new bridge and road approaches to traffic
- Removal of side track and reinstatement of site.

Overall construction scenario sound power levels have been taken from the Construction Noise and Vibration Guideline (Transport, 2016). Based on the above works, it was determined the most representative scenario in the ‘RMS Construction Noise Estimator tool’ would be **‘Bulk earthworks’**. Compound and stockpiling operations were not assessed separately as the compound/stockpile areas are within the overall Spring Creek Bridge construction footprint.

1.4 Proposed schedule, including out of hours works

The recommended standard hours for construction works prescribed by the *Interim Construction Noise Guideline* (ICNG) (Transport, 2016) are as follows:

- Monday to Friday, 7 am to 6 pm
- Saturday, 8 am to 5 pm
- Sunday and Public Holidays, no work.

The proposal would involve work generally being carried out during the daytime on weekdays and until 5pm on Saturdays.

2. Noise estimator input data

2.1 Identify the noise sensitive receivers and the distance to the nearest receivers

Sensitive receivers in this area are predominantly isolated residential properties. The following sensitive receivers have been identified in in the vicinity of the proposal (distance to the closest receiver in brackets):

1. 20281 Kamilaroi Highway, Narrabri (580 m)
2. 87 Bald Hill Road, Narrabri (890 m)

3. ‘Dunraven’ 20576 Kamilaroi Highway, Narrabri (1140 m).

2.2 Identify the noise area category (ie R0 – R4). Give reasoning

The RMS construction noise estimator tool was used to assess the impacts during construction. The Noise area category has been selected as **R0** due to proximity to the Kamilaroi Highway and the isolated nature of residences.

2.3 Indicate type of noise assessment selected. Give reasoning

The ‘distance based (scenario)’ assessment was selected as it considers a number of plant operating together during a certain construction activity. In this case, ‘Bulk earthworks’ was selected as the noisiest activity.

2.4 Identify the background noise levels (RBL or L_{A90}) and the noise management levels (NML or $L_{Aeq(15minute)}$)

The table below provides the background noise levels (also referred to as Rating Background Level (RBL)) and noise management levels.

Noise Area Category		**R0**
RBL or L_{A90}[1] Background level (dB(A))	Day	35[3]
	Evening	30
	Night	30
$L_{Aeq(15minute)}$ Noise Management Level[2] (dB(A))	Day	45
	Day (OOHW)	40
	Evening	35
	Night	35

Notes: [1] L_{A90} = Background noise level

[2] Noise Management Level for works during standard hours = Background level plus 10dB(A)

Noise Management Level (NML) for out of hours works = Background level plus 5dB(A)

[3] Daytime RBL adjusted to be minimum 35 dB(A) in line with current EPA recommendations

2.5 Determine if receivers are in line of sight or behind the barrier (noise wall or row of buildings)

As noted earlier, the nosiest activity was defined to be bulk earthworks. Due to a lack of a solid barrier, residences are considered to have line of sight to the construction works. The outcome of the assessment is recorded in section 3 below.

For the first row of buildings:

Scenario	Bulk earthworks
Is there line of sight to receiver?	Yes

3. Noise and vibration assessment

3.1 Predicted noise levels

The noise estimator tool produced predicted noise levels at different locations for various receivers. To assist with the assessment, common residential receivers were grouped into noise catchment areas (NCAs) for construction noise assessment. For NCA1, affected distances, i.e. the distance where noise levels are expected to exceed the noise management level (as per the EPA *Interim Construction Noise Guideline*), are recorded in the table below together with the predicted noise levels. The results of the construction noise assessment are summarised below.

Catchment distances	**Day (OOHW)**		
	NML, dB(A)	**Predicted noise levels, dB(A)**	**Recommended additional mitigation measures**
Bulk earthworks			
NCA1 (490 m) – in line of sight	40	50	N
NCA2 (700 m) - in line of sight	40	45	-

The outcome of the assessment is also shown in the figure below to visualise the impacts. There are two receivers within 1010 m of the proposal area.

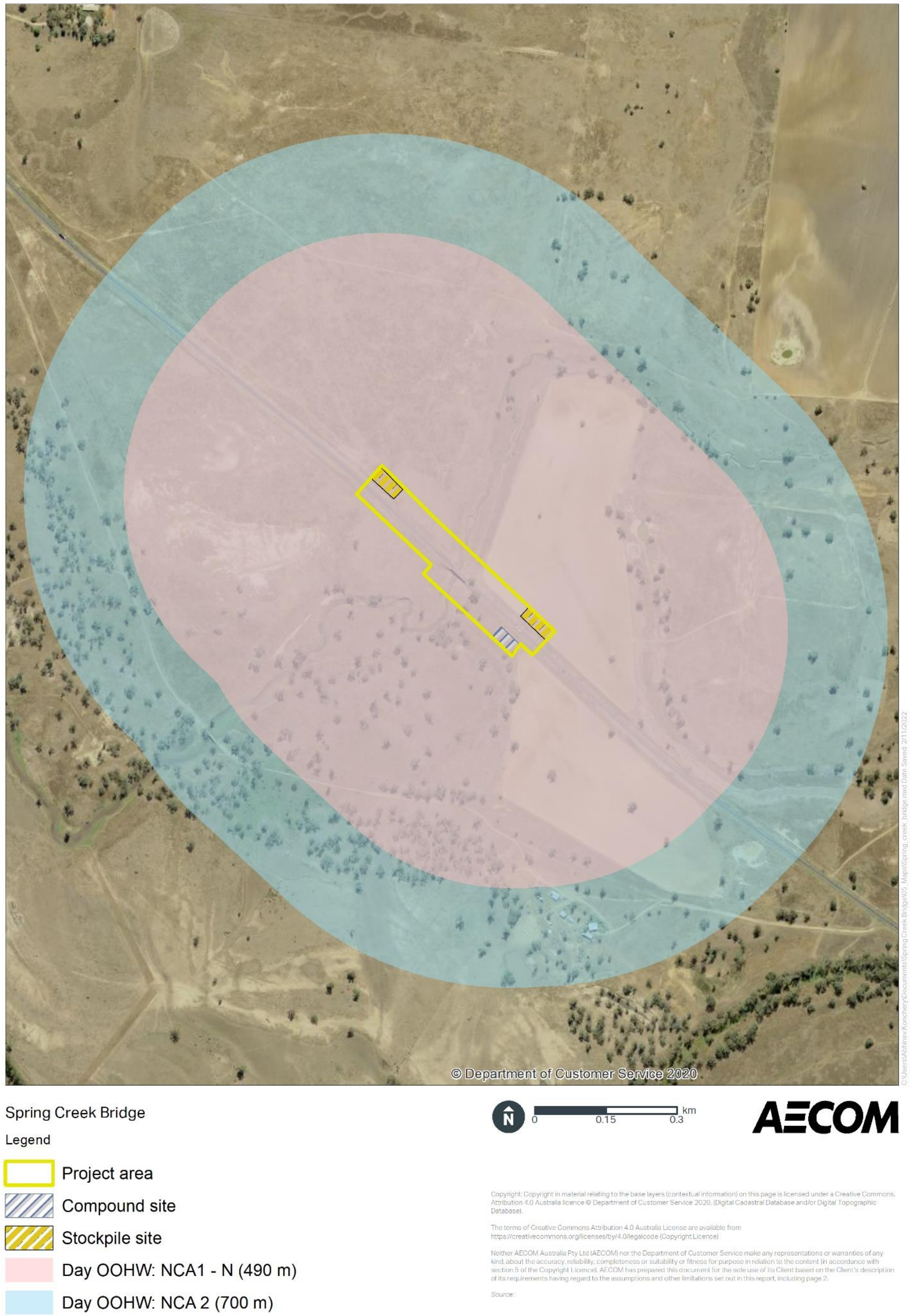

Figure 1 Recommended additional mitigation measure for works during the day

3.2 Vibration assessment

Impact piling has a minimum working distance of 50 m to prevent cosmetic damage, according to 'BS 7385: Evaluation and measurement for vibration in buildings'. There are no buildings or receivers within 50 m, therefore no further considerations have been given.

4. Review of additional mitigation measures

4.1 Review of additional mitigation measures to determine which are feasible and reasonable to apply

Letterbox drop (N=notification) has been recommended for receivers within 490 m radius. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of 5 working days prior to the start of works.

4.2 Additional mitigation measures that are feasible and reasonable to apply

Based on the review of additional mitigation measures in section 4.1, notification of affected receivers is considered feasible and reasonable to implement, in addition to standard mitigation measures.

Prepared for
Transport for NSW
ABN: 76 236 371 088

AECOM

Hazardous Material Survey Report

HW29 Spring Creek Bridge B3858

11-Nov-2022

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Delivering a better world

Hazardous Material Survey Report

HW29 Spring Creek Bridge B3858

Client: Transport for NSW

ABN: 76 236 371 088

Prepared by

AECOM Australia Pty Ltd
Awabakal and Worimi Country, 17 Warabrook Boulevard, Warabrook NSW 2304, PO Box 73, Hunter Region MC NSW 2310, Australia
T +61 2 4911 4900 F +61 2 4911 4999 www.aecom.com
ABN 20 093 846 925

11-Nov-2022

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AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 and ISO45001.

Quality Information

Document	Hazardous Material Survey Report
Ref	60692711
Date	11 November 2022
Prepared by	Aman Kaur
Reviewed by	Haley Bates

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	06-Oct-22	DRAFT - Hazardous Material Survey Report – Bridge B3858	Neil Standen	
0	13-Oct-22	FINAL DRAFT - Hazardous Material Survey Report – Bridge B3858	Neil Standen	
1	11-Nov-22	FINAL - Hazardous Material Survey Report – Bridge B3858	Neil Standen	NRSL

Glossary

Asbestos	The asbestiform varieties of mineral silicates belonging to the serpentine or amphibole groups of rock forming minerals that consist of a mixture that contains one or more of the following minerals: actinolite, amosite, anthophyllite, chrysotile, crocidolite, tremolite.
Asbestos (Friable)	Asbestos or asbestos containing material that is in a powder form or that can be crumbled, pulverised or reduced to powder by hand pressure when dry.
Asbestos (Non-friable)	Asbestos or asbestos containing material that is not friable, including material containing asbestos fibres reinforced with a bonding compound.
Asbestos containing material (ACM)	Any material or thing that, as part of its design, contains asbestos. This may include materials identified, assumed, or suspected to contain asbestos.
Asbestos dust or debris (ACD)	Dust or debris that has settled and is, or assumed to be, contaminated with asbestos.
Asbestos related work	Work involving asbestos that is permitted under the exception set out in Work Health and Safety (WHS) Regulation 419.
Class A licence	A licence that authorises the licence holder to conduct Class A (friable) asbestos removal work and Class B (non-friable) asbestos removal work.
Class B licence	A licence that authorises the licence holder to conduct Class B (non-friable) asbestos removal work only.
Competent person	A person who has acquired through training, qualification or experience the knowledge and skills of relevant asbestos removal industry practice to carry out the task.
Hazardous Materials (Hazmat)	In the context of this report hazardous materials refers to any positively identified, assumed, or suspected materials as defined in **Section 2.0**.
Hazardous Materials Register	A register that identifies assessed hazmat at the site.
Lead in paint	A paint film or component of a paint system containing a lead concentration in excess of 0.1% weight/weight (w/w).
Lead in dust	Dust containing lead in a concentration that exceeds the area specific acceptable limit for surface dust lead loadings.
Licensed asbestos assessor	A person who holds an asbestos assessor licence. This licence is required for air monitoring, conducting clearance inspections, and issuing of clearance certificates for Class A (friable) asbestos removal work.
Licensed asbestos removal work	Asbestos removal work for which a Class A or Class B asbestos removal licence is required.
NATA	National Association of Testing Authorities, Australia.
Polychlorinated Biphenyls (PCBs)	Polychlorinated biphenyl or PCB means a substance in which the biphenyl structure has chlorine atoms substituted for hydrogen atoms to varying degrees. PCBs has the chemical formula $C_{12}H_{10-n}Cl_n$ where 'n' is 1-10. Most commonly found in capacitors associated with fluorescent light fixtures.
Synthetic Mineral Fibres (SMF)	A heterogeneous group of fibrous inorganic materials manufactured into a fibrous product (e.g., glasswool, rockwool and refractory ceramic fibre).

Table of Contents

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was engaged by Transport for NSW (TfNSW) for the provision of hazardous materials consultancy services associated with demolition and bridge replacement works at Spring Creek Culvert (B3858), located on the Kamilaroi Highway 9km northwest of Narrabri, NSW 2390. AECOM carried out a hazardous materials survey (hereafter referred to as 'the survey') at the Site on 19 September 2022 to assist TfNSW in meeting its statutory obligations under the *NSW Work Health and Safety Act 2011 (WHS Act)* and *NSW Work Health and Safety Regulation 2017 (WHS Regulation).*

This report presents the findings of the survey and includes the following appendices:

- **Appendix A** Legislative Framework;
- **Appendix B** Hazardous Materials Register;
- **Appendix C** Photographic Record;
- **Appendix D** NATA Laboratory Report; and
- **Appendix E** Limitations.

2.0 Objective

The objective of the survey was to as far as practicable, identify and evaluate the presence, condition, and extent of hazardous materials at the Site, and to provide demolition specific recommendations in a user-friendly format for TfNSW.

For the purpose of this report, hazardous materials include the following:

- Asbestos containing materials (ACM);
- Lead in paint;
- Synthetic mineral fibre (SMF); and
- Polychlorinated biphenyls (PCB).

3.0 Scope of Work

The scope of work included the following:

- A review of the existing plans and Site documentation, where provided;
- A survey of the accessible areas at the Site to identify and locate hazardous materials;
  - The survey was conducted by a combination of 'destructive' and 'semi-intrusive' techniques where practicable;
- Suspected ACM and lead in paint were sampled. Samples were forwarded to a National Association of Testing Authorities (NATA) accredited laboratory for analysis and issue of NATA endorsed report;
- When sampling was not possible (i.e., lack of accessibility or risk of causing contamination), a reasonable assumption was made as to the presence or absence of a hazardous materials (ACM or lead in paint). This reasonable assumption was based on the surveyors' experience, considering factors such as age, physical appearance, and fixing method. Where possible, non-sampled materials were cross referenced to similarly sampled items and are denoted as "Similar to" in the register:
  - SMF materials were visually identified or as a result of asbestos identification analysis; and
  - Representative fluorescent light fittings were visually inspected and assessed against the *Guidelines for the identification of PCBs and Materials Containing PCBs, United Nations Environmental Programme, 1999*.

- Suspected hazardous materials were photographed where possible;
- Preparation of a hazardous materials register outlining the location, type, extent, condition, and recommendation of the identified hazardous materials; and
- Preparation of a report, including the hazardous materials register, removal recommendations (when hazardous materials are detected or assumed), photographic records and NATA laboratory report.

4.0 Site Description

Site details are outlined in **Table 1**.

Table 1: Property Details

Item	Details
Site Name	Spring Creek Culvert (B3858)
Site Address	Spring Creek Culvert(B3858) located on the Kamilaroi Highway (HW29) 9km northwest of Narrabri, NSW 2390
GPS Coordinates	Latitude: -30.263928. Longitude: 149.721391
Date of Survey	19 September 2022

5.0 Hazardous Materials Information and Methodology

The survey was conducted in accordance with the scope of works detailed in **Section 3.0** and with reference to applicable legislation in **Appendix A**. A complete list of hazardous materials identified or assumed during the Survey, including details about the identification, location, condition, and recommendation has been provided in the hazardous materials register in **Appendix B**. Photographic records and NATA endorsed reports are provided in **Appendix C** and **Appendix D** respectfully.

Hazardous materials information and the adopted methodologies for each are detailed below.

5.1 Asbestos Containing Materials

ACM are defined by the *WHS Regulation* as any material or thing that, as part of its design, contains asbestos. These forms are classified as friable and non-friable asbestos, as defined below.

- **Friable asbestos**: is in a powder form or can be crumbled, pulverised or reduced to a power by hand pressure when dry.
- **Non-friable asbestos** is any material (other than friable asbestos material) that contains asbestos.

Suspected ACMs were sampled and sent for analysis to a NATA accredited laboratory for examination as per *Australian Standard: Method for the Qualitative Identification of Asbestos in Bulk Samples (AS 4964).* The Laboratory Report (306521-[R00]) is provided in **Appendix D**.

5.2 Lead in Paint

Lead paint is defined as a paint film or component of a paint system containing lead greater than 0.1% w/w, as defined in *Australian/New Zealand Standard Guide to hazardous paint management. Part 2: Lead paint in residential, public, and commercial buildings (AS/NZS 4361.2:2017)*.

Where possible, paint samples were collected to include all coatings back to the substrate material.

Paint samples were sent to an external laboratory for analysis with reference to *US EPA Method 6010, Inductively coupled plasma-atomic emission spectrometry* to determine the quantitative concentration of lead (% w/w). The Laboratory Report (306521-[R00]) is provided in **Appendix D**.

5.3 Synthetic Mineral Fibre (SMF)

SMF materials are a heterogeneous group of fibrous inorganic materials manufactured into a fibrous product that is primarily used for insulation purposes. SMF can be classified into three groups (glasswool, rockwool and refractory ceramic fibre (RCF)), as detailed in the SafeWork *Information Guide Safe Management of Synthetic Mineral Fibres – Glasswool and Rockwool, 2015*. Glasswool and rockwool are grouped into bonded and un-bonded classifications based on the use of binding materials. The bonded form contains adhesives or cements, whereas the unbonded form contains little to no adhesives or cements.

SMF were assessed primarily by visual examination or as a result of asbestos identification analysis.

5.4 Polychlorinated Biphenyls

PCBs are chlorinated aromatic hydrocarbons, found as oil in capacitors and transformers used in electrical light fittings, electric motors, ceiling fans and dish washers. For the purpose of this survey, PCBs are limited to capacitors in light fittings.

The location of suspected PCB-containing capacitors was determined by inspecting representative light fittings throughout the Site noting and recording printed capacitor details. Capacitor details were then cross-referenced against *Identification of PCB Containing Capacitors* published by the *Australian and New Zealand Environment and Conservation Council, 1997 (ANZECC)*, and *Guidelines for the identification of PCBs and Materials Containing PCBs, United Nations Environmental Programme, 1999*.

6.0 Results

6.1 Inaccessible Areas

Specific details of inaccessible areas are outlined in the hazardous materials register presented in **Appendix B**. General areas that were inaccessible at the time of inspection included:

- Non-exposed structural material beneath concrete, road-based material etc;
- Subsurface soil, including beneath foundation slabs;
- Concealed building materials;
- Submerged materials; and
- Work at heights.

It is recommended that inaccessible areas listed in the hazardous materials register, be assumed to contain hazardous materials until proven otherwise with appropriate precaution implemented prior to demolition works.

6.2 Survey Findings

Detected or assumed hazardous materials are summarised in **Table 2**.

Table 2: Survey Findings

Summary of detected or assumed hazardous materials			
ACM	**Lead Paint**	**SMF**	**PCB**
Present	**Present**	**-**	**-**

Note:
'Present' means hazardous material identified (by laboratory analysis) or assumed (by evidence based on the surveyor's experience).
'-' means hazardous material was not identified (by laboratory analysis) or assumed (by evidence based on the surveyor's experience).

The findings included:

- ACM was detected to one (1) bulk sample (sample ID: A1) at the Site, at the time of the survey. ACM should be assumed present to the moulded fibre cement to scupper surrounds throughout which were non-friable in nature with approximately less than 10m^2 present. Some fibre cement surrounds to the scuppers were hard to access. These were completely sealed off with a new asphalt pavement layer. All moulded fibre cement surrounding scuppers, including areas where it has been sealed off should be removed prior to any demolition works.

- Lead was detected above the assessment criteria in one (1) paint sample (sample ID: L1) at the Site, at the time of the survey. The bridge had one paint system (yellow); this was found in fair condition. Although the lead content in the sample ID L2 (collected from the south rail) was below the assessment criteria 0.1% w/w, due to the homogenous nature of paint system, all the paint system should be assumed to contain lead over the assessment criteria of 0.1% w/w.
- SMF and PCBs were not identified at the Site, at the time of the survey.

A complete list of hazardous materials identified or assumed during the Survey, including details about the identification, location, condition, and recommendation has been provided in the hazardous materials register in **Appendix B**. Photographic records and NATA endorsed reports are provided in **Appendix C** and **Appendix D** respectfully.

No one section or part of a section of this report should be taken as given an overall idea of this report. Each section must be read in conjunction with the whole of this report, including all appendices.

7.0 Recommendations

The objective of the survey was to determine the presence and condition of hazardous materials and to provide demolition specific recommendations to assist TfNSW in meeting its statutory obligations under the *NSW Work Health and Safety Act 2011* and *NSW Work Health and Safety Regulation 2017*.

ACM was detected in the scupper surrounds at road level throughout the bridge sized culvert. These were found in fair condition. As a short-term mitigation, ACM located to the scupper surrounds should be encapsulated as per Section 7.1.2 if the workers and the public are potentially interacting with the material. Removal of the ACM located to the scupper surrounds should be carried out as per Section 7.1.3 before any demolition works.

Lead content exceeded 0.1% (w/w) in the sample collected from the steel traffic rail located on the upstream side of the culvert (see Photo 5). Lead content was also encountered in the sample collected from the downstream steel traffic rail however it was detected below the assessment criteria of 0.1% (w/w). The bridge is proposed for demolition, as such AECOM recommends lead paint should be addressed with demolition works as per Section 7.2.

Hazardous materials risk management strategies should be implemented where hazardous materials were identified or assumed to be present at the Site prior to the commencement of demolition works. Comments specific for each hazardous material identified or assumed during the survey are detailed in the Hazardous Materials Registers in **Appendix B**.

Non-specific recommendations for the removal of hazardous materials prior to demolition works are further discussed below. A risk assessment and methodology should be developed by the stakeholder engaged to remove / manage the hazardous materials associated with demolition works.

7.1 Asbestos

7.1.1 Mitigate

Non-friable ACM in fair condition that has a low to moderate risk of exposure can be mitigated with a combination of engineering and administrative controls. Mitigation control measures may include the ACM being enclosed, encapsulated or sealed as described below.

- **Enclose** - Placing a fixed physical barrier between the ACM and the surrounding area reducing the risk of exposure to airborne asbestos fibres from general interaction with the material (suitable for non-friable ACM where removal is not reasonably practicable and where the ACM is at risk of damage from work activities).
- **Encapsulate**– ACM is encapsulated in a resilient matrix (e.g., reinforced plastic, vinyls, resins, mastics, bitumen, flexible plaster, or cement) to prevent the release of asbestos fibres into the air (applicable if the ACM cannot be removed or enclosed).
- **Seal** – Covering the surface of the ACM with a protective coating (paint) to reduce fibre release and/or bind the fibres together (sealing is inappropriate where the process of sealing or applying paint will disturb or damage the ACM).

Mitigation control measures are interim in nature and should be supported through regular inspections by a competent person to evaluate the ongoing effectiveness of the applied controls. Removal should be considered when the applied controls are no longer effective through degradation and damage of the applied controls are observed.

The process of encapsulating and sealing ACM is considered as 'asbestos-related works' due to the direct interaction with the ACM. As such, the following should be considered when these mitigation control measures are implemented:

- Engage an appropriately licensed asbestos contractor (Class A or Class B) to undertake the works.
- The licensed asbestos contactor is to ensure they have conducted and implemented the following:
  - Notified the regulator of the licensed asbestos work.
  - Prepared a Safe Work Method Statement and Safety Management Plan.
  - Limited access to the asbestos work area (e.g., barricading, signage).
  - Provided suitable decontamination facilities or processes.
- Engage a hygienist or competent person to undertake air monitoring where asbestos-related work is being carried out, particularly if there is uncertainty as to whether the exposure standard is likely to be exceeded.

7.1.2 Remove

ACM must be removed prior to any construction, demolition, refurbishment, alteration, or maintenance works that are likely to result in the disturbance of ACM.

Any work involving the removal of ACM must be undertaken under controlled conditions, with the following considerations:

- The following licence requirements must be followed with regards to asbestos removal works:
  - **Class A Licence** - For any amount of friable ACM, asbestos containing dust and non-friable asbestos.
  - **Class B Licence** - For greater than 10 m^2 of non-friable ACM and asbestos containing dust associated with the removal of non-friable ACM.
- No licence is required for the removal of up to 10 m^2 of non-friable ACM and asbestos containing dust associated with the removal of less than 10 m^2 of non-friable ACM.
- The licensed asbestos contactor (where used as per licence requirements) is to ensure they have conducted and implemented the following:
  - Notified the regulator of the licensed asbestos removal work.
  - Prepared a Safe Work Method Statement and an Asbestos Removal Control Plan.
  - Limited access to the asbestos work area (e.g., barricading, signage).
  - Provided decontamination facilities appropriate for the type of asbestos removal works.
- For Class A licensed asbestos removal works:
  - Ensure an independent Licensed Asbestos Assessor is engaged to conduct airborne asbestos monitoring prior to, during and following any works.
  - ▪ Airborne asbestos analysis should be undertaken by a NATA Accredited laboratory.
  - Ensure an independent Licensed Asbestos Assessor conducts a clearance inspection following the Class A licensed asbestos removal works. This is undertaken to assess the adequacy of the removal works and to validate that asbestos has been removed to a satisfactory standard and that the affected areas are safe for reoccupation. This must include clearance airborne asbestos monitoring and may include soil validation sampling depending on the asbestos removal work.
- For Class B licensed asbestos removal works:

- Consider engaging an independent Licensed Asbestos Assessor or competent person to conduct airborne asbestos monitoring.
  - Airborne asbestos analysis should be undertaken by a NATA Accredited laboratory.
- Ensure an independent Licensed Asbestos Assessor or competent person conducts a clearance inspection following the Class B licensed asbestos removal works. This is undertaken to assess the adequacy of the removal works and to validate that asbestos has been removed to a satisfactory standard and that the affected areas are safe for reoccupation. This may include clearance airborne asbestos monitoring and / or soil validation sampling depending on the asbestos removal work.

- Clause 79 of the NSW *Protection of the Environment Operations (waste) Regulation 2014* requires asbestos waste transporters (transporting a minimum of 100 kilograms of asbestos waste, or 10 m^2 of asbestos waste that is asbestos sheeting, in any single load) to provide tracking information to the EPA via the WasteLocate online tool. ACM must also be disposed of at a suitably approved waste collection facility. All tipping dockets must be retained.

7.2 Lead Paint

Lead paint should be addressed during demolition works. Lead paint management should be conducted under controlled conditions in accordance with applicable legislation outlined in **Appendix A**. The following recommendations are provided when undertaking lead paint removal works.

Removal methods include:

- **Removal of lead-painted products in its entirety** – Material/structures covered in lead paint may be removed in its entirety (with lead paint in-situ) and replaced with new materials that do not contain lead paint.
- **Removal of lead paint from the structural surface** – This process involves the removal of lead paint from a structure surface only. Lead paint removal may be conducted using the following methods:
  - Wet scraping and wet sanding;
  - On site chemical stripping; and
  - Removal by heat gun and scraper.

The removal of lead paint from structural surfaces may be defined as a lead process or lead risk work based on *WHS Regulation*, *clauses 392 and 394.* As such, the following should be considered:

- Seek approval from the regulator regarding the nature of the removal works with respect to lead processes and lead risk work; and
- Where removal works are deemed a lead process or lead risk work, address relevant *WHS Regulation* clauses associated with lead processes.

The *WHS Regulation (Chapter 7)* outlines specific requirements relating to lead risk work that need to be conducted by a person conducting a business or undertaking (or the contractor engaged to do the work), including:

- Ensuring information is provided to workers about the risks and health effects when working with lead;
- Ensuring health monitoring is provided to workers before lead risk works starts and one month after starting; and
- Ensuring a lead risk work notification form is submitted at least seven (7) days before lead works commences.

Other considerations include:

- Preparation of a Safe Work Method Statement for the selected methodology;
- Limiting access to the lead paint work area (e.g., barricading, signage);

- Providing suitable decontamination facilities and processes;
- Managing lead related waste in accordance with the requirements detailed in *Protection of the Environment Operations (Waste) Regulation 2014*; and
- Schedule 1 of the NSW *Protection of the Environment Operations (waste) Regulation 2014* requires lead waste transporters to provide tracking information to the EPA via the WasteLocate online tool. Lead related waste must be disposed at a suitably approved waste collection facility. All tipping dockets must be retained.

7.3 Hazardous Materials not Detected or Assumed

As no SMF or PCBs were identified or assumed at the Site, no further actions purporting to the management of these hazardous materials are required during demolition and redevelopment works (with the exception of unexpected finds and concealed areas). Should further suspected hazardous materials be identified during demolition and redevelopment works, the unexpected finds protocol detailed in **Section 7.4** should be following prior to continuing refurbishment or demolitions works.

7.4 Unexpected Finds Protocol

When suspected hazardous materials are encountered, the following procedure protocol should be followed:

- Cease work and restricted access by isolating the area with a barrier and warning signage.
- Engage a hazardous materials consultant or equivalent specialist (e.g., licensed asbestos assessor or competent person) to undertake an assessment of the unexpected find.
  - The hazardous materials consultant or equivalent specialist (e.g., licensed asbestos assessor or competent person) should provide information following the assessment detailing the sample result, material identification, and recommendation to appropriately mitigate the find if a hazardous material is identified.
- Hazardous material removal may require the engagement of a licensed contractor and implementation of specific controls which may include air monitoring.
- If the unexpected find is deemed to be emergency asbestos removal work, a SafeWork NSW notification is not required, however the engaged asbestos removal contractor must advise SafeWork NSW within 24 hours of being advised and/or undertaking the emergency works.
- Following the removal of the hazardous material a clearance inspection may be required by a hazardous materials consultant or equivalent (e.g., licensed asbestos assessor or competent person).
- Following successful hazardous material removal works and clearance certificate (where required) remove barriers and recommence demolition and redevelopment works under normal conditions.

Appendix A

Legislative Framework

Appendix A Legislative Framework

The following legislation and guidelines have been referenced throughout the report.

Legislative Framework
Overarching Legislation applicable for all hazardous materials
• *NSW Work Health and Safety Act 2011 (WHS Act).* • *NSW Work Health and Safety Regulation 2017 (WHS Regulation).* • NSW *Protection of the Environment Operations (waste) Regulation 2014.* • *Code of Practice: Demolition Work*.
Asbestos Containing Materials
• *Code of Practice: How to Safely Remove Asbestos.* • *Code of Practice: How to Manage and Control Asbestos in the Workplace.* • *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition [NOHSC:3003(2005)].* • *Australian Standard AS 4964 - 2004, Method for the Qualitative Identification of Asbestos in Bulk Samples.*
Lead Paint
• *Australian Standard AS4361.1 – 2017, Guide to Hazardous Paint Management, Part 1: Lead and Other Hazardous Metallic Pigments in Industrial Applications*. • *Australian Standard AS4361.2 – 2017, Guide to Hazardous Paint Management, Part 2: Lead Paint in Residential, Public and Commercial Buildings*. • Relevant State/Territory specific legislation e.g., *Dept of Environment Climate Change and Water (DECCW) Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes*. • Relevant Codes of practice for working with lead including *SafeWork Australia/NIOSH (1994) National Code of Practice for the Control and Safe Use of Inorganic Lead at Work and Demolition Work.* • *US EPA Method 6010, Inductively coupled plasma-atomic emission spectrometry.*
Synthetic Mineral Fibres
• *SafeWork NSW Information Guide, Safe Management of Synthetic Mineral Fibres (SMF) Glasswool and Rockwool, 2015.* • *SafeWork Australia Guide to Handling Refractory Ceramic Fibres, 2013.*
Polychlorinated Biphenyls
• *Guidelines for the identification of PCBs and Materials Containing PCBs, United Nations Environmental Programme, 1999* • *ANZECC (1997) Identification of PCB-containing Capacitors: An information booklet for Electricians and Electrical Contractors.* • *Polychlorinated Biphenyl (PCB) Chemical Control Order 1997.* • *Polychlorinated Biphenyls Management Plan, Revised Edition April 2003.*

Appendix B

Hazardous Materials Register

Appendix B Hazardous Materials Register

Client: Roads and Maritime Services
Job Number: 60692711
Site ID: Spring Creek Bridge B3858
Address: Over Spring Creek at Crankies Plain on Kamilaroi Highway, located 9km northeast of Narrabri, NSW 2390
Survey date: 19 September 2022
Surveyor: Aman Kaur

Hazardous Materials Register

AECOM Imagine it. Delivered.

No.	Internal / External	Room/Area	Location	Material Application	Approx. Quantity	Unit	Hazmat type	Sample ID	Sample Results	Sub-Result	Friability	Photo No.	Condition	Comments and Removal Recommendations
Spring Creek Bridge B3858 over Spring Creek												**1, 2**		
1	External	Bridge deck (north)	Surrounds of the scupper throughout	Moulded compressed cement	<10	m^2	Asbestos	A1	Asbestos detected	Chrysotile	Non-Friable	3,4	Fair	If there is a likelihood of interaction with the ACM to workers or the general public, consider implementing short term mitigation control measures such as enclosing, encapsulating or sealing the ACM by a licensed asbestos removal contractor or a competent person. Removal of the ACM should be undertaken prior to any demolition or refurbishment which may affect the material in accordance with recommendations in Section 7.
1	External	Bridge deck (throughout)	Surrounds of the scupper throughout	Moulded compressed cement	<10	m^2	Asbestos	As A1	Asbestos detected	Chrysotile	Non-Friable	-	Fair	If there is a likelihood of interaction with the ACM to workers or the general public, consider implementing short term mitigation control measures such as enclosing, encapsulating or sealing the ACM by a licensed asbestos removal contractor or a competent person. Removal of the ACM should be undertaken prior to any demolition or refurbishment which may affect the material in accordance with recommendations in Section 7.
2	External	Bridge deck	Bridge rail post (north)	Yellow paint	34	lin m	Lead paint	L1	Lead detected above 0.1%w/w	0.22% w/w	-	5, 7	Fair	Lead content exceeds 0.1% w/w and is classified as lead paint. Yellow paint systems to other areas of the bridge are assumed to contain lead paint also, not just the bridge post north. Consider removal with reference to AS4361.2-2017 and the SafeWork NSW Code of Practice: Demolition Work.
3	External	Bridge deck	Bridge rail post (south)	Yellow paint	34	lin m	Lead paint	L2	Lead detected below 0.1%w/w	0.093%w/w	-	6, 8	-	Lead content does not exceed 0.1% w/w. This paint system is not classified as lead paint. However, the bridge has the same paint system throughout (yellow paint). Although the lead content in the sample collected on the south rail is below the assessment criteria 0.1% w/w, due to the homogenous nature of paint, demolition recommendations for sample ID 'L1' should be applied for the south rail post as a precaution.
4	External	Bridge	Throughout	-	-	-	SMF and PCB	-	-	-	-	-	-	SMF and PCB's were not identified at the Site, at the time of the survey.
4	External	Non exposed structural material beneath concrete, sub-surface areas, concealed building materials and any submergerd building materials.	Throughout	Inaccessible areas	-	-	-	-	-	-	-	2	-	Area was inaccessible at the time of the inspection. Potential for hazardous materials. The area should be assumed to contain hazardous materials until proved otherwise by a competent person.

Appendix C

Photographic Record

Appendix C Photographic Record

Photo 1 **Spring Creek Bridge B3858 over Spring Creek**

Photo 2 **Spring Creek Bridge B3858 over Spring Creek**

Photo 3 **Spring Creek Bridge B3858 over Spring Creek.** Sample location A1 – Moulded fibre cement to the surrounds of the scuppers (throughout).

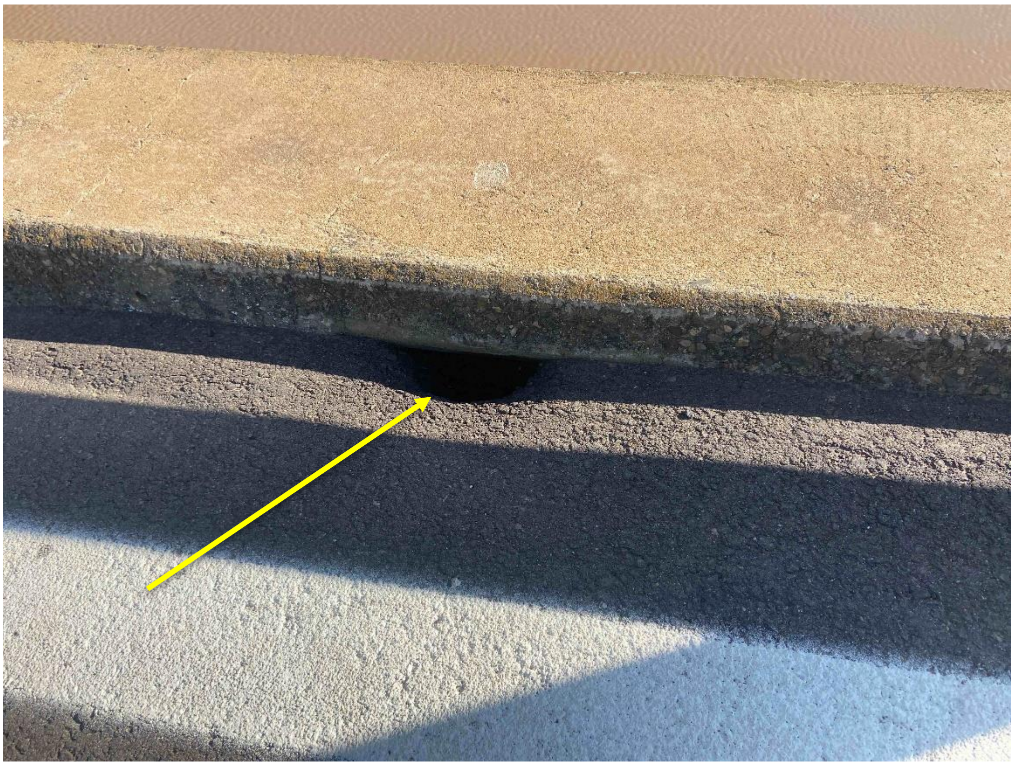

Photo 4 **Spring Creek Bridge B3858 over Spring Creek.** Some of the fibre cement surrounds to the scuppers were hard to access. These were completely sealed off with new bitumen layer. All moulded fibre cement surrounding of the scuppers, including areas where it has been sealed off be removed prior to any demolition works.

Photo 5 **Spring Creek Bridge B3858 over Spring Creek.** Sample location L1 – Yellow paint to north rail

Photo 6 **Spring Creek Bridge B3858 over Spring Creek.** Sample location L2 – Yellow paint to south rail. Although the lead content in the sample collected on the south rail is below the assessment criteria 0.1% w/w, due to the homogenous nature of paint, demolition recommendations for sample ID 'L1' should be applied for the south rail post as a precaution.

Photo 7 **Spring Creek Bridge B3858 over Spring Creek.** Yellow paint to metal rails on both ends of the bridge. Due to the homogenous nature of the paint, all yellow paint should be assumed to contain lead content exceeding the assessment criteria of 0.1%w/w. Paint was found in fair condition.

Photo 8 **Spring Creek Bridge B3858 over Spring Creek.** Yellow paint to metal rails on both ends of the bridge. Due to the homogenous nature of the paint, all yellow paint should be assumed to contain lead content exceeding the assessment criteria of 0.1%w/w. Paint was found in fair condition.

Appendix D

NATA Laboratory Report

Appendix D NATA Laboratory Report

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200   fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 306521

Client Details

Client	AECOM Australia Pty Ltd (Warabrook)
Attention	Neil Standen
Address	17 Warabrook Blvd, Warabrook, NSW, 2304

Sample Details

Your Reference	**TransportNSW - Spring Creek Bridge**
Number of Samples	1 Material, 2 Paint
Date samples received	26/09/2022
Date completed instructions received	26/09/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	04/10/2022
Date of Issue	04/10/2022

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Asbestos Approved By
Analysed by Asbestos Approved Analyst: Lucy Zhu
Authorised by Asbestos Approved Signatory: Lucy Zhu

Results Approved By
Giovanni Agosti, Group Technical Manager
Lucy Zhu, Asbestos Supervisor

Authorised By

Nancy Zhang, Laboratory Manager

Asbestos ID - materials		
Our Reference		306521-1
Your Reference	UNITS	A1
Date Sampled		21/09/2022
Type of sample		Material
Date analysed	-	29/09/2022
Mass / Dimension of Sample	-	10x5x1mm
Sample Description	-	Grey fibre cement material
Asbestos ID in materials	-	Chrysotile asbestos detected
Trace Analysis	-	[NT]

Lead in Paint			
Our Reference		306521-2	306521-3
Your Reference	UNITS	L1	L2
Date Sampled		21/09/2022	21/09/2022
Type of sample		Paint	Paint
Date prepared	-	29/09/2022	29/09/2022
Date analysed	-	30/09/2022	30/09/2022
Lead in paint	%w/w	0.22	0.093

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
Metals-020/021/022	Digestion of Paint chips/scrapings/liquids for Metals determination by ICP-AES/MS and or CV/AAS.

QUALITY CONTROL: Lead in Paint					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			29/09/2022	[NT]	[NT]	[NT]	[NT]	29/09/2022	[NT]
Date analysed	-			30/09/2022	[NT]	[NT]	[NT]	[NT]	30/09/2022	[NT]
Lead in paint	%w/w	0.005	Metals-020/021/022	<0.005	[NT]	[NT]	[NT]	[NT]	100	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Appendix E

Limitations

Appendix E Limitations

AECOM has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Transport for NSW and only those third parties who have been authorised in writing by AECOM to rely on the report. It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the relevant property.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

It is prepared in accordance with the agreed scope of work and for the purpose outlined in AECOM project scope with Transport for NSW (60692711) and **Section 3.0** of this report.

This report should be read in full, and no excerpts are to be taken as representative of the findings. No responsibility is accepted by AECOM for use of any part of this report in any other context.

This report is based on surveying an unfamiliar site. During the survey all reasonable efforts were made by AECOM to identify the physical presence of hazardous materials at the site. However, AECOM cannot guarantee that all hazardous materials within the site have been identified in this report or that the results contained in this report are definitive. Hazardous materials are frequently concealed within the fabric of buildings or within sealed voids, and the ability to sample is restricted by the nature and occupancy of the site. Further, the samples (where collected) are representative only of the specific locations from which they are taken. The results do not necessarily reflect conditions at any location removed from the specific points of sampling. It must always remain a possibility that hazardous materials (other than those identified within this report) may be found during any maintenance, refurbishment or demolition activity, and suitable precautions should always be taken when carrying out such activities.

In this report, we have identified or assumed the presence of hazardous materials (limited to ACM, lead in paint, SMF and PCBs), henceforth referred to as hazardous materials). Until proven otherwise, it should be assumed that any similar materials not otherwise detailed will also contain the corresponding hazardous material. The same assumption should not be made in respect of those materials which are similar to those identified in this report as not containing hazardous material.

Where this report indicates that information has been provided to AECOM by third parties, AECOM has made no independent verification of this information unless required as part of the agreed scope of work. AECOM assumes no liability for any inaccuracies in or omissions to that information.

Except as specifically stated in the report, AECOM makes no statement or representation of any kind as to the suitability of the facility for any purpose and/or the potential risk to human health and safety posed by the presence (or otherwise) of asbestos containing materials, lead containing dust or lead based paints.

The information in this report is considered to be accurate at the date of issue and is in accordance with conditions at the site on the date of inspection. Opinions and recommendations presented herein apply to the site existing at the time of our investigation and cannot necessarily apply to site changes of which AECOM is not aware and has not had the opportunity to evaluate. This document and the information contained herein should only be regarded as validly representing the site conditions at the time of the investigation unless otherwise explicitly stated in a preceding section of this report. AECOM disclaims responsibility for any changes that may have occurred after this time.

Except as required by law, no third party may use or rely on this Report unless otherwise agreed by AECOM in writing. Where such agreement is provided, AECOM will provide a letter of reliance to the agreed third party in the form required by AECOM.

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