Nowra Bridge Project

Submissions report

Roads and Maritime Services | May 2019

NSW GOVERNMENT

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Executive summary

The proposal

Roads and Maritime is proposing to construct a new bridge on the A1 Princes Highway over the Shoalhaven River at Nowra. The Nowra Bridge project (the proposal) includes a new four lane bridge to the west (upstream) of the existing bridge crossings and the removal of vehicular traffic from the existing southbound bridge. The proposal would also include the upgrade of about 1.6 kilometres of the Princes Highway in the vicinity of the bridge, as well as providing key intersection upgrades and modifications to the local road network. The proposal would improve access between North Nowra, Bomaderry, Nowra and the surrounding areas, improve southbound access for large freight vehicles, and improve traffic flows.

Key features of the proposal include:

- Construction of a new bridge to the west (upstream) of the existing bridge crossings over the Shoalhaven River including:
  - Four northbound lanes including a dedicated left turn only lane from Bridge Road to Illaroo Road
  - A 3.5 metre wide shared use path on the western side of the bridge connecting the Illaroo Road intersection to the Bridge Road intersection
- Widening of the existing bridge over Bomaderry Creek
- Minor lane adjustments on the existing northbound bridge to convert it to three lanes of southbound traffic
- Removal of vehicular traffic and closure of the existing southbound bridge to undertake investigation, rehabilitation and repurposing work for adaptive reuse following opening of the new northbound bridge. As part of the proposal, shared paths and maintenance access would be constructed up to the existing southbound bridge and work to prevent unauthorised access would also be carried out. The rehabilitation and repurposing of the existing southbound bridge for adaptive reuse would be subject to a separate consultation and assessment process to the Nowra Bridge Project REF and this Submissions Report
- Upgrading of the Princes Highway to provide three northbound and three southbound lanes from the Bolong Road intersection through to the existing three lanes about 75 metres north of the Moss Street intersection
- Widening of Illaroo Road over a distance of about 270 metres
- Upgrading of the Princes Highway and Illaroo Road intersection to provide:
  - Two southbound right turn lanes from the Princes Highway into Illaroo Road
  - Three dedicated right turn lanes and one dedicated left turn slip lane from Illaroo Road to Princes Highway
  - An acceleration and merge lane for northbound traffic turning into Illaroo Road from Princes Highway
- Upgrading of the Princes Highway and Bridge Road intersection to provide:
  - Two southbound right turn lanes from the Princes Highway into Bridge Road
  - One left turn lane from Bridge Road to the Princes Highway
- Local road adjustments including:
  - Closing the access between Pleasant Way and Princes Highway

  - Restricting turning movements at the intersection of Bridge Road and Scenic Drive
  - Construction of a new local road connecting Lyrebird Drive to the Princes Highway about 300 metres south of the existing Pleasant Way intersection.
- Dedicated off road shared paths and footpaths along the length of the proposal.
- Urban design and social amenity improvements, and landscaping including pedestrian links to the existing southbound bridge.

Roads and Maritime, as the proponent of the project, has prepared this submissions report to meet requirements of Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and to respond to issues raised in submissions during the exhibition of the REF, as well as describe and assess proposed changes and design refinements to the project.

REF display

The REF was placed on public display to seek feedback on the proposal from the community, government agencies and other stakeholders.

The REF was publicly displayed for 33 days between 27 August and 28 September 2018. The REF was available in hard copy at three locations within and near Nowra and electronically on the Roads and Maritime project website. The display locations and website link were advertised directly to 14,000 households in Nowra, Bomaderry and surrounding areas, in the South Coast Register, the Illawarra Mercury and on social media.

A total of 109 submissions were received by Roads and Maritime. Most submissions were received from the community, including individuals, businesses and community groups. Submissions were also received from Shoalhaven City Council, Department of Primary Industries (Fisheries), NSW Environment Protection Authority, Office of Environment and Heritage, and Natural Resources Access Regulator.

This submissions report considers all submissions received during display of the REF.

Summary of submissions and responses

The main issues raised in submissions by the community related to the need and options considered for the proposal. This included consideration of a bypass of Nowra Bomaderry, provision of grade separation at intersections north and south of the river, provision for rail, and elements of the proposal. Traffic and transport, socio-economic and heritage impacts associated with the proposal were also raised.

Shoalhaven City Council's submission related primarily to the needs and options considered, including bypass and grade separation options, redistribution of traffic on local roads and intersection performance, and potential impacts to parking, public space and amenities.

Other agency submissions related primarily to the sensitivity of the receiving environment, with a key issue being water quality during construction and operation. Issues in regards to non-Aboriginal heritage, Aboriginal heritage, flooding and hydrology, and construction noise were also raised.

The main issues raised and their responses are summarised below.

Need and options considered

A substantial number of submissions received commented on the need and options considered for the proposal, particularly with regard to the following:

- Issue: A bypass would be a better solution to address congestion within the Nowra Bomaderry area by reducing the volume of through traffic, including heavy vehicles.

  Response: The local and regional traffic demands both the north and south of the river crossing comprise about 85 per cent of traffic crossing the Shoalhaven River. This means a new bridge at the existing location is needed to address the issues with the existing southbound bridge and deliver for the planned traffic growth along the current Princes Highway corridor in the Nowra Bomaderry area.

  Town bypasses are considered to provide significant benefits in situations where there are a high proportion of vehicles making through trips by reducing congestion and improving road safety. A bypass of Nowra Bomaderry would only take up to 15 per cent of current traffic off the Princes Highway at the Shoalhaven River and would not address the need for a new bridge crossing and intersection upgrades at this location.

  Surveys carried out in 2013, 2014 and 2018 indicate about 85 per cent of journeys crossing of the Shoalhaven River are local and regional trips originating and/or ending within the Nowra Bomaderry area. The findings of the surveys have been corroborated by an independent review carried out in late 2018. A bypass has not been proposed as it would not satisfactorily address current and future traffic growth and congestion associated with local and regional trips crossing the Shoalhaven River during normal day to day peak periods. A new bridge crossing over the Shoalhaven River on the Princes Highway is required as the existing southbound bridge is in poor condition, has high ongoing maintenance costs, and imposes constraints on higher mass limit (HML) and overheight vehicles.

  Roads and Maritime notes that construction of the current proposal would not preclude the future planning of a bypass if and when traffic demand arises.

- Issue: Grade separation of the intersections would provide for more efficient movement of traffic along the Princes Highway and would reduce congestion at intersections.

  Response: Grade separated options have been assessed extensively during the development of the proposal. This included assessing how grade separated intersections would impact traffic flow on the Princes Highway and local road network. The environmental impact of grade separated interchanges was also assessed.

  An assessment of 19 intersection options, including 11 grade separated options, was carried out for the proposal to identify six network options as detailed in the Preferred Option report released in February 2018.The traffic modelling identified some grade separated intersection options performed marginally better than the best performing at grade options while other grade separated options introduced inefficient and unsafe weave, merge and queuing issues that do not presently exist on the network.

  There are a number of significant constraints within and adjoining the road network associated with grade-separated options. For example, the land around Bomaderry Creek presents significant geotechnical constraints to road infrastructure design. The land is also flood prone and additional cost would be incurred to achieve the required level of flood immunity. There would also be potential to affect the local flooding patterns which in turn could impact on other properties.

Grade separated options would have greater environmental impacts than the preferred option, including additional property acquisition on the eastern side of the Princes Highway for the Illaroo Road intersection. At Bridge Road, additional property acquisition would be required which could potentially impact on the heritage curtilage of the State heritage listed Graham Lodge and a grade separated intersection at this location would reduce the amount of land available for Shoalhaven City Council's planned development of the Nowra Riverfront. The potential impacts to Aboriginal and non-Aboriginal heritage, property and land use, the environment and project costs were also considered for each network option.

While there are benefits of grade separation relating to traffic flow and reduced congestion, this option would have an increased impact on construction and future maintenance costs, the environment, property acquisition, future land use and heritage compared with the proposed design.

The proposal was selected because it is the best balance of traffic benefits and potential impacts.

Traffic modelling found Illaroo Road and Bridge Road intersections would perform acceptably into the future and grade separation is not required until there is a substantial increase in traffic on this section of the highway.

Roads and Maritime notes that construction of the current proposal would not preclude the future planning of grade separation if and when the network requires it.

- Issue: The proposal should provide for rail on either the proposed new bridge or the existing southbound bridge.

  Response: A river crossing option that could potentially provide for a future rail extension across the Shoalhaven River was investigated as part of the assessment of the five identified route options. The rail option would likely require long complicated bridge structures with an estimated cost three to five times greater than the least expensive option. It is also noted *Future Transport Strategy 2056* does not identify extending the South Coast Rail line south into Nowra or further as an initiative for investigation in the short, medium or long term. In view of this, the rail option was not progressed further.

The proposal

Many of the submissions received commented on elements of the proposal's design and associated potential impacts, particularly:

- Issue: The proposed design for the upgraded Illaroo Road intersection would not adequately address the existing operational issues particularly with regard to improving the efficiency of movement of vehicles through the intersection. The proposed dedicated left turn could also be introducing a traffic safety risk.

  Response: The Illaroo Road intersection would be upgraded to provide three dedicated right turn lanes for southbound traffic and a dedicated left turn lane for northbound traffic. The design of the intersection has been informed by traffic modelling carried out for the proposal which has identified existing and forecast traffic demands on the intersection. The traffic modelling indicated that there would be an improvement in the performance of the intersection in the peak hour periods which is forecast to continue past 2046.

  The dedicated left turn from Illaroo Road onto the highway will be made under a give way arrangement and on demand pedestrian signals, subject to meeting road design standards. The intersection will be designed to appropriate road design standards in terms of approach angle

and sight distances to minimise any potential safety issues, including dealing with weave manoeuvres for traffic turning into Bolong Road.

- Issue: The proposed closure of Pleasant Way and construction of the new local road connection from the Princes Highway to Lyrebird Drive would result in the redistribution of traffic on local roads, particularly Moss Street and Lyrebird Drive, reduce the level of access to properties and businesses east of the Princes Highway, increase risks to pedestrians and result in increased impacts to residents.

  Response: Pleasant Way would be closed to enable the Bridge Road intersection to be moved as far south as practicable to increase the available storage for vehicles turning right into Bridge Road from the Princes Highway and improve the overall intersection performance.

  Access for southbound traffic would be via the new local road connection that would provide left in and left out access to the Princes Highway and be unsignalised. The removal of traffic signals at this intersection was based on feedback received from the public exhibition of the Preferred Option Report in February 2018, with a large number of community members expressing concern through written submissions and verbal conversations that there were already too many traffic signals along the Princes Highway in the proposal area, and that adding an additional set of signals would further impede traffic flow. This issue was raised again during the exhibition of the REF.

  Access for northbound traffic will be available via the Moss Street intersection. Additional traffic modelling undertaken in response to submissions examined the demand on this intersection and showed the intersection is operating at a poor level of service and is nearing capacity. While the current proposal would place some additional demand on the intersection, the poor performance relates principally to traffic growth along the Princes Highway rather than the redistribution of traffic associated with the proposal.

  While there will be an increase in the number vehicles on some local roads, the existing controls in these areas would continue to minimise the risk to pedestrians. The environmental management measures identified in the REF would minimise impacts to residents and businesses.

- Issue: The proposed changes to the Scenic Drive and Bridge Road intersection would introduce unacceptable impacts to traffic efficiency and road safety and necessitate the need to upgrade the Hyam Street and Bridge Road intersection.

  Response: The intersection of Scenic Drive and Bridge Road would be amended to left in, left out only. In response to submissions, further traffic surveys and modelling was carried out to assess the impact on the Bridge Road and Hyam Street intersection due to the redistribution of traffic from Scenic Drive. This identified that the proposed change would result in increased right turn movements into Hyam Street. However, the current intersection would still continue to perform satisfactorily up to about 2036 even with the likely traffic redistribution and expected levels of growth. The additional work also identified the number of pedestrians crossing Bridge Road is very low and the majority of pedestrians utilise the existing crossing at the Bridge Road and Princes Highway intersection which is being retained in the proposal

- Issue: The proposed changes to traffic lanes and turning movements at the Bolong Road intersection would limit the efficiency of the intersection and would not adequately address safety issues for southbound highway traffic approaching the intersection.

  Response: Development of the design for the Bolong Road intersection has included consideration of all relevant road safety requirements balanced together with optimising the efficiency of the operation of the intersection. This has included consideration of use of the intersection by A-double vehicles which are up to 30 metres in length. The proposed design in

conjunction with the rest of the proposal would provide for all safe vehicle movements through the intersection, and at an acceptable level of efficiency. The design has also addressed safety issues for southbound highway traffic where practicable, noting that there are some significant constraints to fully addressing all safety issues along this section of the highway; including the proximity of Bomaderry Creek bridge to the intersection.

Traffic and transport

A number of submissions received commented on the traffic modelling and on the redistribution of traffic on local roads and potential impacts associated with increased volumes of traffic, particularly:

- Issue: It is unclear whether the traffic modelling has adequately taken account of future forecast population growth and future development in Bangalee, North Nowra and Bomaderry.

  Response: The detailed traffic modelling carried out for the proposal involved a review of historical traffic data and of Shoalhaven City Council's strategic traffic model to determine the appropriate growth rates for the future traffic demands on the road network in the vicinity of the proposal. The modelling considered future land use changes in the surrounding area that would influence the volume of traffic on the road network, and took into account future development sites and general population growth. The modelling also aligned with the rate identified in the Princes Highway Corridor Strategy document for the Princes Highway between Gerringong and Falls Creek.

Socio-economic

- Issue: The proposed impacts to parking, particularly in the civic precinct north of the Shoalhaven Entertainment Centre are considered unacceptable by Council. In their submission, Council identified a number of alternative sites for consideration by Roads and Maritime Services including an area of vacant land behind Nowra Aquatic Park.

  Response: In response to Council's submission additional assessments were carried out to verify the number of car spaces potentially impacted by the proposal and to assess the suitability of alternative locations identified by both Council and Roads and Maritime. The assessments showed that up to about 300 car spaces would be impacted during construction. Proposed alternative parking areas have the potential to provide up to about 370 car parking spaces but are subject to further consultation with Council and private land owners. The proposal will result in the permanent loss of up to 20 car parking spaces but this would not have a material impact on the functionality of parking in these areas.

Water quality

- Issue: The water quality assessment undertaken for the proposal does not appear to provide any quantification of impacts to the Shoalhaven River, or consider the likely pollutant load from discharges from sediment basins under various potential scenarios.

  Response: In response to submissions, additional assessments were carried out on the proposal construction sediment basin discharge and operational stormwater discharge against the NSW Water Quality Objectives. No changes are proposed to the construction sediment discharge limits and operation stormwater quality targets identified in the REF.

Maritime archaeology

- Issue: The potential impacts of the proposal on shipwrecks and submerged maritime heritage sites had not been considered in the Statement of Heritage Impacts prepared for the proposal.

  Response: In response to submissions, a maritime archaeological due diligence assessment was undertaken for the proposal. The assessment included a search of the NSW Maritime

Heritage Register which identified three records at the mouth of the Shoalhaven River, well downstream from the proposal area. One of these records, the shipwreck of 'Unique', was included in the Australian National Shipwreck database. None of these items will be affected by the proposal.

The assessment identified potential for archaeological resources within the project area associated with the Government wharves at Bomaderry and Nowra and unrecorded underwater archaeological resources. The potential for artefacts within the proposal areas is considered to be low.

The issues raised by the community and government agencies and their responses are detailed in Chapters 2 and 3 of this Submissions Report.

Changes to the proposal

In response to submissions and following further design development since display of the REF, changes to the REF proposal have occurred, with the principal changes being as follows:

- Adjustments to the intersection of the Princes Highway and Illaroo Road comprising:
  - provision of pedestrian activated signals on all left slip lanes to improve pedestrian and cyclist safety without reducing traffic efficiency
  - removal of the southbound left slip lane to the residential property and business east of the Princes Highway at Illaroo Road. Access to these properties would be provided by an additional left turn lane located within the signalised intersection to improve pedestrian and cyclist safety
  - inclusion of a staged and staggered at grade pedestrian crossing
- Realignment of the new local road connection to improve intersection geometry at the Princes Highway, to reduce potential vibration impacts on the Graham Family Cemetery and to reduce impacts on land with residential development potential
- Revision of the design of the new Pleasant Way cul-de-sac to avoid impacting on the heritage curtilage of Graham Lodge
- Changes to the number and location of proposed construction ancillary facilities to provide greater flexibility to the construction contractor and to reduce parking impacts during construction
- Further development of construction methodologies, including the use of alternative rock excavation techniques such as penetrating cone fracture blasting and chemical excavation.

The proposed changes to the proposal would result in improved safety for all road users, including cyclists and pedestrians without detracting from the efficiency of traffic movements along the Princes Highway and through the upgraded intersections.

The proposed additional ancillary facilities and alternative construction methodologies for rock excavation would allow greater flexibility to the construction contractor and facilitate more efficient construction potentially reducing construction times and reducing the duration of impacts for receivers in the locality of the works, and for road users.

Changes to the proposal and the associated potential environmental impacts have been described in Chapter 4 of this Submissions Report.

Additional assessments

Redistribution of local road traffic

Further traffic modeling has been carried out to inform additional assessment of the effects of the proposal with regard to the redistribution of traffic associated with the changed access to Scenic Drive from Bridge Road, closure of Pleasant Way, and the new local road connection from the Princes Highway to Lyrebird Drive. This was based around an analysis of the performance of three additional intersections: Bridge Road and Hyam Street, Princes Highway and Moss Street, and Moss Street and Ferry Lane.

The analysis identified that there would be no material impact on the Moss Street and Ferry Lane intersection, the Bridge Road and Hyam Street intersection would perform acceptably up to about 2036, and the proposal would have a very minor effect on the Princes Highway and Moss Street intersection which would be affected more by growth on the Princes Highway than the redistribution of traffic from Pleasant Way.

Assessment of proposed noise barrier

The proposed noise barrier was considered in the concept design however potential impacts of the barrier were not assessed as part of the REF for the proposal. The additional assessment identified that nearby residents will experience reduced amenity during construction of the proposed noise barrier. During operation, there will be a reduced visual amenity for nearby residents, road users and active transport users traveling along this section of the highway. Adjoining residents would also experience a positive impact on amenity by reducing the level of road traffic noise experienced once the proposed noise barrier has been constructed. There are not anticipated to be any new or additional impacts on other environmental issues to those identified in the REF.

The final location and design of the noise barrier will be determined during detailed design in consultation with affected residents.

Review of non-Aboriginal heritage assessments of significance

A review of the assessments of significance was carried out to due to inconsistencies being identified for some items. The statement of heritage impacts for the proposal was updated to include the revised assessment of significance for each item and confirmed there would be no change to the overall significance of the locally listed heritage items.

Maritime archaeological assessment

In response to submissions, a maritime archaeological due diligence assessment was carried out to identify and assess the significance of any maritime archaeological resources that may be impacted by the proposal. The assessment included Nowra Wharf, Bomaderry Wharf (outside the proposal area), and underwater archaeology.

The assessment concluded that impact on Nowra Wharf would include use of the slip 20 metres west of the wharf for access to the Shoalhaven River but would not involve direct impact on archaeological resources associated with the wharf. The assessment noted that the proposal may impact archaeological resources such as piles associated with Bomaderry Wharf. The potential for underwater archaeological resources associated with navigation on the Shoalhaven River was identified as low.

Revised assessment of impacts to parking

The submission from Shoalhaven City Council expressed concern over impacts on parking in the civic precinct, particularly with regard to land north of the Shoalhaven Entertainment Centre which provides significant overflow parking relief for the Council administration building and the entertainment centre precincts. To offset the impacts, Council proposed a number of alternative locations that it considered would be suitable for parking during construction, and could potentially continue to be used for parking following construction of the proposal.

Further assessment has been carried out to confirm the number of car parks currently available at each location identified in the REF and to identify the number of car spaces potentially available at each additional site. The assessment identified that up to about 300 car parking spaces would be potentially impacted during construction, including up to 110 spaces at the informal car park north of the Shoalhaven Entertainment Centre. Up to about 50 spaces would be potentially affected at Greys Beach, however impacts would largely be limited to times outside of peak holiday periods.

Potential alternative parking areas identified by Council and Roads and Maritime to offset the potential impacts during construction were assessed for suitability. The two areas proposed by Council are not favored due to site constraints, such as flooding potential and available access, potential impacts to nearby residents and distance from the site. Three areas proposed by Roads and Maritime have the potential to provide up to about 370 car spaces however are subject to ongoing consultation with Council and private land owners.

The permanent acquisition of land for road infrastructure would result in the permanent loss of 10 car park spaces from the informal parking area north of the Shoalhaven Entertainment Centre and a further 10 spaces of on-street parking along Scenic Drive. The permanent loss of these spaces is not considered to materially affect the functionality of these parking areas.

Revised assessment of impacts to Waterways Swim School

The impact on the Waterways Swim School was considered in the REF but did not make specific reference to the presence of the swimming pool within the building which is essential to the business operation. An additional assessment concluded the proposal would have a permanent negative high impact on the business due to the removal of all buildings located at 1 Scenic Drive.

Assessment of potential impacts to the Regent Honeyeater

The Regent Honeyeater was not identified in targeted surveys and was assessed as having a low likelihood of occurrence, however, one individual was observed in September 2018 less than 100 metres from the study area. An assessment of significance was completed for the species. The proposal would require the removal of 4.68 hectares of vegetation that provides potential foraging habitat for this species when suitable feed trees are in flower. Given the small area of habitat to be removed from next to a major highway and the absence of any breeding sites, the proposal is not expected to have a significant impact on the Regent Honeyeater.

Assessment of the proposal against NSW Water Quality Objectives

An additional water quality assessment was carried out to inform responses to submissions related to construction and operational water quality impacts. This comprised additional quantitative modelling and assessment of the results against the NSW Water Quality Objectives for the Shoalhaven River. The assessment identified that discharges from construction basins would have a short term impact on turbidity, however this would be minimal as any exceedances of the trigger value would be short term and similar to existing turbidity levels. With regard to nutrients (Total Phosphorus, Total Nitrogen), the modeling predicted that discharge levels would be below the respective trigger levels. During operation, the proposal has a net positive impact on water quality

due to the inclusion of stormwater treatment and spill containment structures as part of the new bridge.

Further details regarding the additional assessments undertaken are discussed in Chapter 5 of this Submissions Report.

Safeguards and management measures

The submissions received, additional assessments, and proposed design changes have resulted in several changes to the safeguards and management measures outlined in the REF. The key changes include:

- Revision of existing and addition of new management measures to manage potential impacts on non-Aboriginal heritage including maritime archaeology (NAH4, NAH5, NAH6, NAH10, NAH11, NAH12)
- Addition of new management measures relating to further analysis of flooding impacts during detailed design, including consultation with Council and affected property owners (HY3 and HY4)
- Revision of existing management measure to clarify impacts to boat ramp usage and parking at Grey's Beach Reserve (SE4)
- Additional management measures relating to consultation regarding the proposed noise barrier (SE10), temporary parking arrangements (SE11 and SE12)
- Additional management measures to offset impacts to affected aquatic habitats (B18), to manage risks associated with aquatic pests and diseases (B19), and to notify DPI Fisheries in relation to fish kills in the vicinity of construction works (B20)
- Additional management measures to manage potential water quality impacts during construction and operation (WQ13, WQ15, and WQ16)
- Additional management measures for consultation with DPI Fisheries regarding the final detailed design plans for the new Shoalhaven River and Bomaderry Creek bridges and water quality treatment devices (WQ14), and for temporary instream structures (WQ17)
- Removal of management measures relating to the preparation of a Hazard and Risk Management Plan (SO7, HR1) and a Hazardous Materials Management Plan (SO9) as the matters related to these two plans are addressed through the Construction Environmental Management Plan
- Revision of existing and addition of new management measures relating to waste generated on the site being assessed and classified in accordance with Waste Classification Guidelines (Environment Protection Authority 2014) (WA2), waste materials removed from site being directed to a waste management facility or premises lawfully permitted to accept the materials (WA10), and waste generated outside the site not being received at the site for storage, treatment, processing, reprocessing, or disposal on the site except as permitted by an Environment Protection Licence (W12).

An updated consolidated set of environmental safeguards and management measures is provided in Table 6-1 of this submissions report.

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Appendix E NSW water quality objectives: Assessment of operational water quality

Appendix F Erosion and Sediment Management Report: Nowra Bridge

1 Introduction and background

1.1 The proposal

Roads and Maritime Services (Roads and Maritime) proposes to construct a new bridge on the A1 Princes Highway over the Shoalhaven River at Nowra (the proposal). The proposal includes the construction of a new four lane bridge west (upstream) of the existing bridge crossings and the removal of vehicular traffic from the existing southbound bridge. The proposal would also include the upgrade of about 1.6 kilometres of the Princes Highway in the vicinity of the bridge, as well as providing key intersection upgrades and modifications to the local road network. The proposal would improve access to Nowra and the surrounding areas, improve southbound access for large freight vehicles, and improve traffic flows.

The main features of the proposal include:

- Construction of a new bridge to the west (upstream) of the existing bridge crossings over the Shoalhaven River including:
  - Four northbound lanes including a dedicated left turn only lane from Bridge Road to Illaroo Road
  - A 3.5 metre wide shared use path on the western side of the bridge connecting the Illaroo Road intersection to the Bridge Road intersection
- Widening of the existing bridge over Bomaderry Creek
- Minor lane adjustments on the existing northbound bridge to convert it to three lanes of southbound traffic
- Removal of vehicular traffic and closure of the existing southbound bridge to undertake investigation, rehabilitation and repurposing work for adaptive reuse following opening of the new northbound bridge. As part of the proposal, shared paths and maintenance access would be constructed up to the existing southbound bridge and work to prevent unauthorised access would also be carried out. The rehabilitation and repurposing of the existing southbound bridge for adaptive reuse would be subject to a separate consultation and assessment process to the Nowra Bridge Project REF and this Submissions Report
- Upgrading of the Princes Highway to provide three northbound and three southbound lanes from the Bolong Road intersection through to the existing three lanes about 75 metres north of the Moss Street intersection
- Widening of Illaroo Road over a distance of about 270 metres
- Upgrading of the Princes Highway and Illaroo Road intersection to provide:
  - Two southbound right turn lanes from the Princes Highway into Illaroo Road
  - Three dedicated right turn lanes and one dedicated left turn lane from Illaroo Road to Princes Highway
  - An acceleration and merge lane for northbound traffic turning into Illaroo Road from Princes Highway
- Upgrading of the Princes Highway and Bridge Road intersection to provide:
  - Two southbound right turn lanes from the Princes Highway into Bridge Road
  - One left turn lane from Bridge Road to the Princes Highway
- Local road adjustments including:
  - Closing the access between Pleasant Way and Princes Highway

  - Restricting turning movements to left in and left out at the intersection of Bridge Road and Scenic Drive
  - Construction of a new local road connecting Lyrebird Drive to the Princes Highway about 300 metres south of the existing Pleasant Way intersection
- Provision of pedestrian facilities at all intersections
- Dedicated off road shared paths and footpaths along the length of the proposal.
- Urban design and social amenity improvements, and landscaping including pedestrian links to the existing southbound bridge
- Relocation and/or protection of utility services
- Drainage and water quality management infrastructure along the road corridor
- Property works including acquisition, demolition, and adjustments to accesses
- Temporary ancillary facilities during construction including site offices, construction compounds, and stockpile sites.

Following the REF display period, receipt of submissions and the ongoing review of the concept design, a number of design changes have been made to the proposal and are detailed in Chapter 4 of this submissions report.

A more detailed description of the Nowra Bridge Project is found in Chapter 3 of the Nowra Bridge Project Review of environmental factors (REF) prepared by Roads and Maritime in August 2018.

The proposal location is shown in Figure 1-1. The key features of the proposal are shown in Figure 1-2 and Figure 1-3.

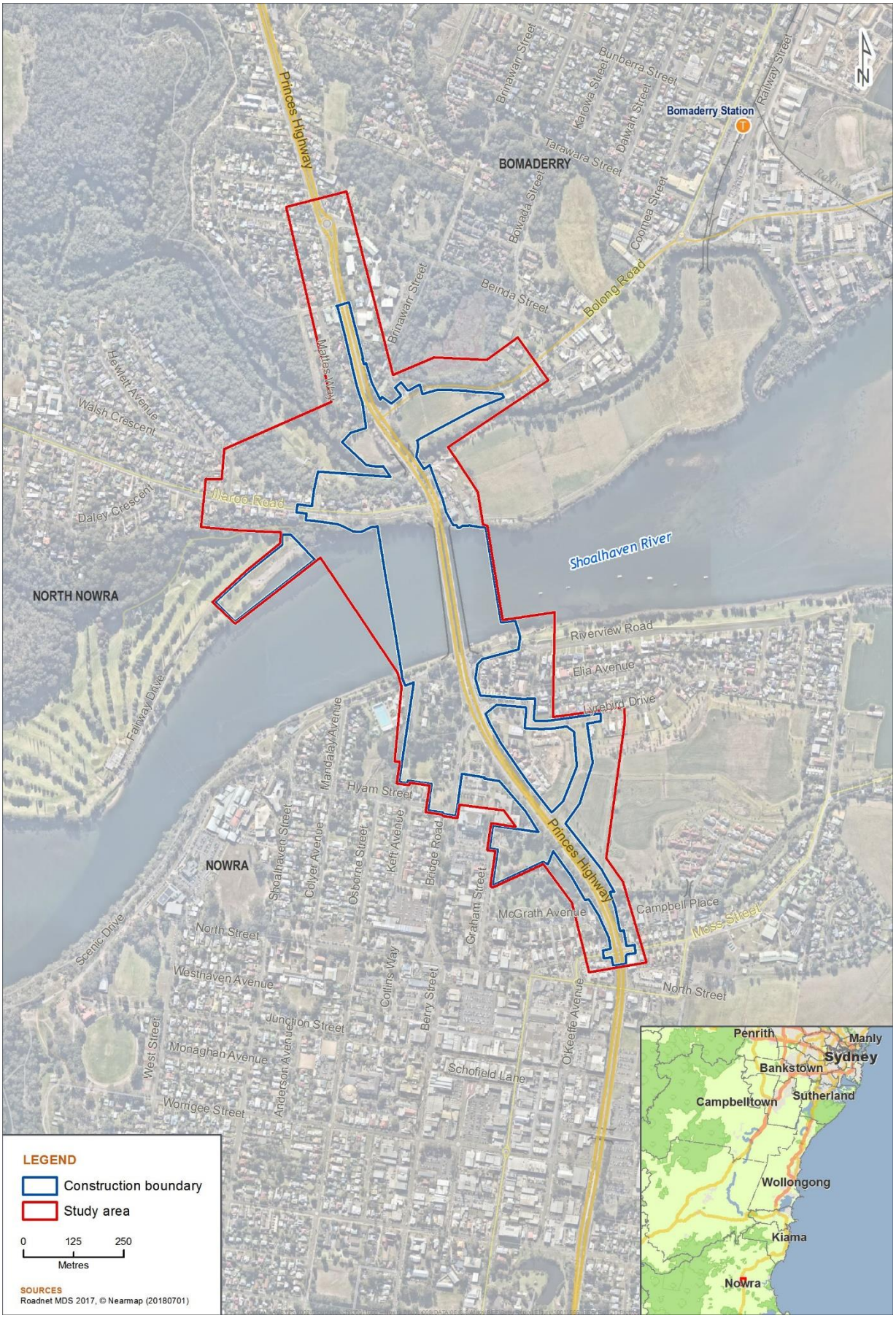

Figure 1-1: Location of the proposal

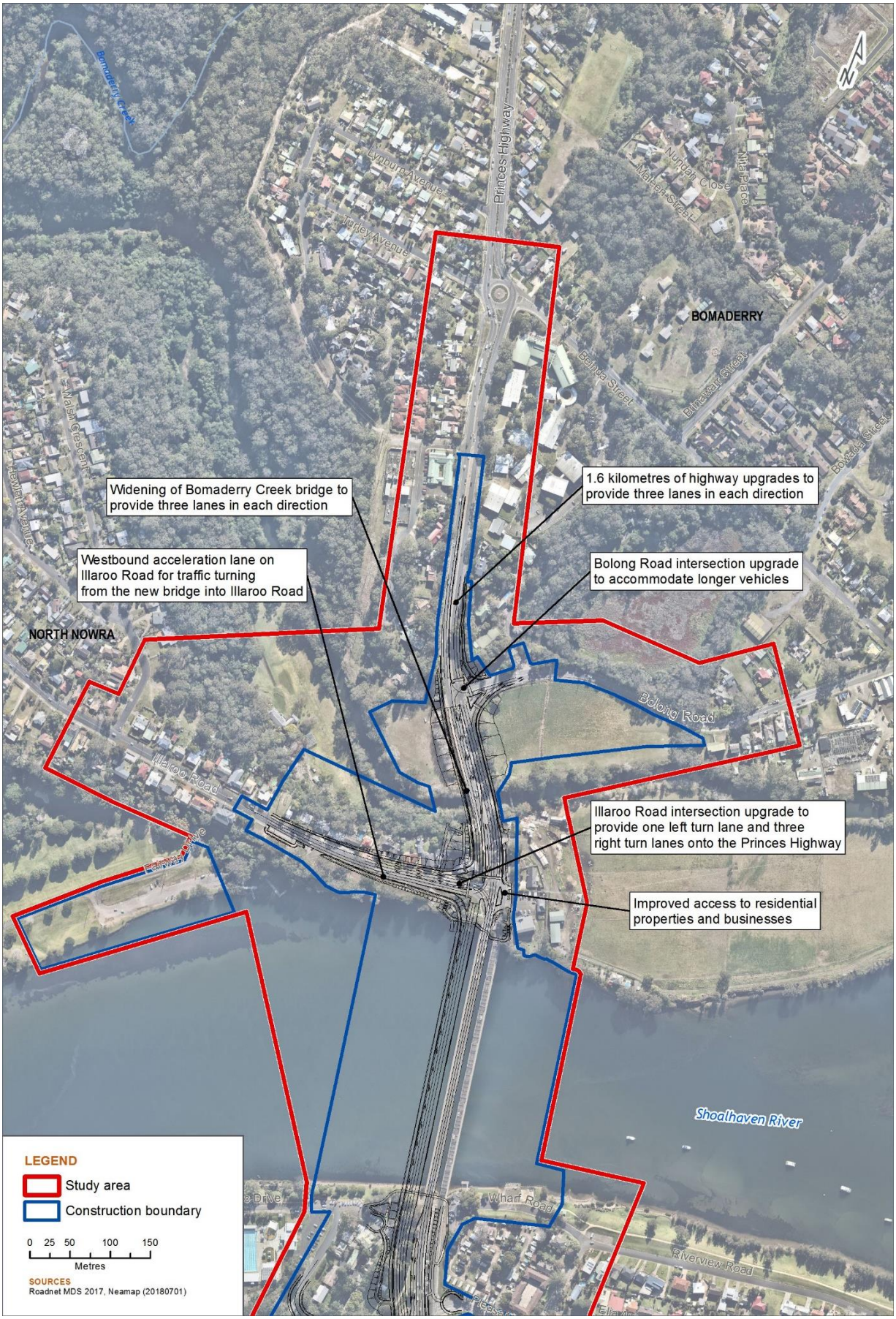

Figure 1-2: Key features of the proposal – north

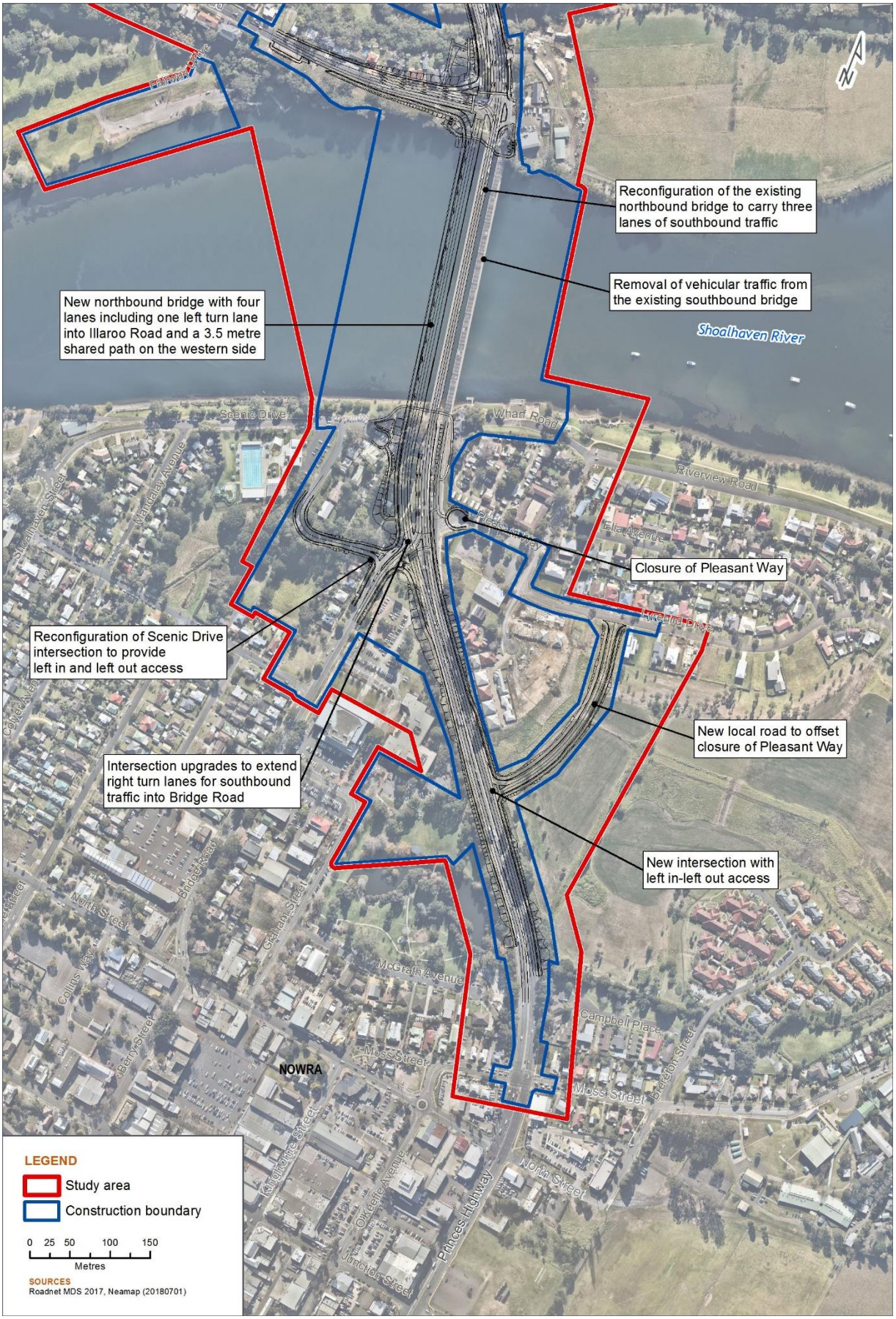

Figure 1-3: Key features of the proposal – south

1.2 REF display

Roads and Maritime prepared a REF to assess the potential environmental impacts of the proposal. The REF was publicly displayed for 33 days between 27 August 2018 and 28 September 2018 at three locations, as detailed in Table 1-1. The REF was placed on the Roads and Maritime project website and made available for download. The display locations and website link were advertised in the South Coast Register, the Illawarra Mercury and on social media. Nearby community members and businesses were notified of the Display of the REF and how to access the documents through letterbox drops to about 14,000 households in Nowra, Bomaderry and surrounding areas.

Table 1-1: Display locations

Location	Address
Shoalhaven City Council	36 Bridge Road Nowra NSW 2541
Nowra Library	10 Berry Street, Nowra NSW 2541
TAFE NSW	60 Beinda Street, Bomaderry NSW 2541

Five community information sessions were held during the display period. These sessions were attended by about 260 community members and provided an opportunity to talk to the project team and ask any questions. Details of these community information sessions are provided in Table 1-2.

Table 1-2: Community information sessions

Location	Address
Nowra School Of Arts, Berry Street, Nowra	Saturday 1 September, 11am to 3pm; and Thursday 6 September, 4pm to 8pm
North Nowra Shops, 1–13 McMahons Road, North Nowra	Saturday 8 September, 11am to 3pm; and Wednesday 12 September, 11am to 3pm
Stockland Nowra, 60 East Street, Nowra	Thursday 13 September, 4pm to 8pm

Table 1-3 provides a summary of the consultation activities undertaken and their community reach.

Table 1-3: Consultation activities carried out during the REF display period

Tool/Activity	Details
Media release	A media release was issued by Roads and Maritime on Monday 27 August 2018, titled '*New Nowra Bridge concept design and environmental assessment on display*'.
Media event	A media event was held on Monday 27 August 2018 at Moorhouse Park to announce the release of the REF and concept design. The event was attended by local Members of Parliament (MPs), key stakeholders, community members and Roads and Maritime representatives with the event covered by local print, television and radio media.

Tool/Activity	Details
Newspaper advertisement	Newspaper advertisements were placed in local papers at the start of the consultation period to and before the information session to raise awareness of the consultation and information sessions. Publications included: • South Coast Register – Wednesday 29 August 2018 • Illawarra Mercury – Wednesday 29 August 2018
Postcard and Environmental Assessment Overview	A community update postcard was produced including the key features of the proposal, details on the community information sessions, how to access the online portal and provide feedback on the REF and concept design. The postcard was distributed to about 14,000 households and businesses in Nowra, Bomaderry and surrounding areas. An Environmental Assessment Overview was produced to summarise the key information contained within the environmental assessment documents. The postcard and overview were made available at the static display locations and community information sessions.
Email notifications	Direct emails were sent from Roads and Maritime on 27 August 2018 to 861 registered stakeholders (community members and groups), local Members of Parliament and other government stakeholders to announce the REF and concept design, as well as to raise awareness of the commencement of the consultation period, how to make a submission and details of the information sessions. Direct emails were also sent to several government agencies on the 28 and 29 August 2018.
Webpage	The project webpage was updated on Monday 27 August 2018 with project information including the REF, the Environmental Assessment Overview, details of how to make a submission, and information about the community information sessions. A total of 4,258 page views were recorded during the consultation period for the project website www.rms.nsw.gov.au/nowrabridge.
Online Interactive Portal	An online interactive portal was used during the consultation period with an animation video providing a visual representation of the features and future look of the project. The online portal allowed users to interact with the concept design using before and after sliders and future journey planner which detailed the anticipated travel time savings for different journeys and a 360 degree drive through. There were a total of 10,874 page views by 7,888 unique users during the consultation period. Users of the online portal were also able to vote on if they liked a feature, weren't sure or did not like a feature. During the display period 706 responses were recorded with 71 per cent of responses positive, 12 per cent neutral and 17 per cent negative.

Tool/Activity	Details
Social Media (Facebook)	Five Facebook posts during the display period reached an audience of 54,856 people. 17,262 Facebook users engaged with the posts during the display period.
Briefing sessions	Roads and Maritime held briefing sessions for Shoalhaven City Council and local Members of Parliament (MPs) prior to the display of the REF. Roads and Maritime also met with the following community groups during the consultation period: • Shoalhaven Business Chamber – 17 September 2018 • Pride of Bomaderry CCB – 20 September 2018 • Shoalhaven Historical Society – 25 September 2018.

In addition to the above public display, Roads and Maritime has had ongoing consultation with potential directly affected property owners regarding the potential impacts of the proposal since February 2018.

1.3 Purpose of the report

This submissions report relates to the REF prepared for the Nowra Bridge Project, and should be read in conjunction with that document.

The REF was placed on public display and submissions relating to the proposal and the REF were received by Roads and Maritime.

This submissions report is structured as follows:

- Chapter 2 summarises the issues raised by the community and provides responses to each issue
- Chapter 3 summarises the issues raised by government agencies and provides responses to each issue
- Chapter 4 describes the changes to the proposal since the display of the REF and the associated environmental impacts
- Chapter 5 outlines the additional environmental studies and assessment that has occurred since the display of the REF
- Chapter 6 provides a summary of all environmental management measures for the proposal including new or revised measures.

2 Response to community issues

Roads and Maritime received 103 community submissions, accepted up until 5 October 2018. Table 2-1 lists the respondents and each respondent's allocated submission number. Multiple submissions from the one respondent have been consolidated to a single submission number. The table also indicates where the issues from each submission have been addressed in Chapter 2 of this report. Government agency submissions are provided in Chapter 3.

Table 2-1: Respondents

Respondent	Submission No.	Section number where issues are addressed
Individual	1	2.2.4
Individual	2	2.2.2
Individual	3	2.2.3
Individual	4	2.11
Individual	5	2.2.3
Individual	6	2.2.5
Individual	7	2.4, 2.11
Individual	8	2.11
Individual	9	2.2.1, 2.2.3, 2.2.5
Individual	10	2.2.2, 2.3.2, 2.5.1
Individual	11	2.3.9
Individual	12	2.6
Individual	13	2.3.4, 2.3.7, 2.5.1,
Individual	14	2.5.1
Individual	16	2.2.4
Individual	17	2.2.2
Individual	18	2.3.9, 2.5.1
Individual	19	2.2.4
Individual	20	2.3.4, 2.6
Individual	21	2.2.3
Individual	22	2.2.5
Individual	23	2.2.3
Individual	24	2.3.1
Individual	25	2.3.9

Respondent	Submission No.	Section number where issues are addressed
Individual	26	2.2.5, 2.3.7, 2.9.2
Individual	27	2.12.2
Individual	28	2.5.1, 2.5.2
Individual	29	2.9.2
Individual	30	2.3.9, 2.9.1
Individual	31	2.3.1, 2.3.6, 2.9.1, 2.9.2
Individual	32	2.3.9
Individual	33	2.3.1
Individual	34	2.9.1
Individual	35	2.3.2
Individual	36	2.5.3
Individual	37	2.11
Individual	38	2.3.3
Individual	39	2.3.6, 2.3.7
Individual	40	2.3.6, 2.12.1
Individual	41	2.3.1
Individual	42	2.2.4, 2.3.1
Individual	43	2.3.4, 2.6
Individual	44	2.3.7
Individual	46	2.3.4, 2.6
Individual	47	2.6, 2.9.1, 2.9.2, 2.9.3
Individual	48	2.2.2
Individual	49	2.2.5
Individual	50	2.2.4, 2.3.4
Individual	53	2.5.3
Individual	54	2.2.1, 2.2.2
Individual	55	2.10
Individual	57	2.2.1
Individual	58	2.11
Individual	59	2.3.1

Respondent	Submission No.	Section number where issues are addressed
Individual	60	2.8
Individual	61	2.2.2
Individual	62	2.3.2, 2.3.7
Individual	63	2.3.6
Individual	64	2.2.2, 2.3.7
Individual	65	2.8
Individual	66	2.3.4
Individual	67	2.3.2, 2.3.6
Individual	68	2.12.2
Individual	69	2.5.1
Individual	70	2.3.2
Individual	71	2.3.9, 2.12.2
Individual	72	2.2.2
Individual	73	2.2.3
Individual	74	2.2.2
Individual	76	2.3.6
Individual	77	2.3.1
Individual	78	2.2.4
Individual	79	2.2.4
Individual	80	2.3.2, 2.3.5, 2.3.6, 2.3.7, 2.3.8
Individual	81	2.2.2
Individual	82	2.3.4
Individual	83	2.12.3
Individual	84	2.8
Individual	85	2.3.3
Individual	86	2.2.3
Individual	87	2.12.1
Individual	88	2.3.7, 2.3.9
Individual	89	2.2.5, 2.5.1
Individual	90	2.3.1

Respondent	Submission No.	Section number where issues are addressed
Individual	91	2.9.2
Individual	92	2.2.2
Individual	93	2.8
Individual	94	2.3.7
Individual	95	2.3.4
Individual	96	2.4
Individual	97	2.3.7
Individual	98	2.2.2, 2.2.4, 2.3.1, 2.3.7, 2.3.9, 2.9.1
Business	100	2.2.4, 2.4, 2.5.1, 2.12.1
Business	101	2.3.2, 2.5.1
Community group	103	2.7, 2.10
Business	104	2.3.2, 2.9.2
Business	105	2.4, 2.5.1
Community group	106	2.2.4
Individual	108	2.2.2, 2.2.4
Community group	109	2.4, 2.7
Community group	110	2.2.4, 2.3.2, 2.4, 2.5.1, 2.9.3
Community group	111	2.2.4
Business	114	2.2.4, 2.3.4, 2.9.3

2.1 Overview of community issues raised

A total of 103 community submissions were received in response to the display of the REF. Each submission has been examined individually to understand the issues being raised. The issues raised in each submission have been extracted and collated, and corresponding responses to the issues have been provided. Where similar issues have been raised in different submissions, only one response has been provided. The issues raised by the community and Roads and Maritime's response to these issues forms the basis of this chapter. Responses to issues raised by government agencies are provided in Chapter 3.

Fourteen per cent of community respondents objected to the proposal, 26 per cent objected to elements of the proposal, 52 per cent offered no position on the proposal while eight per cent of respondents indicated a level of support for the proposal.

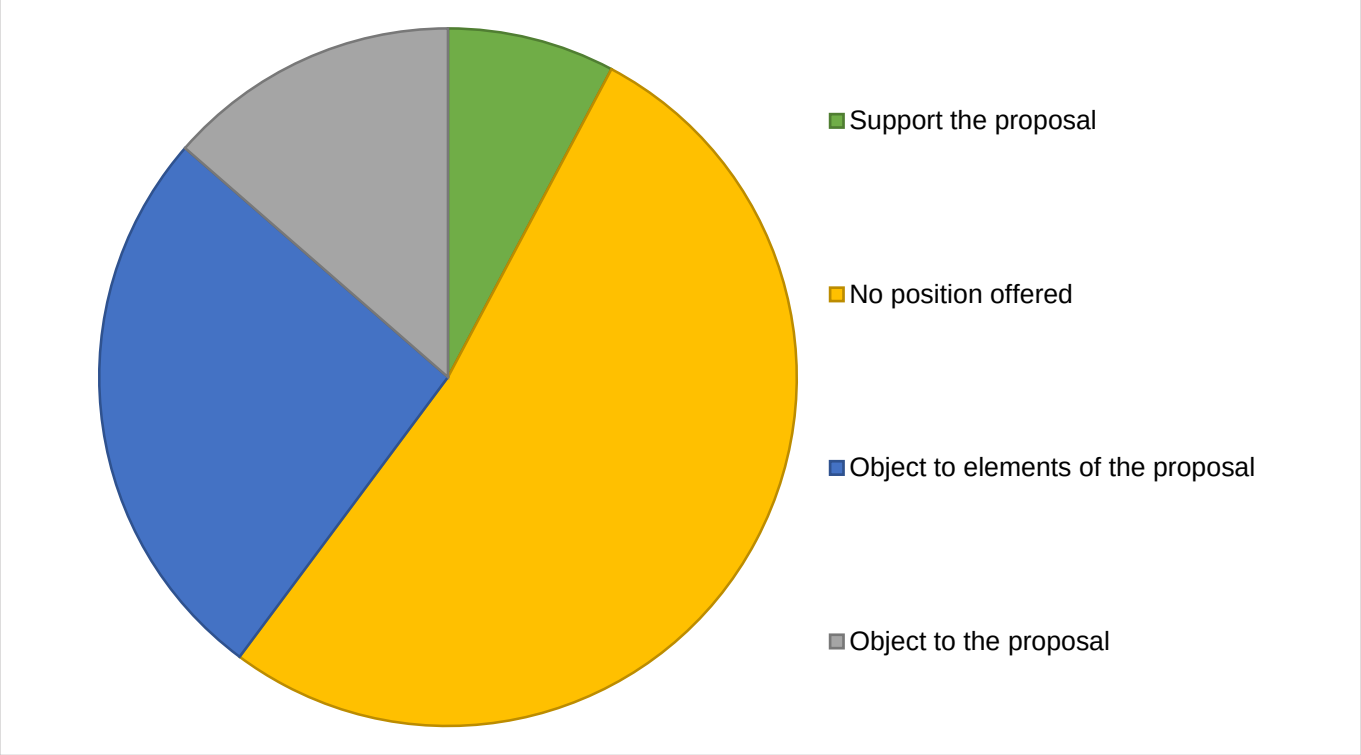

Figure 2-1: Summary of community sentiment to the proposal

The most common issues raised by the community related to:

- Elements of the proposal design including:
  - Intersection layout and configuration including alternate design suggestions for Bolong Road, Illaroo Road and Bridge Road
  - Changes to traffic, operational noise, road safety and visual amenity associated with the new local road connection
  - The proposed timing and anticipated traffic impacts of construction, particularly at Illaroo Road
- Need and options considered during development of the proposal including:
  - The need to consider a bypass of Nowra and Bomaderry
  - Consideration of grade separation at key intersections
  - Continuation of the rail line across the Shoalhaven River
  - Suggestions for alternative options for the bridge and road network
- Consultation, including the level of consultation undertaken during the options identification and selection process and requests for further consultation during the ongoing design
- Traffic and transport impacts including:
  - Traffic modelling undertaken and the anticipated traffic benefits of the proposal
  - Impacts associated with the closure of Pleasant Way and the proposed new local road connection
  - The provision of public and active transport facilities
- Property impacts of the proposal, particularly at Illaroo Road.

2.2 Need and options considered

2.2.1 Need and justification for the proposal

Submission number(s)

9, 54, 57

Issue description

One respondent queried the position presented in the REF that 85 per cent of traffic crossing the river originated within the Nowra Bomaderry area, and in the event that this was the case, there would still be too many vehicles travelling through the main area of Nowra, and that a bypass would be a better option. It was suggested that through traffic was greater than 15 per cent and that a further survey be carried out to confirm this.

A second respondent also queried the statistic of 85 per cent of traffic originating in the local area as they had observed that traffic was constantly heavy

Response

In 2016, the Princes Highway at the Shoalhaven River had an average daily weekday traffic volume of about 52,400 vehicles, making it one of the most utilised sections along the length of the Princes Highway. Traffic volumes on Fridays are about 11 per cent higher than other week days which can be attributed to an increase in through traffic accessing surrounding areas in the Shoalhaven and travelling further south. Sundays and public holidays typically have substantially less total traffic, however peak hour volumes are similar to average weekday peak hour volumes.

During peak holiday periods, such as summer school holidays, long weekends and Easter, through traffic volumes increase as tourists and holiday makers people travel to and from tourist destinations south of Nowra. At the beginning and end of peak holiday periods the network becomes congested, leading to increased queuing and travel time through Nowra and Bomaderry.

Roads and Maritime and Shoalhaven City Council have commissioned origin destination traffic surveys in the years 1994, 2013, 2014 and 2018 to evaluate the traffic patterns in and around Nowra Bomaderry. The surveys were generally undertaken during the shoulder peak periods of February-March and September-October as they represent typical traffic conditions experienced throughout the majority of the year outside of peak holiday periods. An independent assessment (refer Appendix A of this submissions report) of these surveys showed the percentage of through trips, defined as trips which do not start or end within Nowra Bomaderry, has been consistently between 10 and 15 per cent of all trips across the Shoalhaven River bridges across each survey.

The most recent survey undertaken on Wednesday 21 February 2018 showed that of the 53,620 recorded trips across the bridges 6024 (11 per cent) were through trips, 20,926 (39 per cent) were regional trips, defined as having a start or end point within Nowra Bomaderry, and 26,670 (50 per cent) were local trips having both their start and end points within Nowra Bomaderry.

The surveys confirm the majority of trips travelling on the Princes Highway across the Shoalhaven River are local and regional trips with an origin and/or destination within Nowra Bomaderry.

Further discussion regarding a bypass of Nowra is provided in Section 2.2.2.

Issue description

One respondent questioned whether the proposed new bridge could be built as 'fit for purpose' rather than to an arbitrary budget.

Response

The proposal has been developed to meet the identified project primary objectives as stated in Section 2.3 of the REF. Roads and Maritime has also worked to achieve high quality proposal outcomes across secondary objectives related to customer service, time management, budget, environmental impacts and work health and safety.

Following identification of a preferred option that would best meet these objectives, a cost estimate has then been developed for the proposal which is standard procedure for delivering major items of public infrastructure such as the proposal.

Roads and Maritime believes the proposal represents a sustainable and innovative solution which achieves the primary and secondary objectives while demonstrating good value for money.

2.2.2 Bypass options

Submission number(s)

2, 10, 17, 48, 54, 61, 64, 72, 74, 81, 92, 98, 108

Issue description

Thirteen respondents expressed the view that a bypass would be a preferable option to the proposal in addressing congestion within the Nowra Bomaderry area by reducing the volume of through traffic, including heavy vehicles. Several respondents acknowledged that the proposal would go toward addressing traffic congestion but indicated they would still like planning to continue on a bypass of the town.

Response

The local and regional traffic demands to both the north and south of the river crossing, which comprise about 85 per cent of traffic crossing the river, means a new bridge at the existing location is needed to address the issues with the existing southbound bridge and deliver for the planned traffic growth along the current Princes Highway corridor in the Nowra Bomaderry area.

Town bypasses are considered to provide significant benefits in situations where there are a high proportion of vehicles making through trips by reducing congestion and improving road safety. Surveys carried out in 2013, 2014 and 2018 indicate about 85 per cent of journeys crossing of the Shoalhaven River are local and regional trips originating and/or ending within the Nowra Bomaderry area. The findings of the surveys have been corroborated by an independent review carried out in late 2018 (refer Appendix A of this submissions report).

A bypass of Nowra Bomaderry would only take up to 15 per cent of current traffic off the Princes Highway at the Shoalhaven River and not address the need for a new bridge crossing and intersection upgrades at this location. The recently completed Berry Bypass was predicted to take about 75–80 per cent of traffic out of Berry while the Albion Park Rail Bypass is expected to take up to 75 per cent of vehicles out of Albion Park Rail when built.

A bypass has not been proposed as it would not satisfactorily address current and future traffic growth and congestion associated with local and regional trips crossing the Shoalhaven River during normal day to day peak periods.

Transport for NSW's (TfNSW) Future Transport Strategy 2056, which outlines the vision for NSW's transport system over the next 40 years, and the Princes Highway Corridor Strategy both identify the proposal as a short term priority for regional NSW and the Princes Highway. In line with the strategies, the proposal would provide local and regional benefits by:

- improved freight access by removing barriers to high productivity freight vehicles by removing existing constraints to higher mass limit and overheight vehicles crossing the Shoalhaven River at Nowra
- reduced traffic delays and improved journey reliability along the Princes Highway and local road network, especially for forecast growth in day to day peak traffic crossing the Shoalhaven River
- improved road safety for motorists, pedestrians and vulnerable road users
- improved connectivity and accessibility for residents, tourists and emergency vehicles between Nowra and Bomaderry
- Improved connectivity and accessibility for pedestrians and cyclists between Nowra and Bomaderry with the Shoalhaven River foreshore.

A new bridge crossing over the Shoalhaven River on the Princes Highway is required as the existing southbound bridge is in poor condition, has high ongoing maintenance costs, and imposes constraints on higher mass limit (HML) and overheight vehicles.

Roads and Maritime notes that construction of the current proposal would not preclude the future planning of a bypass if and when traffic demand arises.

Section 2.4 of the REF describes the development of strategic alternatives and options, and the process undertaken to select the preferred option.

2.2.3 Rail options

Submission number(s)

3, 5, 9, 21, 23, 73, 86

Issue description

Six respondents raised the matter of including provision for rail on either the proposed new bridge or the existing southbound bridge, with one recommending it should be extended to the Nowra city centre.

One respondent recommended provision be made for a possible future monorail.

Response

TfNSW is the government agency responsible for transport planning, strategy, policy and procurement across all modes of transport in NSW. TfNSW's Future Transport Strategy 2056 is an overarching strategy, supported by a suite of plans to achieve a 40 year vision for NSW's transport system. Future Transport 2056 does not identify extending the South Coast Rail line south into Nowra or further as an initiative for investigation in the short, medium or long term.

Consideration of provision for a future rail crossing of the Shoalhaven River was part of the investigation into strategic alternatives for the proposal as discussed in Section 2.4 of the REF. The alternative would have involved constructing a new bridge east (downstream) of the existing

southbound bridge that could potentially allow for a future rail extension across the Shoalhaven River. Initial evaluation of the strategic alternative noted:

- It would meet most of the proposal objectives but would not necessarily reduce delays and queuing between Bolong Road and Bridge Roads
- A multi-modal bridge would significantly increase the complexity of the design and construction of the new bridge and approaches
- There was considerable community interest in an option that could cater for a future rail extension of the South Coast rail line across the Shoalhaven River into Nowra and potentially further down the south coast
- The alternative presented potential cost benefits by coordinating multi-modal transport needs into a single piece of infrastructure that would offset additional construction costs.

The rail alternative was retained as Option E for further evaluation and assessment against four other route options (Options A to D). The assessment found Option E could provide better opportunities for ease of construction and mitigation of risks due to its semi 'greenfields' nature. However, the uncertainty associated with much of the option (particularly the future rail component) increased the risk of unknown construction issues, design issues and approvals. The option would likely require long complicated bridge structures constructed on soft ground in floodplain areas and would have potential settlement and embankment stability issues. Depending on the chosen alignment, the cost of Option E was estimated to be between three and five times greater than the least expensive options. In view of the identified issues, it was not considered further and a new bridge immediately to the west (upstream) of the existing crossings (Option B) was identified as the preferred route option.

Given that options for rail have been ruled out through the options assessment process described in Section 2.4 of the REF, no provision would be made for a possible future monorail.

2.2.4 Grade separation options

Submission number(s)

1, 16, 19, 42, 50, 78, 79, 98, 100, 106, 108, 110, 111, 114

Issue description

Nine respondents expressed a range of views around options for grade separation covering:

- A preference for grade separation over at grade intersection upgrades
- At grade intersections resulting in continued congestion
- Grade separation providing better traffic flow
- Providing a high level bridge would better allow for grade separation of the intersections to the north and south of the bridge
- Grade separation providing better access to the Nowra CBD
- Grade separation being a better solution to removing through traffic
- The at grade intersection options do not reflect a long term investment in the future of Nowra.

One respondent indicated that they did not agree with the reasons for discounting grade separated options.

Response

Grade separated options have been assessed extensively during the development of the proposal, as described in Section 2.4 of the REF. This included assessing how grade separated intersections would impact traffic flow on the Princes Highway and local road network. The environmental impact of grade separated interchanges was also assessed.

Following the selection of a new bridge immediately to the west of the existing bridges (Option B) as the preferred route option, Roads and Maritime, in consultation with Shoalhaven City Council and other key stakeholders, identified 17 potential intersection options (refer Tables 2-13 to 2-15 in the REF) on the Princes Highway between Bolong Road and Bridge Road. Two further options identified in Shoalhaven City Council's Structure Plan were also considered.

An assessment of the 19 intersection options, including 11 grade separated options, was carried out to identify six network options for the proposal (refer Section 2.4 of the REF and Preferred Option report released in February 2018). The traffic modelling identified that many combinations of grade separated intersection options on the northern and southern sides of the Shoalhaven River introduced inefficient and unsafe weave, merge and queuing issues that do not presently exist on the network. While grade separated options would provide benefits to the local road network, they had an increased level of congestion on the Princes Highway compared to the other network options that were modelled.The modelling also noted:

- Similar intersection options resulted in comparable improvements to intersection and network performance when compared in isolation
- Grade separation on the southern approach would generally result in similar benefits with and without a grade separation on the northern approach
- Grade separation on the southern approach would provide benefits mostly to the highway
- At grade treatments could function adequately for about 25-30 years before any grade separation might be necessary, however this is only the case if a northbound crossing with four lanes is provided with additional lanes on the intersection approaches.

There are a number of significant constraints within and adjoining the road network associated with grade separated options. For example, the land around Bomaderry Creek presents significant geotechnical constraints to road infrastructure design. The land is also flood prone and additional cost would be incurred to achieve the required level of flood immunity. There would also be potential to affect the local flooding patterns which in turn could impact on other properties.

Grade separated options would have greater environmental impacts than the preferred option including additional property acquisition either side of the Princes Highway for the Illaroo and Bolong Road intersections. At Bridge Road, additional property acquisition would be required which could potentially impact on the State heritage-listed Graham Lodge property and other residential and commercial properties located east of the Princes Highway. Further, grade separation at this location would reduce the amount of land available for Shoalhaven City Council plans for development of the Nowra Riverfront Precinct. The potential impact to Aboriginal and non-Aboriginal heritage, property and land use, landscape character and visual impact, the environment and project costs was also considered for each network option. Providing a higher bridge to facilitate grade separation would potentially increase the level of impact to the surrounding environment.

While there are benefits of grade separation relating to traffic flow and reduced congestion, this option would have an increased impact on construction and future maintenance costs, the environment, property acquisition, future land use, landscape character and heritage compared with the proposed design.

The proposal significantly increases the capacity of the existing road network which would provide local and regional benefits by:

- Reduced traffic delays and improved journey reliability along the Princes Highway and local road network, especially for forecast growth in day to day peak traffic crossing the Shoalhaven River
- Improved intersection performance by providing at grade intersections with increased capacity and improved efficiency, ensuring they maintain better levels of service than they currently over the forecast period to 2046
- Improved freight access by removing barriers to high productivity freight vehicles by removing existing constraints to higher mass limit and overheight vehicles crossing the Shoalhaven River at Nowra
- Improved road safety for motorists, pedestrians and vulnerable road users
- Improved connectivity and accessibility for residents, tourists and emergency vehicles between Nowra and Bomaderry
- improved connectivity and accessibility for pedestrians and cyclists between Nowra and Bomaderry with the Shoalhaven River foreshore.

The proposal has been selected as it best meets the proposal objectives by balancing traffic benefits while minimising potential impacts.

Traffic modelling found grade separation is not required unless there is a substantial increase in traffic at this section of the highway. The current design would enable future planning of grade separation if and when the network requires it.

Issue description

One respondent, the Shoalhaven Business Chamber, provided an alternative solution for the proposal which would involve grade separation of the right turn movement out of Illaroo Road. Details provided in the submission include:

- A new single lane bridge and ramp built from the northern side of Illaroo Road, over the Princes Highway and Bomaderry Creek before merging with Bolong Road about 60 metres west of 78 Bolong Road (Scout Hall), removing the need for a right turn from Illaroo Road to the Princes Highway southbound
- Bolong Road and Illaroo Road traffic would merge to a point near Brinawarr Street by providing sufficient merge length for a 60 km/h posted speed limit
- The approach to Bolong Road would be amended to have:
  - A single left lane providing free flow access onto the Princes Highway as an additional lane, removing the current left turn signal phase at Bolong Road intersection
  - Traffic travelling from Bolong Road to Illaroo Road would be provided a single signalised lane for left and right turning traffic, removing any potential weave with southbound Princes Highway traffic
- The Princes Highway southbound would remain two lanes to facilitate the additional lane for Bolong and Illaroo Road traffic
- Traffic signals for southbound traffic area removed at Illaroo Road as a phase is no longer required for traffic turning right out of Illaroo Road. Left turning traffic can be controlled using the current proposed arrangement or splitter island and give way arrangement
- Northbound traffic would be unchanged from the REF proposal

- The two bridges over the Princes Highway and Bomaderry Creek could be provided by 35 metre single span bridges. Impacts to flooding would need to be confirmed
- The north-south pedestrian crossing at Bolong Road would require an appropriate treatment due to the free flow left turn lane from Bolong Road to the Princes Highway.

The alternative solution described by the respondent is similar to intersection Option N6 identified and assessed as part of the proposal (refer Section 2.4.6 and 2.4.7 of the REF). The main difference between the two options is right turning traffic from Illaroo Road merges with the Princes Highway immediately south of Bomaderry Creek in Option N6. Option N6 was reassessed with the alternative solution to determine the benefit of merging right turning traffic from Illaroo Road with Bolong Road or Princes Highway.

Response

A review has been undertaken of the proposed alternative suggested in the Shoalhaven Business Chamber submission. For the purposes of the review, the same assumptions used in assessing the proposal were adopted, in particular future travel demands used in traffic modelling for the proposal.

The analysis of the alternative solution and Option N6 found:

- The alternative solution would result in longer queue lengths on Illaroo Road and Bolong Road in 2046 compared to the proposal. Significant congestion is observed as a result of the merge between Bolong Road and Illaroo Road traffic, resulting in long queues on Illaroo Road in the AM peak hour. In 2046 the number of vehicles entering from Bolong Road and Illaroo Road is forecast to be 2100 vehicles per hour, which is beyond the capacity of a single lane of traffic in free flow conditions.
- The alternative solution would result in longer queue lengths on the Princes Highway southbound compared to the proposal in 2046. The alternative design provides two southbound lanes compared to three southbound lanes in the proposal. Traffic modelling showed the alternative solution has insufficient capacity for the 2300 vehicles per hour forecast to travel southbound on the Princes Highway in 2046, leading to longer queues.
- Similarly, Option N6 has poor performance as a result of having two southbound lanes on the Princes Highway resulting in increased levels of queuing (particularly in the PM peak). Providing a third southbound lane would create a merge point with traffic from Illaroo Road, further increasing congestion.
- Providing a fourth southbound lane on the existing northbound bridge would potentially remove the previous issues identified with the alternative solution and Option N6. A fourth southbound lane would also improve the performance of the proposal.
- Vehicles entering from Illaroo Road in Option N6 were observed to slow down as they enter the Princes Highway to weave across and turn right at Bridge Road to access Nowra CBD. This significantly reduces travel speed, particularly in the AM peak.
- The alternative solution and Option N6 both improve the number of vehicles hours travelled (VHT) based on current traffic demand, however, will deteriorate quicker than the proposal, leading to increased VHT across the model in 2046. This shows the alternative solution would be less congested initially but have higher levels of congestion in the future forecast years.
- Travel time increases for a number of trips across the model, in particular trips between Illaroo Road and Bridge Road in the 2046 AM and PM peak hours and along the Princes Highway southbound in the 2046 PM peak hour. Northbound trips along the Princes Highway would be slightly quicker (10 to 15 seconds) in the alternative solution and Option N6 due to the change in phasing at the Illaroo Road traffic signals.

Overall, the alternative solution and Option N6 would not meet all of the proposal objectives:

- Reduce delays and queuing on the Princes Highway (the alternative solution and Option N6 result in longer queue lengths on the Princes Highway southbound and greater delay across the Princes Highway and local road network when compared to the proposal)
- Reduce ongoing maintenance costs (the alternative solution and Option N6 would have increased whole of life costs compared to the proposal due to additional bridge structures and pavement area)
- Provide the best benefit to our customers (the alternative solution and Option N6 would not provide the best overall traffic benefits to customers with increased queuing and delays on the Princes Highway southbound and Illaroo Road)
- Prioritising the safety of our workers and customers (the alternative solution and Option N6 have increased works over water and flood prone areas that are riskier for construction and maintenance workers. There are number of potential road safety issues with the alternative including additional merge and weave points compared to the proposal)
- Minimise environmental impact (the alternative solution and Option N6 have greater potential impacts than the proposal)
- Deliver a proposal which fits sensitively with the built, natural and community environment (the alternative solution with additional bridges and elevated roadways would have greater landscape character and visual impacts and is not a favourable urban design outcome for the gateway to Nowra).

The alternative solution would not deliver the benefits of the proposal, being,

- Reduced traffic delays and improved journey reliability along the Princes Highway and local road network, especially for forecast growth in day to day peak traffic crossing the Shoalhaven River
- Improved intersection performance by providing at grade intersections with increased capacity and improved efficiency, ensuring they maintain better levels of service than they currently over the forecast period to 2046

Issue description

Two respondents raised the issue of cost in relation to grade separated options. One respondent expressed the view that the at grade intersection option was preferred as it was less costly than grade separation. A second respondent indicated that the cost of grade separation of the intersections would be an extravagance in view of ‘choke points’ beyond the bridge, and that there could also be issues related to obstruction of drivers’ views.

Response

Section 2.4 of the REF provides a detailed account of the assessment of the identified options. Grade separated options were examined initially as part of the analysis of strategic alternatives, and then in further detail in the analysis of intersection options. The analysis considered a range of factors in evaluating the performance of each option with cost being just one factor. As described in a previous response, it was identified that grade separated intersections would provide a small benefit to intersection and traffic performance but this would be disproportionate to the additional cost and greater property and environmental impacts when compared to at grade options.

With regard to the second issue noted, the proposal represents the best value for money for addressing the project objectives and congestion along the Princes Highway between Bolong Road and Moss Street intersections. As part of the design process, the design of the proposal is subject

to a road safety audit process which includes consideration of risks to road user safety including adequate sight lines for drivers and other road users.

Areas of congestion along the Princes Highway outside the proposal will be considered as part of the Illawarra-Shoalhaven Future Transport Plan being prepared by TfNSW and Roads and Maritime Services.

Issue description

One respondent requested clarification regarding whether the proposal included grade separation of intersections.

Response

Roads and Maritime confirms that the proposal does not provide for grade separation of intersections.

2.2.5 Alternative options

Submission number(s)

6, 9, 22, 26, 28, 49, 89

Issue description

Four respondents raised various issues around other options, or variations of options, for the proposal as follows:

- Construction of a double-deck bridge to allow use of the upper deck by Illaroo Road traffic thereby reducing congestion at the Illaroo Road/highway intersection
- Retaining the concrete bridge for southbound traffic only
- Why preference was given to locating the new bridge to the west of the existing bridges, when there would be less impact on the eastern side
- The existing southbound bridge could still be used to carry traffic.

Response

Section 2.4 of the REF provides a detailed account of the strategic alternatives and options considered, including a double-deck bridge. This noted that building a new 'double deck' bridge next to the existing bridges would introduce construction difficulties and costs with little additional benefit, and would require large complex intersections and new infrastructure either side of the bridge to maintain connections with the existing road network. In view of these issues, this option was not considered further.

The proposal does provide for the transfer of southbound traffic to the existing northbound bridge once the new northbound bridge is constructed.

An option immediately to the east of the existing southbound bridge was included in the five route options investigated for the proposal, described in Section 2.4.5 of the REF. This option would impact more properties and businesses (such as the Perfect Catch Seafoods and Takeaway and the Wharf Road Restaurant and Bar on the northern and southern sides of the river respectively) than several of the other options. It was identified that an eastern bridge option would:

- Potentially interfere with the load bearing foundations on the existing southbound bridge, introducing a risk of destabilising the bridge during construction

- Require pedestrians and cyclists to access the existing southbound bridge between the southbound and northbound carriageways, thus reducing the safety of vulnerable road users
- Potentially affect the heritage values of the existing southbound bridge by obstructing views to the bridge from viewpoints to the east of the bridge
- Complicate demolition of the existing southbound bridge, should it be required in the future.

One of the key drivers for the proposal is the condition of the existing southbound bridge. Section 2.2.2 of the REF notes that in general, the ongoing maintenance 'whole of life' costs are higher for an aging iron truss bridge structure compared to a modern cost effective structure. It also noted that if Roads and Maritime was to address only the works identified in the most recent condition assessment, this would potentially require full closure of the bridge for around 12 to 18 months. In addition to maintenance, the REF also identifies that restrictions apply to the existing southbound bridge for overheight and HML heavy vehicles. In view of these and related issues, the preferred option is to remove vehicular traffic from the existing southbound bridge by building a new four lane northbound bridge rather than retaining the existing southbound bridge for use by vehicle traffic.

Issue description

Two respondents considered the proposed four lanes on the new northbound bridge would not be sufficient, and recommended that the number of lanes be increased. A third respondent expressed the view that putting more lanes on the bridge would not ease traffic flow.

Response

The design of the proposal has been informed by detailed traffic modelling which has considered the existing traffic demand as well as future demand, with the modelling considering traffic growth out to 2046. This identified that current and future traffic demand would be adequately met with four lanes (three through, one left turn) on the new northbound bridge and presented the best value for money. The four lane bridge option, which includes widening Bomaderry Creek, provides three traffic lanes in each direction on the Princes Highway between Bolong Road and Moss Street. A three lane bridge option was investigated as part of the analysis of intersection and network options and found to reach capacity well before four lane bridge options. Further discussion on how traffic growth has been considered for the proposal is given in Section 2.5.1.

2.3 The proposal

2.3.1 Bolong Road

Submission number(s)

24, 31, 33, 41, 42, 59, 77, 90, 98

Issue description

Three respondents raised the issue of the changes to the right turns into and out of Bolong Road and the associated changes to the traffic lanes. These related to why the existing northbound lanes would not be retained for through traffic with the proposal now requiring this traffic to stop, and why the existing merge lane for right-turning traffic from Bolong Road had been removed. Several expressed the view that this would not contribute to efficient movement of northbound traffic.

Response

The proposed changes at Bolong Road intersection relate principally to eliminating road safety hazards associated with heavy vehicles turning right out of Bolong Road. Bolong Road is currently a designated B-double truck route, allowing vehicles up to 26 metres in length. Future upgrades of Bolong Road may lead to newer high productivity freight vehicles, with lengths up to 30 metres and weight up to 85 tonnes, being approved.

A road safety audit carried out for the proposal identified a potential risk to road users associated with the right to left merge, specifically where vehicles travelling north on the Princes Highway at the posted speed limit of 70 km/h are not anticipating a merge. The risk is increased for heavy vehicles due to the slow speeds at which they operate along this section of the highway and larger blind spots that exist on the left of a right-hand drive vehicle. The existing right to left merge is not the preferred intersection layout for this type of arrangement and vehicle. The proposed intersection arrangement will remove any potential conflict with northbound traffic when heavy vehicles are turning on to the highway from Bolong Road.

The impact on northbound traffic having to stop at the traffic signals has been considered as part of the traffic modelling for the proposal. The traffic modelling shows the intersection will perform an acceptable level of service up to 2046 due to the demand of right turning traffic from Bolong Road being low.

Issue description

One respondent expressed they still held reservations regarding traffic flow when merging from three to two lanes north of Bolong Road.

Response

A merge from three lanes to two lanes is required north of Bolong Road to connect the proposal to the existing road network which comprises of two lanes northbound.

Traffic modelling carried out for the proposal has considered the merge from three to two lanes north of Bolong Road and the potential impacts to the efficiency of the network in the forecast period. The modelling shows the Princes Highway and all intersections within the proposal would operate at a higher level of service in 2046 than is currently experienced, with the merge from three lanes to two lanes at Bolong Road in place.

Providing three lanes further north of Bolong Road is beyond the scope of the project.

Issue description

Two respondents expressed concern about safety issues for southbound traffic approaching the Bolong Road intersection. These related to the steep gradient approaching the intersection, the limited visibility of the traffic signals, and the short amount of time to react to the signals.

One respondent indicated that it was assumed that the right hand turn at Bolong Road will be permitted only when the northbound traffic is stopped at Illaroo Road.

Response

Development of the design for the proposal has included consideration of all relevant road safety requirements. This has included formal road safety audits to verify that all requirements have been met, and to identify any outstanding issues that would need to be addressed during the next stage of design. The sight lines for southbound traffic approaching Bolong Road will be reviewed during the next stage of design.

There are some significant constraints to fully addressing all safety issues along this section of the highway. The section of the highway between Bolong Road and the Shoalhaven River includes two intersections and the Bomaderry Creek crossing within a relatively short distance (about 300 metres). This has presented a number of significant design challenges with regard to integrating the intersection upgrades and the widening of Bomaderry Creek bridge while concurrently seeking to minimise impacts as far as practicable. This also influences how the northern end of the proposal ties into the existing highway to the north with regard to both the vertical and horizontal road alignments. Widening of the highway to the east to the south of Bolong Road would require major earthworks to carry the road formation, would impact on the adjacent property and require acquisition. This would also impact on the widening of Bomaderry Creek bridge and present several major design challenges in connecting the road pavement to the bridge deck.

Widening the highway to the east north of Bolong Road would incur greater impacts on the property at the corner of the highway and Bolong Road which is listed as a local heritage item, potentially diminishing its heritage values.

Issue description

Two respondents raised the issue of traffic turning left onto the highway from Bolong Road, one indicating that traffic should be able to turn left without stopping at the traffic signals, and one suggesting that there should be a dedicated lane provided on the highway for traffic turning left from Bolong Road.

Response

A left turn without stopping at traffic signals from Bolong Road to the highway is not supported due to road safety concerns associated with the merging of turning traffic with through traffic on the highway, particularly with regard to traffic that then want to turn right at Illaroo Road.

A dedicated left turn lane from Bolong Road to the highway would require a merge before the Illaroo Road intersection. This would introduce road safety issues associated with merging/weaving traffic. It would also require additional acquisition of property and additional widening of Bomaderry Creek bridge.

2.3.2 Illaroo Road

Submission number(s)

10, 35, 62, 67, 70, 80, 101, 104, 110

Issue description

One respondent expressed concern that the operation of the Illaroo Road intersection had not been addressed and that it was ‘still a 19th Century crossover’. A second respondent indicated traffic demands from Illaroo Road would only be met for up to 10 years under the current demands.

Response

The Illaroo Road intersection will be upgraded to provide three dedicated right turn lanes for southbound traffic and a dedicated left turn lane for northbound traffic. The design of the intersection has been informed by traffic modelling carried out for the proposal which has identified existing and forecast traffic demands on the intersection. The proposal also provides additional capacity on the highway with three lanes in both directions from Bolong Road to north of Moss Street. This will also contribute substantially to the performance of the Illaroo Road intersection.

A detailed investigation was carried out for eight intersection options on the section of the highway north of the river (refer Sections 2.4.5 and 2.4.6 of the REF), considering a range of issues including traffic efficiency improvements, impacts on heritage, environment, property, and future land use. This informed the decision-making to arrive at the preferred option for the proposal, including the configuration of the Illaroo Road intersection.

Section 6.1.3 of the REF discusses the performance of the upgraded intersections relative to the current situation. For Illaroo Road, it indicates that based on the traffic modelling forecasts, there would be an improvement in the performance of this intersection going from the current LoS F to LoS B or better until 2046 in the peak hour periods. This is due to the significant increase in capacity at the intersection with an additional right and dedicated left turning lane provided on Illaroo Road and three through lanes on the Princes Highway in each direction. However, on Illaroo Road, while there would be improved performance, by 2046 this would have decreased particularly for the PM peak when the LoS would be similar to current levels.

Further discussion of grade separation is provided in Section 2.2.4 of this submissions report.

Issue description

One respondent expressed concern that Figure 4.1 of the Preferred Option Report suggested that total annual travel time will be back at 2018 levels in 2026/27. The respondent noted that existing intersections, particularly Illaroo Road had queues of over 250 metres during the AM peak period. It was queried how adding a northbound lane on the Princes Highway and a short left turn lane would reduce this as the amount of green light time out of Illaroo Road was unlikely to change significantly.

Response

Figure 4.1 of the Preferred Option Report shows predicted network delays, expressed as vehicle hours travelled (VHT) for the base case and for shortlisted options for the period 2015-2045. VHT is not a representation of individual vehicle travel time. It is a measure of the total travel time for all vehicles in the network being modelled/investigated. As the number of vehicles in the network increases (due to forecast traffic growth in the area) so will VHT. The traffic modelling indicates, as a result of the capacity improvements associated with the proposal, the average time spent by vehicles travelling on the road network would be lower up until the year 2046 compared to that currently experienced.

Issue description

Two respondents raised concerns about the left turn from Illaroo Road onto the highway. One respondent questioned whether two left turn lanes and two right turn lanes out of Illaroo Road should be provided rather than one left turn and three right turn lanes currently proposed. A second respondent asked whether any consideration had been given to the dedicated left turn lane from Illaroo Road being increased to provide two lanes from about 30-40 metres before the traffic signals to allow a larger number of vehicles to turn left.

Response

The current design of the intersection, including this left turn movement, has been based on the forecast traffic demands for the intersection. The traffic modelling carried out for the proposal assessed the demand on the Illaroo Road intersection for the ‘do minimum’ scenario, i.e. without the proposal. This is summarised in the following table. This shows that the left turn demand for the AM peak is about 25 per cent of total demand while for the PM peak it is about 32 per cent.

Table 2-2: Forecast number of left turn movements and total demand for all vehicles from Illaroo Road

Forecast year	AM period		PM period	
	Left turn	Total	Left turn	Total
2026	298	1205	265	831
2036	348	1406	310	970
2046	398	1609	355	1110

The removal of right turning traffic from the left turn lane (as currently exists) will provide sufficient capacity for left turning traffic with a single lane. The modelling forecasts queue lengths on Illaroo Road to increase over time but all queued traffic would typically clear during each green light phase of the intersection up until 2046. In view of the forecast demand and intersection performance, the need for an additional left turn lane is not considered justified.

The proposal does not include an acceleration lane for northbound traffic turning left from Illaroo Road onto the highway. This section of the highway is heavily constrained and there are significant challenges in providing an additional lane to what is provided in the design for the proposal. The inclusion of an acceleration lane would increase weave and merge risks due to those motorists turning right into Bolong Road from Illaroo Road, or require a physical barrier or kerb to prevent the weave manoeuvre. An additional lane would require further widening of Bomaderry Creek bridge, further property acquisition, increased heritage impacts, and require four lanes to merge back to two lanes north of Bolong Road.

Issue description

Two respondents raised potential safety concerns associated with the left turn from Illaroo Road to the highway. One respondent indicated there was a potential safety concern in relation to sufficient sight distance to the right at the intersection. One respondent expressed concern that the left turn from Illaroo Road to the highway could be prone to accidents, and whether it could join the highway further north near Bomaderry Creek bridge.

Response

The intersection has been designed to applicable design standards regarding the approach angle and sight distances to provide for a safe left turn onto the highway. The pedestrian crossing in this lane will be signalised and will operate on demand via a yellow then red arrangement.

There are several major technical constraints associated with shifting the connection to the highway further north, including conflicts with drainage infrastructure and with tying into the bridge approaches.

The current design of the proposal has been subject to a road safety audit which did not identify any specific issues with this turning movement. The ongoing performance of the intersection will be considered during future audits and monitored once the intersection is operational.

Issue description

One respondent asked whether the inclined section of Illaroo Road to and from the highway was going to be too steep or whether the whole intersection was being elevated.

Response

Illaroo Road would be widened over a distance of about 270 metres to provide three dedicated right turn lanes and one dedicated left turn lane to the Princes Highway, and a westbound acceleration lane for northbound traffic turning off the Princes Highway. This will include regrading this section of Illaroo Road to provide a less steep and constant incline down to the highway, and safer movements for vehicles, cyclists, and pedestrians. The level of the intersection will be essentially unchanged due to the existing levels of the highway and existing bridges to the north and south of the intersection.

Issue description

One respondent raised the issue of existing difficulties with access to and from the golf club, particularly for traffic turning right from Fairway Drive. It was noted that this was also the only access to the Greys Beach boat ramp and use of the intersection by vehicles towing boat trailers increased the risk to other vehicles travelling through the intersection. The popularity of the golf course and the use of its facilities were also identified as contributing to traffic on Fairway Drive.

The respondent also asked whether there would be three lanes from the highway to Fairway Drive, with the southern-most lane being a left turn only.

Response

Road and Maritime has carried out additional investigations in response to submissions received (traffic counts, SIDRA analysis) to assess demand on the Illaroo Road/Fairway Drive intersection in relation to the proposal (refer Section 5.1 of this submissions report). The analysis identified that the intersection would perform acceptably up until about 2026, beyond when it was forecast that the Fairway Drive approach would experience significant delays. Despite the relatively small amount of traffic exiting Fairway Drive (up to about 100 vehicles in total during peak hours), the heavy through movement on Illaroo Road restricts the ability of vehicles to turn right out of Fairway Drive.

The analysis identified two potential solutions to address this issue as follows:

- Installing ‘keep clear’ line-marking at the intersection to allow vehicles exiting Fairway Drive a sufficient gap to join the back of the eastbound queue on Illaroo Road
- Banning the right turn movement out of Fairway Drive. Vehicles wanting to access the Princes Highway would travel west on Illaroo Road and undertake a U-turn at the roundabout at McMahons Road.

The road safety audit carried out for the 80 per cent concept design identified a number of matters related to the intersection of Fairway Drive and Illaroo Road, and a potential weaving issue with traffic turning right from the highway into Illaroo Road wanting to access Fairway Drive. These will be further investigated during detailed design. A further road safety audit will be carried out to identify any remaining safety issues.

There are no plans to provide a left turn lane to Fairway Drive. The proposal provides for a short acceleration lane for left turning traffic from the highway into Illaroo Road. For safety reasons, the acceleration lane will end prior to Fairway Drive.

2.3.3 Scenic Drive

Submission number(s)

38, 85

Issue description

One respondent asked why the intersection at Bridge Road and Scenic Drive had been changed to left in, left out.

Response

The proposal shifts the northbound traffic lanes to align with the new northbound bridge, and has also required the reconfiguration of the existing Bridge Road intersection. The proposed realignment and changes to the intersection has reduced the length available for a right turn lane into Scenic Drive. In the current configuration, vehicles waiting to turn right into Scenic Drive queue back into the Bridge Road intersection. This queuing would cause delays to traffic turning right into Bridge Road from the Princes Highway, reducing the overall efficiency of the intersection which in turn causes queuing on the existing southbound bridge.

The redistribution of traffic from Scenic Drive to Hyam Street has been assessed in Section 5.1 of this submissions report. The assessment has found the redistribution of traffic would not affect the performance of the Bridge Road/Hyam Street intersection in the short or medium term. The proposal will also eliminate traffic queuing back into the Princes Highway and Bridge Road intersection, improving the efficiency of the intersection and Princes Highway.

Issue description

One respondent expressed concern about emergency vehicles not being able to turn right into Scenic Drive from Bridge Road which is currently permitted. It was indicated that this change would cause delays for emergency service vehicles if alternative routes, such as Hyam Street, had to be used.

Response

As part of the traffic survey the number of emergency vehicles and the direction in which they were travelling was surveyed over two days between 7am to 10am and 2:30pm to 5:30pm. The survey showed that on 19 October 2018, one ambulance turned right into Scenic Drive in the morning period and three ambulances turned right during the afternoon period. On 26 October 2018 four and one ambulances turned right into Scenic Drive in the morning and afternoon periods respectively.

In terms of distance travelled, it is about 820 metres from the intersection of Bridge Road and Scenic Drive via Scenic Drive to the emergency department at the hospital, and about 855 metres via Bridge Road, Hyam Street and Shoalhaven Street. The additional distance is not anticipated to cause any additional delay to emergency vehicles.

The redistribution of right turning traffic from Scenic Drive to Hyam Street is not anticipated to impact the intersections performance in the short to medium term and therefore is not expected to cause delays to emergency vehicles accessing the Shoalhaven District Memorial Hospital. The redistribution of local traffic is further described in Section 5.1 of this submissions report.

2.3.4 New local road connection

Submission number(s)

13, 20, 43, 46, 50, 66, 82, 95, 114

Issue description

One respondent asked if the new local road connection could be developed concurrently with the Pleasant Way closure. It was noted that outside the peak times of school drop off and pick up at

Nowra High School, Moss Street traffic lights take three to four changes to allow local traffic through, and this could increase without the new local road being ready on time.

Response

The new local road connection will be constructed and opened prior to the closure of the Pleasant Way intersection with the Princes Highway.

Issue description

Two respondents were concerned that the new local road connection would have a permanent effect on the amenity of residents in Lyrebird Drive, resulting in an irreversible change to their quality of life and property value, and permanent changes to the semi-rural outlook from their properties. Particular concern was expressed in relation to noise and dust during construction, increased traffic and noise following completion of the proposal, including reduced road safety, particularly for children.

Response

The REF has included an assessment of the impacts of the proposal on amenity related to changes to local traffic, traffic noise, and other related matters associated with construction and operation of the proposal.

Construction

During construction, it is anticipated there would be a temporary reduction in amenity associated with dust and noise emissions related to construction activities, and with the movement of construction vehicles through the local road network.

Noise emissions will be managed through a Noise and Vibration Management Plan (environmental management measure NV1). This will include arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures. A range of other safeguards have been identified to mitigate and manage noise and vibration impacts, and are listed in Table 6-1.

Impacts on air quality associated with construction activities are expected to be minor, and related mainly to the generation of dust which could affect the amenity of receivers in proximity to construction works. Air quality impacts due to dust generation would be minimised through the implementation of established safeguards and management measures via an Air Quality Management Plan (AQMP) that will be prepared by a suitably qualified and experienced person(s) in consultation with the EPA and implemented as part of the CEMP (environmental management measure AQ1). Environmental management measures AQ2 to AQ4 specifically target dust emissions related to construction activities.

Movement of construction traffic will be managed through Traffic Management Plan (TMP) that will be prepared prior to the commencement of construction (environmental management measure T1). This will include requirements and methods to consult and inform the local community of impacts on the local road network. Implementation of the TMP will minimise inconvenience to local road users associated with the movement of construction vehicles through the local road network.

Operation

Section 6.2.4 of the REF notes there would be an increase in traffic volumes on Lyrebird Drive associated with the new local road connection for the year of opening (2022) and design year (2032, 10 years after opening) . Based on 2017 surveys, the total traffic volume using Lyrebird Drive between 7am and 10pm is 42 vehicles travelling westbound and 81 vehicles travelling eastbound.

The forecast total traffic volume on Lyrebird Drive between 7am and 10pm is presented in Table 2-3 for the opening year and design year.

Table 2-3: Forecast total traffic volume on Lyrebird Drive (7am to 10pm) for the build scenario

Forecast year	Total volume west of new local road connection		Total volume east of new local road connection	
	Westbound	Eastbound	Westbound	Eastbound
2022	330	355	117	181
2032	383	411	135	210

The operational noise assessment did not identify any residential receivers in Lyrebird Drive for consideration for additional noise mitigation reflecting that none of the residences in Lyrebird Drive would experience an increase in traffic noise above the traffic noise criteria used for the noise assessment (as detailed in Section 6.2 of the REF). Environmental management measure NV15 provides for post-construction noise monitoring to be carried out within 12 months of completion of the proposal at representative locations within the proposal area. These locations would be confirmed during detailed design with the information collected being used to confirm the predicted changes in the REF, and to identify whether any additional receivers would qualify for consideration for noise mitigation.

It is noted that the land on the southern side of Lyrebird Drive to the east of the new local road connection is zoned for residential development (R2). At the time of preparation of this report, six residences had been constructed, and construction is currently underway on another residential development to the west of new local road connection. This will already have changed the outlook from residences on the northern side of Lyrebird Drive, and the incremental impact of the new local road is considered to be minor.

Issue description

One respondent requested that consideration be given to tree plantings to mitigate noise and pollution from closing Pleasant Way.

Response

Vegetation is not identified as an effective noise mitigation measure in the Roads and Maritime *Noise Mitigation Guideline* (Roads and Maritime (2014) and therefore has not been considered for the proposal. The proposal does, however, provide for revegetation, landscaping and plantings through the Urban Design and Landscape Plan (UDLP) that will be prepared for the proposal (environmental management measure LV1). This will include the area adjacent to the southbound carriageway of the Princes Highway taking in the current Pleasant Way connection. Existing vegetation will be retained where practicable (environmental management measure LV2), and further investigation will be carried out into the potential installation of retaining walls in this area to reduce impacts on existing vegetation, particularly mature trees (environmental management measure LV4).

Issue description

One respondent expressed concern about the safety of pedestrians and children associated with the new local road connection, particularly with the increase in motor vehicles using Lyrebird Drive and passing Nowra High School.

Response

The new local road connection will have a posted speed limit of 50 km/h which is the same as the speed limit in place along Lyrebird Drive and other local roads in the area. There will be a stop sign at the end of the new local road requiring all vehicles to stop before turning into Lyrebird Drive. The forecast total traffic volume using Lyrebird Drive is presented in an earlier response in Table 2-3. While there will be an increase in the number vehicles, it is not anticipated that this will result in a change to the safety of pedestrians in this area.

The redistribution of traffic from Pleasant Way is anticipated to increase the number of vehicles using Moss Street by 33 and 50 vehicles in the AM and PM peak hour periods respectively. A review of the crash and casualty statistics for the location for the period 2013 to 2017 inclusive did not identify any incidents outside the high school. The existing school zone outside the Nowra High School will remain unchanged. The increase in traffic volume is anticipated to have a negligible impact on the safety of road users and pedestrians along Moss Street.

Issue description

One respondent expressed concerned that the closure of Pleasant Way and its replacement with the new local road connection will greatly affect businesses to the east of the highway, and could result in a loss of jobs. The respondent stated that accessing the Riverside Road area via Moss Street/Ferry Lane would be less convenient, requiring further distance to travel and that the closure of Pleasant Way may result in tourists and newcomers to Nowra bypassing the area. The respondent requested that Pleasant Way be kept open with left in, left out access to minimise business impacts.

Response

The proposed closure of Pleasant Way is principally due to the benefits it has on the operation and performance of the Princes Highway/Bridge Road intersection. The removal of the Pleasant Way signal phase allows more green time for the Princes Highway and right turn into Bridge Road, reducing the overall delay to motorists. The proposed closure of Pleasant Way also enables the Princes Highway/Bridge Road intersection to be moved further south, increasing the amount of available storage for vehicles waiting to turn right into Bridge Road and reduce queueing on the southbound bridge.

Maintaining left in, left out access with short deceleration and acceleration lanes is not considered suitable due to impacts to the proposed shared path and resultant reduction in pedestrian connectivity, as well as the potential impacts on the heritage curtilage of Graham Lodge.

Consultation with the business operators during construction will be managed through the Community and Stakeholder Engagement Plan. Existing businesses with authorised Tourist Attraction Signposting Assessment Committee (TASAC) approved signage will be consulted to develop revised signage if impacted by the proposal (refer environmental management measure SE9). The location(s) of any such the signage will be discussed with the respective business operators. The provision of permanent signage will be investigated as part of detailed design as part of the overall signage design package for the proposal.

Roads and Maritime confirm Pleasant Way will remain open until construction of the new local road is completed and operational.

2.3.5 Bomaderry Creek bridge

Submission number(s)

80

Issue description

One respondent asked whether Bomaderry Creek bridge will be replaced as part of the proposal.

Response

The proposal includes work on Bomaderry Creek bridge. This will involve demolition of the existing footpaths and widening of the structure on both sides. The widened bridge will have a deck length of about 48 metres spanning over two piers between the north and south abutments. This will provide six 3.5 metre traffic lanes, two 1.0 metre shoulders, and two 2.5 metre shared paths.

2.3.6 Shared use paths

Submission number(s)

31, 39, 40, 63, 67, 76, 80

Issue description

Seven respondents raised issues relating to shared paths and pedestrian facilities, as follows:

- Providing safe access for pedestrians and cyclists
- Providing paths of sufficient width for cycling
- Pedestrian crossing facilities at the Illaroo Road intersection
- Whether there would be a pedestrian crossing at the Princes Highway/Pleasant Way intersection, and if so, it is was suggest that there should not be due to impacts on traffic. A pedestrian/cycle overpass/underpass at the Scenic Drive, Bridge Road and Princes Highway intersection would improve safety for pedestrians as well as remove a set of traffic lights for southbound traffic on the Princes Highway at Bridge Road
- Support for the provision of pedestrian and cyclist facilities on the existing southbound bridge and whether there would be a safe route to walk/cycle between Nowra and the TAFE
- Whether the walkways under the bridges on the northern and southern sides of the river were being upgraded and would have a width of 2.5 metres.

Response

Shared use paths are an integral component of the proposal to facilitate safe movement of pedestrians and cyclists through the proposal area, and to connect to and complement existing cycle and pedestrian routes. The new northbound bridge will have a 3.5 metre wide shared use path on the western side of the bridge which will connect to existing footpaths north and south of the bridge.

The proposal includes significant improvements for active transport users including a shared use path with a minimum width of 2.5 metres east of the highway linking the existing southbound bridge and Moss Street. This new shared path will also connect to the existing shared path (Ben's Walk) that runs along the southern foreshore of the Shoalhaven River, with the section beneath the new and existing bridges to be upgraded as part of the proposal. Connections to an upgraded path will be provided on the northern side of the river. Collectively, these will provide substantial

enhancements to active transport within and beyond the proposal area. The final designs of the shared use paths will be confirmed during detailed design, including path widths.

Pedestrians will be able to safely cross the Princes Highway and Illaroo Road via the crossings that would operate under the traffic signals at the intersection. The crossings will provide connections to existing pedestrian routes and to the new shared use paths. The pedestrian crossing at the upgraded Bridge Street intersection will be retained to allow pedestrians to safely cross the Princes Highway. This has been allowed for in the traffic modelling carried out for this intersection, and will not affect the performance of the intersection.

As part of additional investigations carried out by Roads and Maritime following exhibition of the REF, pedestrian counts were recorded on 19 and 26 October at five locations including the path beneath the existing bridges on the southern bank of the river ('Ben's Walk'). The surveys recorded pedestrian numbers for the AM and PM peak periods and are summarised in the following table.

Table 2-4: Recorded pedestrian volumes at Shoalhaven River bridges southern underpass

Date	AM period 7.00am to 10.00am		PM period 2.30pm to 5.30pm	
	Eastbound	Westbound	Eastbound	Westbound
19 October 2018	62	70	48	51
26 October 2018	35	47	42	39

In view of the relatively low existing pedestrian demand in this location, it is not considered warranted to provide an additional grade separated pedestrian crossing at Bridge Road. Safe crossing of the highway is provided for pedestrians through the traffic signals at the upgraded intersection. The proposal will improve the existing path beneath the river crossings, potentially making it more attractive to active transport users and in turn reducing demand on the at grade crossing at Bridge Road. A grade separated pedestrian crossing would not remove the need for traffic signals as these would still be required to allow safe turning for southbound traffic into Bridge Road.

Safe pedestrian and cycle access between Nowra and the TAFE will be available via existing and new crossings and shared use paths.

2.3.7 Construction

Submission number(s)

13, 26, 39, 44, 62, 64, 80, 88, 94, 97, 98

Issue description

Seven respondents asked when construction of the proposal would start and how long it would take to build.

Response

There are a number of steps following the environmental assessment, including project approval, detailed design, and pre-construction activities that would need to be completed before construction can commence. Roads and Maritime is currently targeting the start of major work in 2021, with project completion in 2025.

Issue description

Three respondents noted the impacts that construction activities would have on the Illaroo Road intersection, resulting in consequent impacts for residents of North Nowra and other areas such as Bangalee, Tapitalee, and Cambewarra.

One respondent asked whether there would be any restrictions for eastbound traffic on Illaroo Road turning onto the highway during construction while another stressed the importance of maintaining access through the intersection at all times, particularly for emergency services and to provide an evacuation route during a major bushfire.

Response

The REF recognises the impacts that construction activities will have on traffic using Illaroo Road. These will be managed through a TMP which will be prepared and implemented as part of the CEMP (environmental management measure T1). The TMP will be prepared by the construction contractor for approval by Roads and Maritime and other relevant authorities. It will address, among other matters:

- Measures to maintain access to local roads and properties
- Site-specific traffic control measures (including signage) to manage and regulate traffic movement, such as through the Illaroo Road intersection
- Requirements and methods to consult and inform the local community of impacts on the local road network.

At times, construction works may require the temporary closure of individual traffic lanes, however, the intersection of Illaroo Road and the Princes Highway will remain open during construction.

Issue description

One respondent requested that access for cyclists and pedestrians be maintained during construction.

Response

The construction contractor will be required to provide safe access for pedestrians and cyclists through the site at all times during construction. This will be addressed through the TMP.

2.3.8 Existing northbound bridge

Submission number(s)

80

Issue description

One respondent questioned whether the current northbound bridge is designed for three lanes as they were previously advised it was only designed for two lanes.

Response

The capacity of the existing northbound bridge to carry three lanes of traffic has been reviewed as part of the concept design, and has been determined as adequate.

2.3.9 Support for the proposal

Submission number(s)

11, 18, 25, 30, 32, 71, 88, 98

Issue description

Eight respondents expressed general support for the proposal or aspects of the proposal.

Response

Roads and Maritime has noted this support for the proposal.

2.4 Community consultation

Submission number(s)

7, 96, 100, 105, 109, 110

Issue description

Three respondents considered that Roads and Maritime had not provided the community with the opportunity to study and comment on other options. It was Roads and Maritime should afford the community better consultation and review some of the possible design options and suggestions from Council, the Shoalhaven Business Chamber and other members of the business community.

Response

As detailed in Section 5.2 of the REF, consultation with the community commenced in November 2013 with five community sessions held to give the community the opportunity to submit ideas for the project and provide feedback on the future of the existing southbound bridge. The key issues raised and ideas submitted were used to develop seven strategic alternatives for assessment.

In May 2014, Roads and Maritime undertook a value management workshop to evaluate five identified route options for a new crossing of the Shoalhaven River. Prior to the workshop, two community representatives were selected to participate after expressions of interest were advertised in local newspapers, media outlets, emailed to the project stakeholders, and flyers distributed to nearby residents. The workshop participants also included key stakeholders from Shoalhaven City Council, government agencies and Shoalhaven Business Chamber.

In June 2014, Roads and Maritime released the *Nowra Bridge Project Site Options Development Report* and invited the community to provide feedback on the preferred location for a new bridge. Community information sessions were held at Stockland Nowra and attended by over 950 community members and an online survey received 456 responses during the consultation period. The key issues raised by the community were used to further develop the design and the project.

In late 2014, the community was also invited to provide feedback on options for the existing southbound bridge between the 15 October and 19 December 2014. During the consultation period, nine community sessions were held four locations across Nowra and Bomaderry and were attended by over 1850 community members. Roads and Maritime also reviewed 38 written submission, 676 online survey responses and six suggestions on Facebook during the display period. The majority of responses indicated the bridge should be retained in some form.

After the selection of the preferred route option, 19 potential intersection options were compiled in consultation with Shoalhaven City Council and other key stakeholders. The intersection options were evaluated and the results used to develop six network options for assessment.

In February 2018, the preferred option was announced and the community was again invited to provide feedback between 19 February 2018 and 23 March 2018. Five community session held during the display period were attended by 630 people. Roads and Maritime also received 84 written submissions, 250 online and written survey form responses from community members, interest groups, transport providers, local businesses and government agencies, including Shoalhaven City Council. The issues raised and the outcomes of this round of consultation are documented in the Community Consultation Report available on the Roads and Maritime website.

The key issues raised by the community and key stakeholders during each display period have been considered by Roads and Maritime and used refine the concept design of the proposal where appropriate. Roads and Maritime will continue to consult with the community, Shoalhaven City Council and relevant stakeholders during detailed design and construction of the proposal.

Issue description

One respondent expressed the view that there were higher priorities for public monies than making a video as part of the consultation process.

Response

Roads and Maritime acknowledges that as a public entity, it has an obligation to maximise the value of its funding to the benefit of the community. The proposal is complex with many aspects that will affect the local (and broader) community to differing degrees, and Roads and Maritime strives to ensure an equitable consideration of all issues throughout the proposal. Effective communication of these to the community and other stakeholders is important to assist in providing informed comment on the proposal. Visualisation using animations is a powerful and cost-effective tool allowing a better understanding of the issues associated with the proposal and how they interrelate.

Issue description

One respondent advised that they were the project coordinator of the Gateway Project located within the proposal area, and indicated that they would like to meet with Roads and Maritime to discuss options for the proposal, land acquisition and leasing of land. Concern was expressed specifically with regard to the partial acquisition of the Riverhaven Motel property on Scenic Drive and potential impacts on the future development of the site.

Response

Roads and Maritime is committed to further consultation with all stakeholders and will continue to consult with directly affected property owners during detailed design of the proposal, including the owner of the Riverhaven Motel on Scenic Drive.

Issue description

One respondent indicated that it wished to meet with Roads and Maritime to discuss opportunities that it considered would improve the design of the proposal. These included taking traffic from Illaroo Road heading south on an overpass to link up with Bolong Road.

Response

Roads and Maritime met with the respondent during the REF display period on 17 September 2018, and again on 6 December 2018 to provide further information on the proposal and discuss

opportunities to improve the proposal design. Roads and Maritime is committed to ongoing consultation with the respondent. .

Issue description

One respondent expressed its thanks for the opportunity to provide comment on the proposal, and offered assistance with the provision of historical information or images if required.

Response

The future offer of assistance is noted.

2.5 Traffic and transport

2.5.1 Assessment of impacts

Submission number(s)

10, 13, 14, 18, 28, 69, 89, 100, 101, 105, 110

Issue description

Two respondents expressed the view that the proposal has not planned appropriately for future traffic growth and will reach capacity in the near future. An additional five respondents, seven in total, also raised issues around the traffic modelling carried out for the proposal in relation to the broader network and whether this had adequately taken account of future forecast population growth and future development in Bangalee, North Nowra and Bomaderry. Comment was also made that the proposed upgrade of the highway did not appear consistent with the upgrading of the Princes Highway further north, and that this would not solve the problems for the Nowra / Bomaderry local traffic or the increasing through traffic.

Response

Detailed traffic modelling has been carried out for the proposal. This involved a review of Shoalhaven City Council's strategic traffic model that utilises known demographic Journey to Work and Householder Travel Survey data together with current and future land use forecasts to estimate travel demand within the study region. The strategic model allows for population growth and future land use changes in the surrounding area that would influence the volume of traffic on the road network, and took into account future development sites, such as the Moss Vale Road, Mundamia and Worrigee urban release areas, and general population growth.

Given the nature of the project and the known congestion issues, a microsimulation traffic model was considered the more appropriate method to evaluate potential options as the majority of traffic impacts would be limited to the bridge and associated intersections. This type of computer model is simulates the movement of vehicles through a predefined road network and is used to predict the likely impact of changes to the road network, such as additional traffic lanes, to traffic patterns and flow. This type of model is particularly suited to modelling congested road networks due to its ability to simulate queueing conditions.

The microsimulation model was developed using traffic growth rates, and forecast AM and PM peak hour traffic demands from Council's strategic model. Due to the seasonal traffic fluctuations experienced along the Princes Highway at Nowra, the 100th highest annual hour of traffic flow was used as the design hour for traffic flow, as per Austroads guidelines for traffic modelling.

Initial traffic modelling used a traffic growth rate of 2.7 per cent compounding in five year intervals to forecast future traffic demand. This higher growth rate was adopted for the initial analysis as it was considered to be a conservative upper limit of traffic growth associated with planned development occurring in the short to medium term instead of the forecast period adopted in Council's strategic traffic model. This ensured the preferred option would perform well through to the forecast year of 2046, even if planned land use and population growth differed significantly from that forecast by the strategic models.

A sensitivity analysis was carried out for the traffic modelling for the proposal. This comprised a review of the adopted forecast traffic growth rates against historical traffic data. While the most recent traffic data indicated annual traffic growth on the Princes Highway to be in the order of 1-1.5 per cent, a higher annual growth rate of 1.7 per cent was adopted for the in the final analysis as it aligns with the rate identified in the Princes Highway Corridor Strategy document for the Princes Highway between Gerringong and Falls Creek.

The traffic modelling has considered traffic growth up to the year 2046, which is about 20-25 years after the opening of the new bridge. This shows the Princes Highway and all intersections within the proposal would operate at a higher level of service in 2046 than is currently experienced. It should also be noted that the accuracy and reliability of traffic modelling forecasts reduce with the length of the forecast period.

While the proposal will improve congestion along the Princes Highway and within the local road network between Bolong Road and Moss Street, it is acknowledged other sections of the Princes Highway through Nowra and Bomaderry are also experiencing localised congestion and poor levels of service at some key intersections during peak periods. The Princes Highway Corridor Study, prepared by Roads and Maritime Services in August 2016, outlined the current and expected challenges for the Princes Highway through Nowra and identified specific short, medium and long term priorities for addressing them. One specific priority was to develop a traffic model of the Nowra and Bomaderry town centres to inform the development of a traffic and transport study to address traffic efficiency, road safety and pedestrian and cyclist access and safety issues.

In addition to this, Future Transport 2056 and the Regional NSW Services and Infrastructure Plan commit to develop Regional Future Transport Plans for each of NSW's nine regions to align with the Department of Planning and Environment's 20 year Regional Plans. In addition, Place Plans which consider the implementation of the movement and place framework will be developed for prioritised cities and centres within each region.

Transport for NSW and Roads and Maritime Services have recently commenced work on the Illawarra-Shoalhaven Future Transport Plan. This Plan will provide the overarching strategic transport network vision that will guide future transport planning for the Illawarra-Shoalhaven region and will be prepared in consultation with local government, the Joint Organisation, other state government agencies and Australian Government bodies. The Plan will also identify a number of Place Plans to be developed in collaboration with Councils and state government agencies which will consider the more detailed, place-specific implementation of Future Transport principles.

The Illawarra-Shoalhaven Future Transport Plan is expected to be completed in the 2019/20 financial year.

Issue description

One respondent questioned that considering population growth, what would be the time period for traffic congestion to be similar to that currently experienced.

Response

The modelling for the traffic and transport assessment examined three future years: 2026, 2036, and 2046, and developed forecasts for each year for both the overall network and for key intersections within the proposal study area. Forecasts were compared to the base year, 2014. Tables 6-8, 6-9 and 6-10 in the REF provide a detailed summary of the intersection performance for Bolong Road, Illaroo Road and Bridge Road respectively for the AM and PM peak periods extending out to the 2046 forecast year. The results show:

- The Princes Highway/Bolong Road intersection is forecast to perform at LoS C or better until 2046 (existing overall performance is LoS B for both the AM and PM peaks)
- The overall performance of the Princes Highway/Illaroo Road intersection would improve from the current LoS F to LoS B or better until 2046 in the peak hour periods. However, on the Illaroo Road leg, the improved performance would have deteriorated by 2046, particularly for the PM peak when the LoS would be similar to current levels
- The performance of the Princes Highway/Bridge Road intersection would perform at LoS B or better through to 2046 (existing overall performance is LoS E for the AM peak and LoS D for the PM peak).

The overall network performance is summarised in Table 6-11 of the REF. This shows substantial improvements in average travel times for both the AM and PM peak periods for all three forecast years, compared to the base or 'do minimum' case.

Issue description

Three respondents questioned the travel time savings presented in the REF, with one asking how the proposal would save time for traffic travelling through Nowra given there would be the same number of traffic signals and another asking whether this would remove the need for a bypass. Clarification was requested on the time it would take to travel from Bomaderry to South Nowra during peak periods and the reduction in travel time following completion of the proposal.

Response

The proposed upgrades to the Princes Highway between Bolong Road and Moss Street and intersection upgrades at Bolong Road, Illaroo Road and Bridge Road, will provide travel time savings along the upgraded section of the Princes Highway and within the local road network. While the number of traffic signals would be the same, the increased capacity and improved level of service at the upgraded intersections will allow more vehicles to pass through during each cycle of the traffic signals, resulting in reduced delay and a reduction in travel time.

Traffic modelling undertaken for the proposal indicates travel times southbound between Bolong Road and Moss Street would be reduced by about 44 per cent and 64 per cent in the 2046 AM and 2046 PM peak periods respectively, when compared to the 'do minimum' case. In the northbound direction, travel times would be reduced by about 61 per cent and 63 per cent in the 2046 AM and 2046 PM peak periods respectively. The proposal will also improve travel times for the local road network, particularly for trips accessing the Princes Highway from Illaroo Road.

Traffic travelling through Nowra would benefit from the travel time savings generated by the proposal; however it is acknowledged that a bypass of Nowra and Bomaderry would provide improved travel time savings for traffic that passes through the town without stopping but will not improve travel times for local trips that would continue to use the current Shoalhaven River bridge crossings.

Further discussion regarding a bypass of Nowra is provided in Section 2.2.2.

Issue description

One respondent expressed concern about the extra traffic travelling past the high school from a safety point of view. Concern was also expressed about the congestion that already occurs during school drop off and pick up times all the way along Moss Street to the lights and the area around the Nowra Fresh shopping precinct.

Response

Additional assessment regarding the redistribution of local traffic and responses to issues about the proposed new local road are provided in Sections 5.1 and 2.3.4 of this submissions report respectively.

The redistribution of traffic from Pleasant Way is anticipated to increase the number of vehicles using Moss Street by 33 and 50 vehicles in the AM and PM peak hour periods respectively. The modelling forecasts that by 2026 the performance of the intersection will have deteriorated compared to its existing performance. This is due principally to the level of background growth assumed along the Princes Highway, rather than the redistribution of traffic from Pleasant Way.

A review of the crash and casualty statistics for the location for the period 2013 to 2017 inclusive did not identify any incidents outside the high school. The existing school zone outside the Nowra High School will remain unchanged. The increase in traffic volume is anticipated to have a negligible impact on the safety of road users and pedestrians along Moss Street.

Issue description

One respondent was concerned that the Moss Street intersection is not suitable for school buses and local traffic in the area, considering the plan to close off the current Pleasant Way access for right turning vehicles. Better traffic modelling on the highway is needed up to and past the Moss Street Intersection, and the consideration for larger buses moving to and from the school. Many buses change students at this location to service the more remote villages in the city.

Response

Subsequent to the display of the REF, further assessment was carried out for a number of intersections outside of the proposal area, including the Princes Highway/Moss Street intersection (refer Sections 5.1 of this submission report) . The additional assessment found the redistribution of traffic from Pleasant Way is anticipated to increase the number of vehicles using Moss Street by 33 and 50 vehicles in the AM and PM peak hour periods respectively. The modelling forecasts that by 2026 the performance of the intersection will have deteriorated compared to its existing performance. This is due principally to the level of background growth assumed along the Princes Highway, rather than the redistribution of traffic from Pleasant Way.

An additional traffic survey on Friday 26 October 2018 (second Friday of school term 4) were undertaken to record the number of heavy vehicles turning right into Pleasant Way from the Princes Highway. The survey identified four heavy vehicles (potentially buses) turned right between 6am and 12pm and zero heavy vehicles turned right 12pm and 7pm. The surveys show the use of Pleasant Way by heavy vehicles is low.

The existing Moss Street intersection provides for a right turn movement on a green arrow for northbound traffic, and is suitable for use by heavy vehicles. The introduction of larger buses to transport students is considered a separate issue to the proposal.

2.5.2 Mitigation of impacts

Submission number(s)

28

Issue description

One respondent raised the issue of whether a contra-flow operation would be a solution to easing congestion during peak traffic periods.

Response

The Princes Highway is highly congested and nearing capacity according to Austroads guidelines which state the lane capacity is between 1100 and 1200 vehicles per lane per hour in an urban environment.

During the AM peak period the existing bridges carry about 4000 vehicle per hour and 4800 vehicles per hour in the PM peak period across the five available lanes. Providing an additional southbound lane on the northbound bridge may reduce congestions slightly during the AM peak period. However, providing an additional northbound lane on the southbound bridge using a contra-flow arrangement during the PM peak period would result in the number of southbound vehicles significantly exceeding the available capacity and lead to worse congestion then currently experienced.

Contra-flow arrangements would also require upgrades and additional infrastructure on the approaches to both bridges which would increase project cost and environmental impact.

As a result, Roads and Maritime does not consider a contra-flow arrangement as a suitable option to meet the project objectives.

2.5.3 Public transport

Submission number(s)

36, 53

Issue description

One respondent expressed concern that additional bus stops are needed. It was noted that there is only one bus stop between Illaroo Road and Stockland. It was also suggested that an additional stop before the northern approach of the bridge would help with rail access.

Response

The proposal maintains the existing number of bus stops in the area. The need for additional bus stops would be based on current and future demand and may be considered by the Illawarra-Shoalhaven Future Transport Study being completed by TfNSW.

Issue description

One respondent expressed concern the REF provides very little discussion of public transport and in particular rail linkages to Nowra itself. The submission suggested that there would be more support for the proposal if rail linkages were discussed.

Response

The proposed upgrade of the Princes Highway would benefit all road users, including those using public transport. Responsibility for rail infrastructure planning rests with TfNSW and, as has been noted in Section 2.2.3 of this submissions report, Future Transport 2056 does not identify extending the South Coast Rail line south into Nowra or further as an initiative for investigation in the short, medium or long term.

Consideration of a future rail crossing of the Shoalhaven River was part of the investigation into strategic alternatives for the proposal as discussed in Section 2.4 of the REF and Section 2.2.3 of this submissions report.

The improvements in the efficiency of traffic movements through the road network will also benefit other modes of public transport, including buses and taxis.

2.6 Noise and vibration

Submission number(s)

12, 20, 43, 46, 47

Issue description

Three respondents raised concerns in relation to noise generated during construction and operation of the proposed new local road connection between the Princes Highway and Lyrebird Drive, in particular impacts to residents along Lyrebird Drive. One respondent also requested consideration be given to tree planting to mitigate noise.

Response

A construction and operational noise assessment has been undertaken for the proposal and results detailed in Section 6.6 of the REF. Construction and operational noise impacts are identified and assessed in Section 6.6.4 of the REF. The full construction and operational noise assessment is provided in Appendix D to the REF. The assessment has identified and assessed the potential noise impacts from the proposal, including impacts from construction and operation of the new local road connection.

The assessment of construction noise impacts identified construction noise would result in exceedances of noise management levels at certain receivers for certain construction phases in noise catchments areas NCA06 and NCA07 located adjacent to the new local road connection. It is expected the majority of construction associated with the new local road would be conducted during standard construction hours of 7am to 6pm Monday to Friday and 8am to 1pm on Saturdays. A range of management measures have been developed to manage construction noise including the preparation of a Construction Noise and Vibration Management Plan (environmental management measure NV1) prior to construction in accordance with Roads and Maritime's *Construction Noise and Vibration Guideline*. The Construction Noise and Vibration Management Plan would also detail any need and justification for out of hours works and detail the measures that would be implemented during construction.

The operational noise assessment identified 24 residential receivers who would qualify for consideration of noise mitigation with 14 of these located in NCA06 and none located in NCA07. Residential receivers located on Lyrebird Drive are located within NCA07 and while some of these receivers would experience an increase in traffic noise, they do not exceed any of the three triggers

where a receiver may qualify for consideration of noise mitigation (as detailed in Section 6.2 of the REF).

Vegetation is not identified as an effective noise mitigation measure in the Roads and Maritime *Noise Mitigation Guideline* (Roads and Maritime (2014) and therefore has not been considered for the proposal.

Environmental management measure NV15 provides for post-construction noise monitoring to be carried out within 12 months of completion of the proposal at representative locations within the proposal area. The information collected would be used to confirm the predicted changes in the REF, and to identify whether any additional receivers would qualify for consideration for noise mitigation.

Issue description

One respondent raised the issue of mitigation of traffic noise for the Bomaderry area, and what form this might take, expressing a preference for noise mounds.

Response

As detailed in Section 6.2 of the REF, a noise and vibration assessment was prepared for the proposal which identified properties that qualify for consideration for noise mitigation. The assessment identified that for existing and new residences south of the river and east of the highway (off Hawthorn Avenue), traffic noise impacts could potentially be mitigated by a noise barrier (noise wall) in combination with at-property treatments. Noise mounds or noise walls were not identified as mitigation options in other locations within the proposal area.

The assessment also considered low noise pavement to mitigate road traffic noise but was considered unsuitable due to its poor performance in heavily trafficked areas near intersections, progressive reduction in effectiveness and increased whole of life maintenance costs.

Issue description

One respondent was concerned that the proposal would bring traffic noise much closer to the Thai Riverside Restaurant reducing amenity in the dining area due to a 6 dB(A) increase in traffic noise.

Response

The operational noise and vibration assessment carried out for the REF was prepared in accordance with relevant policies, guidelines and standards as identified in Section 6.2.1 of the REF, including Roads and Maritime's Noise Criteria Guideline and Noise Mitigation Guideline. The assessment did not specifically identify the forecast change in traffic noise for this premises due to it being a commercial receiver. However, traffic noise for the nearby residential property at 33 Bridge Road (refer Appendix F to the Noise and Vibration Assessment prepared for the REF (Appendix D to the REF) is forecast to increase by 0.4 dB(A) (day) and 0.6 dB(A) (night) at the assumed time of opening of the proposal, and by 0.5 dB(A) (day) and 0.6 dB(A) (night) at 10 years after opening. While the proposal will bring traffic closer to the restaurant premises and increase traffic noise slightly, it is considered unlikely that there would be a 6 dB(A) increase in noise levels at this receiver.

2.7 Heritage

Submission number(s)

103, 109

Issue description

The National Trust of Australia expressed support for the recommendations set out in Section 8 of the SoHI.

Response

Roads and Maritime confirms that the recommendations noted will be addressed in the Non-Aboriginal Heritage Management Plan (NAHMP) that will be prepared and implemented as part of the CEMP (environmental management measure NAH1). This will include obtaining all necessary approvals and consultation with all relevant stakeholders including Council. A number of the above recommendations are also specifically addressed in other environmental management measures for non-Aboriginal heritage (refer Table 6-1 of this submissions report).

Matters related to the future of the existing southbound bridge for adaptive reuse will be progressed as a separate proposal as identified in the REF.

Issue description

The National Trust of Australia noted that the repurposing of the existing southbound Nowra bridge for adaptive reuse is not included in the proposal, noting that as an interim step access by pedestrians and cyclists should be prevented while carrying out essential maintenance activities. However, the next steps towards the bridge's adaptive reuse should be addressed as quickly as possible, along with the reassessment of the current Conservation Management Plan (Artefact Heritage, 2015). Provision for an annual inspection of the bridge should also be included within the revised plan.

The respondent also recommended that Roads and Maritime Services retain ownership of the existing southbound bridge in preference to transferring ownership to an organisation without the means to maintain the bridge.

Response

A program for progressing the investigation and assessment of options for the adaptive reuse of the existing southbound bridge will be developed in 2019. This will include review of the current Conservation Management Plan.

As an existing Roads and Maritime asset, the bridge is regularly inspected and maintenance and remedial works are identified and programmed as required. This will continue to occur following identification of a preferred adaptive reuse, and will address all relevant matters associated with preservation of the bridge's identified heritage values.

Roads and Maritime confirms it will retain responsibility for, and will fund, the ongoing maintenance of the existing southbound bridge.

Issue description

The Shoalhaven Historical Society expressed concern about the potential impact of the new local road connection on the Graham Family cemetery during both construction and operation of the proposal. It noted that the greater prominence of the site may increase the potential for accidental or

deliberate damage. It was suggested that a suitably styled fence may assist in delineating and protecting the site.

Response

The SoHI identified that the proposal will not involve any works that would directly affect the physical fabric or encroach upon the heritage curtilage of the Graham Family Cemetery (which is part of the SHR curtilage of Graham Lodge). It noted that construction activities will be carried out within 25 metres of the cemetery which could potentially result in an indirect physical impact by way of vibration. The SoHI did not identify any specific impacts associated with operation of the proposal with regard to the cemetery.

The noise and vibration assessment identified potential for the cemetery to be affected by vibration from construction activities and recommended monitoring in this regard. Management of these potential impacts is addressed through environmental management measure NV8.

Mitigation and management of construction related impacts on non-Aboriginal heritage, including the Graham Family Cemetery site, will be addressed through the NAHMP that will be prepared and implemented as part of the CEMP (environmental management measure NAH1).

With regard to the possible installation of a fence around the site and noting that it is part of an item listed on the SHR, an exclusion zone would be established for construction and this may include temporary fencing. It is not proposed to provide any permanent fencing around this site.

Issue description

The Shoalhaven Historical Society noted that the pavilion associated with the flood boat 'Shoalhaven' in Captain Cook Bicentennial Park will be directly impacted by the proposal and encouraged Roads and Maritime to liaise closely with Shoalhaven City Council to ensure that an appropriate site and structure for housing this heritage item is progressed as part of the proposal.

The respondent also advised that it is aware of a time capsule that was placed somewhere in or around the pavilion during its opening.

Response

The issue of relocation of the pavilion was raised in the submission made by Shoalhaven City Council (refer Section 3.2.11 of this submissions report). Further investigation is being carried out in regard to a methodology to safely relocate the existing structure. Roads and Maritime will consult with Shoalhaven City Council and the Shoalhaven Historical Society with regard to the disposition of the time capsule, if found. This is addressed by environmental management measure SE5 identified in the REF.

Issue description

The Shoalhaven Historical Society recognises the local heritage value of the 'Old Culburra Guesthouse' (also known as M&M Guesthouse) at the Riverhaven Motel site, and has requested that Roads and Maritime make every effort to provide for its relocation rather than its demolition. The Shoalhaven Historical Society notes the challenges associated with this but is of the view that the building should be preserved in another suitable location if possible.

Response

Consideration of potential impacts on the M&M Guesthouse is provided in the SoHI (refer Appendix F to the REF). The assessment identified that the building does not have formal heritage

status under either the Shoalhaven LEP nor the *Heritage Act 1977*. This was confirmed though consultation carried out as part of preparation of the SoHI.

The SoHI recommended that that Roads and Maritime consider options for relocation of this building in consultation with Shoalhaven City Council. This is addressed by environmental management measure NAH9 identified in the REF

Issue description

The Shoalhaven Historical Society noted that there is potential for in-ground heritage remnants in the area around the flood boat pavilion and the Riverhaven Motel and expressed an interest in taking possession of any heritage items uncovered during the project, with a view to adding them to the collection of the Nowra Museum.

Response

The potential for undetected heritage items (both Aboriginal and non-Aboriginal) to occur within the proposal area, particularly in and around the identified heritage areas is acknowledged in the REF. Environmental management measures AH2 and NAH2 address this potential and provide for a process to ensure all appropriate measures are carried out to mitigate and manage impacts with regard to unexpected finds.

Roads and Maritime will consult with all relevant stakeholders with regard to the possession of non-Aboriginal heritage items should any be uncovered during construction.

2.8 Property and land use

Submission number(s)

60, 65, 84, 93

Issue description

Three respondents raised issues regarding the properties along Illaroo Road that would be acquired for the proposal, including the manner of compensation and whether houses on the properties would be demolished.

Response

The property acquisitions proposed as part of the proposal are detailed in Section 3.6 of the REF. A number of properties on the northern side of Illaroo Road would be acquired to accommodate the proposed widening of Illaroo Road, and all buildings on these properties would be demolished and removed.

Consultation is ongoing with directly affected residents and property owners about potential impacts and the property acquisition process and opportunities. Roads and Maritime would continue consult with directly affected landowners during detailed design to refine and confirm the extent of property impacts. The acquisition of property would be undertaken in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*, the NSW Government Land Acquisition Reform 2016 and the Roads and Maritime Land Acquisition Information Guide (Roads and Maritime, 2014).

Issue description

Two respondents enquired about the site of the Riverhaven Motel and the M&M Guesthouse, and whether the buildings on it would be removed. The issues of associated costs and use of the land following construction were also raised.

Response

Roads and Maritime proposes to acquire a portion of the motel site for the proposal, and to lease the remainder of the site for use during construction. The motel and other buildings on the site would be demolished to allow the construction of the new bridge. The costs obtaining the property and removing the existing buildings will be met by Roads and Maritime.

At the conclusion of the project, the portion of the site leased during construction would be returned to the current owner.

2.9 Socioeconomic

2.9.1 Amenity and community

Submission number(s)

30, 31, 34, 47, 98

Issue description

Three respondents noted the proposal would remove the existing amenities building at North Nowra Rotary Park, and enquired whether this would be replaced, with one respondent noting a severe shortage of public toilets in North Nowra.

Response

The proposal does not include replacement of the amenities building. Roads and Maritime will negotiate with Shoalhaven City Council regarding suitable monetary compensation to allow Council to replace this facility as it considers appropriate.

Issue description

One respondent noted that the proposal will result in a significant change of the view from the main dining area of the Thai Riverside Restaurant located at 27 Bridge Road. The existing view toward the north/northeast is predominantly of parkland and trees, with the existing bridges further in the background. The respondent was concerned that the proposal with the new bridge will reduce the quality of this view from the restaurant dining area.

Response

The visual impact assessment carried out for the REF considered changes in views at 10 viewpoints in the proposal area. Viewpoint 9, located at the corner of Bridge Road and the Princes Highway and looking north, is the closest viewpoint to the restaurant. The assessment identified that the proposal will require the removal of almost all of the mature vegetation on the western side of the highway, and assessed this as having a high impact on visual amenity.

The proposal will require the removal of some vegetation in the area between the highway and Scenic Drive, however, this will be minimised as far as practicable and it is anticipated that the area of trees on the northern side of Scenic Drive opposite the restaurant will be less impacted.

A range of environmental management measures have been developed to mitigate and manage impacts on visual amenity. These include:

- Environmental management measure LV1 which provides for the preparation of a UDLP to inform detailed design, and which will also form part of the CEMP. This will address, amongst other matters, the location and identification of existing vegetation and proposed landscaped areas, including species to be used, and procedures for monitoring and maintaining landscaped or rehabilitated areas
- Environmental management measure LV2 which provides for design to avoid impact to prominent trees and vegetation communities as far as practicable possible
- Environmental management measure LV11 which provides for existing trees to be retained within construction facilities areas (including the area to the north of the restaurant), and for those trees to be identified, protected and maintained for the duration of the construction works.

Environmental management measure NV15 provides for post-construction noise monitoring to be carried out within 2-12 months of completion of the proposal at representative locations within the proposal area. These locations would be confirmed during detailed design with the information collected being used to confirm the predicted changes in the REF, and to identify whether any additional receivers would qualify for consideration for noise mitigation.

Issue description

One respondent expressed support for Roads and Maritime and Shoalhaven City Council's joint efforts to enhance the present river foreshore frontage.

Response

The support is noted. Roads and Maritime will continue to work collaboratively with Council to ensure appropriate consideration of all practicable opportunities to enhance the amenity of the river foreshore area where it is directly or indirectly affected by the proposal.

2.9.2 Access and connectivity

Submission number(s)

26, 29, 31, 47, 91, 104

Issue description

Two respondents were concerned the proposal would provide limited access to the Riverview Road area for emergency services vehicles, particularly to the caravan park.

Response

Access to the Riverview Road area will be available via the new local road connection, and via Moss Street as currently exists. Ambulances travelling from the station in Bunberra Street, Bomaderry would travel south along the Princes Highway and access Riverview Road area via the new local road connection. The additional travel distance is about 600 metres (to the intersection of the new local road and Lyrebird Drive) which is not considered to add significantly to travel time.

The shortest route to this area from the Fire and Rescue station at 69 Bridge Road would be via North Street, and then along Moss Street which is unchanged as a result of the proposal.

Issue description

One respondent asked about maintaining access to the boat launching facilities at Greys Beach Boat ramp during construction.

Response

The REF acknowledges the impacts of the proposal on users of the Greys Beach boat ramp and car parking area during construction. This issue was also raised by Shoalhaven City Council in its submission (refer Section 3.2.8 of this submissions report). Subsequent to the exhibition of the REF, Roads and Maritime reviewed the impacts of the proposal on parking at Greys Beach. As a result of this environmental management measure SE4 has been amended to make it clear access to the boat ramp at Greys Beach would be maintained at all times. Access to parking would be largely maintained between the September/October school holidays to the Monday after Anzac Day. Outside of these times about half of the existing parking area (about 50 spaces) would be available.

> ***SE4:*** Use of the Greys Beach Reserve site for temporary construction activities ***will*** ~~should~~ be planned to consider peak usage periods of the river for recreational users. ***Access to the boat ramp at Greys Beach will be maintained at all times. Access to parking would be largely maintained between the September/October school holidays to the Monday after Anzac Day. Outside of these times about half of the existing parking area (about 50 spaces) will be available.***

Members of the public will be kept informed of construction activities through the Community and Stakeholder Engagement Plan, which will include notification of any works or activities that could affect users of this boat ramp. Environmental management measures SE3 and SE4 address management of impacts on users of this area.

Issue description

The operator of the Nowra Golf Club has expressed concern that construction works at Grey's Beach would affect access to the golf club, and asked if there was a plan to manage this issue. It was also asked whether Roads and Maritime would consult with the golf club to work together in minimising restrictions on access to the golf club car park.

Response

A TMP will be prepared as part of the CEMP for the proposal (environmental management measure T1). This will be used by the construction contractor to manage impacts on traffic associated with construction activities, including those activities that will or could affect access to businesses and properties. The TMP will include requirements and methods to consult and inform the local community of impacts on the local road network. These will be integrated with the Community and Stakeholder Engagement Plan noted above.

2.9.3 Business and industry

Submission number(s)

47, 110, 114

Issue description

The operator of the Thai Riverside Restaurant (27 Bridge Road) indicated that the business is very likely to suffer significant impairment due to northbound traffic on the Princes Highway moving closer to the building noting that this will affect both the viability of the business and the value of the property.

The respondent was also concerned that the removal of the right turn into Scenic Drive from Bridge Road will impact access to the parking area for the business and that customers wanting to use the car park will now need to travel a longer route to reach the car park, which will impact on patronage and the viability of the restaurant.

The respondent noted that construction activities are also expected to cause disruptions to the restaurant's business activities.

Response

The REF acknowledges the impacts on the business activities of the Thai Riverside Restaurant both during construction and operation with regard to the changed access arrangements at the Scenic Drive/Bridge Road intersection.

Section 3.3.1 of the REF indicates that a section of Scenic Drive at Bridge Road would be temporarily closed for construction. This is not correct; access to the section of Scenic Drive between Bridge Road down to the river foreshore during construction will be managed through the TMP and Road Occupancy Licence (refer environmental management measure T1). This will provide for continued access to the Thai Riverside restaurant car park during construction.

Roads and Maritime acknowledges that patrons travelling south along Bridge Road would need to travel an additional one kilometre (approximately) to access the restaurant car park located off Scenic Drive. As noted in Section 2.3.3, the widening of the highway has resulted in the shift of the Bridge Road/Princes Highway intersection to the south and required removal of the right turn to avoid impacting on the performance of the revised intersection.

Roads and Maritime will consult further with the operators of this business through the Community and Stakeholder Engagement Plan to ensure it is fully aware of their respective issues and concerns around the operation of their business.

Issue description

The Shoalhaven Business Chamber indicated that there are no current plans to assist businesses with the interruption to their operation during construction. The most affected businesses are the three restaurants, the hotel and caravan park on the southern side of the river, and the golf club on the northern side.

Response

Access to affected businesses will be maintained during construction, either through existing accesses or suitable alternative temporary arrangements, which would be negotiated with the affected business. Temporary impacts on vehicle access will be managed through the TMP with advance notification provided to affected businesses.

Roads and Maritime will consult further with the operators of the affected businesses through the Community and Stakeholder Engagement Plan to ensure it is fully aware of their respective issues and concerns around the operation of their businesses.

Issue description

One respondent expressed concern regarding the impact of the proposal on the business activities of the Wharf Road Restaurant and Bar, particularly in view of the length of the construction period. Information was requested as to how Roads and Maritime will minimise impacts and whether consideration has been given to providing compensation for disruption to business activities.

A request was made for permanent signage at the intersection of Moss Street and Ferry Lane to direct customers to the new access.

Response

Section 6.8.3 of the REF provides an assessment of the proposal on businesses during construction with the main impacts on Wharf Road Restaurant and Bar identified as follows:

- Advertising and directional signage on the property would be less visible once southbound traffic is shifted to the existing northbound bridge, reducing visibility to passing trade
- Noise, vibration and air quality impacts
- Altered business ambience (character and atmosphere) due to alterations in noise and visual impacts, potentially affecting the ability to attract and retain customers
- Construction noise, vibration and air quality could potentially impact on the amenity for guests, particularly at outside areas such as decks and terraces.

The REF identified that the proposal will have a moderate impact on this business.

Management of construction impacts will be addressed through the CEMP prepared for the proposal (refer environmental management measure GEN1). This will include separate sub-plans to manage impacts on amenity associated with construction noise and vibration, dust emissions and other air quality impacts, and changed access to properties.

Access to this business via Wharf Road will be maintained during construction, however, there may be some short term disruptions from time to time associated with the use of the nearby boat ramp to launch and retrieve small watercraft. These disruptions to access will be managed through the TMP with advance notification being provided.

Consultation with the business operators during construction will be managed through the Community and Stakeholder Engagement Plan. Existing businesses with authorised Tourist Attraction Signposting Assessment Committee (TASAC) approved signage will be consulted to develop revised signage if impacted by the proposal (refer environmental management measure SE9). The location(s) of any such the signage will be discussed with the business operators. The provision of permanent signage will be investigated as part of detailed design as part of the overall signage design package for the proposal.

2.10 Biodiversity

Submission number(s)

55, 103

Issue description

One respondent expressed concern about the number of trees required to be removed to accommodate the new bridge, and whether there would be equivalent plantings nearby to compensate.

Response

Development of the design for the proposal has sought to minimise the amount of vegetation, particularly established mature trees, needed to be removed for the proposal. A comprehensive Urban Design Report and Landscape Character and Visual Impact Assessment (Appendix G to the REF) has been prepared for the proposal. This will be used to inform preparation of the UDLP (environmental management measure LV1) which establish the framework for mitigating impacts associated with removal of vegetation. Among other matters, the UDLP will address landscaping and species to be used.

Impacts on biodiversity will be managed and mitigated through a range of environmental management measures that will be implemented through a Flora and Fauna Management Plan (FFMP) that will be prepared as part of the CEMP (environmental management measures B1). There are five environmental management measures (B2, B4, B5, B7, B8) that specifically relate to mitigating impacts on vegetation.

Issue description

The National Trust of Australia advised that it had reviewed the biodiversity assessment prepared for the proposal and supported the recommendations to manage and mitigate impacts.

Response

The Trust's support is noted. The recommendations arising from the biodiversity assessment are reflected in environmental management measures for biodiversity provided in Table 6-1 in this report.

2.11 Future of the existing southbound bridge

Submission number(s)

4, 7, 8, 37, 58

Issue description

Four respondents raised various issues relating to the future use of the existing southbound bridge, with several providing suggestions in this regard. Support for retention of the bridge was expressed by one respondent, while another noted the bridge was used by soldiers marching to the war and a tribute or monument should be placed on the bridge to acknowledge this event.

Issues related to the future of the existing southbound bridge were also raised in submissions from the National Trust of Australia and responses to these have been provided in Section 2.8 of this report.

Response

Matters related to the future of the existing southbound bridge for adaptive reuse will be progressed as a separate proposal as identified in the REF. The suggestions made with regard options for the future use of the bridge will be carried forward to this process. Investigation of adaptive reuse options will include consultation with the community and other stakeholders, and will provide further opportunity to provide comment.

Issue description

One respondent raised the issue of the cost associated with the retention of the existing southbound bridge, expressing the view that there were higher priorities for public monies.

Response

Roads and Maritime has gone through an extensive consultation process with the community and other stakeholders with regard to options for the existing southbound bridge and a detailed account of this is provided in Section 2.4.10 of the REF. The results of the community engagement activities indicated strong support for retaining the existing southbound bridge due to its engineering heritage and community value. Conversations with the community, written submissions and feedback from an online survey showed an overwhelming response to retain the existing southbound bridge in some form. There was a small proportion of the community that wanted to see the bridge removed completely and money instead spent on other projects in the region.

Written submissions were also received from Office of Environment and Heritage (OEH), National Trust of Australia, and Engineers Australia. All of these bodies referred to the historic significance of the existing southbound bridge and voiced their opposition to any options that would see it demolished or relocated.

The cost of the ongoing maintenance of the bridge will be met by Roads and Maritime from its operational budget.

2.12 Out of scope

2.12.1 Council road projects

Submission number(s)

40, 87, 100

Issue description

Three respondents raised issues relating to the relationship of the proposal to planned Council road projects including the East Nowra Sub Arterial (ENSA), the Far North Collector Road and the North Nowra Link Road. These related to:

- Whether the North Nowra Link Road would be built before the proposal
- The anticipated worsening of congestion at the Illaroo Road intersection and the need for an alternative route out of North Nowra
- The perceived absence of a coordinated plan since announcement of the proposal in 2014
- The impact that the ENSA and the Far North Collector Road would have on Illaroo Road and other intersections
- The design and timing of the ENSA
- The benefit of the North Nowra Link Road to the performance of the Illaroo Road intersection.

Response

Roads and Maritime is currently targeting the start of major work for the proposal in 2021, with completion in 2025. Roads and Maritime's understanding of the timing for the North Nowra Link

Road is that the approved funding profile outlines a delivery timeframe of about four years, with survey and land acquisition planned to start in 2018-19 (subject to Australian Government funding being released). Based on this, the North Nowra Link Road could be completed ahead of the proposal. This could potentially reduce demand on the intersection by providing an alternative route for northbound traffic that would otherwise turn left on to the highway from Illaroo Road.

Roads and Maritime has consulted, and will continue to consult, with Council with regard to a range of issues including planned major local road projects. These have been taken into account in the traffic modelling carried out by the proposal, which has identified existing and forecast traffic demands on the Illaroo Road intersection and other intersections.

Roads and Maritime understands that Council is still in the planning stages of the ENSA, and at the time of preparation of this report, no specific date had been announced for construction. Construction of the ENSA would be expected to take about 18 months.

While the proposal will improve congestion along the Princes Highway and local road network between Bolong Road and Moss Street it is acknowledged other sections of the Princes Highway through Nowra and Bomaderry are also experiencing localised congestion and poor levels of service at some key intersections during peak periods. The Princes Highway Corridor Study, prepared by Roads and Maritime Services in August 2016, outlined the current and expected challenges for the Princes Highway through Nowra and identified specific short, medium and long term priorities for addressing them. One specific priority was to develop a traffic model of the Nowra and Bomaderry town centres to inform the development of a traffic and transport study to address traffic efficiency, road safety and pedestrian and cyclist access and safety issues.

In addition to this, Future Transport 2056 and the Regional NSW Services and Infrastructure Plan commit to develop Regional Future Transport Plans for each of NSW's nine regions to align with the Department of Planning and Environment's 20 year Regional Plans. In addition, Place Plans which consider the implementation of the movement and place framework will be developed for prioritised cities and centres within each region.

Transport for NSW and Roads and Maritime Services have recently commenced work on the Illawarra-Shoalhaven Future Transport Plan. This Plan will provide the overarching strategic transport network vision that will guide future transport planning for the Illawarra-Shoalhaven region and will be prepared in consultation with local government, the Joint Organisation, other state government agencies and Australian Government bodies. The Plan will also identify a number of Place Plans to be developed in collaboration with Councils and state government agencies which will consider the more detailed, place-specific implementation of Future Transport principles.

The Illawarra-Shoalhaven Future Transport Plan is expected to be completed in the 2019/20 financial year

2.12.2 Princes Highway

Submission number(s)

27, 68, 71

Issue description

Three respondents raised issues related to other locations along the Princes Highway outside of the proposal area as follows:

- One respondent questioned the lane markings on the Princes Highway south of the Minnamurra Bridge, in relation to providing for a small number of vehicles to turn left to travel to north Kiama
- One respondent noted that there is a lot of traffic congestion on the Princes Highway heading south and north, particularly south of South Nowra. The respondent asked what will happen when the three lanes of traffic merge into two lanes and if anything is going to be done to fix the problem at Albatross Road and through South Nowra
- One respondent noted that numerous traffic lights south of the bridge hold up traffic and suggested that an overhead road be constructed across the highway between Greenwell Point Road and Albatross Road, and that a bridge also be provided at Douglas Street.

Response

The lane markings on the Princes Highway south of the Minnamurra Bridge are provided to safely direct traffic off the highway to North Kiama. Changes to this section of the Princes Highway are beyond the scope of the proposal.

As discussed previously in Section 2.12.1, Transport for NSW and Roads and Maritime Services have recently commenced work on the Illawarra-Shoalhaven Future Transport Plan. This Plan will provide the overarching strategic transport network vision that will guide future transport planning for the Illawarra-Shoalhaven region, including section of the Princes Highway beyond the scope of the proposal.

2.12.3 Urban design

Submission number(s)

80

Issue description

One respondent asked whether there would be an opportunity to display sculptural works on the shared path on the existing northbound bridge as the path will no longer be in use.

Response

The shared path on the existing northbound bridge would be closed to cyclists and pedestrians but retained for maintenance access. It is not proposed to provide any sculptures or other artworks on this path. There may be an opportunity for such works in relation to the adaptive reuse options for the existing southbound bridge and the respondent is encouraged to raise during them during that assessment process.

3 Response to government agency issues

In addition to the 103 community submissions addressed in Chapter 2 of this report, Roads and Maritime received six government agency submissions, accepted up until 13 November 2018. Table 3-1 lists the agencies and their respective allocated submission number. The table also indicates where the issues from each submission are addressed in Chapter 3.

3.1 Overview of the issues raised and advice provided

A total of six government agency submissions were received in response to the display of the REF. Each submission has been examined individually to understand the issues being raised. The issues raised in each submission have been extracted and collated, and corresponding responses to the issues have been provided. Each submission is outlined verbatim and individual responses have been provided specific to each submission. The issues raised by government agencies and Roads and Maritime's response to these issues forms the basis of this chapter.

The most common issues raised by government agencies are listed in Table 3-1.

Table 3-1: Summary of government agencies issues

Respondent	Submission number	Section addressed	Issues raised
Shoalhaven City Council	99	3.2	• Need and options considered • The proposal • Traffic and transport • Consultation • Non-Aboriginal heritage • Noise and vibration
Department of Primary Industries (Fisheries)	107	3.3	• Socio-economic • Water quality • Biodiversity
Office of Environment and Heritage (Regional Operations	112	3.4	• Aboriginal heritage • Flooding and hydrology • Climate change and sustainability • Biodiversity
Office of Environment and Heritage (Heritage)	113	3.5	• Non-Aboriginal heritage • Licensing and approvals • Future use of southbound bridge • Consultation
Environment Protection Authority	115	3.6	• Soil and water quality • Noise and vibration • Air quality • Waste management

Respondent	Submission number	Section addressed	Issues raised
National Resources Access Regulator	116	3.7	• Surface and groundwater sources • Surface and groundwater modelling • Water licensing • Surface and groundwater monitoring • Bridge pylon installation • Waterfront land

3.2 Shoalhaven City Council

3.2.1 Need and options considered

Issue description

Council is adamant that its preferred option is for grade separated intersections and does not support at grade treatments. The at grade proposal can only be supported on the proviso that the Government brings forward the planning and construction of the western bypass of Nowra-Bomaderry for the medium term. Roads and Maritime is requested to consider the need to continue planning for the Western Bypass of Nowra.

Response

Grade separated options have been assessed extensively during the development of the proposal, as described in Section 2.4 of the REF. This included assessing how grade separated intersections would impact traffic flow on the Princes Highway and local road network. The environmental impact of grade separated interchanges was also assessed.

Following the selection of a new bridge immediately to the west of the existing bridges (Option B) as the preferred route option, Roads and Maritime, in consultation with Shoalhaven City Council and other key stakeholders, identified 17 potential intersection options (refer Tables 2-13 to 2-15 in the REF) on the Princes Highway between Bolong Road and Bridge Road. Two further options identified in Shoalhaven City Council's Structure Plan were also considered.

An assessment of the 19 intersection options, including 11 grade separated options, was carried out to identify six network options for the proposal (refer Section 2.4 of the REF and Preferred Option report released in February 2018). The traffic modelling identified that many combinations of grade separated intersection options on the northern and southern sides of the Shoalhaven River introduced inefficient and unsafe weave, merge and queuing issues that do not presently exist on the network. While grade separated options would provide benefits to the local road network, they had an increased level of congestion on the Princes Highway compared to the other network options that were modelled. The modelling also noted:

- Similar intersection options resulted in comparable improvements to intersection and network performance when compared in isolation
- Grade separation on the southern approach would generally result in similar benefits with and without a grade separation on the northern approach

- Grade separation on the southern approach would provide benefits mostly to the highway
- At grade treatments could function adequately for about 25-30 years before any grade separation might be necessary, however this is only the case if a northbound crossing with four lanes is provided with additional lanes on the intersection approaches.

There are a number of significant constraints within and adjoining the road network associated with grade separated options. For example, the land around Bomaderry Creek presents significant geotechnical constraints to road infrastructure design. The land is also flood prone and additional cost would be incurred to achieve the required level of flood immunity. There would also be potential to affect the local flooding patterns which in turn could impact on other properties.

Grade separated options would have greater environmental impacts than the preferred option including additional property acquisition either side of the Princes Highway for the Illaroo and Bolong Road intersections. At Bridge Road, additional property acquisition would be required which could potentially impact on the State heritage-listed Graham Lodge property and other residential and commercial properties located east of the Princes Highway. Further, grade separation at this location would reduce the amount of land available for Shoalhaven City Council plans for development of the Nowra Riverfront Precinct. The potential impact to Aboriginal and non-Aboriginal heritage, property and land use, landscape character and visual impact, the environment and project costs was also considered for each network option. Providing a higher bridge to facilitate grade separation would potentially increase the level of impact to the surrounding environment.

While there are benefits of grade separation relating to traffic flow and reduced congestion, this option would have an increased impact on construction and future maintenance costs, the environment, property acquisition, future land use, landscape character and heritage compared with the proposed design,

The proposal significantly increases the capacity of the existing road network which would provide local and regional benefits by:

- Reduced traffic delays and improved journey reliability along the Princes Highway and local road network, especially for forecast growth in day to day peak traffic crossing the Shoalhaven River
- Improved intersection performance by providing at grade intersections with increased capacity and improved efficiency, ensuring they maintain better levels of service than they currently over the forecast period to 2046
- Improved freight access by removing barriers to high productivity freight vehicles by removing existing constraints to higher mass limit and overheight vehicles crossing the Shoalhaven River at Nowra
- Improved road safety for motorists, pedestrians and vulnerable road users
- Improved connectivity and accessibility for residents, tourists and emergency vehicles between Nowra and Bomaderry
- Improved connectivity and accessibility for pedestrians and cyclists between Nowra and Bomaderry with the Shoalhaven River foreshore.

The proposal has been selected as it best meets the proposal objectives by balancing traffic benefits while minimising potential impacts.

Traffic modelling found grade separation is not required unless there is a substantial increase in traffic at this section of the highway. The current design would enable future planning of grade separation if and when the network requires it.

In relation to planning for a bypass of Nowra Bomaderry, TfNSW's Future Transport Strategy 2056, Transport, which outlines the vision for NSW's transport system over the next 40 years, does not identify a bypass as an initiative for investigation in the short, medium or long term.

Further discussion of bypass options is provided in Section 2.2.2 of this submissions report.

3.2.2 Illaroo Road

Issue description

Traffic signals will be required up front at the intersection of Illaroo Road and Fairway Drive (access to Greys Beach and the Nowra Golf Club) to address pedestrian and vehicular safety for the proposed intensified use of this intersection (proposed for access to the Greys Beach foreshore during the construction phase).

Response

Table 6-6 in the REF identifies that the anticipated numbers of construction vehicles travelling through this intersection would be about 15 vehicles per day on average and up to 21 vehicles per day during the peak construction period. Road user safety (both vehicles and pedestrians) and performance of the intersection would be addressed through the Traffic Management Plan that would form part of the CEMP (environmental management measure T1). This would identify all required controls for this intersection during construction.

Road and Maritime has carried out additional surveys and modelling to assess the long term demand on this intersection related to the proposal (refer Section 5.1 of this submissions report). This identified the performance of the intersection would deteriorate after 2026 due to the increase in traffic on Illaroo Road reducing the ability of vehicles to turn out of Fairway Drive. Potential mitigation measures during operation include:

- Installing 'keep clear' line-marking at the intersection to allow vehicles exiting Fairway Drive a sufficient gap to join the back of the eastbound queue on Illaroo Road
- Banning the right turn movement out of Fairway Drive; vehicles wanting to access the Princes Highway would turn left and travel west on Illaroo Road and perform a U-turn at the roundabout on McMahons Road.

There is no material change in traffic distribution or road alignment as a result of the proposal. The modelled traffic performance is due to the natural traffic growth of the intersection and Illaroo Road. The operational performance and ongoing management of the intersection is therefore considered to be the responsibility of Council to manage as it forms part of the local road network. An opportunity may exist during detailed design of the proposal for the construction contractor to make minor adjustments to the intersection, which would be discussed with Council as they arise.

road safety audit carried out for the 80 per cent concept design identified a number of matters related to the intersection of Fairway Drive and Illaroo Road, and a potential weaving issue with traffic turning right from the highway onto Illaroo Road and wanting to turn left into Fairway Drive. These will be further investigated during detailed design by the construction contractor. A further road safety audit will be carried out to identify any remaining potential safety issues.

Issue description

The proposed 'free left slip lane' out of Illaroo Road (for movements west to north out of Illaroo Road on to the highway) will cause safety and efficiency issues due to the high volume of weave movements between Illaroo Road and Bolong Road. This lane should be signalled with a 'left turn on red after stopping" arrangement as currently exists).

Response

As identified in the REF, the dedicated left turn lane from Illaroo Road is proposed to be a left slip lane. Road users would be required to give way to oncoming northbound traffic on the Princes Highway prior to turning left onto the highway and performing a weave movement to Bolong Road. A signalised 'left turn on red after stopping' is considered to have comparable road safety issues as the give way arrangement as it allows drivers to turn left when northbound highway traffic has a green signal, albeit after stopping on a red signal.

The proposal also includes pedestrian activated signals on the left turn slip lane to stop vehicles while pedestrians or cyclists are crossing the lane, improving the safety of pedestrians and cyclists.

Opportunities to eliminate road safety issues will be investigated further during detailed design of the proposal.

3.2.3 Bridge Road and Scenic Drive

Issue description

Changes at the intersection of Bridge Road and Scenic Drive present an opportunity to incorporate a pedestrian refuge on Bridge Road (immediately south of Scenic Drive) within the current proposed painted median, without impacting two lanes of southbound traffic. This addition should be included to improve vehicular and pedestrian safety on Bridge Road.

Response

Pedestrian numbers were surveyed at the Bridge Road/Princes Highway and Bridge Road/Scenic Drive intersections on 19 and 26 October 2018. The number of pedestrian crossing in a north and south direction across Bridge Road at the Princes Highway and Scenic Drive are presented in Table 3-2.

Table 3-2: Recorded pedestrian volumes at Princes Highway/Bridge Road and Bridge Road/Scenic Drive intersections

Intersection	Date	AM period 7.00am to 10.00am	PM period 2.30pm to 5.30pm
Princes Highway / Bridge Road	19 October 2018	6	1
	26 October 2018	9	16
Bridge Road / Scenic Drive	19 October 2018	6	3
	26 October 2018	7	15

The introduction of an uncontrolled mid-block pedestrian refuge just south of Scenic Drive is not considered appropriate due to the proximity to Scenic Drive, possible sight distance issues and the introduction of an additional pedestrian and vehicle conflict point where there are already high traffic volumes and turning movements. The proposal also reduces the distance between Scenic Drive and the Princes Highway/Bridge Road intersection, making it more attractive to pedestrians and cyclists.

The need for additional pedestrian facilities should consider desire lines along Bridge Road as well as any conflicting turning movements or driveways that may impact the safety of a midblock pedestrian facility when determining the most appropriate location. If Council considers a pedestrian

facility is required on Bridge Road, a proposal can be made through the Active Transport or Safer Roads programs.

In view of the low demand and reduction in distance to the signalised facilities at the Princes Highway from Scenic Drive, a pedestrian refuge is not being considered as part of the proposal.

Issue description

Council is of the opinion that Scenic Drive should be permanently closed to Bridge Road. The restrictions proposed at Scenic Drive will result in unacceptable traffic impacts at the Bridge Road/Hyam Street intersection.

The Bridge Road/Hyam Street intersection will require traffic signals up front to address pedestrian and vehicular safety in this location. Additionally, traffic signals will be required to manage high volume traffic experienced in peak periods at this location.

Response

The right turn movement restrictions at the Bridge Road/Scenic Drive intersection would increase right turning traffic volumes at the Bridge Road/Hyam Street intersection. The proposed change is anticipated to increase the number of vehicles turning right into Hyam Street during the 2018 AM and PM peak periods by 100 and 79 vehicles respectively. The number of vehicle turning right out of Hyam Street is anticipated to increase by 18 and 13 vehicles in the 2018 AM and PM peak hours respectively.

The modelling indicates the intersection will maintain good levels of service beyond 2036, even with the likely traffic redistribution and expected levels of growth. After this, intersection performance reduces to LoS C and LoS E in 2046 during the AM and PM peak periods due to increased delay on Hyam Street and Bridge Road southbound. Intersection control may be required to accommodate future demands but is considered not required in the short or medium term.

The permanent closure of Scenic Drive would redistribute an increased number of vehicles to the Bridge Road/Hyam Street intersection, further reducing the performance of the intersection.

Roads and Maritime has also carried out additional pedestrian surveys on the 19 and 26 October 2018 at the Bridge Road / Hyam Street intersection. The number of pedestrian crossing in a north and south direction across Bridge Road at Hyam Street are presented in Table 3-3.

Table 3-3: Recorded pedestrian volumes at Bridge Road/ Hyam Street intersection

Intersection	Date	AM period 7.00am to 10.00am	PM period 2.30pm to 5.30pm
Bridge Road / Scenic Drive	19 October 2018	4	9
	26 October 2018	6	13

The above survey results show limited pedestrian demand at this location. The movement of pedestrians during construction will be addressed by environmental management measure T1 identified in the REF.

The redistribution of traffic from Scenic Drive as a result of the proposal is not considered to impact the operational performance of the Bridge Road/Hyam Street intersection in the short or medium term. As a result, Roads and Maritime is not proposing additional intersection treatments at this location as part of the proposal.

The redistribution of local traffic is further described in Section 5.5 of this submissions report.

Issue description

An opportunity exists to reduce the impact on Nowra Aquatic Park by establishing a new local road off Hyam Street in accordance with planning for the Nowra Riverfront Leisure and Entertainment Precinct. The concept prepared by Roads and Maritime retains Scenic Drive in its current location with limited access, left in and left out only. The new local road would provide improved and safe access to the foreshore area to the west of the Highway.

Response

The opportunity is noted, however, traffic modelling carried out for the proposal and the proposed changes to the intersection of Bridge Road and Scenic Drive, identified there was not sufficient demand for a new local road connection with Hyam Street. It is noted alternative access to the foreshore area west of the highway is also available via Mandalay Avenue.

3.2.4 New local road connection

Issue description

Council does not accept the amended proposal of “left in/left out” at the proposed new connection to Lyrebird Drive. This will have an unacceptable impact on residents and businesses of Pleasant Way, Wharf Road, Hawthorn Avenue, Riverview Road, Elia Avenue, Lyrebird Drive, and Ferry Lane. This will also negatively impact the residents and Nowra High School Community on Moss Street. The situation proposed by the concept design will create unacceptable travel times and resulting delays for vehicular traffic in these locations. (Additionally, safety, noise and amenity will be unduly impacted by the amended proposal.

Council strongly advocates for the previously proposed traffic signals at the new junction to be reinstated, noting RMS previously documented that the proposed new signals would not adversely impact traffic flows on the Highway, compared to current conditions.

Response

The removal of the traffic signals at the intersection of the new local road connection and the Princes Highway was based on feedback received from the public display of the Preferred Option Report in February 2018. A total of 630 people attended five drop in sessions, with a large proportion providing feedback that there were already too many too many traffic signals along the section of the Princes Highway in the proposal area, and that adding an additional set of signals would further impede traffic flow. Written submissions were also received from 13 respondents regarding the same issue.

The traffic signals were originally proposed principally to replace the right turn for northbound traffic that currently exists at the Pleasant Way intersection. The demand for this, however, is very low, and can be adequately met through the right turn at the Moss Street intersection.

Section 6.1.3 of the REF relates to potential traffic impacts and acknowledges there would be an increase in traffic volumes on sections of Lyrebird Drive and Hawthorn Avenue associated with the new local road connection. Consideration of this upon amenity is also provided in Section 6.8 of the REF and in the supporting noise and vibration assessment and socioeconomic assessment reports. The noise and vibration assessment identifies that total traffic noise levels are not predicted to noticeably increase for residences along these streets. Additional assessment regarding the

redistribution of local traffic and responses to issues about the proposed new local road are provided in Sections 5.1 and 2.3.4 of this submissions report respectively.

The speed limit along these locals roads will remain at 50 km/h and it is not anticipated that there would be a material change to safety in this area. However, this would be included in the future road safety audit, and Roads and Maritime will consult with Council with regard to any identified safety issues.

The design of the proposal provides for the future installation of traffic signals and allows for all turning movements should there be an identified demand.

3.2.5 Other road design issues

Issue description

All slip lanes in the concept design are of inadequate width. The network is highly vulnerable to breakdowns and accidents, especially in the vicinity of the river (lane weaving, multiple lanes, multiple exit and entry points in this location particularly). All slip lanes should be designed to an adequate width to accommodate such events in line with best practice standards).

Response

The design of the slip lanes has been developed in accordance with Section 6.4 (Road Width between Kerbs and between Kerb and Safety Barrier) of Guide to Road Design, Part 4A (Austroads, 2017). This specifies

> *The width provided between kerbs or between kerb and safety barrier must be sufficient to accommodate the design vehicle swept path and possibly the check vehicle (especially between barriers) plus a 0.5 m clearance from both sides of their swept path to the line of kerb or barrier.*
>
> *It is desirable to provide a width no less than 5.0 m between kerbs and between kerbs and roadside barriers to allow for the passing of broken-down vehicles. It is important to apply this width where long lengths of parallel kerbing (or kerbing and barrier) apply. In some cases, the widths required to cater for the design vehicle swept paths are greater than 5.0 m.*

The design for the proposal provides a minimum 5.5 metres between kerbs which allows for swept paths of design vehicles and clearances.

3.2.6 Pedestrians and cyclists

Issue description

Pedestrian and cyclist considerations will need to be more thoroughly examined once more detail is released (the current concept plans do not allow the proposed pedestrian and cyclist links to be interrogated in detail). The proposed Princes Highway upgrade does not cater for an efficient pedestrian/cyclist link from the old bridge into Nowra which is a significant omission. Council's objective is to improve this link and better integrating east-west in the foreshore precinct and northern fringe of the Nowra CBD. This land is already somewhat disconnected and the proposed new bridge will exacerbate this. A pedestrian/cyclist "overpass" must be provided to connect the Pleasant Way precinct to the civic precinct to improve pedestrian/cyclist accessibility over the proposed wider Princes Highway and minimise the number of times pedestrians/cyclists have to interrupt traffic when crossing the Princes Highway. The existing crossing is highly utilised and will intensify when the old bridge is transformed into a higher order pedestrian and cyclist link.

Response

The proposal provides an efficient pedestrian and cyclist link from the existing southbound bridge into Nowra. Section 3.2.3 of the REF provides details of the shared paths that will be provided as part of the proposal. This includes a shared path on the eastern side of the highway running from the Shoalhaven River south to Moss Street. The upgraded path will connect to the existing path that runs along the southern bank of the Shoalhaven River providing access from the eastern side of the highway to Nowra CBD.

Roads and Maritime has also carried out additional pedestrian surveys at the Princes Highway/ Bridge Road/Pleasant Way intersection and the pedestrian underpass on the southern foreshore. The results of these are summarised in Table 3-4 and Table 3-5 for the crossings north and south of the intersection.

Table 3-4: Recorded pedestrian volumes, Princes Highway/Bridge Road intersection

Date	AM period 7.00am to 10.00am		PM period 2.30pm to 5.30pm	
	North	South	North	South
19 October 2018	1	13	2	16
26 October 2018	0	21	0	19

Table 3-5: Recorded pedestrian volumes, southern foreshore pedestrian underpass

Date	AM period 7.00am to 10.00am		PM period 2.30pm to 5.30pm	
	Westbound	Eastbound	Westbound	Eastbound
19 October 2018	70	62	51	48
26 October 2018	47	35	39	42

The above survey results show limited pedestrian demand crossing the Princes Highway at the Bridge Road intersection, with a higher demand observed at the foreshore underpass. Noting that improved connectivity across the highway will be provided by upgrades to the existing path beneath the river crossings, making it more desirable, Roads and Maritime does not consider there is sufficient justification for a pedestrian/cyclist overpass at this location.

Issue description

The concept design illustrates a duplication of a pedestrian/cyclist path in the Scenic Drive precinct (at the bend).

Response

The pedestrian/cyclist path on Bridge Road terminates at Scenic Drive and does not continue down Scenic Drive. The lines that run parallel to the kerb lines on Scenic Drive in the design drawings denote the ‘back of kerb’, rather than a pedestrian/cyclist path.

Issue description

The concept plan of the Nowra Bridge indicates pedestrian access to the foreshore from the western side of the Highway. Access must be accessible and must also consider improving accessibility, comfort and safety of the underpass through to Mavromattes Reserve. This will be particularly important noting Council's preference to close Scenic Drive from Bridge Road in accordance with the Nowra Riverfront Leisure and Entertainment Precinct package.

Response

Roads and Maritime confirms that access will be provided from the shared path on the eastern side of the Princes Highway down to the river foreshore, connecting with the existing path that runs parallel to the river and beneath the existing bridges. This access has been designed to comply with all relevant disability access requirements, and this will be confirmed during detailed design.

The proposal also includes the upgrading of the path beneath the existing bridges to provide the required minimum path width and overhead clearance. The final concept design will also incorporate features to address Crime Prevention Through Environmental Design (CPTED) objectives. These would be developed in consultation with Council.

Issue description

The works will result in reduced accessibility to the Aquatic Park from the highway and operational impacts (amenity, noise, vibration and acoustic) associated with the ancillary site located on the adjacent Riverhaven Motel site.

Response

Section 3.3.1 of the REF identifies that Scenic Drive would be closed between Bridge Road and where Scenic Drive starts to run parallel with the river near the Nowra Aquatic Park car park during construction. This statement is inaccurate; rather access along this section of Scenic Drive will be controlled and managed through the Traffic Management Plan that will form part of the CEMP (refer environmental management measure T1). Access to the Nowra Aquatic Park will also be available via Hyam Street/Mandalay Avenue/Scenic Drive as noted in the REF. The additional travel time is identified as an impact and it was concluded that this would be moderate.

Impacts on amenity of aquatic park users will be limited to the construction phase, and these have been assessed in the REF. The existing environmental management measures, for example in relation to construction noise and air quality, identified in the REF will mitigating amenity impacts on park users. It is not anticipated that there will be any material impacts on amenity associated with operation of the proposal.

3.2.7 Parking

Issue description

Council does not accept the parking impacts proposed in the civic precinct (particularly land to the north of the Shoalhaven Entertainment Centre) which provides significant overflow parking relief for the Council administration building and entertainment centre precincts. A replacement 120 space (minimum) car park needs to be provided within reasonable walking distance of and with safe pedestrian linkages back to the civic precinct. Council suggests this needs to be provided on land between Scenic Drive and Hyam Street, with a road link between Scenic Drive and Hyam Street and safe and efficient pedestrian access back to the traffic signals required at the intersection of Bridge Road and Hyam Street.

As mentioned previously, Roads and Maritime should consider constructing a car park to the rear of the Aquatic Park for use during construction and consider dedicating the infrastructure to Council once the construction is complete. This car park will need to be in addition to the 120 spaces to be replaced as a result of the impact to the triangle site north of Shoalhaven Entertainment Centre.

Response

A revised assessment of impacts to parking as a result of the proposal is provided in Section 5.5 of this submissions report.

The suggested provision of traffic signals at the intersection of Bridge Road and Hyam Street is addressed in Section 3.2.3 of this submissions report.

3.2.8 Amenity

Issue description

Construction activities [in Moorhouse Park] will impact on access to the foreshore associated with the ancillary site and will affect amenity. Further information is required to better understand these impacts.

Response

Section 6.8.3 of the REF acknowledges the impacts of construction activities on Moorhouse Park including likely restrictions on access to the foreshore in the vicinity of Ancillary Site 3, immediately to the west of the highway, and impacts on amenity in this locality. As noted in the REF, it is likely the pedestrian path along the foreshore would need to be closed at times during construction for safety reasons. Environmental management measure SE7 addresses the issue of maintaining access to the river foreshore areas, including pathways, as far as practicable, subject to safety considerations. Environmental management measure SE1 addresses keeping the community informed of any construction activities that could affect access, including to areas of open space.

Roads and Maritime will consult further with Council to provide any necessary clarification with regard to impacts on access and amenity in Moorhouse Park.

Issue description

The loss of the playground and park area [at Moorhouse Park] needs to be addressed to ensure that loss to social infrastructure as a result of the bridge project is managed. Roads and Maritime must ensure that suitable replacements or monetary compensation is provided to Council to ensure that this infrastructure can be replaced in the fullness of time.

Response

Roads and Maritime acknowledges that the proposal would result in a reduction in public open space between Scenic Drive and the highway, and that this will affect amenity through loss of social infrastructure. This is recognised in the REF, and Roads and Maritime will consult further with Council with regard to offsetting permanent impacts. This is addressed through environmental management measure SE2.

Issue description

The works involve impact to the use of Greys Beach for parking, passive recreation and access to the boat ramp as a result of the site being utilised for a potential ancillary site and launching area. It is acknowledged that the proposed lease indicates that the boat ramp is not included in the lease area but will be utilised for the storage of plant and material, launching of construction barges and

transfer of plant and materials during the construction of the Nowra Bridge. North Nowra Rotary Park is significantly impacted by the acquisition of land required for the northbound landing of the bridge and the widening of Illaroo Road.

Greys Beach has been recently master planned and some works undertaken on the boat ramps, access ways and car parking. The area is highly utilised, particularly from September through to May by watercraft users. Appendix I of the exhibited material indicates that Greys Beach will be affected by a temporary lease of part of the land, construction of a temporary jetty and associated exclusion zone. The lease / works will have significant impact on users of this area; specifically the reduced navigable water area of the Shoalhaven River will impact non-motorised sporting groups which practice and race in this location. In addition, the Study indicates that during the construction of the Nowra Bridge (i.e. such as during craning new sections of the bridge into place), marine vessels will be restricted and, in these events, community and river users would be notified in advance. This will also impact users of Paringa Park in the same regard. The Study indicates that there would be an overall high impact.

Roads and Maritime must consider potential replacement infrastructure to minimise impact to watercraft users during construction of the Nowra Bridge.

In addition, Roads and Maritime must ensure that Greys Beach is returned to its original or improved condition once construction is complete.

Council would encourage dialogue with Roads and Maritime to ensure that the needs of the user groups are met as part of the finishing of the site after the project is complete. The works will restrict navigable water area of the Shoalhaven River which is utilised by non-motorised sporting groups. The direct impact of the works to Paringa Park are considered minor as it is not associated with any lease or land acquisition, however the reduction of the navigable water area could have significant impacts for Shoalhaven River user groups. Indirect impacts will occur as a result of the significant impacts to Greys Beach during the construction of the Nowra Bridge. As per recommendations made for Greys Beach, Roads and Maritime must consider potential replacement infrastructure to minimise impact to watercraft users during construction of the Nowra Bridge. Council is open to liaising with the affected groups and Roads and Maritime regarding a suitable solution to this impact. ***Response***

The REF acknowledges the impacts of the proposal on users of the Greys Beach boat ramp and car parking area during construction, and notes Council's advice regarding utilisation of the area, particularly from September through to May. The revised assessment of parking impacts at Greys Beach (refer Section 5.5 of this submissions report) has provided amendments to environmental management measure SE4 to provide clarity on access to the boat ramp and to the provision of parking. The revised environmental management measure SE4 is described in a previous response.

A navigational exclusion zone and 50 metre navigation channel would be implemented during construction of the proposal. The navigational exclusion zone would extend 200 metres upstream and 100 metres downstream of the existing bridges and would be marked by navigation buoys in the river. An exclusion zone would also be established in the river adjacent to the Greys Beach ancillary site.

The movement of barges and other watercraft would be carried out in accordance with all applicable maritime safety requirements. Members of the public will be kept informed of construction activities through the Community and Stakeholder Engagement Plan, which will include notification of any works that could affect users of this and other boat ramps (environmental management measure SE1). Environmental management measures SE3 and SE4 address management of impacts on users of this area and at the other boat ramp in the proposal area.

All construction work sites and ancillary sites, including the Greys Beach area, will be returned to at least their pre-construction state, unless otherwise detailed in the proposal design. This will be carried out progressively during the construction program where possible, and at the completion of construction for all remaining sites. This is addressed through environmental management measure LV10.

Roads and Maritime will consult further with Council to ensure there is no material change to access or amenity of user groups following completion of construction and restoration of the Greys Beach ancillary site. This will include consideration of opportunities to improve amenity in this and other affected open space areas.

Issue description

North Nowra Rotary Park will largely be affected as a result of the works associated with the Nowra Bridge. The existing amenities building, car park and paths will be absorbed as a result of the bridge landing, realignment of the intersection and widening of Illaroo Road. Appendix I of the exhibited material indicates that the remaining area of the park will be returned to public use with relocated parking area and shared park. As it has been noted that it does not appear that the amenities building will be replaced as part of the reopening of the park, Council requests that a new amenities building is included in the reopened park to compensate for the loss of open space and associated social impact. If an amenities building within the park is not deemed necessary, Council will liaise with Roads and Maritime to determine a suitable replacement location.

Response

The REF identifies that the proposal would substantially reduce the open space area of North Nowra Rotary Park, and would impact on infrastructure including the existing amenities building, car park, and footpath. The proposal does not include replacement of the amenities building. Instead, Roads and Maritime will consult with Council regarding reasonable compensation to allow Council to replace this facility at a location deemed appropriate by Council after construction of the proposal.

Issue description

The works will require maritime activity periodically from Nowra Wharf which will have a minor impact. It is unclear how periodic this will be or the timeframe in which the Nowra Wharf could be used for maritime activity such as the launching of construction barges and transfer of plant and material.

Similar to Greys Beach, the wharf and boat ramp may be closed to marine vessels during certain construction activities. There will be some impact in these situations where the restriction of the use of the wharf and boat ramp impacts practice and race use by water sport groups and users. Roads and Maritime must provide suitable replacement infrastructure to minimise impact to watercraft users during construction of the Nowra Bridge. Council is open to liaising with the affected groups and Roads and Maritime regarding a suitable solution to this impact. The works will impact the amenity of the foreshore area during construction which will result in reduced access/use of the public open space. The foreshore area generally will also be impacted at the old Nowra Sailing Club site as detailed above. During construction of the Nowra Bridge, it is expected that the amenity of the foreshore area will be impacted. There are no suggested management actions to minimise this impact.

Response

The frequency of use of the Wharf Road boat ramp will be determined by the construction contractor, with use being limited to small watercraft to access water-based construction areas. The

type of watercraft will be similar to those that currently use the boat ramp. Larger watercraft such as barges will instead use the temporary jetty that would be installed at Ancillary Site 3 for loading and transportation of construction materials and plant.

The REF identified that use of the boat ramp to access the river may require temporary short term closures which could cause disruptions for other users. Advance notification of any closures will be provided through the Community and Stakeholder Engagement Plan (environmental management measure SE1). Roads and Maritime will continue to liaise with Council to ensure minimal impacts on users of this boat ramp.

Issue description

The works will impact the park as a result of the realignment and widening of the Princes Highway. The acquisition and realignment/widening of the Princes Highway will result in a reduced overall area, removal of the significant native trees which provide visual buffer and improved amenity and encroachment into the existing skate park on the southern side of Harry Sawkins Park.

Appendix I of the exhibited material does not address any management of impacts on Harry Sawkins Park. Appendix G (Urban Design and Landscape Character and Visual Impact Assessment) identifies that the length of Harry Sawkins Park will be heavily landscaped with native vegetation to compensate for the loss of the existing significant vegetation. Reducing the width of the southern landscaping buffer may need to be considered in order to reduce the impact on the existing skate park. Any installation of native trees should involve trees of a considerable size in order to maintain some level of visual buffer and amenity within Harry Sawkins Park. Council would encourage dialogue with Roads and Maritime to continue to discuss the detailed design of this section of the project. Any potential damage or loss to this infrastructure must be suitably addressed and replaced by Roads and Maritime in consultation with Council.

Response

The SEIA (refer Appendix I to the REF) identifies that a portion of Harry Sawkins Park adjacent to the Princes Highway will be permanently acquired to accommodate the widening of the highway. This will result in a reduction in the area of the park and the removal of vegetation. The consequent impacts on visual amenity associated with the removal of vegetation in this and other areas adjacent to the highway have been considered in the Urban Design Report and Landscape Character and Visual Impact Assessment (Appendix G to the REF). Mitigation of these impacts will be addressed through the UDLP (environmental management measure LV1) which will incorporate landscape treatments and replanting. Significant vegetation will be retained where practicable (environmental management measure LV2) and further investigation will be carried out with regard to using retaining walls in specific locations, including south of the Bridge Road intersection, in order to retain existing vegetation (environmental management measure LV4).

The proposal is not considered likely to materially reduce amenity with regard to users of the park given that works will be limited to the eastern edge of the park. Management of impacts on the park associated with construction activities will be addressed through the CEMP (environmental management measure GEN1).

Roads and Maritime notes the suggestion regarding reducing the width of the southern landscaping buffer in order to reduce the impact on the existing skate park, and will consult with Council with regard to this and other opportunities to mitigate impacts on the skate park.

Issue description

The proposed acquisition to allow widening on the western side of the Princes Highway threatens to impinge on the amenity of the Council administration building. Council requests detail from Roads

and Maritime about proposed noise abatement treatments and a commitment which ensures that there is no loss of amenity during the construction phase and thereafter.

Response

The noise and vibration assessment (Appendix D to the REF) prepared for the proposal included the Council administration building as a receiver (identification number OSR_0018). The assessment was prepared in accordance with relevant guidelines and standards as identified in Sections 4 and 9 of the Noise and Vibration Assessment report.

Construction noise and vibration impacts will be managed through the NVMP that will be prepared and implemented as part of the CEMP (environmental management measure NV1). The NVMP will include provision for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures.

The operational noise assessment did not identify any non-residential receivers (including the Council administration building) for consideration for additional noise mitigation. Environmental management measure NV15 provides for post-construction noise monitoring to be carried out within 2-12 months of completion of the proposal at representative locations within the proposal area.

3.2.9 Noise and vibration

Issue description

The exhibition material identifies noise and vibration impacts and potential amelioration measures. Council requires further detail to adequately consider this aspect of the proposal. In particular, Council should be consulted in the design and location of any sound barriers and any other measures of this nature. Concern is raised in relation to the impacts such measures will have on visual amenity and heritage items.

Response

An assessment of the proposed noise wall is provided in Section 5.2 of this submissions report. The location and design of the proposed noise wall will be further developed during detailed design of the proposal in consultation with affected residents and will consider potential impacts on visual amenity. Road and Maritime will continue to consult with Council and all other relevant stakeholders on matters related to mitigation of operational traffic noise impacts associated with the proposal.

3.2.10 Landscape character and visual impact

Issue description

Council reiterates its willingness to work closely with Roads and Maritimes urban design consultants to ensure integration between the Nowra Bridge project and the river foreshore masterplan. The landscaping of the closed section of the southbound carriageway of Princes Highway directly adjacent to Gateway Park must consider the impact to Gateway Park from an access and visual impact perspective. Council would encourage dialogue with Roads and Maritime in relation to the design of the local road, and the landscaping of the closed section of the Highway.

Response

Roads and Maritime confirms it is committed to continuing to working closely with Council to achieve the best possible urban design and landscape outcome balancing the needs of all stakeholders involved with the proposal.

3.2.11 Non-Aboriginal heritage

Issue description

The works involve significant impact (loss) to the existing heritage listed Bicentennial Memorial (Floodboat Shelter), access to the foreshore area from the western side of the highway and significant impact (loss) to the existing playground along the foreshore. It is noted that part of Moorhouse Park along the foreshore area will be part of a potential ancillary site. This detail needs to be provided to ascertain the full extent of the impact. In relation to the Bicentennial Memorial, Council encourages dialogue with Roads and Maritime for the relocation of the structure as suggested in Appendix F (Non-Aboriginal Statement of Heritage Impact) of the exhibited material. Other locations for the siting of the memorial should be assessed in relation to heritage impact. Consideration of a new site for the Bicentennial Memorial must be undertaken in consultation with Council and must ensure that it remains within the riverfront area to ensure the intrinsic relationship with the Shoalhaven River continues. The relocation of the memorial must be fully funded by Roads and Maritime.

Response

Part of Moorhouse Park at the eastern end of Scenic Drive would be partly affected by permanent road infrastructure associated with widening the Princes Highway and construction activities associated with use of the area as an ancillary site for construction of the new northbound bridge and related activities. Specific details with regard to use of this area would be determined by the construction contractor. Responses to issues raised in relation to impacts on amenity and access in the affected area of Moorhouse Park are provided in Sections 3.2.8 and 3.2.10 respectively.

With regard to impacts on the Captain Cook Bicentennial Memorial, Roads and Maritime is investigating the technical feasibility of relocating the pavilion structure. If relocating the structure is feasible, the site for its relocation would be determined in consultation with Council. Environmental management measure NAH4 has been revised to reflect this as follows:

> ***NAH4:*** ~~Determine a~~ ***Roads and Maritime will investigate the technical feasibility and*** suitable location for relocation of the pavilion structure associated with the Captain Cook Bicentennial Memorial, in consultation with Shoalhaven City Council. ***Subject to the feasibility and suitable location being determined for relocation, Roads and Maritime will meet all reasonable costs associated with its relocation.***

3.2.12 Traffic and transport

Issue description

Significant traffic impacts are highly likely following the construction of the Nowra Bridge project. Contrary to Review of Environmental Factors and Concept Design considerations, Council is of the opinion that traffic congestion issues will be exacerbated by the proposed merging of three lanes to two, particularly in times of higher seasonal traffic demand. Council reiterates that the Nowra Bridge project, in conjunction with the Berry to Bomaderry upgrade and continued background traffic growth, will bring forward the need to extend three lanes of traffic in each direction continuous through Bomaderry and South Nowra.

Response

Under the proposal three lanes will merge to two lanes north of Bolong Road heading north. Traffic modelling carried out for the proposal has considered the merge point and the potential impacts to the efficiency of the network in the forecast period. The modelling shows the Princes Highway and

all intersections within the proposal would operate at a higher level of service in 2046 than is currently experienced, with the merge from three lanes to two lanes at Bolong Road in place.

During periods of higher seasonal demand, the network is anticipated to experience increased levels of congestion, as the network has been designed to accommodate the 100th highest annual hour of traffic flow experienced during the year.

While the proposal will improve congestion along the Princes Highway and within the local road network between Bolong Road and Moss Street, it is acknowledged other sections of the Princes Highway through Nowra and Bomaderry are also experiencing localised congestion and poor levels of service at some key intersections during peak periods. The Princes Highway Corridor Study, prepared by Roads and Maritime Services in August 2016, outlined the current and expected challenges for the Princes Highway through Nowra and identified specific short, medium and long term priorities for addressing them. One specific priority was to develop a traffic model of the Nowra and Bomaderry town centres to inform the development of a traffic and transport study to address traffic efficiency, road safety and pedestrian and cyclist access and safety issues.

In addition to this, Future Transport 2056 and the Regional NSW Services and Infrastructure Plan commit to develop Regional Future Transport Plans for each of NSW's nine regions to align with the Department of Planning and Environment's 20 year Regional Plans. In addition, Place Plans which consider the implementation of the movement and place framework will be developed for prioritised cities and centres within each region.

Transport for NSW and Roads and Maritime Services have recently commenced work on the Illawarra-Shoalhaven Future Transport Plan. This Plan will provide the overarching strategic transport network vision that will guide future transport planning for the Illawarra-Shoalhaven region and will be prepared in consultation with local government, the Joint Organisation, other state government agencies and Australian Government bodies. The Plan will also identify a number of Place Plans to be developed in collaboration with Councils and state government agencies which will consider the more detailed, place-specific implementation of Future Transport principles.

The Illawarra-Shoalhaven Future Transport Plan is expected to be completed in the 2019/20 financial year.

Providing three lanes further north of Bolong Road is beyond the scope of the proposal.

3.2.13 Property and land use

Issue description

Civic Precinct: The Nowra Bridge Project will significantly impact the northern portion of the Civic Precinct and Hotel site (i.e. Council Administration Building, Shoalhaven Entertainment Centre, Harry Sawkins Park and surrounding car parking areas). The site is considered a key location for future development to provide a defined gateway to Nowra. There will be significant impacts on the development potential of this site and the future of this site will need to be reviewed. Roads and Maritime must be open to the mitigation of the potential negative impacts on the development potential of this site.

Response

Roads and Maritime acknowledges Council's concerns with regard to its intention to establish a defined gateway to Nowra. Development of the design has sought to minimise impacts on surrounding land, and this has been part of the decision-making process giving preference to at grade designs for intersections rather than grade separation which has a greater impact footprint.

The need for the design of the proposal to provide clear identification of a gateway of entry to the Nowra CBD from Bridge Road is acknowledged in the Urban Design Report and Landscape Character and Visual Impacts Assessment (Appendix G to the REF) which will be used to inform preparation of the UDLP for the proposal. Roads and Maritime will consult with Council during preparation of the UDLP to ensure appropriate consideration of all elements contributing to high quality outcomes for such a gateway are incorporated into the plan.

3.2.14 Community Infrastructure Strategic Plan

Issue description

The Socio-economic Impact Assessment does not refer to Council's *Community Infrastructure Strategic Plan* (Shoalhaven City Council, 2017) as the relevant guiding document for social infrastructure but it does refer to the rescinded *Shoalhaven City Council Public Open Space Plan* (Shoalhaven City Council, 2008). This study will need to be revised.

Response

The reference to the *Shoalhaven City Council Public Open Space Plan* in Section 6.8 of the REF is in the context of the impacts of the proposal on open space.

Section 4.2.1 of Council's *Community Strategic Infrastructure Plan* notes that public open space, sport and recreation are Council-managed land and water bodies that are broadly available for public leisure and recreation, pedestrian and cycle movement, sport or for nature conservation purposes.

It further notes that the open space network provides a variety of functions within the Shoalhaven community and local area as follows:

- Passive recreation, providing a setting for informal play and physical activity, relaxation and social interaction
- Active recreation, providing a setting for formal structured sporting activities and when not in use provides a possible recreation function
- Environmental appreciation, providing a setting where people can enjoy nearby nature and protect local biodiversity and natural area values
- Encumbered open space, providing a setting to house auxiliary functions within public lands (utility), or is otherwise undeveloped.

It is noted that while the *Shoalhaven City Council Public Open Space Plan* has been superseded by the *Community Infrastructure Strategic Plan*, the assessment of impacts of the proposal on open space as documented in Section 6.3 of the SEIA is considered to still be valid.

3.2.15 Further consultation

Issue description

The exhibited material identifies that there will be significant impact on a number of Council owned and managed lands and assets, including during the construction phase and at the completion of the works. Compensation and/or replacement of infrastructure is a high priority and must be genuinely considered by Roads and Maritime in consultation with Council. Council has been preparing a master plan for Gateway Park over a number of years with significant investment made in preparing technical investigations such as flood constraints. The project is currently on hold to ensure that it accurately reflects the Nowra Bridge Project acquisition and construction works.

Monetary compensation to Council may be appropriate in the event that the impacts of the Bridge Project require the work already undertaken to be significantly revised.

Infrastructure provided as a result of the impact to Council-owned and managed assets will need to be effected in consultation with Council and in accordance with Council's adopted Community Infrastructure Strategic Plan.*Business and Property Manager*
In a letter dated 15 August 2018 Roads and Maritime advised Council about acquisitions of Council owned land as well as proposals to occupy various parcels of Council owned land during the construction phase of the Nowra Bridge project.

It is noted that Roads and Maritime staff have indicated (verbally) a willingness to consider alternative proposals for various parcels of land currently identified for acquisition. Council strongly requests that these discussions remain open to determine a resolution suitable to both Council and Roads and Maritime.

It is reiterated that there are various Council assets in the land proposed to be acquired and negotiations must be undertaken to appropriately protect, relocate or compensate for the loss of these assets and the reduced access to these assets during construction and thereafter.

Strategic Planning
Nowra Riverfront Precinct Master Planning Project and Heritage Truss Bridge:

The riverfront precinct covers land to the east and west of the Highway as shown in the Figure 1 below.

The impacts discussed in the main body of this submission will have significant implications for this precinct and further consultation between Council and RMS is required to mitigate these impacts. It is of particular relevance that proposed land acquisition within the precinct will result in significant loss of development potential. Roads and Maritime must provide adequate compensation for the loss of this land. Additionally and/or alternatively, Council encourages dialogue with Roads and Maritime to explore development options of this land that better align with Council objectives for the Riverfront Precinct than are currently proposed by Roads and Maritime.

Response

Roads and Maritime acknowledges that further consultation with Council will be required on a range of issues to provide Council with assurance that appropriate and reasonable consideration has been given to all issues raised by Council. Roads and Maritime confirms it is committed to ongoing consultation with Council to facilitate mutual agreement on outcomes for the issues raised, as described in the identified environmental management measures for the proposal. This will also include negotiations regarding reasonable compensation for all the matters noted by Council.

3.2.16 Future use of the existing southbound bridge

Issue description

An opportunity exists to thoughtfully consider integration of the Heritage Bridge with Mavromattes Reserve to ensure the future of the bridge as a public open space is accessible, well utilised, and connects with the foreshore area. It is acknowledged that Section 6.4.1 and 6.7.2 of Appendix I of the exhibited materials addresses this opportunity. This is an important aspect of the proposal to ensure that the impact endured during the construction of the bridge is alleviated by an improved community and social outcome once the project is complete. Council would encourage dialogue with Roads and Maritime to continue to discuss this opportunity.

The existing bridge to the east is an important heritage item to the community. It is supported that this is retained, however adequate provision needs to be made to ensure connection to the Riverfront Precinct and safe, accessible and convenient movement both across the bridge and on each side of the bridge.

Council supports the need for an Interpretation Strategy for the Bridge. Council identifies the opportunity and importance of infrastructure and interpretive information about the bridge and the other heritage items in the area.

If the bridge is to be dedicated to Council, adequate monetary contribution should be provided by Roads and Maritime to ensure Council can appropriately maintain the heritage bridge into the future. Council encourages dialogue and commitment to this matter.

Response

Section 3.2.3 of the REF identifies that it is proposed to retain the existing southbound bridge, close it to vehicular traffic, and maintain it for adaptive reuse following opening of the new northbound bridge. It also identifies that the rehabilitation and repurposing of the existing southbound bridge for adaptive reuse would be subject to a separate consultation and assessment process.

The assessment and evaluation of adaptive reuse options will include consideration of the above matters noted by Council concerning connectivity and communication of the heritage values of the bridge. With regard to connectivity, Section 3.2.3 of the REF identifies that shared paths would be constructed up to the existing southbound bridge, facilitating future connections to active transport facilities that may be provided on the bridge.

Table 5-5 in the REF identifies that Roads and Maritime will continue to be responsible for maintaining the existing southbound bridge. Roads and Maritime confirms that this position remains unchanged.

3.2.17 Residual assets

Issue description

Roads and Maritime should consider the gifting to Council of any residual assets resulting from the construction of the Nowra Bridge Project, particularly those assets that could enhance some of Council's longer-term projects:

- Barge loading facilities; and
- Car park to the rear of Nowra Aquatic Park which may be used during construction and retained in perpetuity by Council as a new car park for the Aquatic Park.

Response

Barge loading facilities are intended to be temporary and for use solely for construction activities. They will be removed as part of restoration of the ancillary facilities they are associated with. Roads and Maritime will consider the matter related to car parking as part of ongoing consultation with Council.

As previously noted in Sections 3.2.7 and 5.5, Roads and Maritime is of the view that a temporary car parking area to the rear of the Nowra Aquatic Park would not be a suitable site for parking in view of the identified constraints.

3.3 NSW Department of Primary Industries (Fisheries)

3.3.1 Socioeconomic

Issue description

The new bridge and alignment traverse the Shoalhaven River estuary and Bomaderry Creek. The Shoalhaven River and its tributaries support valuable aquaculture and recreational and commercial fishing industries. The potential impacts from construction of the new bridge are of interest to this Department.

As was identified in the REF, aquaculture (oyster farming) occurs downstream in the Shoalhaven and Crookhaven Rivers. The REF has found that the proposal is unlikely to result in direct or indirect impacts on aquaculture, however the potential for translocation of invasive species and pathogens into the Shoalhaven system has not been considered. A protocol for ensuring that appropriate aquatic biosecurity precautions are undertaken during construction should be developed in consultation with the Biosecurity section of DPI Fisheries. We also recommend that Roads and Maritime consult with local oyster growing representatives to ensure that they kept informed about the project and that potential threats to their industry are being adequately addressed.

Response

The potential for the translocation of invasive species and pathogens into the Shoalhaven river system is acknowledged in view of the likely use of water-based construction plant, such as barges. Management of this risk is addressed through new environmental management measure B19:

> ***B19: All machinery and vessels used during construction are to be verified as clean and free of potential weeds, pests and pathogens prior to arrival to site. Procedures to prevent the introduction or spread of aquatic pests, diseases and saltwater weeds will be developed in consultation with DPI Aquatic Biosecurity and implemented during construction.***

Commencing prior to construction and continuing during construction, engagement with local oyster growing representatives will occur through a structured consultation process. This will be managed through a Community and Stakeholder Engagement Plan that will be developed and implemented by the construction contractor as identified in Section 5.6.2 of the REF.

3.3.2 Licensing and approvals

Issue description

Roads and Maritime Services must apply for and obtain a Part 7 permit for harm marine vegetation (s.205) under the FM Act from Fisheries NSW prior to any works at the site. Permit application forms are available from the DPI Fisheries website at: http://www.dpi.nsw.gov.au/fisheries/. In accordance with Section 3.3.3 of the Policy and Guidelines for Fish Habitat Conservation and Management (2013), the permit issued by DPI Fisheries will require the development of an offset strategy detailing habitat compensation (on a 2:1 basis) to be provided for the loss of seagrass, saltmarsh and mangroves

Response

The need for a permit under Part 7 of the FM Act for harm to marine vegetation is acknowledged in Table 7-2 of the REF; this also notes that the application for permit will be made prior to any works

that could harm marine vegetation. A response to the matters to be addressed in an offset strategy is provided in the following section.

3.3.3 Biodiversity

Issue description

The REF has identified the requirement for offsetting of aquatic habitats to ensure that the project will result in 'no net loss' of key fish habitat. The Department would like to reiterate that during the design phase, as a first principle, every effort must be made to avoid or minimise impacts to marine vegetation.

The Department will require the development of an offset strategy which clearly quantifies the predicted area of impact to key fish habitats and demonstrates that the principles of avoid, mitigate and offset have been applied to the proposal. Investigations into suitable offsets for loss of marine vegetation at a rate of 2:1 per m^2 should undertake at the earliest opportunity. Monetary compensation will only be considered by the Department if all other possible options to identify and rehabilitate appropriate compensatory areas have been exhausted.

Response

The REF identifies that the proposed bridge would impact about 0.03 hectares of seagrass (*Zostera muelleri*) on the southern riverbank, comprising a Type 1 key fish habitat under the FM Act. It also identifies that up to 0.06 hectares of seagrass may be impacted by the temporary barge mooring and loading facilities on the southern riverbank and at Greys Beach.

During development of the concept design, consideration has been given to avoiding or minimising impacts on marine vegetation where feasible. Further opportunities would be considered during the next stage of design but it is anticipated that these will relate principally to construction methodologies in view of the preferred alignment for the proposed new bridge.

With regard to offsetting unavoidable impacts on marine vegetation, a new environmental management measure B18 has been added as follows:

> ***B18: Roads and Maritime will determine and implement a suitable offset strategy for impacts to affected key fish habitat in accordance with the Guideline for Biodiversity Offsets (Roads and Maritime 2016) and the DPI's Policy and guidelines for fish habitat conservation and management (DPI 2013), in consultation with DPI (Fisheries).***

Issue description

Rehabilitation of the riparian zone (including replanting of native riparian and marine vegetation) where it is degraded or disturbed by the works is to be carried out at the completion of the road works.

Response

Rehabilitation of the riparian zone is captured through environmental management measure B11.

3.3.4 Environmental management

Issue description

All the safeguards and management measures detailed in Table 6.10.4 of the REF should be fully implemented. In particular we support the proposal to direct operational water to land based

treatment facilities prior to discharge. All possible improvements of operational water quality through WSUD should be incorporated during detailed design.

DPI Fisheries has reviewed the proposal in light of the above and has no objections to the proposed works, provided that:

- All works conform to and are consistent with the REF prepared by SMEC (dated August 2018), Appendices and other information placed on public exhibition. In particular, all the proposed safeguards and measures to minimise environment impacts detailed in sections 6 and 7 of the REF and Appendices must be fully implemented
- Environmental safeguards (e.g. silt curtains, sediment fences, booms etc.) are to be installed consistent with “Managing Urban Stormwater: Soils and Construction” (4th Edition Landcom, 2004, aka the Blue Book) to ensure that there is no escape of turbid plumes into the adjacent aquatic environment
- Split rock used in reclamation works in or adjacent to the waterway must be clean and free of fines
- Spill kits suitable for the containment of fuel and oils spills should be kept on site.

Response

The safeguards and management measures in Table 6.10.4 of the REF are reproduced in Table 7-1 of this report including safeguards and management measures relating to operational water quality and WSUD (WQ5, WQ6). Roads and Maritime reiterates that all identified safeguards and management measures in the REF will be implemented to mitigate and manage environmental impacts associated with the proposal.

Environmental management measure GEN1 identifies that a CEMP will be prepared to minimise and manage the environmental impacts of the proposal related to construction activities. Environmental management measure WQ1 identifies that a SWMP and ESCP’s will be prepared and implemented as part of the CEMP and will guide management of impacts related to water quality. The SWMP and ESCPs will be prepared in accordance with the ‘Blue Book’.

Management of the risk of fines impacting on water quality will be addressed through new environmental management measure WQ13:

> ***WQ13: Split rock used in reclamation works in or adjacent to the waterway must be clean and free of fines.***

Environmental management measure WQ10 provides for the preparation and implementation of an Emergency Spill Plan as part of the CEMP. This plan will include measures to avoid spillages of fuels, chemicals, and concrete wash or fluids into any waterways, and responses, such as the use of spill kits, to mitigate and manage incidents in the event of spillages.

3.3.5 Consultation

Issue description

The final detailed design plans for the new bridges at Shoalhaven River and Bomaderry Creek, (including designs for detention basins for road drainage from the bridge and road approaches) are to be submitted to DPI Fisheries for review and comment.

The design and construction of any instream temporary working structures is to be undertaken in consultation with DPI Fisheries.

Response

The detailed design plans for the new bridges at Shoalhaven River and Bomaderry Creek, and for water quality treatment devices will be provided to DPI Fisheries for review and comment. Roads and Maritime will consider all comments provided with regard to any further revisions to the final design. This is addressed through new environmental management measure WQ14:

> ***WQ14: The final detailed design plans for the new bridges at Shoalhaven River and Bomaderry Creek, and for water quality treatment devices will be provided to DPI Fisheries for review and comment. Roads and Maritime will consider all comments provided with regard to any further revisions to the final design.***

The REF identifies that in-stream structures are likely to be required during construction. It notes that this is unlikely to result in blockage of fish passage but could affect the flow regime of the affected waterway. Design and construction of any such temporary structures would be carried out with reference to *Policy and guidelines for fish habitat conservation and management* (2013 update) (DPI, 2013) as is provided for in environmental management measure B11. Consultation regarding the design and construction of temporary in-stream structures with DPI Fisheries is addressed by a new environmental management measure WQ17:

> ***WQ17: DPI Fisheries will be consulted with regard to the design and construction of any instream temporary working structures.***

Issue description

Copies of the Construction Environmental Management Plan (CEMP) and Environmental Work Method Statements (EWMS), including soil and water management plans, for bridge construction and instream temporary working structures are to be submitted to DPI Fisheries for review and concurrence.

Response

The CEMP, EWMS, and other relevant supporting documents will be provided to DPI Fisheries for review prior to construction. Finalisation of the CEMP and other documents will consider comments provided by DPI Fisheries. Concurrence will be sought for all matters where DPI Fisheries has a statutory responsibility.

Issue description

DPI Fisheries (1800 043 536) is to be immediately notified of any fish kills in the vicinity of the works. In such cases, all works other than emergency response procedures are to cease until the issue is rectified and written approval to proceed is provided by DPI Fisheries

Response

Roads and Maritime will immediately notify DPI Fisheries of any fish kills in the vicinity of the works. This safeguard is captured through a new environmental management measure B20:

> ***B20: Roads and Maritime will immediately notify DPI Fisheries of any fish kills in the vicinity of the works.***

3.3.6 Landscape character and visual impact

Issue description

The Urban Design and Landscape Plan should be designed using fish friendly' foreshore structures and to comply with the 'Environmentally Friendly Seawalls' publication produced by the Office of

Environment & Heritage. Hard engineering solutions and vertical retraining structures must be minimised, with final foreshore designs incorporating appropriate endemic vegetation.

Response

An UDLP will be prepared to inform detailed design and will form part of the CEMP, as identified in environmental management measure LV1. This measure has been revised to include reference to foreshore structures with regard to design treatments for built elements of the proposal, and to add 'Environmentally Friendly Seawalls' publication to the list of guidelines to be referenced in preparation of the UDLP.

> ***LV1***: An Urban Design and Landscape Plan (UDLP) will be prepared to inform detailed design and will form part of the CEMP. Development of the UDLP will draw on the Urban Design Report and Landscape and Visual Assessment prepared for the REF.
> The UDLP will present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment.
> The UDLP will include design treatments for:
>
> - Location and identification of existing vegetation and proposed landscaped areas, including species to be used
> - Built elements including retaining walls, bridges, ~~and~~ noise walls***, and foreshore structures***
> - Pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings
> - Fixtures such as seating, lighting, fencing and signs
> - Details of the staging of landscape works taking account of related environmental controls such as erosion and sedimentation controls and drainage
> - Procedures for monitoring and maintaining landscaped or rehabilitated areas.
>
> The UDLP will be prepared in accordance with relevant guidelines, including:
>
> - Beyond the Pavement urban design policy, process and principles (Roads and Maritime, 2014)
> - Landscape Guideline (RTA, 2008)
> - ***Environmentally Friendly Seawalls' (OEH, 2009)***
> - Bridge Aesthetics (Roads and Maritime 2012)
> - Noise Wall Design Guidelines (RTA, 2006)
> - Shotcrete Design Guideline (RTA, 2005).Landscape Guideline (RTA, 2008)
> - Bridge Aesthetics (Roads and Maritime 2012)
> - Noise Wall Design Guidelines (RTA, 2006)
> - Shotcrete Design Guideline (RTA, 2005).

3.4 NSW Office of Environment and Heritage (Regional Operations)

3.4.1 Aboriginal heritage

Issue description

OEH is satisfied that the requirements for Registered Aboriginal Party (RAP) consultation have been addressed. However, there are discrepancies between the information presented in the REF and that provided in Appendix E – Aboriginal cultural heritage assessment report:

- The summary of information provided relating to the total number of Aboriginal sites and PADs within the proposal area are not consistent
- The summary of information provided relating to the number of sites to be impacted are not consistent
- Table 6-30 in the REF and Table 10.1 in Appendix E–Aboriginal cultural heritage assessment report are not consistent
- Graham Lodge (SHR No. 01699)/Graham Lodge (AHIMS ID 52-5-0879) should be included in the list of sites that will be impacted by the proposal.

Response

The summary of information provided relating to the total number of Aboriginal sites and PADs within the proposal area is not consistent

Table 10.1 in the Aboriginal Cultural Heritage Assessment Report (Appendix E to the REF) identifies 14 sites that were assessed with regard to being impacted by the proposal (noting that one of these is Graham Lodge which is no longer proposed to be used as an ancillary site and would therefore now not be impacted).

A total of five PADs were excavated during the test excavation program. Aboriginal objects were identified at all five PADs. Based on the results of the test excavation, four new artefact scatters, and one habitation site/artefact scatter were identified across the study area. In addition, two previously recorded surface artefact sites were redefined from isolated artefacts to artefact scatters. Table 7.3 in the CHAR lists identified subsurface artefact scatters and previously recorded sites that were redefined, and is reproduced below.

The summary of information provided relating to the total number of Aboriginal sites and PADs within the proposal area is not consistent

Table 10.1 in the CHAR identifies eight sites that would be impacted by the proposal at the time of preparation of the REF (and which is now reduced to seven with Graham Lodge no longer proposed to be sued as an ancillary site), and identifies the type, degree and consequence of harm to each site. There is a discrepancy between this table and Table 6-30 in the REF associated with site Nowra Bridge PAD 4 (AHIMS ID 52-5-0858), with the latter identifying there would be a partial loss of value to the site. The correct consequence of harm is that provided in the CHAR, i.e. there would be no loss of value.

Table 6-30 in the REF and Table 10.1 in Appendix E –Aboriginal cultural heritage assessment report are not consistent

Table 6-30 in the REF contains a transcription error for site Nowra Bridge PAD 4 (AHIMS ID 52-5-0858). The response under 'Consequence of harm' should read 'No loss of value' rather than 'Partial loss of value'.

Graham Lodge (SHR No. 01699)/Graham Lodge (AHIMS ID 52-5-0879) should be included in the list of sites that will be impacted by the proposal

The REF identifies that the proposal involves use of part the heritage curtilage of the SHR-listed Graham Lodge as an ancillary site (Ancillary Site 4). However, subsequent to the display of the REF, Roads and Maritime is no longer proposing to use this site, which occupied the northern half of the Graham Lodge property. The design has also been revised to avoid the intrusion into the heritage curtilage related to the Pleasant Way cul-de-sac (discussed further in Section 4.4).

In view of the above changes, it is not anticipated that there would be any impacts to Graham Lodge. However, in the event of any activities or works where this may be would be required, an application would be made for an AHIP, supported by appropriate documentation, prior to works within the property. This is addressed through environmental management measure AH4.

Issue description

OEH supports the REF recommendations for Roads and Maritime and the construction contractor to:

- Prepare an Aboriginal Heritage Management Plan (AHMP) in accordance with the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (Roads and Maritime, 2012) and Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime, 2015) and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented for managing impacts on Aboriginal heritage. The AHMP will be prepared in consultation with all relevant Aboriginal groups.
- Apply for an Aboriginal heritage impact permit (AHIP) for the overall proposal area, including Nowra Bridge 1 (AHIMS ID 52-5-0852), Nowra Bridge 2 (AHIMS ID 52-5-0853), Nowra Bridge 6 (AHIMS ID 52-5-0872), Nowra Bridge 7 (AHIMS ID 52-5-0875), Nowra Bridge 8 (AHIMS ID 52-5-0876), Nowra Bridge 9 (AHIMS ID 52-5-0874), and Nowra Bridge 10 (AHIMS ID 52-5-0873).
- Collection of surface artefacts and salvage excavations will be completed prior to any activities (including pre-construction activities) which may harm Aboriginal objects at these locations.
- Where possible, avoid all subsurface impact to Graham Lodge Aboriginal Artefact Scatter (AHIMS ID 52-5-0879). Where impacts are unavoidable, salvage excavations will be undertaken in accordance with an AHIP and a Section 60 permit under the *Heritage Act 1977*.
- Collect surface artefacts across Nowra Bridge 1 (AHIMS ID 52-5-0852) and Nowra Bridge 2 (AHIMS ID 52-5-0853) prior to construction, in accordance with an AHIP.
- Conduct targeted salvage excavation within Nowra Bridge 2 (AHIMS ID 52-5-0853), Nowra Bridge 7 (AHIMS ID 52-5-0875), Nowra Bridge 8 (AHIMS ID 52-5-0876), and Nowra Bridge 9 (AHIMS ID 52-5-0874) prior to construction in accordance with an AHIP.
- Determine in accordance with the recommendations of Registered Aboriginal Parties and OEH long term arrangements for the management of excavated artefacts, such as reburial or a keeping place.

- Prepare and implement a Heritage Interpretation Strategy that addresses the cultural significance of the proposal location within the Dharawal landscape and archaeological finds from the study area. Develop the strategy in consultation with the Registered Aboriginal Parties.
- Maintain ongoing consultation with the Registered Aboriginal Parties during detailed design and construction.

Response

OEH's support for the REF recommendations is noted.

3.4.2 Flooding and hydrology

Issue description

We recommend that Roads and Maritime more fully assess flood impacts and damages on the identified residential properties to inform meaningful negotiations with owners and occupiers. The REF does not consider the implications of the adverse flood impacts to emergency response arrangements for the affected community and residents. It is recommended that Roads and Maritime consult with the SES to establish what impacts the new bridge will have on emergency response and flood access requirements during large to extreme flood events and the Local Flood Plan.

Response

Section 6.3.3 of the REF provides discussion on the potential impacts of flooding on access in relation to the Scenic Drive, Mandalay Avenue and Hyam Street locality. It does not however,, provide any specific comment on changes to access for emergency response personnel and vehicles during major flood events.

The flooding analysis will be reviewed as part of detailed design, and particularly with regard to any changes to the design that could affect flooding behaviour and changes in flood levels from that presently existing.

During detailed design, Roads and Maritime will also consult with the NSW State Emergency Service (SES) to discuss the incremental impact of the proposal on flood levels and behaviour, and to identify opportunities to mitigate impacts on access.

Issue description

As the proposed Nowra Bridge and approaches are affected by flooding and have the potential to affect flood behaviour, it should be considered in accordance with the NSW Government's Flood Prone Land Policy as set out in the NSW Floodplain Development Manual (2005). The primary objective of the policy is to reduce the impact of flooding and flood liability on individual owners and occupiers, and to reduce the private and public losses resulting from flooding, utilising environmentally positive methods wherever possible.

Response

The Flood Prone Land Policy Statement in Section 1.1.1 of the NSW Floodplain Development Manual (Department of Infrastructure, Planning and Natural Resources 2005) identifies that implementation of the policy should use ecologically positive methods where possible. These are listed in the following table together with a response as to how the proposal addresses each of the methods noted.

Table 3-6: Consideration of NSW Flood Prone Land Policy

Method	Response
A merit approach shall be adopted for all development decisions in the floodplain to take into account social, economic and ecological factors, as well as flooding considerations.	The REF prepared for the proposal has included consideration of social, economic and ecological factors for the assessment of impacts provided in Chapter 6 of the REF. All the matters identified will be considered by Roads and Maritime with regard to decision-making for the proposal.
Both mainstream and overland flooding shall be addressed, using the merit approach, in preparation and implementation by councils of strategically generated floodplain risk management plans.	Not applicable to the proposal, however, it is noted that the flooding analysis prepared for the proposal may be of value to Shoalhaven City Council in future revisions of the current Lower Shoalhaven River Floodplain Risk Management Plan.
The impact of flooding and flood liability on existing developed areas identified in floodplain risk management plans shall be reduced by flood mitigation works and measures, including on-going emergency management measures, the raising of houses where appropriate and by development controls.	The flooding analysis will be reviewed as part of detailed design, and particularly with regard to any changes to the design that could affect flooding behaviour and changes in flood levels from that presently existing. During detailed design, Roads and Maritime will consult with the NSW SES to discuss the incremental impact of the proposal on flood levels and behaviour, and to identify opportunities to mitigate impacts on access.
The potential for flood losses in all areas proposed for development or redevelopment shall be contained by the application of ecologically sensitive planning and development controls.	The potential for increased flood losses associated with the increase in flood levels attributable to the proposal will be investigated during detailed design, with a view to identifying practicable opportunities to further mitigate flood risk impacts.

Issue description

Following review of the Nowra Bridge REF (RMS, August 2018) and the RMS Nowra Bridge Project Technical Paper - Flooding and Hydrology Assessment (Arup for SMEC for RMS, June 2018), we provide the following comments with relevance to floodplain risk management for consideration.

The assessment appears to indicate that Arup relied on the hydrologic models and assessment which informed Shoalhaven City Council's (SCC) Lower Shoalhaven River Floodplain Risk Management Study and Plan (2008) (LSR FRMS&P) allied to the 2013 TUFLOW model developed for Shoalhaven Starches (with some modification around the bridge) to establish existing flood behaviour. It is, however, notable that there are significant differences between the peak flood level estimates reported in each study.

Post bridge behaviour and impacts were then reportedly determined by modifying the hydraulic model to include the proposed works and rerunning the same hydrologic inputs.

Both documents discuss negative flood behaviour impacts at residential properties on Scenic Drive, Mandalay Avenue, Hyam Street and Bridge Road. They indicate, however, that no mitigation is proposed and are silent on compensation.

Response

The difference in flood levels between the 2008 and 2013 flood studies is a result of different hydraulic models adopted to derive design flood levels. The 2008 flood study used a quasi 1D/2D CELLS model, which was later superseded by a more advanced hydraulic model (TUFLOW) in the 2013 flood study that better represents flood storage in the floodplain.

The review of the flooding analysis is addressed through new environmental management measure HY3:

> ***HY3: The flooding analysis will be reviewed as part of detailed design, particularly with regard to any changes to the design that could affect flooding behaviour and changes in flood levels from that presently existing. This will consider the incremental impact on residential properties and on other affected development. The review will include consultation with relevant stakeholders including Shoalhaven City Council and OEH.***

Issue description

The assessment is unclear as to what %AEP flood first overtops the residential floors under existing conditions or how much difference the proposed bridge makes to the probability of the onset of flooding or to the level of above floor flooding in each event above that. This information would appear to be requisite to inform negotiations with affected owners and occupiers.

Response

The flooding analysis considered changes in flood levels for the following six design flood events in order of increasing magnitude: 10 per cent AEP, five per cent AEP, two per cent AEP, one per cent AEP, 0.05 per cent AEP, and the probable maximum flood (PMF). Table 6-41 in the REF provides a summary of flood levels at 28 properties for the two per cent and one per cent flood events for existing conditions and for the proposal. The table also identifies existing floor levels for each of the properties listed.

As noted in the REF, no residences would be affected by the 10 per cent or five per cent AEP events following construction of the proposal, and none are affected by the existing 10 per cent or five per cent AEP events.

Of the 28 properties listed:

- Eleven properties would not be affected by flooding (above existing floor levels) for floods up to the one per cent AEP flood event
- An additional four properties would not be affected by flooding for floods up to the two per cent AEP flood event
- For the remaining properties, the changed level of flooding relative to existing floor levels can be ascertained from the information presented in Table 6-41.

The flooding analysis did not identify the changed probability of occurrence with respect to two per cent and one per cent flood events; rather this was assessed in terms of changed flood levels for the two events.

During detailed design, further review of the bridge design would be carried out with an objective being to identify whether there are any feasible and reasonable opportunities to reduce identified flooding impacts, for example through increasing the size of the waterway cross section. In view of this, it is not considered necessary at this point to provide further specific comment on the changed nature of flooding with regard to major flood events.

Issue description

It would also appear necessary to conduct a thorough damage assessment across the full flood range up to and including the PMF for each property, with and without the proposed bridge to determine the dollar value of the impact as either a differential Annualised Average Damage or a difference in Net Present Value to inform negotiations with affected owners and occupiers.

It is further noted that in the REF:

Table 5-4: Issues raised by Shoalhaven City Council (p114 REF)

Issue raised	Response / where addressed in REF
Concern over the 0.2 m increase in flood levels and that the affected property owners are consulted.	Roads and Maritime has conducted surveys to establish existing floor levels of flood affected properties to enable the full extent of impacts to be assessed. Refer Flooding and Hydrology Assessment in Appendix H and Section 6.6 of the REF

Neither the REF nor Technical Report, however, indicate that such consultation with affected property owners has occurred, or what information will be used to inform those negotiations.

Response

The flooding analysis will be reviewed as part of detailed design, with specific consideration given to any changes to the design that could affect flooding behaviour and changes in flood levels from that presently existing. Roads and Maritime will then conduct a damage assessment for affected properties related to the incremental impact of the proposal, and this will be used to inform consultation with affected residents. This will draw on existing available information such as the Lower Shoalhaven Flood Study, which included consideration of flood damages associated with increased rainfall and with sea level rise.

The carrying out of a damage assessment and subsequent consultation with affected property owners is addressed through new environmental management measure HY4:

> ***HY4: Roads and Maritime will carry out a damage assessment during detailed design for affected properties related to the incremental impact of the proposal, and this will be used to inform consultation with affected residents.***

Issue description

It is further noted that despite SCC advising RMS on 13 June 2018: “Council does currently hold flood data which is the old CELLS model for the Lower Shoalhaven River. Council is in the process of reviewing and new flood modelling is currently underway which is to be completed by mid of 2020.”

No reference to SCC’s review and revised modelling is made anywhere in either document.

As was the case with the interaction between the Berry Bypass Investigations and Design with the Broughton Creek Floodplain Risk Management Study and Plan, there could be significant benefit to both RMS and SCC from ensuring better co-ordination and co-operation between the Nowra Bridge investigation and design and LSR FRMS&P [Lower Shoalhaven River Floodplain Risk Management Study and Plan] processes.

Response

As noted previously, the flooding analysis will be reviewed as part of detailed design. This will include consultation with Council with regard to any information that could contribute to the review.

Issue description

While the REF states: “The flood immunity of the new northbound bridge would not be impacted by climate change.” The climate change impact assessment is not entirely clear about whether the assessment is for post development conditions and does not clearly document what impact climate change makes to the flood immunity of the proposed works more generally or the associated risks to life and liabilities.

OEH’s Water Floodplain & Coasts staff would be happy to meet with RMS to provide further assistance or discuss as necessary.

Response

It is confirmed that assessment of potential impacts related to climate change apply to the built proposal, as outlined in Section 6 of Appendix H to the REF, and in Section 6.14 of the REF. The flooding and hydrology assessment considered the following two climate change scenarios:

- Scenario 1 – 10 per cent increase in rainfall intensity of the 1% AEP flood event, coupled with 0.4 m sea level rise
- Scenario 2 – 30 per cent increase in rainfall intensity of the 1% AEP flood event , coupled with 0.9 m sea level rise.

This identified that peak flood levels in the Shoalhaven River floodplain would increase by up to 0.4 metres and 1.1 metres in Scenario 1 and Scenario 2 respectively. The flood levels of Shoalhaven River immediately upstream of the proposed bridge increase between 0.4 metres and 1.3 metres due to climate change. As a result, the flood levels at properties in the Moorhouse Park area would increase by the same degree as the flood levels for the Shoalhaven River.

Roads and Maritime will consult with OEH’s Water Floodplain & Coasts staff as part of the flooding analysis review. This is addressed in new environmental management measure HY3 described in a previous response.

3.4.3 Biodiversity

Issue description

The REF and supporting assessment concludes the proposal is not likely to result in a significant impact on threatened species, and therefore a Species Impact Statement (SIS) or Biodiversity Development Assessment Report (BDAR) is not required. We concur that a Biodiversity Development Assessment Report (BDAR) and biodiversity offsets are not required for Part 5 activities under Section 7.8 of the BC Act, unless there is likely to be a significant impact on threatened species, and RMS elect not to prepare a Species Impact Statement (SIS).

Response

OEH's concurrence is noted.

Subsequent to the display of the REF, Roads and Maritime was made aware of a sighting of a single individual Regent Honeyeater (*Anthochaera phrygia*) adjacent the proposal area. This species is listed as critically endangered under both NSW and Commonwealth legislation. Section 6.9.2 of the REF identified this species as potentially occurring in the locality with a low probability of occurrence. In view of this, no formal assessment of significance was carried out for this species.

However, given the sighting of this species in close proximity to the proposal area, an assessment of significance has been prepared with reference to the specified criteria under the TSC Act and EPBC Act. Further details of this are provided in Section 5.8. The assessment concluded that there was unlikely to be a significant impact on this species under both NSW and Commonwealth legislation.

Issue description

The project is identified as a 'pending Part 5 assessment' under clause 29(1) of the Biodiversity Conservation (Savings and Transitional) Regulation 2017. This means that the project's biodiversity impacts may be assessed under the *Threatened Species Act 1995*. We note however that these provisions require the proposed activity to commence within 18 months of the BC Act commencement date (25 August 2017), or else the BC Act provisions apply.

Response

The requirement to commence the proposal within 18 months of commencement of the *Biodiversity Conservation Act 2016* in order for the relevant provisions of the Biodiversity Conservation (Savings and Transitional) Regulation 2017 is noted.

Issue description

The REF and supporting assessment states that impacts will avoided during design and residual impacts minimised through management and mitigation means. We also note that RMS Biodiversity Offset Guidelines (2016) suggest offset thresholds for road projects assessed under Part 5. The Nowra Bridge project does not meet the RMS 2016 offset thresholds, and a BDAR is not required unless the proponent "opts in" to the biodiversity offset scheme under the BC Act.

Notwithstanding however, we consider there remains opportunity to offset impacts on terrestrial biodiversity that cannot be avoided or minimised through detailed design. We therefore recommend Roads and Maritime consider preparing a biodiversity offset strategy for terrestrial biodiversity as a condition of activity approval.

Response

Section 6.9.4 of the REF notes that Roads and Maritime is committed to offsetting impacts associated with the proposal in line with its biodiversity offset guidelines (Roads and Maritime, 2016) and in general accordance with the OEH principles for the use of biodiversity offsets in NSW. Biodiversity offsets are not required in accordance with the RMS Biodiversity Offset Guidelines (2016) and therefore a biodiversity offset strategy will not be prepared.

3.5 NSW Office of Environment and Heritage (Heritage)

3.5.1 Non-Aboriginal heritage

Issue description

The plans show a new cul-de-sac proposed within the SHR curtilage of Graham Lodge. The SoHI states that this is an anomaly and the detailed design, which is yet to be developed, will avoid any permanent intrusion into the curtilage of Graham Lodge.

No permanent intrusion into the curtilage of Graham Lodge is supported for any road changes, including the cul-de-sac shown proposed for Pleasant Way to the north of Graham Lodge.

It is noted that the area within the SHR curtilage of Graham Lodge has the potential to contain archaeological information of State and local heritage significance. As the proposed works within the SHR curtilage are temporary, all efforts must be made to avoid impact to archaeology, as is currently planned. Impacts to archaeology within the SHR curtilage for a temporary facility are unlikely to be considered justifiable.

All efforts must be made to avoid impact to archaeology, particularly within Graham Lodge, including minimising excavation wherever possible.

Response

Subsequent to the exhibition of the REF, the design of the cul-de-sac at Pleasant Way has been revised to avoid intruding into the heritage curtilage of Graham Lodge. Further details are provided in Section 4.3, including a figure showing the new location of the cul-de-sac relative to the heritage curtilage.

The REF identified the use of the northern half of the Graham Lodge property as ancillary site for construction (Ancillary Site 4). Roads and Maritime is no longer proposing to use this site. This will substantially mitigate the risk of impacts to the heritage values of the Graham Lodge.

Issue description

The Captain Cook Bicentennial Memorial is listed on the LEP and is located within the footprint of an embankment next to the realigned northbound lanes. The proposed works will result in the relocation of this item. It has been proposed to determine a suitable location in consultation with Shoalhaven City Council.

Response

Roads and Maritime is currently assessing the feasibility of relocating the Captain Cook Bicentennial Memorial. Due to its unique design and construction technique, there is a substantial risk that the item may be damaged during its relocation. Roads and Maritime is investigating suitable techniques to minimise the risk of damage during relocation. Should the structure be deemed unsuitable for relocation due to an unacceptable risk of damage, risks associated with damage, or the risk or cost of relocation, Roads and Maritime confirms that it will continue to consult with Council regarding options for relocating Captain Cook Bicentennial Memorial.

This safeguard is addressed through environmental management measure NAH4 which has been updated in response to Council's submission detailed in Section 3.2.11.

Issue description

Lynburn is a locally listed heritage property on the northern side of the Shoalhaven River. The new road will extend approximately 20 metres into the Lynburn property removing existing mature plantings. A temporary construction compound is also proposed within the Lynburn property which is highly likely to lead to the destruction of further vegetation. Any plantings removed must be reinstated along the revised property boundary.

The construction compound at Lynburn must be located to avoid impacts to existing vegetation.

Re-landscaping of Lynburn must be undertaken by Roads and Maritime at the completion of works using mature specimens of appropriate trees. This must be based on a landscaping plan that includes historic and/or endemic species. This plan should be approved by Shoalhaven City Council prior to implementation.

Response

The REF has identified and assessed the impacts of the proposal on the local heritage property 'Lynburn', which has been informed by the SoHI prepared for the proposal (refer Attachment F to the REF). Management and mitigation of impacts on this property are specifically addressed through environmental management measure NAH5, which relates to further investigation to minimise impacts to the curtilage of 'Lynburn', and retention of screening vegetation where possible.

With regard to use of part of the property as an ancillary facility, as a general principle, a criterion for the selection of ancillary facilities is avoidance of the need to clear vegetation. It is anticipated that there would not be a need to clear any vegetation beyond that identified in the REF as required for the built elements of the proposal. Environmental management measure LV11 addresses the retention and protection of existing trees within construction facilities areas.

Reinstatement of plantings is addressed through environmental management measures LV1, which relates to preparation of the UDLP for the proposal, including landscaping treatments and replanting of vegetation, and LV2, which relates to retention of existing vegetation as far as practicable. Any works to occur on the Lynburn property, including revegetation, would be subject to the approval of the property owner.

Shoalhaven City Council will be consulted during preparation of the UDLP.

Issue description

Illowra is a locally listed heritage property on the northern side of the Shoalhaven River. The new road will extend approximately 3m into the Illowra property removing existing mature plantings. Any plantings removed must be reinstated along the revised property boundary.

Re-landscaping of Illowra should be undertaken by Roads and Maritime at the completion of works using mature specimens of appropriate trees. This must be based on a landscaping plan that includes historic and/or endemic species. This plan should be approved by Shoalhaven City Council prior to implementation.

Response

The REF has identified and assessed the impacts of the proposal on the local heritage property 'Illowra', which has been informed by the SoHI prepared for the proposal (refer Appendix F to the REF). Environmental management measure NAH5, which relates to the investigation of opportunities to minimise impacts on the heritage curtilage of 'Lynburn' and mitigating impacts on screening vegetation, has been revised to include 'Illowra'.

NAH5: Where practicable, investigate opportunities to minimise impacts to the curtilage of 'Lynburn' (LEP No.130) ***and 'Illowra' (LEP No. 136)***. ~~The screening vegetation will be retained where possible or replanted after construction to minimise visual impact.~~ ***Wherever possible, natural screening adjacent to heritage items along the Princes Highway will be retained. Where impact to vegetation cannot be avoided new plantings will be considered.***

Reinstatement of plantings is addressed through environmental management measures LV1, which relates to preparation of the UDLP for the proposal, including landscaping treatments and replanting of vegetation, and LV2, which relates to retention of existing vegetation as far as practicable.

Shoalhaven City Council will be consulted during preparation of the UDLP.

Issue description

The SoHI does not discuss the potential impacts of the construction of a new bridge on shipwrecks or submerged maritime heritage sites. The proposal has the potential to substantially impact maritime heritage sites both above and below water and under the riverbed.

There is no search of the NSW Maritime Heritage Database listed in the document and the site surveys only appear to involve visual inspections from the foreshores and did not include any diver inspections or remote sensing surveys.

A detailed maritime archaeological assessment must be undertaken as a priority to inform the development of the detailed design. It must be undertaken by a suitably qualified and experienced maritime archaeologist. The assessment should identify the archaeological potential and significance of maritime heritage sites including shipwrecks, maritime infrastructure, archaeological items and/or relics (both above and below water) that may be impacted by the proposal. The assessment should also include procedures and management strategies for the unexpected discovery of heritage items and/or relics. Underwater surveys may also need to be undertaken and may require remote sensing and/or diver-based investigations.

Response

A search of the NSW Maritime Heritage Register identified three records at the mouth of the Shoalhaven River, well downstream from the proposal area. None of these will be affected by the proposal. A search of the Australian National Shipwreck database identified one shipwreck (the 'Unique') which is one of the three records noted on the NSW Maritime Heritage Register.

A maritime archaeological due diligence assessment for the proposal was carried out in November 2018 (refer Appendix B to this submissions report). Further details of the assessment are provided in Section 5.3. The assessment identified potential for archaeological resources within the study area associated with the Government wharves at Bomaderry and Nowra and unrecorded underwater archaeological resources. The assessment concluded that the potential for artefacts is considered to be low. The recommendations of the assessment are captured in environmental management measures NAH11 and NAH12.

3.5.2 Future use of the existing southbound bridge

Issue description

The existing bridge is listed on the Roads and Maritime s170 register and has been identified as the only American pin-jointed Whipple truss bridge in service in NSW. The proposal will result in termination of the existing truss bridge's historic use as the major transportation route in the region across the Shoalhaven River. This is a key aspect of the item's heritage significance. The SoHI

states that the retention of the existing truss bridge as a pedestrian/cycleway is considered a positive heritage outcome. Options for the retention of this bridge include the consideration of removal of non-original elements, primarily the 1980s walkway attached to the eastern side of the bridge, along with guardrails and road signs, and development of an Interpretation Strategy.

As the existing bridge is listed on the Roads and Maritime s170 register and has been identified as the only American pin-jointed Whipple truss bridge in service in NSW it must be retained and conserved for future reuse.

Response

The REF and supporting SoHI acknowledge the heritage values of the existing southbound bridge. The REF identifies that the bridge would be retained, and that investigation and assessment of options for adaptive reuse following the removal of vehicular traffic will be carried out as a separate process to the current proposal.

Issue description

The Heritage Division must be consulted early in the development of options for the rehabilitation and repurposing of the existing bridge, prior to the development of a final design and preparation of the REF.

Response

Roads and Maritime has committed to the ongoing maintenance of the existing southbound bridge and to carry out further consultation into options for adaptive reuse.

Further consultation will be undertaken with OEH Heritage Division with regard to adaptive reuse options for the existing southbound bridge. This will occur as part of the separate environmental assessment and determination process.

Issue description

Any interpretation strategy and plan for the existing bridge should include the identification of relevant historical themes and stories and proposed interpretation measures including plans and locations. The strategy and plan should be prepared in accordance with the Heritage Council of NSW *Interpreting Heritage Places and Items Guidelines*. A copy of the proposed interpretation strategy and plan must be submitted to the Heritage Division for comment prior to implementation.

Response

The investigation and assessment of options for adaptive reuse for the existing southbound bridge will be carried out as a separate process to the current proposal. Roads and Maritime confirms that the separate assessment process will include preparation of a heritage interpretation strategy for the existing southbound bridge consistent with Section 8.2.8 of the SoHI, and in accordance with the Heritage Council of NSW *Interpreting Heritage Places and Items Guidelines*.

Environmental management measure NAH6 has been revised to clarify that any heritage interpretation strategy to be prepared for the proposal will exclude matters relating to the existing southbound bridge. Environmental management measure NAH6 has been revised as follows:

> ***NAH6: Consideration should be given to the preparation of a*** ~~A~~ heritage interpretation strategy ***as part of the proposal. An interpretation strategy would consider interpretation opportunities for heritage items located within the study area.*** ~~will be prepared including an interpretation of archaeological remains should any be uncovered. The interpretation strategy will include the history, associations and significance of the~~

~~existing southbound bridge, interpretive signage, panels or displays at the entry points to the bridge or at locations along its span.~~ ***A heritage interpretation strategy for the existing southbound bridge will be addressed through the separate adaptive reuse assessment process.***

Roads and Maritime will provide a copy of any draft interpretation strategy to the Heritage Division for comment prior to finalisation and implementation.

3.5.3 Licencing and approvals

Issue description

It is proposed that a temporary construction compound be installed within the SHR curtilage of Graham Lodge. The compound will be for the storage and movement of equipment and machinery and include the possible erection of temporary fabric such as fencing. These and any other works within the SHR curtilage will require approval under the *Heritage Act 1977*.

Approval under the *Heritage Act 1977* is required from the Heritage Council of NSW prior to any works within the SHR curtilage of Graham Lodge. This must address any potential impacts associated with the temporary construction compound and potential archaeological impacts. These comments are not to be construed as implicit approval for any works with the grounds of Graham Lodge. Any application for works within Graham Lodge will be assessed on its own merits.

Response

Use of part of the SHR-listed Graham Lodge curtilage for construction activities including a temporary construction compound would comprise a work as defined under section 57(1) of the *Heritage Act 1977*, and would therefore require application for approval of the works under section 60 of the Act. Subsequent to the exhibition of the REF, Roads and Maritime has determined that this proposed ancillary site would no longer be used. This notwithstanding, Roads and Maritime confirms that no works would occur within the property until approval has been granted.

3.5.4 Consultation

Issue description

Further discussion must be undertaken with the Heritage Division to ensure that the detailed design of the new bridge does not cause undue visual and physical impacts on the existing Nowra Bridge's curtilage.

Response

Section 7.2.2 of the SoHI (Appendix F to the REF) provides a detailed assessment of the impacts of the proposal with regard to the existing southbound bridge, considering both physical impacts and visual impacts. It concludes that there would be a negligible physical impact to the bridge, and that the removal of traffic would potentially result in a positive impact. It concludes there would be a minor visual impact, noting that the design of the proposed new northbound bridge has been developed to minimise visual impacts on the existing southbound bridge.

Roads and Maritime confirms that it will continue consultation with OEH Heritage Division during detailed design with regard to the final design of the new bridge.

3.6 NSW Environment Protection Authority

3.6.1 Noise and vibration

Issue description

The EPA has conducted a review of both Chapter 6.2 "Noise and vibration" of the REF and of Appendix D to the REF - 'Nowra Bridge Project - Princes Highway Upgrade, Noise and Vibration Assessment, 17 August 2018, prepared for Roads and Maritime Services by Renzo Tonin and Associates ("the NVIA"). The EPA provides the following recommendations.

With regard to the construction phase of the project, EPA notes that the REF predicts, at times, significant impacts (more than 25dB(A) over noise management levels (NML) to the surrounding community due to airborne noise from construction works, specifically those associated with bulk earthworks, paving and bridgeworks. Significant exceedances of the identified noise goals in particular are predicted, even with noise mitigation measures in place, and the project is expected to require significant 'out of hours' work. The EPA considers that prior approval and clear justification should be required for any construction works on the project outside the standard hours in the Interim Construction Noise Guideline.

With regard to recommended EPL conditions for construction noise associated with the project, the EPA considers that the construction NMLs adopted in the REF and Technical paper are appropriate, and that any exceedances of the NMLs indicates the potential for construction noise impacts which should be addressed in a construction noise and vibration management plan for the project (noted as proposed in Table 7.1 of the REF and Table 37 of the NVIA). Table 37 of the NVIA proposes a suite of noise and vibration mitigation and management measures to address the expected impacts. It should be clearly acknowledged, however, that the implementation of a construction noise and vibration management plan will not, in many cases, be able to reduce the impacts from the works to a level that even approaches the relevant construction noise and vibration goals.

EPA considers that the paramount construction noise management measures will be:

i) Effective communication with, and management responses to, the concerns of the affected community;

ii) The need for clear justification, clear community support and prior approval to carry out any construction works outside the recommended standard hours defined in Section 2.2 of the Interim Construction Noise Guideline (ICNG);

iii) The early erection of temporary construction and where possible permanent operational noise barriers and/or other mitigation measures proposed in the REF; and

iv) The need to minimise any construction traffic movements outside standard hours, and particularly at night time (10pm to 7am), to reduce the potential for sleep disturbance as much as possible.

Response

Section 3.3.2 of the REF identifies the anticipated need for some works to be carried out outside of standard construction hours, such as where works would interrupt the operation of the Princes Highway, involve utility relocations, or delivery and placement of pre-cast concrete bridge elements. The potential impacts of these works have been assessed in Section 6.2.4 of the REF, and Roads and Maritime has developed a range of management measures to manage construction noise,

including for works outside of standard construction hours. These have been identified from the *Construction Noise and Vibration Guideline* (Roads and Maritime, 2016). This guideline has been developed and incorporates the measures identified in the *Interim Construction Noise Guideline* (Dept. of Environment and Climate Change, 2009) and the *Transport for NSW Construction Noise Strategy* (TfNSW, 2016). The guideline is also consistent with the Construction Noise and Vibration Strategy released by TfNSW in April 2018.

Roads and Maritime acknowledges the importance of effective communication to mitigating and managing construction noise and vibration impacts on receivers affected by construction activities. The NVMP, which will form part of the CEMP, will be prepared prior to construction in accordance with Roads and Maritime's *Construction Noise and Vibration Guideline* and will address all required management measures (environmental management measure NV1).

With specific reference to the first three matters identified in the EPA submission, the NVMP will:

- Identify arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures
- Identify the circumstances under which out of hours works will be considered; the procedure will require appropriate justification for any such works and appropriate consultation with affected receivers
- Where feasible, use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; and consideration of site topography when situating plant (environmental management measure NV2); these would be installed as early as practicable during construction. Environmental management measure NV14 provides for operational noise treatments will be implemented at the start of the construction period where practicable.

Environmental management measure NV5 provides for construction work to be carried out during standard daytime working hours as far as practicable while environmental management measure NV6 provides for construction respite periods, including for out of hours works.

3.6.2 Air quality

Issue description

It is noted that a quantitative and project specific air quality impact assessment has not been undertaken for this Nowra Bridge Project and it is assumed this is due to the smaller construction footprint and type of activity. Nevertheless, the EPA has conducted a review of Chapter 6.13 'Air Quality' of the REF for the project and provides the following recommendations.

The REF indicates that for all sensitive receivers, PM_{10} and dust deposition predicted for the proposed development will comply with relevant EPA criteria. To manage potential air emissions from the proposal, the EPA also recommends as part of any approval of the Project Application that a detailed air quality management plan be prepared by a suitably qualified and experienced person(s) for the proposal in consultation with the EPA. It is noted that such a plan is proposed in Chapter 6.13.4 of the REF. It is important to note that the EPA will be guided by such a document in determining and placing any air emissions monitoring requirements as conditions of any EPL that may be applied for the proposal.

Response

Roads and Maritime confirms that a quantitative air quality assessment was not prepared in view of the scale of the proposal, and that the majority of impacts associated with the proposal will relate principally to the construction phase.

With regard to the recommendation that preparation of the air quality management plan be carried out by a suitably qualified and experienced person, environmental management measure AQ1 has been revised to incorporate this as follows:

> ***AQ1:*** An Air Quality Management Plan (AQMP) will be prepared ***by a suitably qualified and experienced person(s) in consultation with the EPA*** and implemented as part of the CEMP. The AQMP will include, but not be limited to:
>
> - Potential sources of air pollution
> - Air quality management objectives consistent with any relevant published EPA and/or OEH guidelines
> - 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.

3.6.3 Waste management

Issue description

The EPA recommends the following conditions be incorporated into any Project Approval:

i) All waste materials removed from the site shall only be directed to a waste management facility or premises lawfully permitted to accept the materials.

ii) Waste generated outside the site shall not be received at the site for storage, treatment, processing, reprocessing, or disposal on the site, except as expressly permitted by a licence under the *Protection of the Environment Operations Act 1997*, if such a licence is required in relation to that waste.

iii) All liquid and/or non-liquid waste generated on the site shall be assessed and classified in accordance with Waste Classification Guidelines (Environment Protection Authority 2014), or any superseding document.

Response

Recommended conditions i) and iii) have been incorporated into environmental management measures WA2 and WA10 respectively. Recommended condition ii) is addressed through new environmental management measure WA12. The environmental management measures have been revised as follows:

> ***WA2:*** All waste will be managed and disposed of in accordance with the POEO Act. ***All liquid and/or non-liquid waste generated on the site will be assessed and classified in accordance with Waste Classification Guidelines (Environment Protection Authority 2014), or any superseding document.***
>
> ***WA10:*** All waste will be disposed of to an appropriate licensed facility. ***All waste materials removed from the site will only be directed to a waste management facility or premises lawfully permitted to accept the materials.***
>
> ***WA12: Waste generated outside the site will not be received at the site for storage, treatment, processing, reprocessing, or disposal on the site, except as expressly permitted by a licence under the Protection of the Environment Operations Act 1997, if such a licence is required in relation to that waste.***

3.6.4 Water quality

Issue description

Water Quality Objectives assessment

The EPA has reviewed of Chapter 6.10 "Water quality" of the REF (Chapter 6.10), the 'Nowra Bridge Project Soil and Water Assessment August 2018'' prepared by SMEC Australia Ply Ltd and Roads and Maritime Services (the Soil and Water Assessment) and the ''Nowra Bridge Project Preliminary Erosion and Sediment Management Report August 2018'' prepared by SMEC Australia Ply Ltd (the Erosion and Sediment Report).

In reviewing these documents, the EPA finds that the methodology used:

- Is largely inconsistent with the national framework and EPA policy for considering the potential impact of discharges on receiving waters
- Does not provide the necessary information for considering a licensed discharge(s).

Environmental values of water

Under section 45 of the *Protection of Environment Operations Act 1997* (POEO Act), the EPA must consider the environmental values of water when exercising any licensing functions (including issuing a new licence). The POEO Act Dictionary defines the environmental values of water as those specified in the ANZECC (2000) guidelines. The NSW Water Quality Objectives (NSW WQOs) are the agreed environmental values and long-term goals for assessing and managing the likely impact of activities on surface and groundwater in NSW. The NSW WQOs and ANZECC (2000) guidelines provide the framework to assess the potential impacts of a discharge on the environmental values of receiving waters.

Although Chapter 2.5 (page 15) of the Erosion and Sediment Report gives some detail on the receiving water quality, there does not appear to be any quantification of the parameters stated in comparison with ANZECC values other than above or below relevant ANZECC Guidelines.

Page 16 of the Erosion and Sediment Report assessment nominates discharge criteria from sediment basins for total suspended solids (TSS) as 50mg/L, pH as 6.5-8.5 and Oil and Grease as "None visible". However there does not appear to be a thorough discussion as to how these figures were arrived at, apart from quoting the "Blue Book" standard parameters. Even though the environmental values of the receiving waters were considered in the assessment, discharge criteria for water pollutants must be developed in consideration of the environmental values of water. Consistent with s45 of the POEO Act the impact assessment must determine whether the discharge will maintain or restore the environmental values of the receiving waters. Where this is not possible the proponent must consider any practical measures that can be taken to restore or maintain the relevant environmental values. It does not appear as though the reports provide any quantification of impacts to the Shoalhaven River, or consider the likely pollutant load from discharges from sediment basins under various potential scenarios.

Response

An additional assessment for the proposal was undertaken to assess water quality issues associated with discharge from sediment control structures to be constructed as part of the main construction works (Appendix D to this submissions report). The report NSW water quality objectives: Assessment of construction water quality, Nowra bridge project (SEEC, 2018) found:

- The MUSIC model is conservative in predicting total suspended solids (TSS) concentrations in tidal environments

- The TSS loads are expected to increase marginally by 3.9% during the main construction period
- Post construction the average TSS levels are predicted to decrease by around 2.2% however median values will increase by 1.5%
- The existing average TSS concentration is approximately 12.6 NTU which higher that the trigger value of 10 NTU
- Post construction 1.5% is expected to result in an average TSS concentration of 6.4mg/L which equates to approximately 12.8 NTU
- The predicted total nitrogen (TN) concentrations are expected to decrease by up to 0.44% on days of discharge
- The predicted total phosphorus (TP) concentrations are expected to increase by up to 1.1% on days of discharge
- The TP and TN concentrations are close to the trigger values and do not increase significantly over the background catchment conditions
- Small loads are associated with the proposed construction phase basin discharge limits and the TN and TP exceedances are representative of the prevailing catchment conditions rather than the main construction phase of the project.

Issue description

The pollution caused or likely to be caused

It is unclear from the impact assessment whether all pollutants that pose a risk of non-trivial harm to human health or the environment have been considered. Discharges from sediment basins could include, for example, pollutants such as residual coagulants and/or flocculants and their breakdown products.

Response

Further assessments have been carried out to characterise the potential impacts of the proposal on construction and operational water quality. Table 5-20 in Section 5.8.3 provides an updated assessment of construction water quality impacts against the NSW WQOs, Table 5-21 and in Section 5.8.4 provides a similar updated assessment for operational water quality impacts. The updated construction water quality assessment is supported by the revised Erosion and Sediment Management Report (Appendix F to this submissions report).

Issue description

Practical measures

Given that the reports do not provide adequate quantification of impacts on the receiving environment, the EPA considers that there is not an adequate consideration of practical measures to prevent, control, abate or mitigate pollution, including, for example:

- Avoiding or reducing discharges to waters (e.g. reusing for irrigation and/or dust suppression)
- Varying the sediment basin size and design
- Minimising pollution by discharging via vegetated swales
- Mitigating impacts by discharging pollutants at a particular concentration, volume, frequency or timing (e.g. avoiding discharges during low flows).

Depending on the duration of the disturbance, the practices and principles for erosion and sediment control contained in Volume 2D - Main Road Construction could be appropriate.

Response

Further assessments have been carried out to better quantify the potential impacts of the proposal on construction and operational water quality. Detailed summaries are provided in Sections 5.8.3 and 5.8.4 of this report. The full reports are provided as Appendix D and Appendix E to this submissions report. The updated construction water quality assessment is supported by the revised Erosion and Sediment Management Report (Appendix F to this submissions report). This considers the specific matters raised by the EPA and includes a range of recommendations (Table 7) to effectively manage construction phase water quality risks and impacts.

Issue description

TSS/turbidity correlation

The EPA recommends that the ratio adopted for TSS/turbidity is validated during the project and treatment measures adjusted accordingly if the relationship varies for this location. It should also be noted that there may not be a linear relationship between TSS and turbidity, in which case a simple ratio may not be appropriate.

Response

The EPA's advice with regard to the need to validate the correlation between TSS and turbidity is acknowledged. This is implicitly captured in environmental management measures WQ1 and WQ7.

3.7 Natural Resources Access Regulator

Issue description

The Natural Resources Access Regulator (NRAR) notes that the proposed works are exempt from requiring a controlled activity approval as the works are being undertaken by a public authority. Notwithstanding this, NRAR requests that the REF should consider and respond to the relevant Controlled Activity Guidelines.

Response

The following Controlled Activity Guidelines have been identified as being of relevance to the proposal:

- Guidelines for instream works on waterfront land
- Guidelines for riparian corridors on waterfront land
- Guidelines for watercourse crossings on waterfront land.

'Waterfront land' includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary. Under clause 41 of the Water Management (General) Regulation 2018, Roads and Maritime, as a public authority, is exempt from section 91E(1) of the *Water Management Act 2000* in relation to all controlled activities that it carries out in, on or under waterfront land.

Instream works on waterfront land

The *Guidelines for instream works on waterfront land* indicate that the design and construction of instream works should consider, but not be limited to, the following:

- Identify the width of the riparian corridor in accordance with the NSW Office of Water guidelines for riparian corridors
- Consider the full width of the riparian corridor and its functions in the design and construction of any instream works; where possible, the design should accommodate fully structured native vegetation
- Identify alternative options and detail the reasons for selecting the preferred option/s
- Minimise the design and construction footprint and proposed extent of disturbances to soil and vegetation within watercourse or waterfront land
- Maintain or mimic existing or natural hydraulic, hydrologic, geomorphic and ecological functions of the watercourse; demonstrate the instream works will not have a detrimental impact on these functions
- Maintain the natural geomorphic processes
- Accommodate natural watercourse functions
- Maintain the natural hydrological regimes
- Protect against scour by designing and providing necessary scour protection
- Stabilise and rehabilitate all disturbed areas including topsoiling, revegetation, mulching, weed control and maintenance in order to adequately restore the integrity of the riparian corridor
- Monitor and maintain all in-stream works until suitably stabilised.

Riparian corridors on waterfront land

The *Guidelines for riparian corridors on waterfront land* indicate that the overarching objective of the controlled activities provisions of the WM Act is to establish and preserve the integrity of riparian corridors. Ideally the environmental functions of riparian corridors should be maintained or rehabilitated by applying the following principles:

- Identify whether or not there is a watercourse present and determine its order in accordance with the Strahler System
- If a watercourse is present, define the riparian corridor (RC)/vegetated riparian zone (VRZ) on a map in accordance with Table 1
- Seek to maintain or rehabilitate a RC/VRZ with fully structured native vegetation in accordance with Table 1 (of the guideline)
- Seek to minimise disturbance and harm to the recommended RC/VRZ
- Minimise the number of creek crossings and provide perimeter road separating development from the RC/VRZ
- Locate services and infrastructure outside of the RC/VRZ; within the RC/VRZ provide multiple service easements and/or utilise road crossings where possible
- Treat stormwater runoff before discharging into the RC/VRZ.

Watercourse crossings on waterfront land

The *Guidelines for watercourse crossings on waterfront land* indicate that the design and construction of crossing structures should consider, but not be limited to, the following:

- Identify the width of the riparian corridor in accordance with the NSW Office of Water guidelines for riparian corridors
- Consider the full width of the riparian corridor and its functions in the design and construction of crossings; where possible, the design should accommodate fully structured native vegetation.
- Minimise the design and construction footprint and extent of proposed disturbances within the watercourse and riparian corridor
- Maintain existing or natural hydraulic, hydrologic, geomorphic and ecological functions of the watercourse
- Demonstrate that where a raised structure or increase in the height of the bed is proposed there will be no detrimental impacts on the natural hydraulic, hydrologic, geomorphic and ecological functions
- Maintain natural geomorphic processes
- Maintain natural hydrological regimes
- Protect against scour
- Stabilise and rehabilitate all disturbed areas including topsoiling, revegetation, mulching, weed control and maintenance in order to adequately restore the integrity of the riparian corridor

Bridges - additional design considerations:

- Ideally, bridges shall be elevated and span the riparian corridor
- Bridge piers or foundations should not be located within the main channel of the watercourse
- The bridge design must be certified by a suitably qualified engineer

Causeways or bed level crossings - additional design considerations

- The deck of the crossing shall be at the natural bed elevation
- The crossing should have a vertical cut-off wall on the downstream side of the crossing to a minimum depth of one metre and minimum width of 100 millimetres
- Approaches to crossings should be sealed and incorporate appropriate roadside drainage, such as stabilised table drains where necessary.

Culverts - additional design considerations

- Box culverts are preferred to pipes
- Align culverts with downstream channel
- Incorporate elevated dry cells and recessed wet cells with the invert at or below the stable bed level
- The culvert design must be certified by a suitably qualified engineer.

Comment

The design for the proposal is considered to appropriately address the relevant matters specified in the respective guidelines, and noting that the proposal is located in an area already highly modified by development essentially of a similar nature to the proposal. The identified safeguards and management measures are considered to adequately address the performance outcomes within the guidelines.

Issue description

Assessment of impacts on surface and groundwater sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.

Response

The REF has assessed the potential impacts on surface and groundwater, and related matters. Appendix K to the REF (Soil and water quality assessment) provides a comprehensive review of potential impacts on surface water and groundwater. With regard to the latter, it notes that a search of the NSW Department of Primary Industries, Office of Water, All Groundwater Map identified six registered groundwater bores in proximity to the proposal area. These were located outside the proposal area, and related to groundwater monitoring at Bomaderry electrical substation and the Former Nowra Gasworks site.

Once operational, the proposal is not likely to lead to a significant change in water quality within the Shoalhaven River or Bomaderry Creek. The proposal will incorporate water quality treatment measures to mitigate water quality impacts from stormwater runoff from the new northbound bridge.

Significant groundwater inflows are considered unlikely to be encountered during earthworks. Only minor groundwater ingress is expected during piling for bridge construction.

A review of the NSW Water Register was undertaken in December 2018 and identified licences within the Kangaroo River Management Zone. The proposal will not impact licensed users within the Shoalhaven River Water Source.

The biodiversity assessment carried out for the REF identified one plant community within the study area as having potential groundwater interaction with one groundwater dependent ecosystem (GDE): Spotted Gum-Blackbutt shrubby open forest on the coastal foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion. It was identified that the proposal was unlikely to significantly alter subsurface flows to the GDE.

Table 6-1 identifies the safeguards and management measures that will be implemented to manage impacts to water resources, particularly with regard to water quality; no additional safeguards are considered necessary.

Issue description

Full technical details and data of all surface and groundwater modelling.

Response

Quantitative water quality modelling was carried out for the REF with further modelling carried out following the REF exhibition to assess water quality issues associated with discharge from sediment control structures that would be used during the main construction works. Details on the modelling are provided in Appendix K (Soil and water assessment) to the REF, and in Section 5.7 of this report.

No groundwater modelling was carried out for proposal in the absence of any significant groundwater resources in the proposal study area.

Issue description

Preparation of a detailed site water balance.

Response

The proposal is located in the lower reaches of the Shoalhaven River and is tidally influenced. A review of the NSW Water Register did not identify any current water licenses in proximity to the proposal. In view of this, and the limited impacts of the proposal on water resources, preparation of a site water balance is not considered necessary.

Issue description

Assessment of any volumetric water licensing requirements.

Response

It is anticipated that water requirements for construction could be met from Shoalhaven City Council's urban water supply without the need for a separate volumetric water license.

Issue description

Proposed surface and groundwater monitoring activities and methodologies.

Response

The safeguards and management measures for the proposal include water quality monitoring as part of the Soil and Water Management Plan to be prepared as a part of the CEMP. Surface water quality monitoring will be undertaken prior to construction to establish a baseline water quality, and regularly during the construction to monitor potential impacts. Sampling locations will include upstream and downstream of creek crossings and meet the requirements of the *Guideline for Construction Water Quality Monitoring (*Roads and Maritime, 2003).

It is not proposed to carry out any monitoring of groundwater.

Issue description

Installation of pylons into the bed of the Shoalhaven and identify potential impacts.

Response

One option for construction of the columns for the bridge piers is to drive steel casings (tubes) into the river bed from a floating barge. Spoil is removed from within the casings by a piling rig and collected on the barge for later transfer to land and then disposal. A floating boom is deployed around each steel casing. Concreting is carried out using a tremie, which comprises a hopper with a long pipe with the outlet located below the water level. The outlet is kept immersed in fresh concrete so that the rising concrete from the bottom displaces the water without washing out the cement content. This construction methodology minimises risk to water quality.

The final construction methodology for construction of the bridge piers will be determined in accordance with all specified Roads and Maritime requirements.

Issue description

Rehabilitation of waterfront land at the completion of works.

Response

The REF includes commitments to rehabilitate/revegetate all areas disturbed by construction activities, including the river foreshore, at the end of construction. These are captured in environmental management measure LV1 which addresses preparation of an Urban Design and Landscape Plan (UDLP).

4 Changes to the proposal

The REF for the proposal was prepared based on a concept design. The proposal has since been refined to account for design changes and in response to submissions received during the display of the REF. This chapter describes the changes to the proposal and any additional assessment undertaken.

4.1 Changes to Princes Highway/Illaroo Road intersection

4.1.1 Description

The following changes have been made to the design for the Princes Highway/Illaroo Road intersection:

- Removal of the southbound slip lane to 476 and 480 Princes Highway, and reduction in the length of the adjoining traffic island to address safety issues identified in the road safety audit carried out for the proposal in July 2018 based on the concept design
- Removal of the median offset in the pedestrian crossing on the Princes Highway on the northern side of the intersection to address a potential risk that pedestrians may continue walking and enter the carriageway when vehicles approach from behind, resulting in vehicle-pedestrian collisions.

The revised design for the intersection is shown in Figure 4-1.

4.1.2 Potential impacts

The design changes to the intersection are refinements rather than substantive new elements. There is no change to the identified construction boundary of the intersection associated with the changes. The design changes do not introduce any new or changed impacts to those identified and assessed in the REF.

4.1.3 Revised safeguards and management measures

No additional or revised safeguards and management measures are proposed for the design changes to the Illaroo Road intersection.

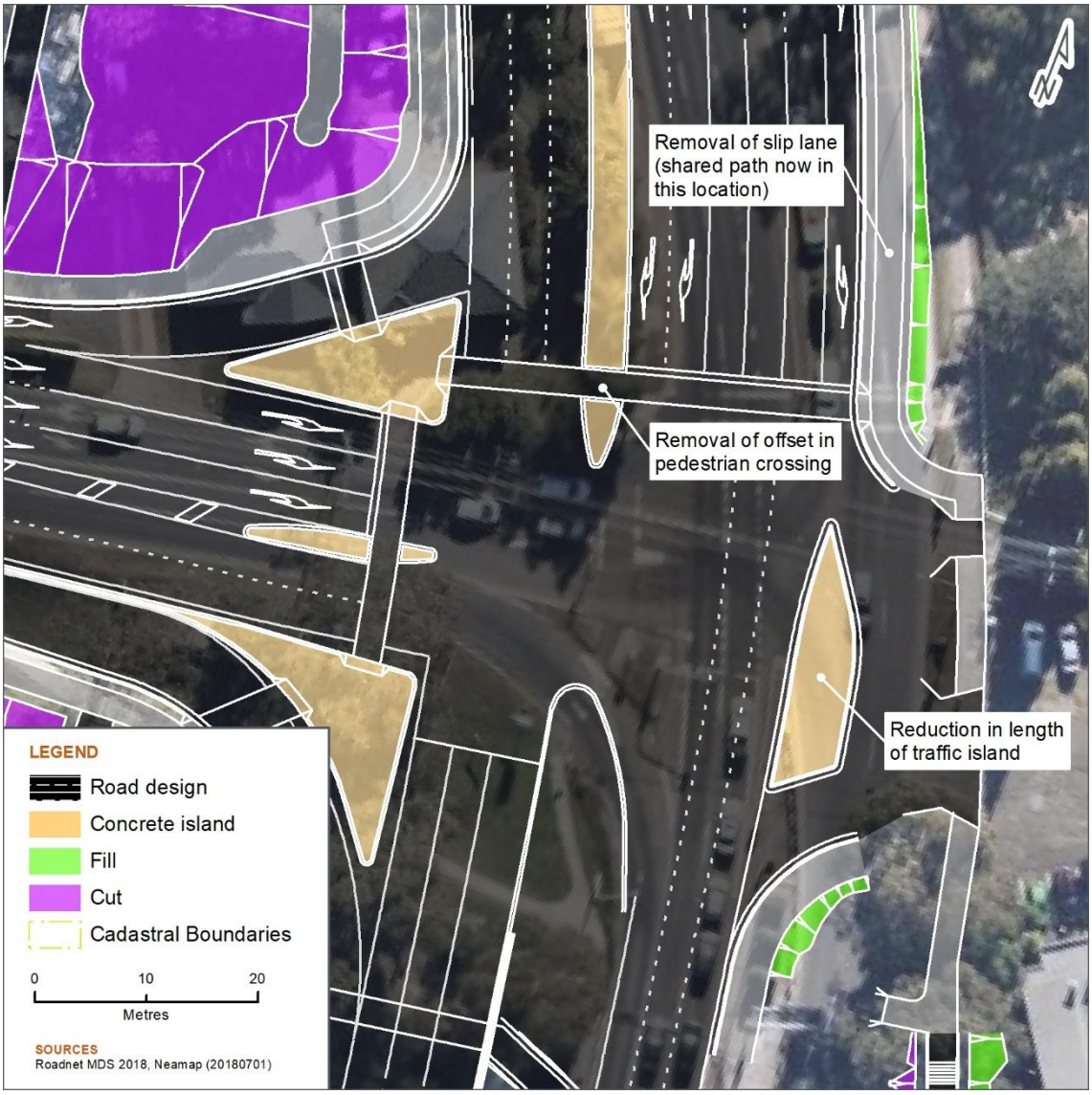

Figure 4-1: Revised design for the Princes Highway/Illaroo Road intersection

4.2 Changes to new local road connection

4.2.1 Description

The following changes have been made to the design for the new local road connection:

- Moving the intersection at Lyrebird Drive about eight metres to the east to increase the intervening distance between the road and the adjacent Graham Family Cemetery, which is a listed heritage item under the Shoalhaven LEP
- Minor realignment to remove the bend that was in the previous iteration of the design, and to straighten the approach to the Princes Highway.

Both of these design changes improve safety for road users. The revised design is shown in Figure 4-2.

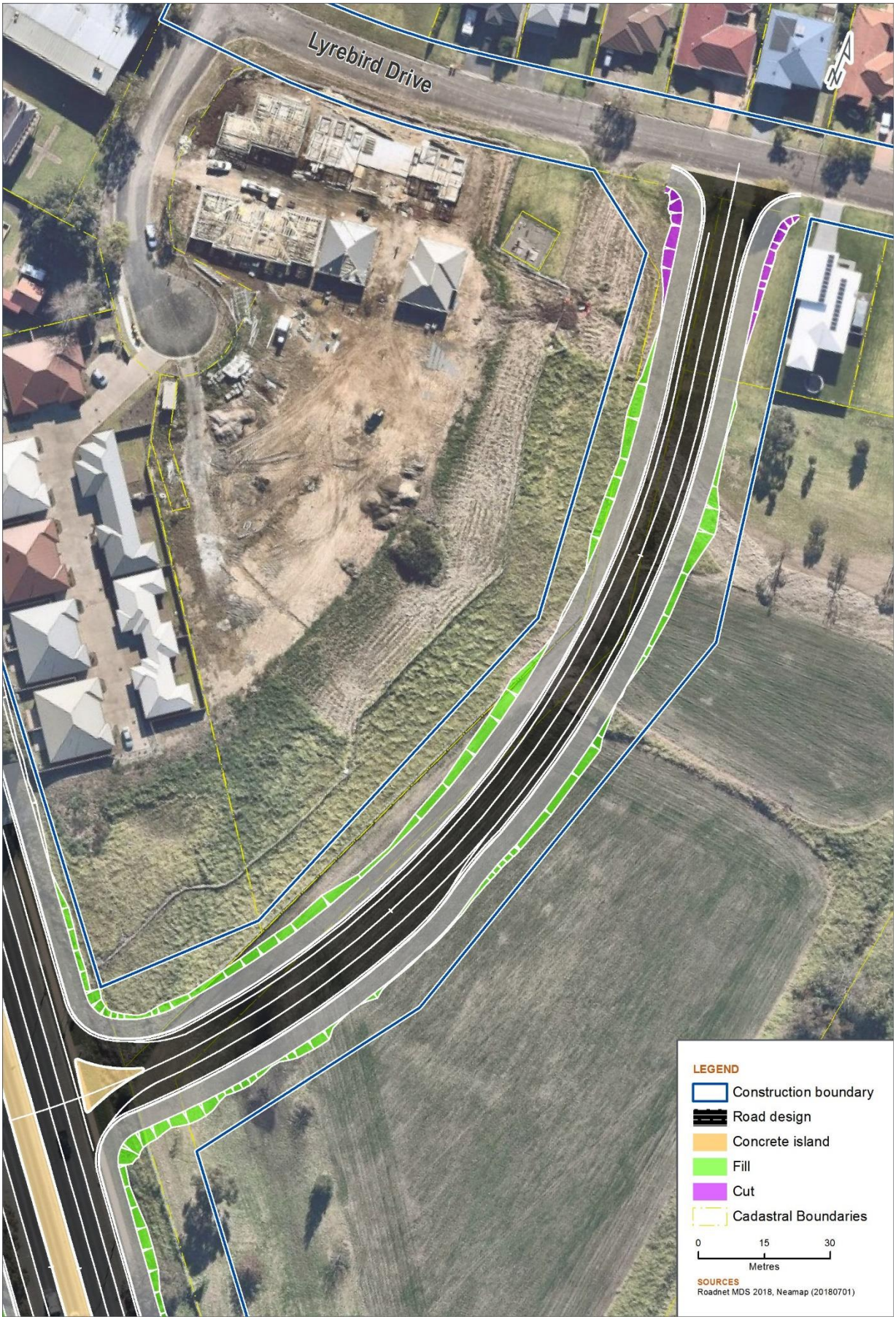

Figure 4-2: Revised design for new local road connection

4.2.2 Potential impacts

The eastward shift in the intersection at Lyrebird Drive would intrude further into the adjoining property, however, no further property impacts would occur as the whole property was assessed as being required for the proposal in the REF. The realignment of the new local road connection has resulted in several small areas of embankments adjacent to the southbound carriageway intruding slightly beyond the original construction boundary but still remaining within the proposal study area. This would not result in any new or changed property impacts to those assessed in the REF

The shift in the intersection would also bring construction and operational noise sources, construction vibration sources, and construction air emissions closer to the adjoining residence on the southern side of Lyrebird Drive. Construction noise, vibration and air quality impacts would be managed through the existing environmental management measures described in Table 6-1. The realignment is not anticipated to increase operational noise impacts to the adjacent property.

The REF identified potential amenity impacts (noise, vibration and dust emissions) to the IRT Greenwell Gardens aged care facility associated with construction of the new local road connection. The facility is located in Brereton Street, about 480 metres to the southeast. The realignment of the new local road connection is not anticipated introduce any new or changed impacts to this receiver.

This design change does not introduce any new or changed flooding or drainage impacts to those identified in the REF.

4.2.3 Revised safeguards and management measures

No additional or revised safeguards and management measures are proposed for the design changes to the new local road connection. The identified impacts can be effectively managed through implementation of the management measures proposed in the REF.

4.3 Revised design for the Pleasant Way cul-de-sac

4.3.1 Description

The submission from the OEH noted that the design for the new Pleasant Way cul-de-sac intruded into the heritage curtilage of Graham Lodge. Subsequent to the display of the REF, the design of the cul-de-sac has been revised to address this issue. This has involved moving the cul-de-sac slightly to the west to avoid the heritage curtilage of Graham Lodge. The diameter of the cul-de-sac has also been increased to allow better access for maintenance and general access vehicles. The revised design is shown in Figure 4-3.

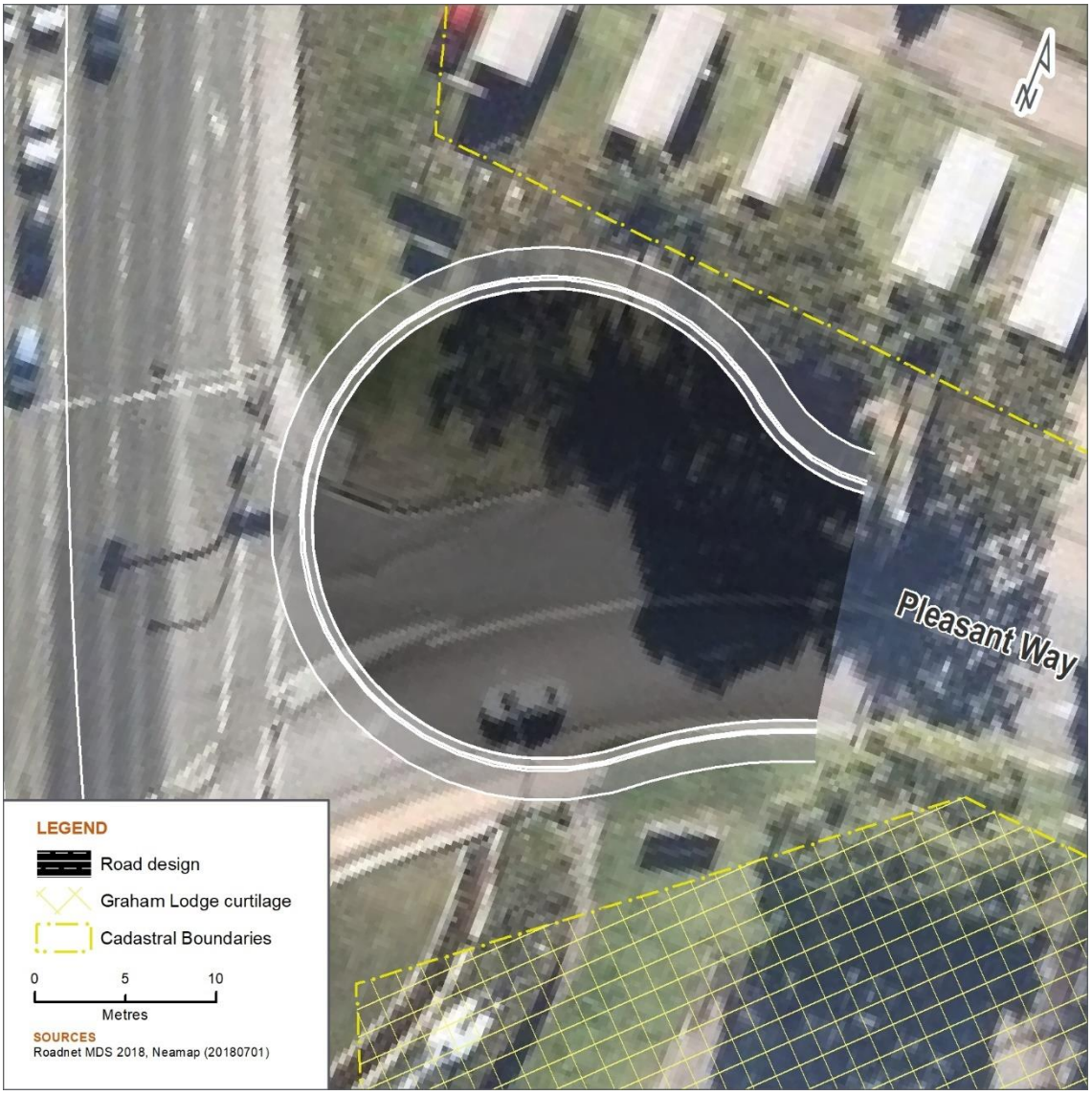

Figure 4-3: Revised design for Pleasant Way cul-de-sac

4.3.2 Potential impacts

The revised design of the Pleasant Way cul-de-sac avoids impacting on the heritage curtilage of Graham Lodge. This design change does not introduce any new or changed impacts to those identified in the REF.

4.3.3 Revised safeguards and management measures

No additional or revised safeguards and management measures are proposed for the design change to the Pleasant Way cul-de-sac.

4.4 Ancillary facilities

4.4.1 Description

Following the display of the REF, Roads and Maritime Services identified four additional sites for assessment as potential locations for additional construction ancillary facilities. The description and location context for each the proposed additional ancillary facility sites are described in Table 4-1 and the locations are shown in Figure 4-4. A further two additional areas for potential additional ancillary facilities were also proposed by Shoalhaven City Council; these are described in Table 4-2 and their locations also shown in Figure 4-4. The additional potential sites have been numbered to follow on from the proposed sites identified in the REF.

Table 4-1: Location context of potential additional ancillary facility sites identified by Roads and Maritime

Site	Lot and DP	Location context
6	Lot 221 DP1182436	**Bolong Road site** This site would be within the property located on the corner of Princes Highway and Bolong Rd and is within the study area. The property is predominantly cleared farmland. Bomaderry Creek runs along the southern boundary of the property. Access would be available from both Bolong Road and the Princes Highway. The property is privately owned.
7	Lot 1 DP738519 Lot 2 DP624434	**Scenic Drive site** This site would be within the vacant property at 2 Scenic Drive and is partially within the study area. The site is predominantly cleared land and is adjacent to residential properties on Bridge Road and Hyam Street. Some vegetation is present to the north of the property adjacent Scenic Drive. Access would be available using established driveways from Scenic Drive and Bridge Road. The property is privately owned.
8	Lots 1&2 DP199958 Lot 1 DP 797111 Lot 1 DP1036766 Lot B DP161648	**Hyam Street site** This site would be within vacant property located on the corner of Bridge Road and Hyam Street and is partially within the study area. The site is predominantly cleared land and is adjacent to residential properties on Bridge Road and Hyam Street. The area is currently used for informal car parking, accessed from Hyam Street. The properties are privately owned.
9	Lot 52 DP209295	**Harry Sawkins Park site** This site would be within a parcel of land immediately to the south of the Shoalhaven City Council building and is partially within the study area. The land is currently occupied by a car park immediately adjacent to the council building with the land further to the south comprising the northern third of Harry Sawkins Park. The parkland area contains both established trees and areas of open space, and there is an unnamed artificial waterbody immediately to the south of this parcel of land that generally comprises the central portion of Harry Sawkins Park. Use of the site would predominately be restricted

Site	Lot and DP	Location context
		to cleared areas to avoid/minimise the need for clearing of vegetation. Access would be available from Graham Street and could also be available through the public car park. The property is public land under the care and control of Shoalhaven City Council.

Table 4-2: Location context of potential additional ancillary facility sites identified by Shoalhaven City Council

Site	Lot and DP	Location context
10	Lot 1 DP909036	**Nowra Aquatic Park site** This site would be within the southern part of the property containing the Nowra Aquatic Park and is outside of the proposal study area. The property is predominantly cleared land and adjoins the rear of nine residential properties on Mandalay Avenue and Hyam Street. Existing infrastructure on the site includes a large drainage culvert and an elevated electricity substation. Access would be available from Hyam Street. The property is public land under the care and control of Shoalhaven City Council.
11	Lot 8 DP809132 Lot 100 DP1071707	**Gateway Park site** This site comprises two adjoining parcels of land located off Lyrebird Drive adjacent to the new local road connection and is partially within the study area. The site would be located in predominantly cleared land at the western end of the parcels of land with residential properties to the north and a retirement home to the east. Access to the site would be available from Lyrebird Drive, Riverview Road, and Ferry Lane. The two parcels of land are public land under the care and control of Shoalhaven City Council.

Ancillary site 4 identified in the REF, located on the northern half of the Graham Lodge property, is no longer proposed to be used in view of the heritage values of the property and to avoid impacts to the existing business operating from the former Shoalhaven Visitor Information Centre building.

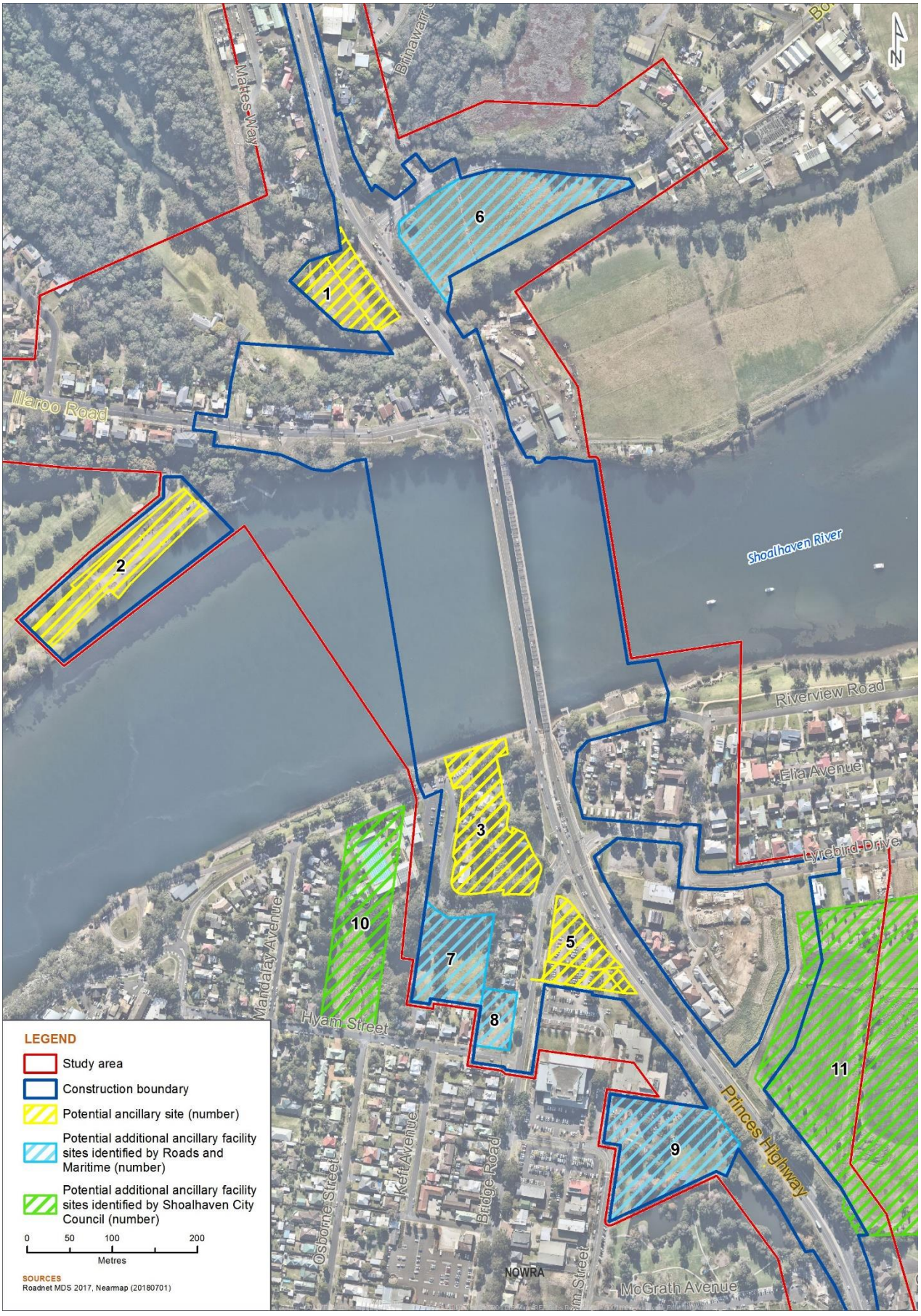

Figure 4-4: Potential additional ancillary facility sites

4.4.2 Potential impacts

Assessment of the proposed additional ancillary facilities has been carried out considering the following criteria from the REF:

- Operational during a flood event and avoid or minimise impacts to surrounding properties
- More than 40 metres from a watercourse
- More than 50 metres from residential dwellings
- In previously disturbed areas that do not require the clearing of native vegetation
- Outside the drip line of trees
- On relatively level ground
- Away from areas of heritage value.

The positioning of any additional ancillary facilities would aim to meet all of the above criteria. However, due to the nature of the proposal area and the surrounding environment, this may not be possible. Consultation with the Roads and Maritime Environment Manager would be carried out to confirm the suitability of any additional ancillary facilities and whether any additional environmental controls or assessment would be required.

Assessment of the potential impacts of the proposed additional ancillary facilities is provided in Table 4-3.

Table 4-3: Potential impacts of proposed additional ancillary facilities

Site	Compliance with location criteria	Potential impacts	Included in proposal ancillary facilities and indicative use
6	**Bolong Road site** • The site is subject to flooding • The site is located less than 40 metres from a waterway (Bomaderry Creek) • There are two Aboriginal heritage sites adjacent to the property: Nowra Bridge 10 (AHIMS ID 52-5-0873) has low overall significance, Nowra Bridge PAD 5 (AHIMS ID 52-5-0854) has unknown significance. The site meets all other criteria listed in Section 4.4.2	The site is subject to flooding in events greater than or equal to the 10 per cent AEP. Potential impacts could include inundation, damage to or loss of plant and equipment, and erosion of exposed areas. These impacts are generally unavoidable and risk of flooding would need to be managed through appropriate work site planning and management responses via a project-specific flood management plan. Potential flooding impacts and risk associated with flooding would be managed through updated environmental management measure HY2. The site is within 40 metres of Bomaderry Creek. Potential impacts to water quality could include sedimentation and spills. Potential water quality impacts would be managed through existing environmental management measures WQ1, WQ2, WQ8, WQ10, and WQ11. Aboriginal heritage site Nowra Bridge 10 (NB10) is adjacent to the proposed ancillary site. NB10 is directly impacted by construction and therefore has been assessed in the REF. Potential impacts to NB10 would be managed through existing environmental management measure AH3 which requires an AHIP to be obtained prior to any impact. Aboriginal heritage site Nowra Bridge PAD 5 (NB PAD 5) is not impacted by construction, and therefore has not been assessed in the REF. The proposed	Yes, it is proposed to include the site as a potential ancillary site for the proposal. Indicative use: • Temporary materials and plant storage • Temporary office and workers amenity buildings.

Site	Compliance with location criteria	Potential impacts	Included in proposal ancillary facilities and indicative use
		ancillary site would be confined to the construction footprint identified in Figure 1-2 and would avoid any impact to NB PAD 5. Potential impacts to NB PAD 5 would be managed through existing environmental management measure AH1 which requires the preparation of an Aboriginal Heritage Management Plan which would provide specific guidance and controls to be implemented to avoid impacts to Aboriginal heritage outside the construction boundary. The site would need to be acquired or leased for the construction period.	
7	**Scenic Drive site** • The site is subject to flooding • The site is located less than 50 metres from residential dwellings. • Some vegetation removal may be required • Two non-Aboriginal heritage items; 'Kilsyth' Federation weatherboard residence, 33 Bridge Road, Nowra (Lot 1, DP 152217) and 'Uuna' late Victorian weatherboard cottage and garden (Lot A, DP 161648) are directly adjacent to the site. • The site is directly adjacent to Aboriginal heritage site Nowra Bridge 6 (AHIMS 1052-5-0872)	The site is subject to flooding in events greater than or equal to 2% AEP. Potential impacts could include inundation, damage to or loss of plant and equipment, and erosion of exposed areas. These impacts are generally unavoidable and risk of flooding would need to be managed through appropriate work site planning and management responses via a project-specific flood management plan. Potential flooding impacts and risk associated with flooding would be managed through updated environmental management measure HY2. Nine residential dwellings including two locally listed heritage residences are within 50 metres of the proposed ancillary site. Potential impacts to neighbouring properties could include increased noise, vibration, and dust emissions from activities such as vehicle movements, plant and material storage. Potential impacts to these properties would be	Yes, it is proposed to include the site as a potential ancillary site for the proposal. Indicative use: • Temporary materials and plant storage • Parking of construction vehicles.

Site	Compliance with location criteria	Potential impacts	Included in proposal ancillary facilities and indicative use
	• A portion of the site is outside the proposal study area and hasn't been assessed for Aboriginal heritage. The site meets all other criteria listed in Section 4.4.2	considered in the compound and access point layout. Potential impacts would be managed through environmental management measures NV1 to NV10 and AQ1 to AQ5. Selective removal of established trees may be required for access to the grassed area. Potential impacts to vegetation would be managed through existing environmental management measures B1 to B4. Two locally listed heritage residences, Kilsyth' and 'Uuna' are directly adjacent the site. Potential vibration impacts to these properties were considered in the REF as they are within 50 metres of construction. Potential vibration impacts would be managed through environmental management measures NV1, NV8, NV9, and NV11. Aboriginal site Nowra Bridge 6 is located within the construction footprint and has been assessed in the REF. Potential impacts to this site would be managed through environmental management measure AH3 which requires an AHIP to be acquired prior to any impact. A portion of the site is outside the proposal study area and therefore was not assessed in the REF. Following the display of the REF, a PACHCI Stage 1 assessment was completed for the area of the site located outside the proposal study area. The Stage 1 assessment concluded the proposed use of this site as an ancillary facility is unlikely to have an impact on	

Site	Compliance with location criteria	Potential impacts	Included in proposal ancillary facilities and indicative use
		Aboriginal cultural heritage. The site would need to be acquired or leased for the construction period.	
8	**Hyam Street site** • The site is subject to flooding • The site is located less than 50 metres from residential dwellings. • Two non-Aboriginal heritage items; 'Kilsyth' Federation weatherboard residence, 33 Bridge Road, Nowra (Lot1, DP152217) and 'Uuna' late Victorian weatherboard cottage and garden (Lot A, DP161648) are directly adjacent to the site. • A portion of the site is outside the proposal study area and hasn't been assessed for Aboriginal heritage. The site meets all other criteria listed in Section 4.4.2	The site is subject to flooding in events greater than or equal to 0.05% AEP. Potential impacts could include inundation, damage to or loss of plant and equipment, and erosion of exposed areas. These impacts are generally unavoidable and risk of flooding would need to be managed through appropriate work site planning and management responses via a project-specific flood management plan. Potential flooding impacts and risk associated with flooding would be managed through updated environmental management measure HY2. Nine residential dwellings including two locally listed heritage residences are within 50m of the site. Neighbouring properties could experience increased vehicle movements, noise, vibration, and dust emissions from activities on site such as plant and material storage. These potential impacts would be managed through existing environmental management measures NV1 to NV10. Impacts to these properties would need to be considered in compound and access point layout Two locally listed heritage residences, Kilsyth' and 'Uuna' are directly adjacent the site. Potential vibration impacts to these properties were considered in the REF and would be managed through environmental	Yes, it is proposed to include the site as a potential ancillary site for the proposal. Indicative use: • Temporary materials and plant storage • Parking of construction vehicles.

Site	Compliance with location criteria	Potential impacts	Included in proposal ancillary facilities and indicative use
		management measures NV1, NV8, NV9, and NV11. A portion of the site is outside the proposal study area and therefore was not assessed in the REF. Following the display of the REF, a PACHCI Stage 1 assessment was completed for the area of the site located outside the proposal study area. The Stage 1 assessment concluded the proposed use of this site as an ancillary facility is unlikely to have an impact on Aboriginal cultural heritage. The site would need to be acquired or leased for the construction period.	
9	**Harry Sawkins Park site** • The site is subject to flooding • The site is located less than 40 metres from a waterway • Some vegetation removal may be required • A portion of the site is outside the proposal study area and hasn't been assessed for Aboriginal heritage. The site meets all other criteria listed in Section 4.4.2	The site is subject to flooding in events greater than or equal to 10 per cent AEP. Potential impacts could include inundation, damage to or loss of plant and equipment, and erosion of exposed areas. These impacts are generally unavoidable and risk of flooding would need to be managed through appropriate work site planning and management responses via a project-specific flood management plan. The impacts and risk associated with flooding would be managed through updated environmental management measure HY2. The site is within 40 metres of an unnamed artificial waterbody. Potential impacts to water quality could include sedimentation and spills. Potential water quality impacts would be managed through existing environmental management measures WQ1, WQ2,	Yes, it is proposed to include the site as a potential ancillary site for the proposal. Indicative use: • Public parking to offset impacts to existing parking facilities (refer Section 5.2 of this report).

Site	Compliance with location criteria	Potential impacts	Included in proposal ancillary facilities and indicative use
		WQ8, WQ10, and WQ11. Selective removal of established trees may be required for access to the grassed area. Potential impacts to vegetation would be managed through existing environmental management measures B1 to B4. A portion of the site is outside the proposal study area and therefore was not assessed in the REF. Following the display of the REF, a PACHCI Stage 1 assessment was completed for the area of the site located outside the proposal study area. The Stage 1 assessment concluded the proposed use of this site as an ancillary facility is unlikely to have an impact on Aboriginal cultural heritage. The site would need to be acquired or leased for the construction period.	
10	**Nowra Aquatic Park site** • The site is subject to flooding • The site is located less than 40 metres from a waterway • The site is located less than 50 metres from residential dwellings • Vegetation removal would be required • The site is outside the proposal study area and hasn't been assessed for Aboriginal heritage.	The site is subject to flooding in flood events greater than or equal to the 2 per cent AEP. Potential impacts could include inundation, damage to or loss of plant and equipment, and erosion of exposed areas. A large culvert exists under Hyam Street which releases water to a natural gully/drainage line that traverses a large portion of the proposed ancillary site. A temporary crossing of the watercourse would be required to enable a substantial portion the site to be utilised. Potential impacts to water quality could include sedimentation and spills.	No, the site is considered to have substantial constraints associated with its use including: • Flood risk • Large number of sensitive receivers • Removal of vegetation • Unknown Aboriginal heritage value • Potential need to relocate the existing electrical substation • Poor access

Site	Compliance with location criteria	Potential impacts	Included in proposal ancillary facilities and indicative use
	The site meets all other criteria listed in Section 4.4.2	There are 30 residential dwellings within 50 metres of the site. Neighbouring properties could experience increased vehicle movements, noise, vibration, and dust emissions from activities on site such as plant and material storage. A large stand of mature vegetation exists in the northern portion of the site which may require removal. The site is outside the proposal study area and therefore was not assessed in the REF. Further Aboriginal heritage investigations would be required to determine any potential Aboriginal heritage within the site. Use of the site may require relocation of the existing electrical substation located adjacent to Hyam Street. The site would need to be acquired or leased for the construction period.	• The need for substantial civil works to manage drainage through the site. In view of these constraints, and the associated costs and benefits associated with using the site, this site was not considered further
11	**Gateway Park site** • The area is subject to flooding • The western part of the site is less than 50 metres from residential dwellings • The site is outside the proposal study area and has not been assessed for Aboriginal heritage. The site meets all other criteria listed in Section 4.4.2	The site is subject to flooding in flood events greater than or equal to the 10 flood AEP. Potential impacts could include inundation, damage to or loss of plant and equipment, and erosion of exposed areas. Forty-six residential dwellings including Greenwell Gardens Aged Care Facility are with 50 metres of the site, however the majority of the site is more than 50 metres from residential dwellings. Neighbouring properties could experience increased vehicle movements, noise, vibration, and dust emissions from	No, the site is considered to have substantial constraints associated with its use including: • Flood risk • Large number of sensitive receivers • Traffic impacts • Unknown Aboriginal heritage value In view of these constraints, and the

Site	Compliance with location criteria	Potential impacts	Included in proposal ancillary facilities and indicative use
		activities on site such as plant and material storage. A portion of the site is outside the proposal study area and therefore was not assessed in the REF. Further Aboriginal heritage investigations would be required to determine any potential Aboriginal heritage within the site. Local roads such as Riverside Drive, Lyrebird Drive, Ferry Lane and Moss Street would experience increased vehicle movements from construction traffic accessing the site to and from the Princes Highway, increasing congestion at the Moss Street and Princes Highway intersection. The site would need to be acquired or leased for the construction period.	associated costs and benefits associated with using the site, this site was not considered further.

4.4.3 Revised safeguards and management measures

Environmental management measure HY2 has been updated for the ancillary facilities.

Impact	No.	Environmental safeguard	Responsibility	Timing	Reference
Flooding	HY2	***As part of t***~~T~~he CEMP***, a flood management plan will be prepared and*** will include appropriate management measures to manage the risk and impacts of flooding including, but not limited to: • ***Steps to be taken in the event of a flood warning*** • Removal or securing of loose material • Storage or removal of plant and equipment • Storage of fuels and chemicals.	Construction Contractor	Pre-construction/ construction	Project specific control

4.5 Changes to construction methodology

The upgrade of the Illaroo Road intersection would require extensive excavation of the section of Illaroo Road immediately to the west of the highway, involving removal of a substantial volume of rock. It was identified that alternative construction methodologies would need to be available to the construction contractor to facilitate rock excavation.

4.5.1 Description

In addition to conventional blasting methods considered in the REF, alternative rock excavation methods may be needed to minimise potential noise and vibration impacts along the project alignment, particularly with the aim of minimising vibration-related impacts to nearby items of Aboriginal heritage.

Alternative methodologies to be applied during construction for the purpose of rock excavation and similar activities would need to:

- Minimise vibration at nearby receivers, including items of Aboriginal heritage significance
- Be able to effectively be used along the project alignment in areas of deep cut, and achieve the same or similar results as louder, more vibration-intensive activities such as jackhammering
- Minimise impacts on the surrounding environment.

Based on the above requirements, two potential low-vibration construction methodologies were identified that could facilitate rock-breaking, including penetrating cone fracture (PCF) blasting and chemical rock excavation.

PCF blasting involves inserting a hollow plastic tube into the rock substrate, which is then filled with a powdered, smokeless propellant and closed with a small cap. An electric match is inserted into

the cap to ignite the propellant that results in a detonation. A 200 gram charge of PCF blasts the same volume of rock as a 1.2 kilogram explosive charge, while releasing about one tenth of the energy (vibration and air overpressure/blast).

Chemical rock breaking involves injecting an expanding mortar and cracking agent into the rock face that causes the rock to break apart.

4.5.2 Potential impacts

Low vibration rock excavation techniques such as PCF and chemical rock breaking would occur at locations adjacent to sensitive receivers and have the potential to generate dust. However, these rock excavation techniques are considered to generate less dust than the use of jackhammers or similar construction plant. PCF blasting has the potential to release small amounts of gases, including carbon dioxide, water, nitrogen, carbon monoxide and hydrogen. The release of gases would be minor and are expected to have a negligible impact on local and regional air quality.

Sensitive receivers located near the revised construction ancillary facilities have the potential to be impacted by dust generated from these sites. The impact of dust emissions on sensitive receivers is expected to be comparable with the dust generation predictions documented in the project REF.

The potential impact of blasting (conventional or low vibration techniques) for the proposal would be managed through the development of a Blast Management Plan as part of the CEMP (environmental management measure GEN1).

4.5.3 Revised safeguards and management measures

No additional management measures are proposed for this change in construction methodology. The identified impacts can be effectively managed through implementation of the management measures proposed in the REF.

5 Additional environmental assessment

Additional investigations and assessments have been carried out since the REF display period due to project design refinements and in response to submissions received from the community and Government agencies as outlined in Chapter 2 and Chapter 3 of this report respectively.

Table 5-1 provides a summary of the additional assessments carried out including a summary of their scope, the reason the assessment was required and where the additional assessment is provided in this report.

Table 5-1: Summary of additional assessment

Environmental factor	Assessment	Need for further assessment	Where addressed in this report
Traffic and transport	Redistribution of local road traffic	Additional studies were undertaken to assess the potential impacts at several local road intersections	Section 5.1
Noise	Assessment of proposed noise barrier	Assessment was undertaken for a proposed noise barrier on the eastern side of the Princes Highway south of the Shoalhaven River	Section 5.2
Non-Aboriginal heritage	Review of non-Aboriginal heritage assessments of significance	The assessments of significance in the SoHI have been reviewed and clarification of the statement of significance of each item has been provided	Section 5.3
Non-Aboriginal heritage	Maritime archaeological assessment	Additional assessment was undertaken to assess the potential impacts of the proposal on maritime archaeology	Section 5.4
Socio-economic	Revised assessment of impacts to parking	Additional assessment was completed to assess the potential impacts to parking during construction and operation of the proposal.	Section 5.5
Socio-economic	Revised assessment of impacts to Waterways Swim School	Additional assessment was undertaken to further consider impacts of the proposal on the Waterways Swim School at 1 Scenic Drive	Section 5.6
Biodiversity	Assessment of potential impacts to the Regent Honeyeater	Additional assessment was undertaken to assess the potential impact of the proposal on the Regent Honeyeater	Section 5.7

Environmental factor	Assessment	Need for further assessment	Where addressed in this report
Water quality	Assessment of the proposal against NSW Water Quality Objectives	Additional assessment was undertaken to assess the potential construction and operational water quality impacts of the proposal against the NSW Water Quality Objectives for the Shoalhaven River catchment	Section 5.8

5.1 Redistribution of local road traffic

5.1.1 Methodology

The proposal will result in the redistribution of traffic within the local road network. In response to a number of submissions which raised issues related to this and to potential traffic impacts on local roads outside of the immediate proposal study area, additional traffic investigations have been carried out comprising assessment of:

- The performance of the Illaroo Road/Fairway Drive intersection and the need for traffic signals in the short, medium and long term
- The performance of the Bridge Road/Hyam Street intersection and the need for traffic signals in the short, medium and long term due to the right turn restrictions proposed at the Scenic Drive/Bridge Road intersection
- The performance of the Princes Highway/Moss Street and the Moss Street/Ferry Lane intersections in the context of the proposed closure of Pleasant Way and the proposed new local road connection.

The additional traffic and transport assessment has been prepared in accordance with:

- Roads and Maritime Traffic Modelling Guidelines, February 2013 Version 1.0
- Highway Capacity Manual (HCM, 2016)
- Guide to Traffic Generating Developments, Version 2.2 Roads and Maritime, October 2002
- Austroads Guide to Traffic Engineering Practice.

The approach to the assessment generally comprised:

- Carrying out traffic counts and queue lengths at the intersections to be modelled
- Modelling the base scenario and, where necessary, performing calibration using observed queue lengths; this was carried out using SIDRA (Signalised & unsignalised Intersection Design and Research Aid) software
- Incorporating turning restrictions and redistribution of traffic through the modelled intersections
- Forecast traffic for AM and PM peak hours for the future years 2026, 2036 and 2046
- Modelling of each future year scenario.

The following intersections were modelled for the additional assessment:

- Illaroo Road / Fairway Drive
- Bridge Road / Hyam Street
- Princes Highway / Moss Street
- Moss Street / Ferry Street.

The assessment modelled intersections in isolation rather than as part of the model developed for the REF assessment. This was deemed sufficient for the purposes of this study due to the large distances between the study intersections and those adjacent to them.

Traffic data

Classified intersection counts were collected for the following intersections:

- Illaroo Road/Fairway Drive
- Bridge Road/Hyam Street
- Princes Highway/Moss Street
- Moss Street/Ferry Lane.

The traffic counts were collected on 19 October 2018 and 26 October 2018 between 7-10 am (AM peak) and 2:30-5:30 pm (PM peak). As each intersection was modelled in isolation, the peak hours for each intersection were determined separately. The peak hours (and dates) for each intersection are listed in the following table.

Table 5-2: Peak hours for modelled intersections

Intersection	AM peak hour/date	PM peak hour/date
Bridge Road/Hyam Street	8:00–9:00, 26 October	3:30–4:30, 19 October
Illaroo Road/Fairway Drive	8:15–9:15, 19 October	3:00–4:00, 19 October
Moss Street/Ferry Lane	8:15–9:15, 19 October	3:15–4:15, 19 October
Princes Highway/Moss Street	8:15–9:15, 19 October	2:45–3:45, 26 October

Queue length data were recorded on the same dates as the traffic counts in each five minute interval for the following legs:

- Bridge Road/Hyam Street – west leg
- Princes Highway/Moss Street – all legs
- Moss Street/Ferry Lane – north leg.

Signal timings

The Princes Highway/Moss Street intersection is the only intersection of the four modelled which is signalised. History files from the Sydney Coordinated Adaptive Traffic System (SCATS) were obtained for this intersection for 19 October 2018, coinciding with the intersection counts for the AM peak period. While the information for the PM peak period occurred on 26 October 2018, it was assumed that there was no material difference between the signal phasings and timings for the same time period between the two dates. The SCATS data allowed the existing signal phasings and timings to be determined.

Base model development

SIDRA models were developed for the following intersections:

- Illaroo Road/Fairway Drive
- Bridge Road/Hyam Street
- Moss Street/Princes Highway
- Ferry Lane/Moss Street.

Base models were calibrated to ensure the modelled queue lengths resembled the observed queue lengths from the traffic surveys. This was achieved by increasing gap acceptance parameters at the priority intersections. In future years however, gap acceptance parameters were set back to default values as it is assumed drivers will behave more aggressively in response to longer delays.

The existing intersection performance was assessed based on the following parameters at each intersection:

- Degree of saturation (DoS)
- Level of Service (LoS)
- Maximum queue length (in metres).

Six scenarios have been modelled, these being for the years 2026, 2036 and 2046 without the proposal (do minimum scenario) and with the proposal.

5.1.2 Description of existing environment

Illaroo Road/Fairway Drive intersection

Traffic counts carried out in November 2017 identified the two-way weekday daily traffic volumes on Illaroo Road to be 17,600 vehicles. Intersection counts for the observed AM and PM peak hours are presented in Table 5-3.

Table 5-3: Summary of intersection counts for Illaroo Road/Fairway Drive intersection

Direction	19 October 2018		26 October 2018	
	AM peak period (8.15 to 9.15)	PM peak period (15.00 to 16.00)	AM peak period (8.00 to 9.00)	PM peak period (15.00 to 16.00)
Right into Fairway Drive	10	6	7	6
Left into Fairway Drive	14	23	17	20
Right out of Fairway Drive	8	31	6	19
Left out of Fairway Drive	4	16	4	18
Illaroo Road westbound	604	876	953	782
Illaroo Road eastbound	1070	786	623	892

Bridge Road/Hyam Street intersection

Traffic counts carried out in November 2017 identified the two-way weekday daily traffic volumes on Bridge Road to be 13,100 vehicles. Intersection counts for the observed AM and PM peak hours are

presented in Table 5-4. The intersection currently operates at a LoS A in both the AM and PM peak period.

Table 5-4: Summary of intersection counts for Bridge Road/Hyam Street intersection

Direction	19 October 2018		26 October 2018	
	AM peak period (8.00 to 9.00)	PM peak period (15.30 to 16.30)	AM peak period (8.00 to 9.00)	PM peak period (15.00 to 16.00)
Right into Hyam Street	198	78	205	92
Left into Hyam Street	12	9	23	12
Right out of Hyam Street	6	13	13	7
Left out of Hyam Street	105	99	111	149
Bridge Road northbound	328	829	337	733
Bridge Road southbound	583	342	581	347

The maximum queue lengths in number of vehicles recorded for this intersection are presented in Table 5-5. The longest queues are experienced by traffic turning right into Hyam Street from Bridge Road.

Table 5-5: Maximum queue length recorded at Bridge Road/Hyam Street intersection

Direction	19 October 2018		26 October 2018	
	AM period	PM period	AM period	PM period
Right into Hyam Street	4	4	12	6
Right out of Hyam Street	2	4	1	2
Left out of Hyam Street	3	6	3	7

Bridge Road/Scenic Drive intersection

Intersection counts for the observed AM and PM peak hours are presented in Table 5-6.

Table 5-6: Summary of intersection counts for Bridge Road/Scenic Drive intersection

Direction	19 October 2018		26 October 2018	
	AM peak period (8.00 to 9.00)	PM peak period (15.15 to 16.15)	AM peak period (8.00 to 9.00)	PM peak period (15.15 to 16.15)
Right into Scenic Drive	100	79	88	65
Left into Scenic Drive	18	32	16	30
Right out of Scenic Drive	18	13	14	19

Direction	19 October 2018		26 October 2018	
	AM peak period (8.00 to 9.00)	PM peak period (15.15 to 16.15)	AM peak period (8.00 to 9.00)	PM peak period (15.15 to 16.15)
Left out of Scenic Drive	31	92	31	65
Bridge Road northbound	399	876	419	830
Bridge Road southbound	835	432	831	416

The maximum queue lengths in number of vehicles recorded for this intersection are presented in Table 5-7. The longest queues are experienced by traffic turning right into Hyam Street from Bridge Road.

Table 5-7: Maximum queue length recorded at Bridge Road/Scenic Drive intersection

Direction	19 October 2018		26 October 2018	
	AM period	PM period	AM period	PM period
Right into Scenic Drive	3	5	4	4
Left/right out of Scenic Drive	3	6	5	5

Moss Street/Princes Highway intersection

Traffic counts carried out in November 2017 identified the two-way weekday daily traffic volumes on the Princes Highway south of Bridge Road to be 42,500 vehicles. Intersection counts for the observed AM and PM peak hours are presented in Table 5-8.

Table 5-8: Summary of intersection counts for Princes Highway/Moss Street intersection

Direction	19 October 2018		26 October 2018	
	AM peak period (8.15 to 9.15)	PM peak period (15.30 to 16.30)	AM peak period (8.15 to 9.15)	PM peak period (14.45 to 15.45)
Movements from Princes Highway southbound (northern approach)				
Left into Moss Street	163	239	154	189
Right into Moss Street	239	196	231	197
Princes Highway southbound	1361	1561	1287	1532
Turn movements from Princes Highway northbound (southern approach)				
Left into Moss Street	1	22	5	11
Right into Moss Street	154	115	160	154
Princes Highway	1031	1053	1119	1262

Direction	19 October 2018		26 October 2018	
	AM peak period (8.15 to 9.15)	PM peak period (15.30 to 16.30)	AM peak period (8.15 to 9.15)	PM peak period (14.45 to 15.45)
northbound				
Turn movements from Moss Street eastbound (western approach)				
Left to Princes Highway	128	259	98	238
Right into Princes Highway	62	79	70	115
Moss Street eastbound	133	172	114	179
Turn movements from Moss Street westbound (eastern approach)				
Left into Princes Highway	26	40	27	40
Right into Princes Highway	205	217	212	211
Moss Street westbound	183	123	181	98

The Princes Highway/Moss Street intersection currently performs at LoS D and E during the AM and PM peak periods respectively. The DoS is just below 1.0 during the PM peak, indicating the intersection is already close to operating at capacity.

The Princes Highway northbound has maximum queue lengths up to 5, 23 and 14 vehicles for the left turn, straight and right turn lanes respectively in the AM period. In the PM period, the maximum queue lengths are 10, 37 and 16 vehicles across the left turn, straight and right turn lanes.

The Princes Highway southbound has maximum queue lengths of up to 10, 20 and 13 vehicles across the left turn, straight and right turn lanes in the AM period. In the PM period, the maximum queue lengths are 10, 40 and 13 vehicles across the left turn, straight and right turn lanes.

In the AM period, Moss Street has a maximum queue length of 29 and 18 vehicles in the westbound and eastbound directions respectively. In the PM period, the maximum queue lengths are 43 and 21 vehicles in the westbound and eastbound directions respectively.

Ferry Lane/Moss Street intersection

Intersection counts for the AM and PM peak hours at the Moss Street/Ferry Lanes intersection are presented in Table 5-9.

Table 5-9: Summary of intersection counts for Moss Street/Ferry Lane intersection

Direction	19 October 2018		26 October 2018	
	AM peak period (8.15 to 9.15)	PM peak period (15.15 to 16.15)	AM peak period (8.00 to 9.00)	PM peak period (15.15 to 16.15)
Right into Ferry Lane	5	12	12	6

Direction	19 October 2018		26 October 2018	
	AM peak period (8.15 to 9.15)	PM peak period (15.15 to 16.15)	AM peak period (8.00 to 9.00)	PM peak period (15.15 to 16.15)
Left into Ferry Lane	22	46	25	36
Right out of Ferry Lane	63	44	48	53
Left out of Ferry Lane	20	59	18	45
Moss Street eastbound	132	314	127	313
Moss Street westbound	359	222	346	215

5.1.3 Potential impacts

Illaroo Road/Fairway Drive intersection

This intersection would perform acceptably up until about 2026. Beyond this, it is forecast that the Fairway Drive approach would experience significant delays. The intersection performance is presented in Table 5-10.

Table 5-10: Intersection performance at Illaroo Road / Fairway Drive

Approach	AM peak			PM peak		
	DoS	LoS	95th percentile queue (m)	DoS	LoS	95th percentile queue (m)
2018						
Fairway Drive (S)	0.133	C	2.6	0.463	D	11.2
Illaroo Road (E)	0.163	A	0	0.235	A	0
Illaroo Road (W)	0.285	A	1.5	0.211	A	1.3
Total	**0.285**	**A**	**2.6**	**0.463**	**A**	**11.2**
2026						
Fairway Drive (S)	0.285	F	5.5	0.923	F	33.7
Illaroo Road (E)	0.193	A	0	0.277	A	0
Illaroo Road (W)	0.337	A	2.1	0.251	A	2.1
Total	**0.337**	**A**	**5.5**	**0.923**	**A**	**33.7**
2036						
Fairway Drive (S)	0.782	F	16.4	2.491	F	290.7
Illaroo Road (E)	0.218	A	0	0.33	A	0
Illaroo Road (W)	0.402	A	2.9	0.301	A	3.7
Total	**0.782**	**A**	**16.4**	**2.491**	**E**	**290.7**

Approach	AM peak			PM peak		
2046						
Fairway Drive (S)	1.338	F	50	5.195	F	415
Illaroo Road (E)	0.266	A	0	0.382	A	0
Illaroo Road (W)	0.469	A	4.7	0.353	A	7.2
Total	**1.338**	**A**	**50**	**5.195**	**F**	**415**

Despite the relatively small amount of traffic exiting Fairway Drive (up to about 100 vehicles in total during peak hours), the heavy through movement on Illaroo Road after 2026 would reduce the ability of vehicles to turn right out of Fairway Drive. Potential mitigation measures include:

- Installing 'keep clear' line-marking at the intersection to allow vehicles exiting Fairway Drive a sufficient gap to join the back of the eastbound queue on Illaroo Road
- Banning the right turn movement out of Fairway Drive. Vehicles wanting to access the Princes Highway would travel west on Illaroo Road and perform a U-turn at the roundabout on McMahons Road.

There is no material change in traffic distribution or road alignment as a result of the proposal. The modelled traffic performance is due to the natural traffic growth of the intersection and Illaroo Road. The operational performance and ongoing management of the intersection is therefore considered to be the responsibility of Council to manage as it forms part of the local road network. An opportunity may exist during detailed design of the proposal for the construction contractor to make minor adjustments to the intersection, which would be discussed with Council as they arise.

The intersection would be managed during construction through environmental management measure T1.

Bridge Road/Hyam Street intersection

The right turn movement restrictions at the Bridge Road/Scenic Drive intersection would increase right turning traffic volumes at the Bridge Road/Hyam Street intersection. The proposed change is anticipated to increase the number of vehicles turning right into Hyam Street during the 2018 AM and PM peak periods by 100 and 79 vehicles respectively. The number of vehicle turning right out of Hyam Street is anticipated to increase by 18 and 13 vehicles in the 2018 AM and PM peak hours respectively.

The modelling indicates the intersection will maintain good levels of service beyond 2036, even with the likely traffic redistribution and expected levels of growth. After this, intersection performance reduces to LoS C and LoS E in 2046 due to increased delay on Hyam Street and Bridge Road southbound. Intersection control may be required to accommodate future demands but is considered not required in the short or medium term. The intersection performance is presented in Table 5-11.

Table 5-11: Intersection performance at Bridge Road/Hyam Street

Approach	AM peak			PM peak		
	DoS	LoS	95th percentile queue (m)	DoS	LoS	95th percentile queue (m)
2018						
Bridge Road (S)	0.192	A	0	0.1	A	0
Bridge Road (N)	0.389	A	16.5	0.248	A	10.5
Hyam Street (W)	0.116	A	3.4	0.216	B	5.6
Total	**0.389**	**A**	**16.5**	**0.435**	**A**	**10.5**
2026						
Bridge Road (S)	0.218	A	0	0.1	A	0
Bridge Road (N)	0.532	A	37.8	0.454	A	26.9
Hyam Street (W)	0.396	B	9.4	0.444	C	10
Total	**0.532**	**A**	**37.8**	**0.494**	**A**	**26.9**
2036						
Bridge Road (S)	0.251	A	0	0.2	A	0
Bridge Road (N)	0.634	A	56.9	0.646	A	43.9
Hyam Street (W)	0.828	D	23.9	0.987	F	36.5
Total	**0.828**	**A**	**56.9**	**0.987**	**A**	**43.9**
2046						
Bridge Road (S)	0.284	A	0	0.2	A	0
Bridge Road (N)	0.745	A	89.3	0.976	D	138.4
Hyam Street (W)	1.671	F	205.7	2.283	F	232.9
Total	**1.671**	**C**	**205.7**	**2.283**	**E**	**232.9**

The traffic counts included recording the number of emergency vehicles using this intersection and the Bridge Road/Scenic Drive intersection as it is one of the preferred routes for accessing Shoalhaven District Memorial Hospital. The number of emergency vehicles using the intersection was very low with four observed during the AM period and six observed during the PM period. For the Bridge Road/Hyam Street intersection, the numbers were also low with six vehicles recorded during the AM period and 13 vehicles during the PM period. The redistribution of traffic from Scenic Drive is not considered to have an impact on emergency vehicles accessing Shoalhaven District Memorial Hospital.

The redistribution of traffic from Scenic Drive as a result of the proposal is not considered to impact the operational performance of the Bridge Road/Hyam Street intersection in the short or medium term. As a result, Roads and Maritime is not proposing additional intersection treatments at this location as part of the proposal.

Environmental management measure T1 would mitigate any impacts to the intersection during construction of the proposal.

Moss Street/Princes Highway intersection

The closure of Pleasant Way is forecast to redistribute about 33 vehicles and 50 vehicles to the northbound right turn lane at the Moss Street intersection in the 2018 AM and PM peak hours respectively.

The modelling forecasts that by 2026 the performance of the intersection will have deteriorated compared to its existing performance. This is due principally to the level of background growth assumed along the Princes Highway, rather than the redistribution of traffic from Pleasant Way. The intersection performance results are presented in Table 5-12.

Table 5-12: Intersection performance at Moss Street / Princes Highway intersection

Approach	AM peak			PM peak		
	DoS	LoS	95th percentile queue (m)	DoS	LoS	95th percentile queue (m)
2018						
Princes Highway (S)	0.574	C	150.5	0.758	C	181.7
Moss Street (E)	0.882	E	152.9	0.762	E	117.9
Princes Highway (N)	0.686	D	210.8	0.975	E	305.6
Moss Street (W)	0.741	D	93.7	0.947	E	173.9
Total	**0.882**	**D**	**210.8**	**0.9975**	**D**	**305.6**
2026						
Princes Highway (S)	0.799	D	192.7	1.048	E	237.1
Moss Street (E)	0.988	F	249.9	0.985	F	202.8
Princes Highway (N)	1.018	F	532	1.053	F	674.5
Moss Street (W)	0.818	E	123.9	1.026	F	278
Total	**1.018**	**F**	**532**	**1.053**	**F**	**674.5**
2036						
Princes Highway (S)	0.919	D	242.6	1.22	F	443.1
Moss Street (E)	1.183	F	579.8	1.217	F	545
Princes Highway (N)	1.172	F	1079.5	1.205	F	1358.9
Moss Street (W)	0.94	E	167.9	1.223	F	640.6
Total	**1.183**	**F**	**1079.5**	**1.223**	**F**	**1358.9**
2046						
Princes Highway (S)	1.039	E	322	1.373	F	653.3
Moss Street (E)	1.332	F	880	1.37	F	806.4
Princes Highway (N)	1.348	F	1764	1.396	F	2178.4

Approach	AM peak			PM peak		
Moss Street (W)	1.054	F	287.9	1.376	F	942.9
Total	**1.348**	**F**	**1764**	**5.195**	**F**	**2178.4**

A sensitivity test was carried out which considered a scenario where traffic signals were provided at the new local road connection allowing all traffic movements. This reduced the number of vehicles turning right into and out of Moss Street. However, even under this scenario, the modelling indicates that the Princes Highway/Moss Street intersection would require upgrading by 2026 due to the levels of background growth on the Princes Highway. Should traffic volumes remain at 2018 levels, with the only change being the redistributed southbound right turn traffic from Princes Highway to Pleasant Way, the intersection would perform at an acceptable level.

The Moss Street/Princes Highway intersection is outside the scope of the proposal. Upgrades to this intersection are not considered as part of the proposal.

Ferry Lane/Moss Street intersection

The intersection is forecast to operate satisfactorily up to 2046 indicating the redistribution of the traffic as a result of the project will not impact the performance of the intersection in the long term. The intersection performance results are presented in Table 5-13.

Table 5-13: Intersection performance at Ferry Lane / Moss Street intersection

Approach	AM peak			PM peak		
	DoS	LoS	95th percentile queue (m)	DoS	LoS	95th percentile queue (m)
2018						
Terara Road (E)	0.191	A	0.3	0.129	A	1
Ferry Lane (N)	0.097	A	2.4	0.118	A	3.2
Moss Street (W)	0.083	A	0	0.189	A	0
Total	**0.191**	**A**	**2.4**	**0.189**	**A**	**3.2**
2026						
Terara Road (E)	0.217	A	0.4	0.147	A	1.3
Ferry Lane (N)	0.119	A	2.9	0.148	A	4
Moss Street (W)	0.114	A	0	0.246	A	0
Total	**0.217**	**A**	**2.9**	**0.246**	**A**	**4**
2036						
Terara Road (E)	0.25	A	0.5	0.172	A	1.8
Ferry Lane (N)	0.156	A	3.9	0.188	A	5.1
Moss Street (W)	0.133	A	0	0.283	A	0
Total	**0.25**	**A**	**3.9**	**0.283**	**A**	**5.1**

Approach	AM peak			PM peak		
2046						
Terara Road (E)	0.283	A	0.6	0.196	A	2.2
Ferry Lane (N)	0.194	A	4.8	0.243	A	6.8
Moss Street (W)	0.149	A	0	0.32	A	0
Total	**0.283**	**A**	**4.8**	**0.32**	**A**	**6.8**

The traffic modelling indicates the additional vehicles turning right from the Princes Highway into Moss Street as a result of the proposal do not impact the performance of this intersection in the long term. No additional intersection treatments are therefore proposed.

5.1.4 Revised safeguards and management measures

No additional management measures are proposed. The impacts identified can be managed through implementation of the management measures proposed in the REF.

5.2 Assessment of proposed noise barrier

5.2.1 Methodology

The operational noise assessment for the proposal identified that a noise barrier could be an effective at road mitigation measure for residences adjacent to the Princes Highway between Graham Lodge and the new local road connection.

The Noise and Vibration Assessment (refer Chapter 6.2 and Appendix D to the REF) noted the following matters with regard to a noise barrier:

- A maximum barrier height of eight metres would achieve the required insertion loss of more than 10 dB(A)
- A design barrier height of 5.5 metres would achieve the required insertion loss of more than 10 dB(A)
- Three of the five receivers exceeding the Roads and Maritime Noise Criteria Guideline (NCG) criteria with the design barrier height of 5.5 metres are double storey dwellings
- A barrier of eight metres provides minimal benefit over the design barrier height of 5.5 metres
- A barrier height of 5.5 metres would provide effective noise mitigation at up to 12 receivers (10 properties) to comply with NCG criteria.

The proposed noise barrier was considered in the concept design however potential impacts to other environmental issues were not assessed as part of the REF for the proposal. Additional design work following display of the REF has enabled the potential impacts of the proposed noise barrier to be assessed. The environmental assessment of potential impacts for the proposed noise barrier focuses on the environmental issues for which additional impacts to those identified in the REF are anticipated.

5.2.2 Description of existing environment

The upgrade of this section of highway are predicted to not increase noise levels over the “No Build” scenario, however the existing noise levels area classified as acute. Properties built in the last five years off Hawthorne Avenue that back onto the highway between Graham Lodge and the new local road connection, have been conditioned under the development application (DA) to be constructed in a manner to reduce internal noise levels to an acceptable standard in accordance AS3671 Acoustics – Road traffic noise intrusion – Building siting and construction. Existing developments at this location would not have the same level of at property noise mitigation currently in place.

The proposed noise barrier would be located on the eastern side of the highway between the shared path and the adjoining property boundaries (refer Figure 5-1). The width of this area is about 8-10 metres and is within the existing construction boundary. The barrier would extend from the southern boundary of Graham Lodge to the new local road connection, a distance of about 200 metres. There is existing boundary fencing 1.8 metres in height running along the rear of the properties.

This area between the highway and the adjoining properties currently contains established trees which would be removed for the proposal.

5.2.3 Potential impacts

Noise and vibration

The occupants of the adjoining residences would be the receivers most affected by construction of the proposed noise barrier. The noise and vibration assessment prepared for the REF (Appendix D to the REF) identified that these receivers would experience exceedances above the relevant NMLs associated with construction activities within and outside standard construction hours. There are not anticipated to be any new or additional construction noise impacts to those identified in the REF.

The noise and vibration assessment identified 17 receivers potentially affected in relation to structural damage and 44 receivers with regard to human comfort. The residences adjoining the proposed noise barrier would be among the receivers potentially affected, however vibration impacts are not anticipated to change from those identified in the REF.

The noise and vibration assessment also considered vibration-related impacts on heritage listed structures, with Graham Lodge being of relevance to the proposed noise barrier. The assessment recommended that dilapidation surveys be done on all structures where vibration monitoring was required, which included Graham Lodge. It also advised that specific minimum working distances based on the DIN 4150-3 heritage structural damage criteria should be determined once specific items of plant and their operating locations become known at detailed design. As noted, the vibration assessment was conservative and it is not anticipated there would be any new or changed vibration impacts from those assessed for the REF affecting Graham Lodge.

The management measures identified in the REF including the preparation and implementation of a Construction Noise and Vibration Management Plan (environmental management measure NV1) are sufficient to mitigate and manage the potential impacts associated with construction of the proposed noise barrier.

Non-Aboriginal heritage

The northern end of the proposed noise barrier would be located at the southern end of the property boundary of the State heritage-listed Graham Lodge, outside the heritage curtilage of the property. The barrier would partially obscure views from Graham Lodge to the general south-east for a

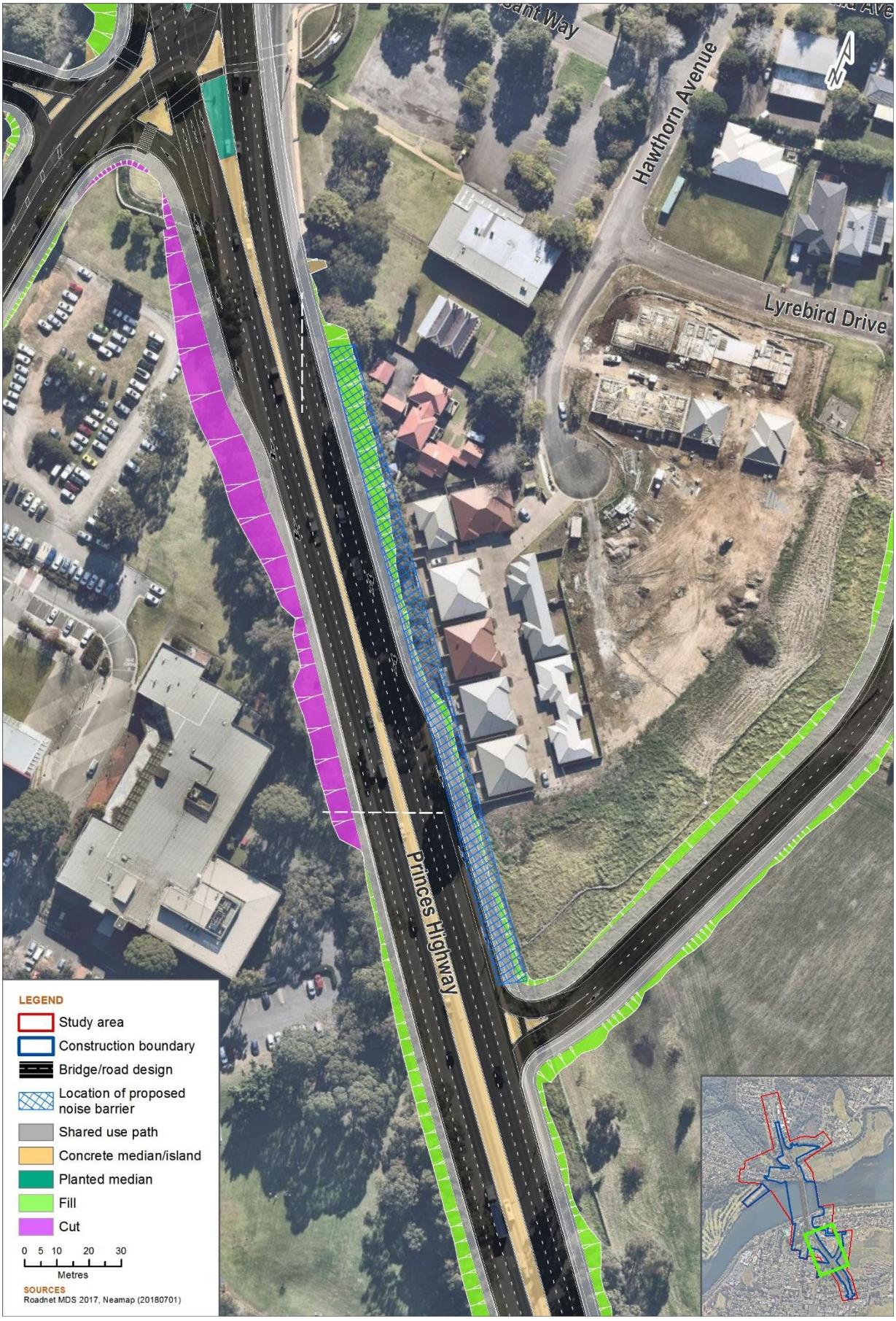

Figure 5-1: Location of proposed noise barrier

distance of about 10 metres, with views beyond that already obscured by the existing adjoining residential development.

The statement of significance for Graham Lodge (refer Appendix F to the REF) noted that part of its significance relates to its aesthetic quality as a substantial nineteenth century Victorian Georgian residence still overlooking much of its original pastoral landholdings. These views are to the east and south east in the general opposite direction of the proposed noise barrier. Views to Graham Lodge have the potential to be impacted by the noise barrier depending on the final location and design of the barrier which would be determined during detailed design. Further assessment of the impacts to Graham Lodge would be addressed during detail design. Additional environmental management measure NAH10 has been added to cover this:

> ***NAH10: Potential impacts of the proposed noise barrier on State heritage listed Graham Lodge (SHR No. 01699) would be assessed during detailed design***

Landscape and visual amenity

The location of the proposed noise barrier is in Landscape Character Zone (LCZ) 6 as defined in the Urban Design Report and Landscape Character and Visual Impact Assessment prepared for the proposal (Appendix G to the REF). The impact to LCZ 6 was assessed as high-moderate in the REF due to the moderate sensitivity of the predominantly commercial zone and high magnitude of change associated with widening the highway and associated new infrastructure. It is considered the assessed impact would remain the same for the proposed noise barrier as the magnitude of change is already rated high, the highest possible rating.

The visual impact assessment used a number of defined viewpoints within the proposal area to assess visual impacts. Viewpoint 10 is relevant to the proposed noise barrier; this is located on the Princes Highway to the south of the new local road connection looking north. The southern part of the proposed noise barrier would be visible to the right of this viewpoint. The overall visual impact of the proposal from this viewpoint was assessed as being high-moderate principally associated with the removal of existing roadside vegetation for the proposal. It is considered that the assessed impact would be the same for the proposed barrier which would introduce a completely new built element into the landscape, as the magnitude of change is rated as high, the highest possible rating.

Views from adjoining properties are already limited by the 1.8 metre high boundary fencing that runs the entire length of the existing residential properties. Views to the road are also filtered through the existing roadside vegetation that would be removed for the proposal. The proposed noise barrier would be within 10 metres of the adjoining property boundaries and would visible from the residences, with the recommended height of 5.5 metres extending 3.7 metres above the top of the existing fencing. The frontages of all affected properties are generally towards Hawthorn Avenue rather than to the highway which would reduce their visual sensitivity to the proposed noise barrier to a degree. The overall impact however, would be regarded as high based on the close proximity of the barrier, the minimum recommended height, and the reduced area available for landscaping and plantings.

Environmental management measure LV1 required the preparation and implementation of an Urban Design and Landscape Plan would address the potential impacts associated with landscape and visual amenity of the proposed noise barrier.

Flooding and hydrology

The proposed noise barrier would not be located across any major drainage lines, noting that the existing highway already acts as a barrier to east-west drainage. The effect of the barrier on local

drainage would be addressed through both the design of the wall and the drainage design for the proposal.

The southern part of the proposed noise barrier would be located in an area affected by flooding in major flood events as a result of ponding of floodwaters in the lower lying area to the east of the highway. The barrier would not be located in any areas containing flow paths for major flood events.

There are not anticipated to be any new or additional impacts on flooding and drainage to those identified in the REF.

Socioeconomic

Socioeconomic impacts associated with the proposed noise barrier would include:

- Reduced amenity for adjoining residents during construction (but noting there would already be an existing impact associated with construction activities for the upgrading of the highway, shared path, etc.)
- Reduced visual amenity for adjoining residents, for occupants of vehicles and active transport users travelling along this section of the highway once the barrier has been constructed.

The proposed noise barrier would have a positive impact on amenity of nearby residents by reducing the level of road traffic noise emissions at the adjoining residences.

Biodiversity

The proposed noise barrier would be located in an area presently occupied by roadside vegetation however this vegetation would be removed for construction of the proposal. There are not anticipated to be any new or additional impacts on biodiversity to those identified in the REF.

5.2.4 Revised safeguards and management measures

An additional environmental safeguard has been included for the proposed noise barrier.

Impact	No.	Environmental safeguard	Responsibility	Timing	Reference
Non-Aboriginal Heritage	**NAH10**	***Potential impacts of the proposed noise barrier on State heritage listed Graham Lodge (SHR No. 01699) would be assessed during detailed design***	**Construction contractor**	**Detailed design**	**Project specific control**
Impact on visual amenity	**SE10**	**Roads and Maritime will consult with affected residents with regard to the location and design of the proposed noise barrier on the eastern side of the Princes Highway south of the Shoalhaven River. This will include investigation and consideration of alternative options for noise mitigation.**	**Roads and Maritime**	**Detailed design**	**Project specific control**

5.3 Review of non-Aboriginal heritage assessments of significance

5.3.1 Methodology

A SoHI was prepared as part of the REF to assess the impacts of the proposal on non-Aboriginal heritage. The SoHI contained assessments of significance for 13 heritage items which drew on existing heritage listings for each of the items. For two items, 'Lynburn' and 'Illowra', there were inconsistencies between the criteria in the assessments of significance and the overall statement of significance.

A review of the existing heritage listings has been carried out focussing specifically on the criteria for assessment of heritage significance, and whether any considered differences could have bearing on the statement of significance for each item. The SoHI has been updated to provide clarification regarding the statements of significance for each heritage item.

5.3.2 Description of existing environment

The SoHI identified 13 non-Aboriginal heritage items within the proposal study area. The SoHI was updated to provide clarification regarding two items, 'Lynburn' and 'Illowra'. The existing environment in relation to these items is detailed below.

'Lynburn' – timber Federation residence and garden, Mattes Way, Bomaderry

Designed by leading Sydney architect Howard Joseland, who was commissioned to design several fine buildings on the Berry Estate in the late 19th century, 'Lynburn' was built by George Muller and completed in 1895.

An ornate Federation residence, the weatherboard residence features two front gabled projections, a skillion verandah and complex slate roof with terracotta ridge capping and unusual timber decoration to gable ends. Despite a fire that occurred in 1981, the exterior of the residence has been sensitively restored and the interior remains largely intact featuring several marble fireplaces and original lathe and plaster ceilings. The grounds of the property contain several mature trees. Road widening associated with previous upgrading of the Princes Highway slightly reduced the garden, and resulted in the removal of several mature spotted gum trees and reconstruction of the entry gates.

Heritage listing: LEP Item No. 130, local significance

'Illowra' – Federation timber Berry Estate residence and garden, 125 Brinawarr Street, Bomaderry

Designed by leading Sydney architect Howard Joseland, 'Illowra' was built in 1906 for Mark F. Morton as part of the Berry Estate. The large Federation residence, which features an attic storey, is constructed of weatherboard with tall chimneys in rendered brick and a complex high-pitched jerkin-head roof. The residence is largely concealed from the surrounding streetscape, with plantings and the property fencing concealing the house from view from Princes Highway, Bolong Road and Brinawarr Street.

Heritage listing: LEP Item No. 136, local significance

5.3.3 Potential impacts

The assessments of significance for 'Lynburn' (LEP No. 130) and 'Illowra' (LEP No. 136) have utilised the assessments of heritage significance under each significance criteria as per the LEP listing. Two criteria; F (rarity) and G (representativeness), were assessed as being significant at a State level, however the overall statement of significance concluded that these items were of local significance and both items are listed as locally significant on the Shoalhaven LEP.

No further information has been identified as part of the assessment in relation to the previously assessed heritage significance under the two criteria noted for these two items, or on the summary statements of significance in the LEP. Both items are therefore considered significant at a local level as per their LEP listings.

There are no changes to the significance of these heritage items and therefore no changes to the impacts described in the REF.

5.3.4 Revised safeguards and management measures

No additional or revised safeguards and management measures are required.

5.4 Maritime archaeological assessment

5.4.1 Methodology

A maritime archaeological due diligence assessment was carried out by RPS in November 2018. This assessment was undertaken to address maritime archaeological constraints within the proposal study area, including identification and assessment of the significance of any maritime archaeological resources, identification of any potential impacts to these resources, and to provide strategies for their management.

The scope of the assessment comprised:

- Identification of maritime archaeological resources including but not limited to any shipwreck, infrastructure or archaeological relic (both above and below water)
- Overview of the development directly north and south of the Shoalhaven River and Bomaderry Creek
- Overview of the development of transport on the Shoalhaven River
- Assessment of maritime archaeological potential
- Assessment of significance of identified maritime archaeological resources
- Assessment of impacts of the proposal
- Recommendations and management strategies for identified and unexpected maritime archaeological resources.

A copy of the maritime archaeological due diligence assessment is provided in Appendix B.

5.4.2 Description of existing environment

Two Government wharves fall within the project area, Bomaderry Wharf and Nowra Wharf.

Bomaderry Wharf

The former Bomaderry Wharf is located on the northern bank of the Shoalhaven River about 50 metres to the east of the existing southbound bridge (refer Figure 5-1). The Perfect Catch Seafoods & Takeaway business is located immediately to the north with a slope leading down to the wharf location.

Nowra Wharf

The Nowra Wharf is located on the southern side of the Shoalhaven River adjacent to the Nowra Sailing Club (refer Figure 5-2). An existing timber wharf and its underlying concrete pile footings are present together with concrete and timber footings of the earlier 1884 and 1902-1904 wharf. There is an existing operational boat ramp to the west of the wharf.

Underwater archaeological resources

Due to flooding impacts, water movement, and scour, archaeological resources associated with the two Government wharves would be limited to structural fabric such as timber piles. Structural fabric would also have been impacted but to a lesser extent.

Rock at the mouth of Broughton Creek was removed in 1904 with the Shoalhaven River being dredged to provide access for ocean-going steamers to Nowra. Dredging would have also impacted the potential for intact archaeological resources and it is unlikely that intact archaeological resources would be identified within areas that have been subjected to dredging.

No underwater archaeological resources have been recorded within the proposal area and the potential for unrecorded shipwrecks to occur is low.

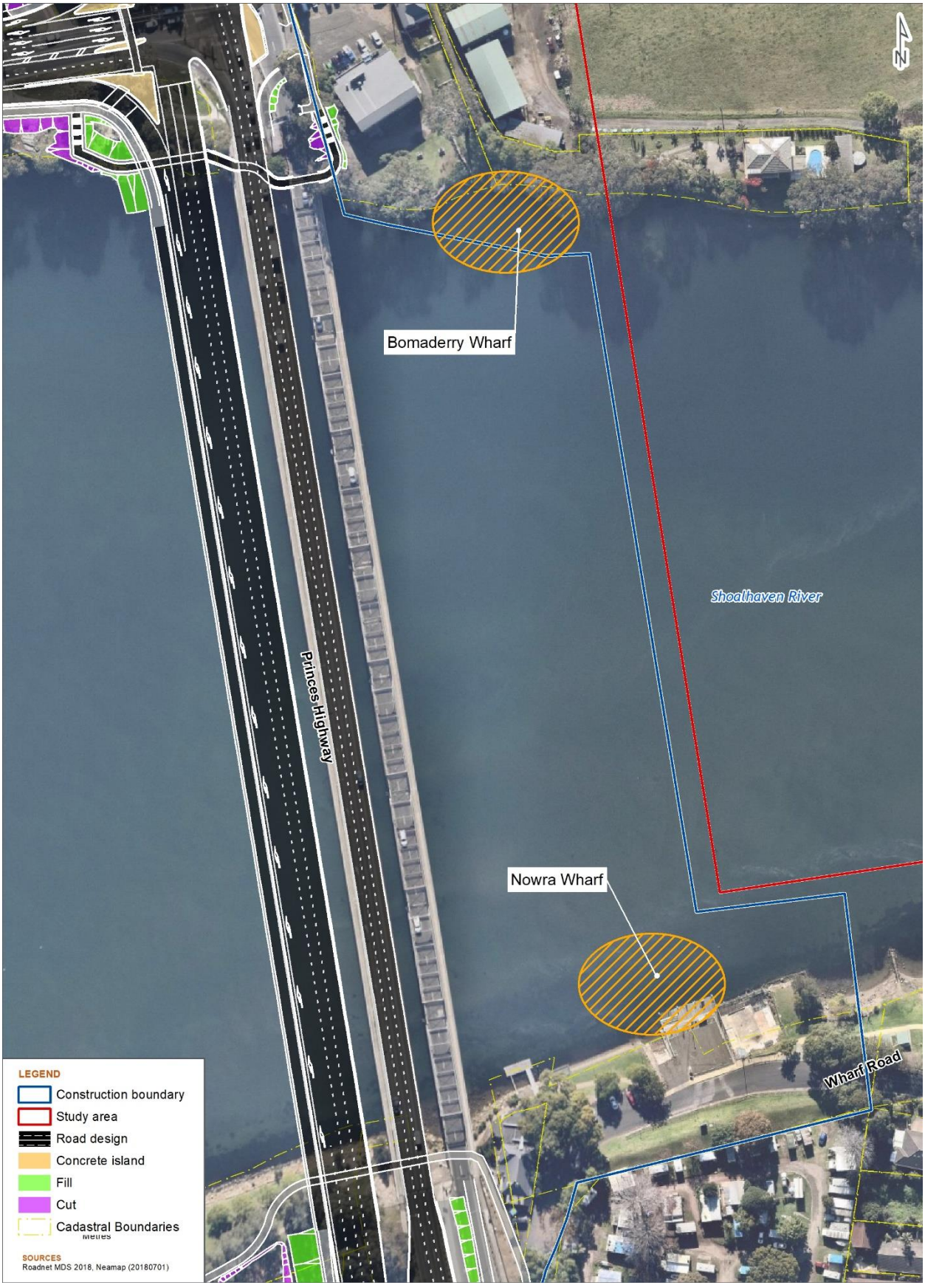

Figure 5-2: Locations of Bomaderry Wharf and Nowra Wharf

5.4.3 Potential impacts

Bomaderry Wharf

The wharf at Bomaderry consisted of timber piles and a horizontal timber platform. It also included a loading apparatus and store set back from the water. Due to the impact of flooding, water movement and scouring, the potential for archaeological resources associated with the wharf would be limited to structural fabric such as but not limited to timber piles. It is unlikely that archaeological resources such as artefacts discarded as part of the active use of the wharf would be identified in situ.

Landscaping carried out in the past would have affected the potential for archaeological resources associated with infrastructure such as the loading apparatus or store. In view of this, it is unlikely archaeological resources associated with any land-based infrastructure would be identified.

The land based infrastructure associated with the wharf at Bomaderry would fall outside the impact area for the project. The proposal may impact archaeological resources such as piles associated with the wharf within the proposal area.

The assessment of significance in accordance with the NSW Heritage Manual and the Archaeological Assessment Guidelines (NSW Heritage Office, 1996) is provided in the following table.

Table 5-14: Significance assessment for Bomaderry Wharf

Criterion	Comment
A – historical significance	Identified archaeological resources associated with the Government wharf at Bomaderry would be of local significance as part of a system of transport on the Shoalhaven River.
B – associative significance	The wharf at Bomaderry is a Government wharf. It is not associated with a person of importance in the local area or NSW.
C – aesthetic or technical significance	If identified, archaeological resources associated with the wharf at Bomaderry would not considered to be of aesthetic significance or significant for demonstrating creative or technical achievement in the local area or NSW.
D – social significance	If identified, it is unlikely archaeological resources associated with the wharf at Bomaderry would demonstrate a strong association with the local community.
E – research potential	If identified, archaeological resources associated with the wharf would provide an understanding of construction technologies.
F – rarity	If identified, archaeological resources associated with the wharf at Bomaderry would not be considered rare with archaeological resources associated with other landing places on the Shoalhaven River having been identified.
G - representativeness	If identified, archaeological resources associated with the wharf at Bomaderry are unlikely to be considered representative.

Nowra Wharf

Nowra Wharf is within the proposal area. Potential impacts on the wharf would be associated with the use of the ramp 20 metres west of the wharf for access to the Shoalhaven River. The proposal would not involve direct impact on above or below water archaeological resources associated with the wharf.

The assessment of significance in accordance with the NSW Heritage Manual and the Archaeological Assessment Guidelines (NSW Heritage Office, 1996) is provided in the following table.

Table 5-15: Significance assessment for Nowra Wharf

Criterion	Comment
A – historical significance	Nowra Wharf is of local significance as part of a system of transport on the Shoalhaven River. It demonstrates the relationship between Nowra and the Shoalhaven River and the importance of the Shoalhaven River for transport.
B – associative significance	Nowra Wharf is not associated with a person of importance in the local area or NSW.
C – aesthetic or technical significance	Nowra Wharf is not considered to be of aesthetic significance or significant for demonstrating creative or technical achievement in the local area or NSW.
D – social significance	Nowra Wharf is not considered to demonstrate a strong association with the local community.
E – research potential	Flooding caused repeated damage to Nowra Wharf, with the wharf rebuilt in 1898, 1904 and 1935. Fabric associated with the three phases of the wharf would provide an understanding of construction technologies and responses to advances in transport technologies such as the transition from sail to steam and the introduction of rail.
F – rarity	Nowra Wharf is not rare with archaeological resources associated with other landing places on the Shoalhaven River having been identified.
G - representativeness	Nowra Wharf is representative of a landing place on the Shoalhaven River. It is important in demonstrating construction technologies and responses to advances in transport technologies such as the transition from sail to steam and the introduction of rail.

Underwater archaeological resources

There is no surface expression of archaeological resources associated with other intertidal archaeological resources such as landing places. Water movement and scouring would affect the potential for archaeological resources associated with infrastructure on the Shoalhaven River. There are no recorded shipwrecks in the Shoalhaven River at Nowra. The potential for unrecorded shipwrecks is low due to dredging, repeated flooding and scouring. The potential for underwater archaeological resources is low. Should archaeological resources be identified there is potential for the items to be of local significance.

The assessment of significance in accordance with the NSW Heritage Manual and the Archaeological Assessment Guidelines (NSW Heritage Office, 1996) is provided in the following table.

Table 5-16: Potential significance of underwater archaeological resources

Criterion	Comment
A – historical significance	If identified, archaeological resources associated with navigation on the Shoalhaven river would be of local significance as part of a system of transport on the Shoalhaven River.
B – associative significance	If identified, underwater archaeological resources associated with navigation on the Shoalhaven River may be associated with merchant and settler, Alexander Berry.
C – aesthetic or technical significance	If identified, it is unlikely underwater archaeological resources associated with navigation on the Shoalhaven river would be of aesthetic significance or significant for demonstrating creative or technical achievement in the local area or NSW.
D – social significance	If identified, it is unlikely underwater archaeological resources associated with navigation on the Shoalhaven River would demonstrate a strong association with the local community.
E – research potential	If identified, underwater archaeological resources associated with navigation on the Shoalhaven river would provide an understanding of maritime technologies and patterns of navigation on the Shoalhaven River.
F – rarity	If identified, underwater archaeological resources associated with navigation on the Shoalhaven River would be considered rare as no such resources have been recorded on the river.
G – representativeness	If identified, underwater archaeological resources associated with navigation on the Shoalhaven River may be representative of the craft or cargoes used or distributed on the Shoalhaven River.

5.4.4 Revised safeguards and management measures

Five additional mitigation measures have been included for the proposal and potential impacts to maritime archaeology.

Impact	No.	Environmental safeguard	Responsibility	Timing	Reference
Maritime archaeology	**NAH11**	**A remote sensing survey using side-scan sonar of the project impact area will be conducted to confirm the presence or absence of submerged archaeological resources within the impact area. In the event that underwater archaeological resources are identified as a**	**Roads and Maritime**	**Pre-construction**	**Maritime archaeological due diligence assessment, RPS, 2018**

Impact	No.	Environmental safeguard	Responsibility	Timing	Reference
		result of underwater surveys a diving inspection will be carried out by qualified commercial divers, supervised by a qualified maritime archaeologist, to confirm the nature and significance of the archaeological resource. If archaeological resources of State significance are identified, the Heritage Division, as Delegate of the NSW Heritage Council will be notified in accordance with Section 144 of the NSW *Heritage Act 1977*.			
Maritime archaeology	**NAH12**	**If the potential for additional impact of Nowra Wharf is identified, photographic recording will be carried out for the wharf and slip prior to impact in accordance with the *Photographic Recording of Heritage Items using Film or Digital Capture* (Heritage Council, 2006).**	**Roads and Maritime**	**Prior to construction Construction**	**Maritime archaeological due diligence assessment, RPS, 2018**

5.5 Revised assessment of impacts to parking

5.5.1 Methodology

The proposal will result in impacts to parking during construction and operation. In response to a number of submissions that raised issues related to parking, additional information has been collected to inform a review of potential impacts on parking during construction and operation of the proposal.

Counts of car parking spaces were carried out on 21 November 2018 at the following locations:

- North Nowra Rotary Park, Illaroo Road
- Public off-street car park adjacent to Fairway Drive at Greys Beach
- The northern side of Scenic Drive, west of the Princes Highway
- The informal parking area to the north of the Shoalhaven Entertainment Centre (SEC) and the Shoalhaven City Council main office
- Bridge Road northbound.

5.5.2 Description of existing environment

The proposal area contains a mix of on-street car parking and off-street formal car parks. The majority of parking available is unrestricted parking (ie no time limits), however in the Nowra CBD a number of on and off street car parking areas are subject to time limits of between five minutes and three hours.

The REF identified a total of 269 parking spaces that would be potentially impacted by the proposal. The number and location of these parking spaces is provided in Table 5-17.

Table 5-17: Number and location of parking spaces potentially impacted by the proposal

Location	REF	Revised	Description
North Nowra Rotary Park	14	13	The formal car parking area can accommodate up to 13 vehicles, parking at a 90 degree angle to the through road. There are no time restrictions and no formal markings for the parking spaces
Greys Beach	100	100	This area can accommodate up to about 100 vehicles, on a partly sealed area accessed from Fairway Drive, and which also services the boat ramp at Greys Beach. Due to the slope of the unsealed sections and area required for manoeuvring space for trailer parking, the capacity of the parking area would be less than the 100 estimated spaces. There are no time restrictions and no formal markings for parking spaces. There are five 15 minute time restricted spots for boat trailer transitions to and from the boat ramp. There are also two disabled car parking spaces.
Scenic Drive	20	59	This location can accommodate up to 59 vehicles, servicing the local businesses and visitors to Moorhouse Park and the Shoalhaven River foreshore area. There are no time restrictions and no formal markings for the parking spaces.
SEC informal	50	110	This area can accommodate up to about 140 vehicles, on a mix of gravel and grass surfaces. There are no time restrictions and no formal markings for the parking spaces.
Bridge Road	10	17	There is unrestricted on street parking on the Bridge Road northbound between Hyam Street and Scenic Drive. There are about 17 parking spots on this section of Bridge Road and there are no time restrictions or clearways.
Pleasant Way	75	0	This site is no longer proposed to be used and would therefore not be impacted by the proposal.
TOTAL	**269**	**299**	

5.5.3 Potential impacts

North Nowra Rotary Park, Illaroo Road

There are not considered to be any material differences to parking at North Nowra Rotary Park from the impacts assessed in the REF.

Public off-street car park adjacent to Fairway Drive, Greys Beach

The existing car parking area at Grey Beach boat ramp will be impacted during construction of the proposal. Access to the boat ramp will be maintained at all times. It is anticipated there would be minimal impacts to parking in this location between the start of the September/October school holidays and the Friday after Anzac day. Outside of these times it is anticipated that about half of the parking area would be available to boat ramp users. Consultation with boat ramp users, council, and other relevant community groups would be undertaken regarding any changes to the availability of parking.

There is limited alternative parking in proximity to Grey's Beach. Constraints on parking boat trailers at Greys Beach may direct boat owners to the three other boat ramps in the area, these being at The Lions Park off Bolong Road providing access to Bomaderry Creek, at Nowra Wharf on the southern side of the river, and at the Shoalhaven Ski Park which is privately owned.

There is very limited on-site parking available at the Bomaderry Creek boat ramp with space available for about nine vehicles with trailers. There are no parking restrictions on Bolong Road in the immediate proximity of the boat ramp area, however, given Bolong Road is only one lane in each direction, on-street parking of boat trailers could affect traffic movement along this section of Bolong Road.

There is no off-street parking for boat trailers at Nowra Wharf, however, parking is available nearby on Wharf Road and further to the east on Riverview Road. On-street parking of boat trailers is unlikely to affect traffic movement, in view of the relatively small volumes of traffic.

The use of Shoalhaven Ski Park is subject to entry fees and is unlikely to be utilised.

The Grey's Beach area would be used only for construction, and would be reinstated following the completion of works. There would not be any long term impact on car parking in this area.

On-street parking on the northern side of Scenic Drive, west of the Princes Highway

During construction, Scenic Drive will have restricted access from Bridge Road to where it turns west to run parallel to the river. This will impact on all existing parking in this section of Scenic Drive and the cul-de-sac to the east. Some of the demand for parking in this area is associated with the existing businesses at 1/1A Scenic Drive which will be leased for the proposal.

Users of existing on street parking would be displaced further along Scenic Drive and potentially into Mandalay Street, as there are parking restrictions outside the Nowra Aquatic Park. Use of these areas for parking is unlikely to impact on road users or on access to properties.

Restrictions on parking will only apply for the construction period.

The construction of the new bridge and realignment of the Scenic Drive cul-de-sac as part of the proposal would result in the permanent loss of 10 on-street parking spaces in this area. The permanent loss of 10 parking spaces is not considered to materially affect the functionality of parking in this area.

Informal parking area to the north of the Shoalhaven Entertainment Centre and Shoalhaven City Council building

The northern part of the informal parking area to the north of the Shoalhaven Entertainment Centre and Shoalhaven City Council building will be directly impacted by the proposal. This area provides about 140 car park spaces of which about 110 would be affected by construction.

The temporary loss of car parking spaces during construction would impact principally on staff and visitors to the Shoalhaven Entertainment Centre and Shoalhaven City Council, requiring them to find alternative parking in the surrounding area, ideally within similar walking distance of the existing car parking area, and with safe access. Shoalhaven City Council operates two car parks within 400 metres of Shoalhaven Entertainment Centre, Graham Street car park which provides about 128 all day spaces and Bridge Road car park which provides about 196 all day spaces. The Graham Street car park is highly utilised while the Bridge Road car park is typically underutilised with parking available at the site most days.

Limited parking would be available in nearby streets but this would be less than the 110 affected spaces in the informal car parking area. Use of on-street parking would require users to walk further to the Shoalhaven Entertainment Centre and Shoalhaven City Council buildings and, for parking locations west of Bridge Road, would also require crossing of public roads.

The permanent acquisition of land for the proposal would affect about 10 car park spaces in this area in the long term. The permanent loss of 10 car park spaces is not considered to materially affect the functionality of the informal parking area.

Bridge Road northbound

Works on Bridge Road will extend to about 80 metres south of Scenic Drive, and will affect existing on-street parking in this location. The demand for parking in this area is considered to be low with alternative parking available further to the south on Bridge Road and in other nearby areas. It is acknowledged that the availability of alternative parking would be affected by the loss of the 100 car park spaces in the informal car parking area to the north of the Shoalhaven Entertainment Centre and Shoalhaven City Council building.

Users of on-street parking along this section of Bridge Road during construction will be required to find alternate parking in the local area. This may also require users to walk further to reach their destination and may also require crossing of public roads.

Restrictions on parking will only apply for the construction period. There would not be any long term impact on car parking in this area.

Pleasant Way

The car park adjacent to Pleasant Way within the Graham Lodge property was part of a proposed ancillary site. This location is no longer proposed to be used and the car parking area will now not be impacted by the proposal.

Alternative parking options

A number of potential alternative areas for car parking have been identified that could offset the loss of the car parking spaces during construction. These are listed in Table 5-18 and comment provided on each area.

Table 5-18: Potential alternative car parking areas for construction

Location	Comment
Nowra Aquatic Park Rear of Nowra Aquatic Park property adjoining Hyam Street	This location was suggested by Council but considered unfeasible due to site constraints that would require substantial civil works to address. These constraints include existing infrastructure on the site (drainage culvert, electricity substation), and flood risk. In view of these constraints, and the associated costs and benefits associated with using the site, this site was not considered further. Refer to Table 4-3 for assessment of potential impacts for this site
Harry Sawkins Park South of council administration building adjacent to existing administration car park	There is an existing formal parking area at the northern end of the park which adjoins the Shoalhaven City Council building. The parkland area to the south of the formal parking area contains both established trees and areas of open space, with an unnamed artificial waterbody at the southern extent. The predominantly cleared area just to the south of the formal parking area could potentially provide up to 100 parking spaces. Use of the site would generally be restricted to cleared areas to avoid/minimise the need for clearing of vegetation. Access would be available from Graham Street and could also be available through the public car park. Access from the existing car park to the south of the council building may require removal of a number of trees and use of this area for parking would reduce the amenity of the park for users. The property is public land under the care and control of Shoalhaven City Council. Refer to Table 4-3 for assessment of potential impacts for this site
Scenic Drive site Within the vacant lot located at 2 Scenic Drive	This is a privately owned block of land with the southern part largely cleared. There are five residences/businesses adjoining the property (with their frontages on Bridge Road). Alternative access to this property may be available through 37 Bridge Road which is under the same ownership. Refer to Table 4-3 for assessment of potential impacts for this site
Hyam Street site Within the vacant located at 41 Bridge Road (corner of Bridge Road and Hyam Street)	This property comprises four parcels of land privately owned by two parties. It is currently being used as an informal car park with the main access being off Hyam Street. There is a residential property immediately to the west (37 Hyam Street) and a professional services premises opposite (45 Bridge Road). The arrangements for use of this area for parking are not known. It is estimated the area could provide about 60-70 car park spaces. Refer to Table 4-3 for assessment of potential impacts for this site
Gateway Park site Comprises two adjoining parcels of land located off Lyrebird Drive adjacent to the new local road connection	This location was suggested by Council but was not considered practicable. Its location on the eastern side of the Princes Highway would require crossing of the highway with the nearest designated crossing points being the pedestrian crossing at Bridge Road and the underpass at Harry Sawkins Park. This would require visitors/staff travelling to the Shoalhaven City Council building to walk substantial distances (in the order of 600-700 metres). The property is public land under the care and control of Shoalhaven City Council.

It is proposed to provide additional parking at Harry Sawkins Park, 2 Scenic Drive, and 41 Bridge Road to offset the loss of the car parking spaces during construction. This would provide up to 370 car parking spaces to offset the impact to the 329 car parking spaces that would be impacted during construction.

5.5.4 Revised safeguards and management measures

Environmental management measure SE4, which relates to the Greys Beach reserve, has been amended to provide clarity on access to the boat ramp and to the provision of parking. Two new environmental management measures, SE11 and SE12 have been added in relation to further consultation to be carried out by Roads and Maritime.

Impact	No.	Environmental safeguard	Responsibility	Timing	Reference
Impact on Greys Beach Reserve	SE4	Use of the Greys Beach Reserve site for temporary construction activities ***will*** ~~should~~ be planned to consider peak usage periods of the river for recreational users ***Access to the boat ramp at Greys Beach will be maintained at all times. Access to parking would be largely maintained between the September/October school holidays to the Monday after Anzac Day. Outside of these times about half of the existing parking area (about 50 spaces) will be available.***	Roads and Maritime Construction Contractor	Detailed design Construction	Project specific control
Parking during construction	***SE11***	***Consultation with Council and the other property owners will be carried out to confirm the suitability of the identified areas proposed for temporary car parking and specific matters relating to their use.***	***Designer***	***Detailed design***	***Project specific control***
Impact on Greys Beach Reserve	***SE12***	***Consultation with boat ramp users, Council, and other relevant community groups would be undertaken regarding any changes to the availability of parking at Greys Beach.***	***Designer, Construction contractor***	***Detailed design***	***Project specific control***

5.6 Revised assessment of impacts to Waterways Swim School

5.6.1 Methodology

Assessment of impacts on the Waterways Swim School has been carried out in general accordance with the Roads and Maritime *Environmental Impact Assessment Practice Note on Socio-economic assessment* (EIA-05). The impact of the proposal on the school was considered in the REF but did not make specific reference to the presence of the swimming pool within the building.

5.6.2 Description of existing environment

The Waterways Swim School is located at 1 Scenic Drive which would be leased for the proposal to establish the main construction site for the new northbound bridge. The school is located within a building at the northern end of the property opposite the Nowra Aquatic Park and contains a small swimming pool.

5.6.3 Potential impacts

Use of the property at 1 Scenic Drive for construction would likely require the removal of all existing buildings including that being used by the Waterways Swim School. The REF identified that all business operations at 1 Scenic Drive would permanently cease and that the business operators would need to relocate to new premises.

The operators of the Waterways Swim School may have difficulty in finding suitable alternative premises to continue their business operations given the nature of the business and the need for access to a suitable pool to conduct lessons.

The proposal would have a permanent negative high impact on this business.

5.6.4 Revised safeguards and management measures

Further consultation with the operators of the Waterways Swim School would be effectively managed through the Community and Stakeholder Engagement Plan that would be prepared for the proposal (Safeguard SE1). No additional or revised safeguards and management measures are required.

5.7 Assessment of potential impacts to the Regent Honeyeater

5.7.1 Methodology

Consideration of potential impacts of the proposal on the Regent Honeyeater (*Anthochaera phrygia*) has been made with reference to:

- The matters specified in section 94 of the TSC Act regarding a significant effect on threatened species, populations or ecological communities, or their habitats
- Matters of National Environmental Significance, Significant Impact Guidelines 1.1 – issued by the Australian Government Department of the Environment, 2013.

The assessments of significance are provided in Appendix C of this submissions report.

5.7.2 Description of existing environment

The proposal study area is located within the Sydney Basin Bioregion in the Illawarra IBRA subregion, and occurs entirely within the Shoalhaven Alluvial Plain Mitchell landscape (V3). Most of the study area comprises undulating landforms associated with the Shoalhaven River and floodplain and Bomaderry Creek. The study area is predominantly cleared of native vegetation with current land uses including residential, commercial, and public recreation.

Terrestrial habitats within the study area have been modified by past and current land uses. Remaining areas of bushland occur within Rotary Park on the northern bank of the Shoalhaven River west of the highway, containing substantial fauna habitat features including several large sandstone overhangs. There is also riparian vegetation associated with Bomaderry Creek forming a corridor that runs northwest from the highway and connecting to Bomaderry Creek Regional Park. This corridor is known to host a number of threatened biota including Yellow-bellied Glider (*Petaurus australis*), Powerful Owl (*Ninox strenua*) and Gang-gang Cockatoo (*Callocephalon fimbriatum*). While the park is located close to the study area, the Princes Highway and Illaroo Road form a barrier to ground-dwelling fauna and those species sensitive to urban landscapes that may attempt to use it.

At the Princes Highway crossing, the Shoalhaven River is an open mature estuary. The river provides a variety of habitats including mud flats, seagrass, mangroves, and estuarine, many of which may be utilised by threatened species. The river is mapped as key fish habitat by NSW DPI Fisheries. In accordance with criteria identified in the Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013), the river is classified as a Type 1 highly sensitive key fish habitat and Class 1 major fish habitat.

There are no declared critical habitats present within the study area.

An individual Regent Honeyeater was observed at the intersection of Keft Avenue and Hyam Street, Nowra in September 2018, with the sighting reported in the 10 September 2018 edition of the Illawarra Mercury. (Hanscombe, 2018). The location of the sighting is less than 100 metres from the proposal construction boundary. The environment of the locality where the individual Regent Honeyeater was observed is a suburban street within Nowra.

5.7.3 Potential impacts

The Regent Honeyeater inhabits dry open forest and temperate woodland particularly Box-Ironbark woodland and riparian forests at scattered locations in south-eastern and eastern Australia (Higgins et al. 2001). Key tree species include Mugga Ironbark (*Eucalyptus sideroxylon*), Yellow Box (*E. melliodora*), White Box (*E. albens*), Broad-leaved Apple (*Angophora floribunda*) Swamp Mahogany (*E. robusta*) and Spotted Gum (*Corymbia maculata*). The total current population comprises about 350-400 individuals following substantial, long-term decline (Commonwealth of Australia, 2016). There are less than five known key breeding areas within the Regent Honeyeater's current distribution (Commonwealth of Australia 2016, Crates *et al*., 2018). The loss, fragmentation and degradation of breeding and foraging habitat for agriculture and residential development is the main threat to the Regent Honeyeater.

The assessments of significance have considered the construction and operational impacts of the proposal on the Regent Honeyeater and the outcomes of these assessments are summarised as follows.

TSC Act assessment

The Regent Honeyeater was not identified in targeted surveys carried out for the proposal based on consideration of the likelihood of occurrence as part of the biodiversity assessment methodology for the proposal. As previously noted, the assessment was triggered by the sighting of a single individual in September 2018 about 60 metres from the proposal boundary.

The proposal would require the removal of 4.68 hectares of vegetation that provides potential foraging habitat for this species when suitable feed trees are in flower. Given the small area of habitat to be removed and the absence of any breeding sites, the proposal is not expected to have a significant impact on the Regent Honeyeater during either construction or operation.

EPBC Act assessment

Considering the small area of vegetation to be removed, the rare occurrence of the Regent Honeyeater in the Nowra area and that the sighting was not within the study area, the proposal is unlikely to have a significant impact on the Regent Honeyeater during either construction or operation.

5.7.4 Revised safeguards and management measures

No additional or revised safeguards and management measures are proposed.

5.8 Assessment of the proposal against NSW Water Quality Objectives

In its submission, the EPA expressed concern over the environmental value of waters and the nominated discharge criteria for the project. An additional assessment was carried to further assess the potential construction and operational water quality impacts of the proposal against the NSW WQOs for the Shoalhaven River catchment (Appendix D and Appendix E respectively to this submissions report). The assessments should be read in conjunction with the REF.

The NSW WQOs are the environmental values and long-term goals for consideration when assessing and managing the likely impact of activities on waterways. As noted in *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (DECC 2006), they are not intended to be applied directly as regulatory criteria, limits or conditions but are one factor to be considered by industry, the community, planning authorities or regulators when making decisions affecting the future of a waterway

5.8.1 Methodology

The additional construction water quality assessment generally comprised:

- Review of previous work carried out for the REF
- Confirmation of relevant environmental values for the proposal
- Review of general water quality impacts of road construction and typical water quality management during road construction
- Review of the ‘Blue Book discharge limits
- Review of the Shoalhaven River catchment characteristics and existing water quality data (covering the period 1992-2018)

- Stormwater modelling using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC)
- Assessment of impacts.

MUSIC modelling was used to assess the impacts of proposed construction sediment basing discharge limits on the receiving environment. MUSIC estimates stormwater pollutant generation and simulates the performance of stormwater treatment devices individually and as part of a treatment train ((individual devices connected in series to improve overall treatment performance).

The MUSIC model involves the following three-step process:

- Development of a MUSIC model of the existing catchment
- Calibration of the developed MUSIC model against observed water quality data
- Modelling the impact of proposed construction sediment basin discharges on the receiving environment.

The additional assessment for operational water quality provides an analysis of the potential impact associated with the proposed stormwater runoff on various parameters relevant to the NSW WQOs, including:

- Turbidity (TSS, visual clarity, and colour)
- TN
- TP
- Chemical contaminants
- Toxicants
- Surface films and debris.

5.8.2 Description of existing environment

All drainage from the proposal area flows into the Shoalhaven River, a wave-dominated barrier estuary with an open entrance that flows into the Tasman Sea. At the proposal area, waters are tidal and brackish. The Shoalhaven River has four main tributaries, the Mongarlowe, Corang, Endrick and Kangaroo Rivers. The catchment contains the major water storage of Tallowa Dam which is part of the Greater Sydney water supply system owned and operated by WaterNSW.

Key water management issues in the catchment include:

- Water sharing with Greater Sydney
- Water quality, associated with pollution and weed growth
- Riverbank management, associated with rural development
- Environmental water, related to ensuring sufficient flows and refreshes to maintain river health.

There are some sensitive environmental features that could potentially be affected by operational water quality impacts associated with the proposal. These are:

- Several small areas of seagrass (*Zostera muelleri*) within the proposal area.
- Mangrove stands which occur along the banks of the Shoalhaven River east and west of the existing bridges, but with very limited occurrence within the proposal area.

There are no coastal wetlands or littoral rainforest listed under the Coastal Management SEPP that occur in the proposal study area. There are numerous oyster leases in the lower reaches of the Shoalhaven River estuary, about 11.5 kilometres downstream from the proposal.

5.8.3 Construction water quality

Background

Construction of the proposal could impact water quality through erosion and sedimentation of disturbed areas. Nutrients and other pollutants potentially mobilised by rainfall runoff over exposed soils, such as phosphorus, heavy metals and organic chemicals, could also be discharged into the river during construction.

An additional Conceptual Erosion and Sedimentation Management Report (refer Appendix F to this submissions report) was developed for the proposal by Strategic Environmental and Engineering Consulting (SEEC). The Conceptual Erosion and Sedimentation Management Report proposed a series of water quality standards (discharge limits) for site dewatering and discharges from sediment basins in accordance with the Blue Book (Landcom, 2004). These are presented in the following table.

Table 5-19: Water quality standards for construction site dewatering

Parameter	Recommended standard
TSS	50 mg/L
pH	6.5 to 8.5
Oils and greases	None visible

Assessment of potential impacts

The MUSIC model is conservative in predicting TSS concentrations in tidal environments. However, it is assumed the predicted increase in loads and concentrations from the proposed construction phase works is relative and can be proportionally applied.

TSS loads are expected to increase marginally by 3.9 per cent with the adopted construction phase basin discharge criteria during the main construction period.

Following construction phase sediment basin discharge events, average TSS levels are predicted to decrease by around 2.2 per cent, however median values will increase by 1.5 per cent. Historical monitoring results indicate that the average TSS concentration is around 6.3 mg/L (12.6 NTU) which is higher than the trigger value of 10 NTU. An increase of 1.5 per cent is therefore expected to result in an average TSS concentration of 6.4 mg/L. This equates to about a turbidity level of 12.8 NTU.

Predicted TN concentrations are expected to decrease by up to 0.44 per cent on days of discharge while predicted TP concentrations are expected to increase by up to 1.1 per cent on days of discharge.

TP and TN concentrations are predicted to be close to, or above, the trigger values for these indicators, but do not increase significantly over the background catchment conditions. Given the small loads associated with proposed construction phase basin discharge limits, it is considered

these exceedances are representative of the prevailing catchment conditions rather than any impacts associated with the main construction phase of the proposal.

Table 5-20 details the potential impacts associated with the proposed construction sediment basin discharge limits relative to NSW WQOs.

Table 5-20: Assessment of construction water quality impacts against the NSW WQOs

Key indicator	Numerical criteria (trigger value)	Discussion	Potential impact from proposed discharge limits
Total Phosphorus (TP)	Estuaries: 30 µg/L (for aquatic ecosystem protection).	Excessive phosphorus could lead to stimulation of the growth of nuisance plants which could dominate and change the dynamics of the aquatic ecosystem (eg eutrophication, algae and macrophytes). Eutrophication occurs when excessive plant growth deprives the water column of oxygen thereby killing other forms of aquatic biota. The growth of algae is also stimulated by excessive nutrients and may result in a build-up of toxins in the water column. The availability of inorganic phosphorus from soil is strongly controlled by pH. Maximum phosphate availability occurs in the pH range of 6.0-7.0. The soils are expected to have a pH range of around 5.0-6.5.	MUSIC modelling indicated an average existing TP concentration of about 25.2 µg/L for the existing catchment. The majority of TP organic material is expected to be present in topsoil. Road construction programming typically involves the clearing of vegetation and stripping of topsoil as one of the first activities, with the subsoils only exposed for the majority of the construction period. Local controls are provided for topsoil stockpiles (eg cover crops, bunds) and excess runoff from disturbed topsoil areas would be captured by construction sediment basins with expected reductions in TP associated with retention, settlement and removal of deposited sediment. TP is further reduced by the flocculation of remaining colloidal material prior to discharge. MUSIC modelling has predicted the main construction works would result in a relatively unchanged mean TP concentration of 25.0 µg/L within the receiving waterways during the entire construction period. More specifically for the construction phase sediment basin discharges, modelling has predicted the proposed discharge limit would result in a mean TP concentration of 18.6 µg/L within the receiving waterways, This is generally a slight increase of 1.1 per cent from existing conditions of 18.4 µg/L on days of discharge. Modelling also provides TP loads from the construction phase sediment basin discharges to the receiving environment. The proposed discharge limit would result in a small increase of annual TP loads of 6.8 per cent for the construction period.

Key indicator	Numerical criteria (trigger value)	Discussion	Potential impact from proposed discharge limits
			While there are modelled exceedances of the trigger value for this indicator, these exceedances are characteristic of the prevailing catchment conditions rather than the impacts of the proposed construction phase sediment basin discharge limits. As such, the proposed discharge limits would have minimal impacts on this indicator.
Total Nitrogen (TN)	Estuaries: 300 µg/L (for aquatic ecosystem protection).	Excessive nitrogen could lead to stimulation of the growth of nuisance plants which could dominate and change the dynamics of the aquatic ecosystem. (e.g. algae and macrophytes). Most nitrogen in surface soils is immobilised, bound as organic nitrogen associated with humus. A small proportion is steadily turned into inorganic (mineralised) forms such as nitrate compounds through nitrification that can be released to groundwater or soil water. Direct addition of fertiliser can increase the levels of nitrate in a soil.	Limited historical water quality monitoring in this location indicates that TN is highly variable with TN levels recorded between 50 and 2300 µg/L. MUSIC modelling indicates an average existing TN concentration of about 226.7 µg/L for the existing catchment. The majority of TN from the proposal is expected to be present in topsoil. Road construction programming typically involves the clearing of vegetation and stripping of topsoil as one of the first activities, with the subsoils only exposed for the majority of the construction period. Local controls are provided for topsoil stockpiles (e.g. cover crops, bunds) and excess runoff from disturbed topsoil areas would be captured by construction sediment basins with expected reductions in TN associated with retention, settlement and removal of deposited sediment. TN can be further reduced by the flocculation of remaining colloidal material prior to discharge. Modelling predicts that the proposal would result in a mean TN concentration of about 227.2 µg/L within the receiving waterway, generally an increase of less than 0.2 per cent above existing levels. More specifically for the construction phase sediment basin discharges, modelling has predicted that the proposed discharge

Key indicator	Numerical criteria (trigger value)	Discussion	Potential impact from proposed discharge limits
			limit would result in a mean TN concentration of 189 µg/L within the receiving waterways, generally a decrease of around 0.4 per cent on days of discharge. Modelling also provides estimates of TN loads from the construction phase sediment basin discharges to the receiving environment. The proposed discharge limit would result in a small decrease of annual TN loads of around 1.2 per cent. While there are modelled exceedances of the trigger value for this indicator, these exceedances are characteristic of the prevailing catchment conditions rather than the impacts of the proposed construction sediment basin discharge limits. As such, the proposed discharge limits would have minimal impacts on this indicator.
Chlorophyll-a (Chl-a)	Estuaries: 4 µg/L (for aquatic ecosystem protection).	Chl-a concentration is often used as a general indicator of plant biomass as nutrients alone cannot indicate whether a waterbody actually has a nuisance plant problem. Increased Chl-a in the water indicates that plants, algae or cyanobacteria are actually growing. Chl-a is usually measured in a waterbody so is not a typical stormwater pollutant.	None expected, as Chl-a is not expected to be present in construction phase sediment basin discharges.
Turbidity	Estuaries: 0.5-10 NTU (for aquatic ecosystem protection). A 200 mm diameter black disc should be able to be sighted horizontally from a distance of more than 1.6 m	Turbidity is the presence of suspended particulate and colloidal matter consisting of suspended clay, silt, phytoplankton and detritus measured by a technique called nephelometry, which measures the fraction of light scattered	Turbidity and TSS are the principal pollutants of concern associated with road construction projects. Detailed modelling has been completed to assess the turbidity impacts of the proposed discharge limits on the receiving environment.

Key indicator	Numerical criteria (trigger value)	Discussion	Potential impact from proposed discharge limits
	(approximately 6 NTU) (for primary contact recreation). Suspended solids: less than 40 µg/L (freshwater) (for aquatic foods, cooked).	at right angles to the light path of water. Increased turbidity can reduce light penetration through the water column and therefore reduce the level of photosynthetic activity. Turbidity increases with sediment load.	The MUSIC modelling generally indicates that the trigger value is exceeded in the Shoalhaven River. The model results are expected to be conservative as the model cannot account for the impact of naturally saline water that would result in a lower turbidity level as observed in historical water quality data. The average TSS level as observed with the historical sampling is 6.3 mg/L compared with the modelled average concentration of 26.7 mg/L. The MUSIC model predicts an increase of 3.9 per cent in the TSS loads for the entire period modelled. TSS concentrations are expected to decrease on the days of basin discharge by 2.2 per cent with the average TSS levels decreasing from 2.45 mg/L to 2.40 mg/L. However, the median values increased from 0.71 mg/L to 0.72 mg/L (1.5 per cent). Assuming that the MUSIC concentrations are conservative and that the increase of the concentration is relative, the observed median TSS concentration would be expected to increase from 3.8 NTU to 3.86 NTU. There is predicted to be minimal impact on this indicator as any impacts above trigger values are short-term in nature, are similar to the existing turbidity levels, and only experienced for the duration of construction. A number of mitigation measures typically implemented for road construction projects would also be implemented, such as those detailed in the revised ESMR (Appendix F to this submissions report) and the ESCP (provided in Appendix K to the REF).
Dissolved	Estuaries: 80-110 per cent (for aquatic	The dissolved oxygen concentration in a waterbody is highly dependent on	No significant change is expected as a result of the proposed construction phase sediment basin

Key indicator	Numerical criteria (trigger value)	Discussion	Potential impact from proposed discharge limits
Oxygen	ecosystem protection).	temperature, salinity, biological activity (microbial, primary production) and rate of transfer from the atmosphere.	discharge limits providing sediment is adequately managed to limit changes to salinity and nutrients (microbial activity). It is anticipated that the construction phase sediment basin discharges could improve dissolved oxygen levels in some circumstances through increased catchment flow.
pH	Estuaries: 7.0-8.5 (for aquatic ecosystem protection); 5.0-9.0 (for primary contact recreation).	pH is a measure of the acidity or alkalinity of water and has a scale from 0 (extremely acidic) to 7 (neutral), through to 14 (extremely alkaline).	The proposed construction sediment basin discharge limits are expected to be consistent with the trigger values for this indicator for all WQOs except for estuaries (6.5 vs 7.0). However, the proposed discharges are consistent with the pH of natural stormwater runoff of fresh water into the Shoalhaven River estuary and, given the small quantities relative to the river flows, are not expected to impact on this objective.
Temperature	Iterative (for aquatic ecosystem protection). 15–35^{o}C (for primary contact recreation). Less than 2^{o}C change over one hour (for aquatic foods, cooked).	Aquatic ecosystem functioning is very closely regulated by temperature. Temperature changes can occur naturally as part of normal diurnal (daily) and seasonal cycles, or as a consequence of human activities (anthropogenic).	The water temperature in the construction phase sediment basins is not expected to be significantly different from local waterways as the depth is relatively shallow (less than 2 m). Cold water pollution is not expected in basins/dams less than 15 m deep. No impacts are expected.
Chemical contaminants	Iterative (for aquatic ecosystem protection and primary contact recreation). Waters containing chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreation (for primary and secondary	Chemical contaminants are likely to be sourced either from spills that may occur during construction or from naturally contaminants or toxicants made soluble when runoff occurs over disturbed soils.	Chemical contamination from spills is likely to be restricted to oil spills from plant and machinery or from uncontrolled concrete washout activities. Both spill occurrences are readily cleaned up as part of routine construction activities and addressed by the proposed construction phase sediment basin discharge limits (pH and visible oils and grease).

Key indicator	Numerical criteria (trigger value)	Discussion	Potential impact from proposed discharge limits
	contact recreation).		While there is potential for some mobilisation of chemical contaminants from runoff over naturally occurring soils, these contaminants are largely removed from discharges following treatment to remove sediment within the supernatant. There is not considered to be a potential impact from the proposed construction phase sediment basin discharge limits that would result in an exceedance of these trigger values.
Biological assessment indicators	Iterative (for aquatic ecosystem protection)	Refer to comments on blue-green algae, faecal coliforms, enterococci, protozoans and nuisance organisms.	Refer to comments on blue-green algae, faecal coliforms, enterococci, protozoans and nuisance organisms.
Visual clarity and colour	Natural visual clarity should not be reduced by more than 20% (for visual amenity and primary and secondary contact recreation). Natural hue of the water should not be changed by more than 10 points on the Munsell Scale (for visual amenity and primary and secondary contact recreation). The natural reflectance of the water should not be changed by more than 50% (for visual amenity and primary and secondary contact recreation).	Clarity is a measure of how clear or transparent water is. It indicates how much light is available for photosynthesis at different depths.	This indicator is largely assessed above in relation to turbidity and TSS. There is limited baseline information on the natural visual clarity, hue and reflectance of the receiving environments to determine whether there is likely to be a predicted change in the nominated indicator. However, given the minor change in TSS concentrations and loads, it is unlikely that construction phase sediment basin discharge would adversely impact on this environmental value.
Toxicants (as applied to aquaculture activities)	For aquatic foods (cooked) the following applies: Metals: • Copper: less than 5 µg/L.	Heavy metals and organochlorines can accumulate in aquatic foods to toxic levels.	None expected, as construction phase sediment basin discharges are not predicted to be outside the triggers values nominated for this indicator.

Key indicator	Numerical criteria (trigger value)	Discussion	Potential impact from proposed discharge limits
	• Mercury: less than 1 µg/L. • Zinc: less than 5 µg/L. Organochlorines: • Chlordane: less than 0.004 µg/L (saltwater production) • PCB's: less than 2 µg/L.		
Faecal coliforms	Median bacterial content in fresh and marine waters of <1000 faecal coliforms per 100 mL, with 4 out of 5 samples <4000/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month) (for secondary contact recreation). For primary contact recreation, Beachwatch considers waters are unsuitable for swimming if: • the median faecal coliform density exceeds 150 colony forming units per 100 millilitres (cfu/100mL) for five samples taken at regular intervals not exceeding one month, or • the second highest sample contains equal to or greater than 600 cfu/100mL (faecal coliforms) for five samples taken at regular intervals not exceeding one month. For primary contact recreation, ANZECC 2000 Guidelines recommend: • Median over bathing season of <150	Coliforms are bacteria present in the digestive tracts of animals including humans and are found in their wastes and are used as an indicator of faecal contamination.	None expected from the release of construction phase sediment basin discharges.

Key indicator	Numerical criteria (trigger value)	Discussion	Potential impact from proposed discharge limits
	faecal coliforms per 100 mL, with 4 out of 5 samples <600/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month). For aquatic foods (cooked), guideline in water for shellfish: • The median faecal coliform concentration should not exceed 14 MPN/100mL; with no more than 10 per cent of the samples exceeding 43 MPN/100 mL. For aquatic foods (cooked), standard in edible tissue: • Fish destined for human consumption should not exceed a limit of 2.3 MPN E coli /g of flesh with a standard plate count of 100,000 organisms /g.		
Enterococci	Median bacterial content in fresh and marine waters of <230 enterococci per 100 mL (maximum number in any one sample: 450-700 organisms/100 mL) (for secondary contact recreation). For primary contact recreation, Beachwatch considers waters are unsuitable for swimming if: • the median enterococci density exceeds 35 cfu/100mL for five samples taken at regular intervals not exceeding one month, or	Intestinal enterococci are a functional group of organisms from the *Enterococcus* and *Streptococcus* genera that are excreted in human and animal waste and are used as an indicator of faecal contamination.	None expected from the release of construction phase sediment basin discharge.

Key indicator	Numerical criteria (trigger value)	Discussion	Potential impact from proposed discharge limits
	• the second highest sample contains equal to or greater than 100 cfu/100mL (enterococci) for five samples taken at regular intervals not exceeding one month. For primary contact recreation, ANZECC 2000 Guidelines recommend: • Median over bathing season of <35 enterococci per 100 mL (maximum number in any one sample: 60-100 organisms/100 mL).		
Protozoans	Pathogenic free-living protozoans should be absent from bodies of fresh water. (Note, it is not necessary to analyse water for these pathogens unless temperature is greater than 24 ^{o}C) (for primary contact recreation)	Protozoans are waterborne pathogens that indicate water contaminated with human or animal waste.	None expected from the release of construction phase sediment basin discharge.
Algae and Blue-green algae	<15 000 cells/mL (for primary contact recreation). No guideline is directly applicable for aquatic foods (cooked), but toxins present in blue-green algae may accumulate in other aquatic organisms.	Blue-green algae are a type of bacteria known as Cyanobacteria. They photosynthesise using sunlight to produce oxygen. Low levels of blue-green algae are present in freshwater all the time. However a series of favourable environmental factors including warm water temperatures, sunny days and nutrients can lead to a blue-green algae bloom. Blooms lead to environmental and visual impacts.	Refer to comments on temperature, Total Phosphorus and Total Nitrogen.
Nuisance	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green	The presence of macrophytes, algal mats etc will be impacted by the amount	None expected from the release of construction phase

Key indicator	Numerical criteria (trigger value)	Discussion	Potential impact from proposed discharge limits
organisms	algae, sewage fungus and leeches should not be present in unsightly amounts (for visual amenity and primary contact recreation).	of nutrients / organic matter in the waterway. Refer to discussion on Total Phosphorus, Total Nitrogen and Chlorophyll a.	sediment basin discharge.
Surface films and debris	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour (for visual amenity and primary and secondary contact recreation). Waters should be free from floating debris and litter (for visual amenity and primary and secondary contact recreation).	Refer to discussion on chemical contaminants.	Refer to discussion on chemical contaminants.

5.8.4 Operational water quality

Background

As detailed in the REF, drainage on the existing bridges across the Shoalhaven River and Bomaderry Creek do not have any form of treatment and discharge runoff directly to the respective waterway. Runoff from the roadway to the north and south of the Shoalhaven River bridges is directed into Council's piped stormwater system. There are no treatment measures incorporated into the existing local stormwater system, nor is there any spill containment in place.

The proposal provides for the capture and treatment of stormwater runoff from the new bridge and approaches, as well as operational spill containment. The drainage design would be considered further during detailed design and would seek to meet the proposal stormwater quality treatment design targets identified in Table 6-61 of the REF and Table 5-21 of this submissions report.

Due to the lack of available space surrounding the highway corridor, there are limited opportunities for installation and operation of water quality treatment devices. Proprietary products, such as reinforced concrete pit systems and gross pollutant traps, may be utilised. Operational water quality treatment and quantity would be designed in consideration of the Roads and Maritime *Water Sensitive Urban Design Guidelines* (2017) (environmental management measure WQ5).

Table 5-21: Proposal operational stormwater quality treatment design targets

Pollutant/parameter	Design target
TSS	85% retention of the annual average load
TN	45% retention of the annual average load
TP	65% retention of the annual average load

Assessment of potential impacts

The potential impacts to water quality in the Shoalhaven River following opening of the new bridge were assessed in Section 6.10.3 and Appendix K of the REF. Further assessment has been undertaken of the proposal stormwater treatment design targets (i.e. operational stormwater discharge targets) in relation to the NSW WQOs for the Shoalhaven River (refer Appendix E to this submissions report). This showed that implementation of stormwater treatment and spill containment as part of the proposal, where there currently is none, would have a net positive impact on water quality for the following parameters:

- Turbidity (TSS, visual clarity and colour)
- TN
- TP
- Chemical contaminants
- Toxicants
- Surface films and debris.

Stormwater treatment would reduce the debris, sediment, TP and TN loads discharged from the new bridge and approaches, and would therefore reduce concentrations in the receiving

environment, improving compliance with the NSW WQOs. Table 5-22 details the potential impact of operation of the proposal relative to NSW WQOs.

Table 5-22: Assessment of operational water quality impacts against NSW WQOs

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
Total Phosphorus	Estuaries: 30 µg/L (for aquatic ecosystem protection).	Excessive phosphorus could lead to stimulation of the growth of nuisance plants which could dominate and change the dynamics of the aquatic ecosystem (e.g. eutrophication, algae and macrophytes). Eutrophication occurs when excessive plant growth deprives the water column of oxygen thereby killing other forms of aquatic biota. The growth of algae is also stimulated by excessive nutrients and may result in a build-up of toxins in the water column. The availability of inorganic phosphorus from soil is strongly controlled by pH. Maximum phosphate availability occurs in the pH range of 6.0-7.0. The soils are expected to have a pH range of around 5.0-6.5.	Stormwater from the existing bridges drains directly into the receiving environment without treatment. The proposal will incorporate treatment for stormwater runoff, which will reduce TP loads and concentrations in the receiving environment. The proposal will improve the levels of TP in stormwater runoff, thereby improving compliance with the WQO. The MUSIC model indicates that the average TP concentration downstream of the bridge is 24 µg/L.
Total Nitrogen	Estuaries: 300 µg/L (for aquatic ecosystem protection).	Excessive nitrogen could lead to stimulation of the growth of nuisance plants which could dominate and change the dynamics of the aquatic ecosystem (eg algae and macrophytes). Most nitrogen in surface soils is immobilised, bound as organic nitrogen associated with humus. A small proportion is steadily turned into	Stormwater from the existing bridges drains directly into the receiving environment without treatment. The proposal will incorporate treatment for stormwater runoff, which will reduce the TN loads and concentrations in the receiving environment. The proposal will improve the levels of TN in stormwater runoff, thereby improving compliance

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
		inorganic (mineralised) forms such as nitrate compounds through nitrification that can be released to groundwater or soil water. Direct addition of fertiliser can increase the levels of nitrate in a soil.	with the WQO. The MUSIC model indicates that the average TN concentration downstream of the bridge is 230 µg/L.
Chlorophyll-a (Chl-a)	Estuaries: 4 µg/L (for aquatic ecosystem protection).	Chl-a concentration is often used as a general indicator of plant biomass as nutrients alone cannot indicate whether a waterbody actually has a nuisance plant problem. Increased Chl-a in the water indicates that plants, algae or cyanobacteria are actually growing. Chl-a is usually measured in a waterbody so is not a typical stormwater pollutant.	None expected, as Chl-a is not expected to be present in operational stormwater runoff in significant quantities.
Turbidity	Estuaries: 0.5-10 NTU (for aquatic ecosystem protection). A 200 mm diameter black disc should be able to be sighted horizontally from a distance of more than 1.6 m (approximately 6 NTU) (for primary contact recreation). Suspended solids: less than 40 µg/L (freshwater) (for aquatic foods, cooked).	Turbidity is the presence of suspended particulate and colloidal matter consisting of suspended clay, silt, phytoplankton and detritus measured by a technique called nephelometry, which measures the fraction of light scattered at right angles to the light path of water. Increased turbidity can reduce light penetration through the water column and therefore reduce the level of photosynthetic activity. Turbidity increases with sediment load.	Stormwater from the existing bridges drains directly into the receiving environment without treatment. The proposal will incorporate treatment for stormwater runoff, which will reduce the sediment loads and concentrations in the receiving environment. The proposal will improve the turbidity in stormwater runoff. The MUSIC model indicates that the average TSS concentration downstream of the bridge will decrease from 7.70 µg/L to 7.68 mg/L. The median TSS concentration decreases from 0.35 mg/L (0.7 NTU) to

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
			0.36 mg/L (0.66 NTU)
Dissolved Oxygen	Estuaries: 80-110 per cent (for aquatic ecosystem protection).	The dissolved oxygen concentration in a waterbody is highly dependent on temperature, salinity, biological activity (microbial, primary production) and rate of transfer from the atmosphere.	No significant change is expected as a result of runoff from the proposal. However, dissolved oxygen concentrations might improve slightly as a result of improved sediment retention in runoff compared to the existing conditions.
pH	Estuaries: 7.0-8.5 (for aquatic ecosystem protection). 5.0-9.0 (for primary contact recreation).	pH is a measure of the acidity or alkalinity of water and has a scale from 0 (extremely acidic) to 7 (neutral), through to 14 (extremely alkaline).	None expected, as runoff from the proposal is unlikely to have significantly different pH to that from the existing bridges.
Temperature	Iterative (for aquatic ecosystem protection). 15 – 35 ^{o}C (for primary contact recreation). Less than 2 ^{o}C change over one hour (for aquatic foods, cooked).	Aquatic ecosystem functioning is very closely regulated by temperature. Temperature changes can occur naturally as part of normal diurnal (daily) and seasonal cycles, or as a consequence of human activities (anthropogenic).	None expected, as runoff from the proposal is unlikely to have significantly different temperature to that from the existing bridges.
Chemical contaminants	Iterative (for aquatic ecosystem protection and primary contact recreation). Waters containing chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreation (for primary and secondary contact recreation).	Chemical contaminants are likely to be sourced either from spills that may occur during construction or from naturally contaminants or toxicants made soluble when runoff occurs over disturbed soils.	Stormwater from the existing bridges drains directly into the receiving environment without treatment and with no spill containment present. The proposal will incorporate treatment for stormwater runoff, as well as spill containment. This significantly reduces the potential for chemical contaminants to be washed into the receiving environment, thereby improving compliance with the WQO.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
Biological assessment indicators	Iterative (for aquatic ecosystem protection)	Refer to comments on blue-green algae, faecal coliforms, enterococci, protozoans and nuisance organisms.	Refer to comments on blue-green algae, faecal coliforms, enterococci, protozoans and nuisance organisms.
Visual clarity and colour	Natural visual clarity should not be reduced by more than 20 per cent (for visual amenity and primary and secondary contact recreation). Natural hue of the water should not be changed by more than 10 points on the Munsell Scale (for visual amenity and primary and secondary contact recreation). The natural reflectance of the water should not be changed by more than 50 per cent (for visual amenity and primary and secondary contact recreation).	Clarity is a measure of how clear or transparent water is. It indicates how much light is available for photosynthesis at different depths.	This indicator is largely assessed above in relation to turbidity and TSS. Given the likely improvements in TSS concentrations and loads (refer to comments above regarding turbidity), it is likely that visual clarity and colour would also improve.
Toxicants (as applied to aquaculture activities)	For aquatic foods (cooked) the following applies: Metals: • Copper: less than 5 µg/L. • Mercury: less than 1 µg/L. • Zinc: less than 5 µg/L. Organochlorines: • Chlordane: less than 0.004 µg/L (saltwater production) • PCBs: less than 2 µg/L.	Heavy metals and organochlorines can accumulate in aquatic foods to toxic levels.	Stormwater from the existing bridges drains directly into the receiving environment without treatment and with no spill containment present. The proposal will incorporate treatment for stormwater runoff, as well as spill containment. This significantly reduces the potential for toxicants to be washed into the receiving environment, thereby improving compliance with the WQO.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
Faecal coliforms	Median bacterial content in fresh and marine waters of <1000 faecal coliforms per 100 mL, with 4 out of 5 samples <4000/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month) (for secondary contact recreation). For primary contact recreation, Beachwatch considers waters are unsuitable for swimming if: • the median faecal coliform density exceeds 150 colony forming units per 100 millilitres (cfu/100mL) for five samples taken at regular intervals not exceeding one month, or • the second highest sample contains equal to or greater than 600 cfu/100mL (faecal coliforms) for five samples taken at regular intervals not exceeding one month. For primary contact recreation, ANZECC 2000 Guidelines recommend: • Median over bathing season of < 150 faecal coliforms per 100 mL, with 4 out of 5 samples <600/100 mL (minimum of 5 samples taken at regular	Coliforms are bacteria present in the digestive tracts of animals including humans and are found in their wastes and are used as an indicator of faecal contamination.	None expected from stormwater runoff from the proposal.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
	intervals not exceeding one month). For aquatic foods (cooked), guideline in water for shellfish: • The median faecal coliform concentration should not exceed 14 MPN/100mL; with no more than 10 per cent of the samples exceeding 43 MPN/100 mL. For aquatic foods (cooked), standard in edible tissue: • Fish destined for human consumption should not exceed a limit of 2.3 MPN E Coli /g of flesh with a standard plate count of 100,000 organisms /g.		
Enterococci	Median bacterial content in fresh and marine waters of <230 enterococci per 100 mL (maximum number in any one sample: 450-700 organisms/ 100 mL) (for secondary contact recreation). For primary contact recreation, Beachwatch considers waters are unsuitable for swimming if: • the median enterococci density exceeds 35 cfu/100mL for five samples taken at regular	Intestinal enterococci are a functional group of organisms from the *Enterococcus* and *Streptococcus* genera that are excreted in human and animal waste and are used as an indicator of faecal contamination.	None expected from stormwater runoff from the proposal.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
	intervals not exceeding one month, or • the second highest sample contains equal to or greater than 100 cfu/100mL (enterococci) for five samples taken at regular intervals not exceeding one month. For primary contact recreation, ANZECC 2000 Guidelines recommend: • Median over bathing season of < 35 enterococci per 100 mL (maximum number in any one sample: 60-100 organisms/ 100 mL).		
Protozoans	Pathogenic free-living protozoans should be absent from bodies of fresh water. (Note, it is not necessary to analyse water for these pathogens unless temperature is greater than 24 ^{o}C) (for primary contact recreation)	Protozoans are waterborne pathogens that indicate water contaminated with human or animal waste.	None expected from stormwater runoff from the proposal.
Algae and Blue-green algae	<15.000 cells/mL (for primary contact recreation). No guideline is directly applicable for aquatic foods (cooked), but toxins present in blue-green algae may accumulate in other aquatic	Blue-green algae are a type of bacteria known as Cyanobacteria. They photosynthesise using sunlight to produce oxygen. Low levels of blue-green algae are present in freshwater all the time. However a series of	Refer to comments on temperature, Total Phosphorus and Total Nitrogen.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
	organisms.	favourable environmental factors including warm water temperatures, sunny days and nutrients can lead to a blue-green algae bloom. Blooms lead to environmental and visual impacts.	
Nuisance organisms	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, sewage fungus and leeches should not be present in unsightly amounts (for visual amenity and primary contact recreation).	The presence of macrophytes, algal mats etc will be impacted by the amount of nutrients / organic matter in the waterway. Refer to discussion on Total Phosphorus, Total Nitrogen and Chlorophyll a.	None expected from stormwater runoff from the new bridge.
Surface films and debris	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour (for visual amenity and primary and secondary contact recreation). Waters should be free from floating debris and litter (for visual amenity and primary and secondary contact recreation).	Refer to discussion on chemical contaminants.	Stormwater from the existing bridges and its approaches drains directly into the receiving environment without treatment and with no spill containment present. The proposal will incorporate treatment for stormwater runoff, as well as spill containment. This significantly reduces the potential for contaminants such as oils, gross pollutants and petrochemicals to be washed into the receiving environment, thereby improving compliance with the WQO.

5.8.5 Revised safeguards and management measures

Based on the additional construction and water quality assessment, five additional mitigation measures have been included for the proposal to mitigate potential impacts to construction and operational water quality.

Impact	No.	Environmental safeguard	Responsibility	Timing	Reference
Water quality	***WQ15***	***Operational spill containment of a minimum of 20,000 litres will be provided to ensure that spills on the new bridge and approaches can be captured before reaching sensitive environments.***	***Roads and Maritime***	***Detailed design***	***Project specific control***
Water quality	***WQ16***	***Management of water quality during construction will incorporate the following measures:*** • ***Where practicable, water from construction sediment basins will be reused in preference to discharge.*** • ***Construction sediment basin outlets will be rock armoured to meet Blue Book design requirements.*** • ***Basin dewatering activities will be carried out in accordance with Roads and Maritime's Environmental Management of Construction Site Dewatering.*** • ***Floating siphon devices will be used where practicable to minimise resuspension of sediment during dewatering operations.***	***Construction contractor***	***Construction***	***Project specific control***

6 Environmental management

The REF for the Nowra Bridge Project identified the framework for environmental management, including safeguards and management measures that would be adopted to avoid or reduce environmental impacts (Section 7.2 of the REF).

After consideration of the issues raised in the public submissions and changes to the proposal, the safeguard and management measures have been revised. Revised safeguards and management measures are listed in Table 6.1

Should the proposal proceed, environmental management will be guided by the framework and measures outlined below.

6.1 Environmental management plans (or system)

A number of safeguards and management measures have been identified 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 management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Project Environmental Management Plan (PEMP) and a Construction Environmental Management Plan (CEMP) will be prepared to describe safeguards and management measures identified. The PEMP and CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The PEMP and CEMP will be prepared prior to construction of the proposal and must be reviewed and certified by Roads and Maritime environment staff 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 PEMP and CEMP would be developed in accordance with the specifications set out in Specification G36 – Environmental Protection (Management System), Specification G38 – Soil and Water Management (Soil and Water Plan), Specification G40 – Clearing and Grubbing, and Specification G10 – Traffic Management.

6.2 Summary of safeguards and management measures

The REF for the Nowra Bridge Project identified a range of environmental outcomes and management measures that would be required to avoid or reduce the environmental impacts.

After consideration of the issues raised in the public submissions, the environmental management measures for the proposal (refer to Chapter 7 of the REF) have been revised. Should the proposal proceed, the environmental management measures in Table 6-1 will guide the subsequent phases of the proposal. Additional and/or modified environmental safeguards and management measures to those presented in the REF are in ***bold italics*** and deleted measures, or parts of measures, have been struck out.

Environmental management measures SO7, SO9, and HR1 have been removed from Table 6.1 as matters relating to hazard and risk management are adequately covered by Specification G36 – Environmental Protection and environmental management measure GEN 1 – preparation of a CEMP.

Table 6-1: Summary of environmental safeguards and management measures

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
GEN1	General - minimise environmental impacts during construction	A CEMP will be prepared and submitted for review and endorsement of the Roads and Maritime Environment Manager 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.	Roads and Maritime, Construction Contractor	Pre-construction / detailed design	Section 3 of *G36 Environment Protection*
GEN2	General - notification	All businesses, residential properties and other key stakeholders (e.g. schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity.	Roads and Maritime, Construction Contractor	Pre-construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
GEN3	General – environmental awareness	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: • Areas of Aboriginal heritage sensitivity • Threatened species habitat • Adjoining residential areas requiring particular noise management measures.	Roads and Maritime, Construction Contractor	Detailed design / Pre-construction	Project specific control
Traffic and transport					
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 Roads and Maritime *Traffic Control at Work Sites Manual* (RTA, 2010) and *Specification G10 Control of Traffic* (Roads and Maritime, 2018). The TMP will include: • Confirmation of haulage routes • Measures to maintain access to local roads and properties • Site specific traffic control measures (including signage) to manage and regulate traffic movement • Measures to maintain pedestrian and cyclist access • Requirements and methods to consult and	Construction Contractor	Pre-construction	Section 4.8 of *G36 Environment Protection*

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		inform the local community 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 • Monitoring, review and amendment mechanisms.			
T2	Traffic and transport	Undertake consultation with local and regional bus companies prior to and during construction.	Construction Contractor	Pre-construction / Construction	Project specific control
T3	Traffic and transport	Undertake consultation with Shoalhaven City Council regarding potential impacts to parking during construction and operation.	Roads and Maritime	Pre-construction	Project specific control
T4	Traffic and transport	Undertake consultation with emergency services and Shoalhaven District Memorial Hospital before and during construction to confirm any diversions during construction.	Construction Contractor	Pre-construction / Construction	Project specific control
T5	Traffic and transport	Undertake consultation with property owners regarding changes to access arrangements. Targeted notification to affected residents and businesses will be conducted prior to the completion of altered local road connections,	Construction Contractor	Pre-construction / Construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		where road closures and detours are proposed.			
T6	Traffic and transport	Notifications will be issued to the local community regarding changes to pedestrian and cycle path access, diversions or alternative routes and any proposed changes to parking.	Construction Contractor	Pre-construction / Construction	Project specific control
T7	Traffic and transport	Schedule partial road closures to avoid peak holiday periods.	Construction Contractor	Construction	Project specific control
T8	Traffic and transport	Provide advance notification to the community where impacts to on-street and off-street parking is unavoidable.	Construction Contractor	Construction	Project specific control
T9	Traffic and transport	Obtain a Road Occupancy Licence where required.	Construction Contractor	Pre-construction / Construction	Project specific control
Noise and vibration					
NV1	Construction noise and vibration	A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will ***be in accordance with the Roads and Maritime Construction Noise and Vibration Guideline (RMS, 2016)*** ~~generally follow the approach in the Interim Construction Noise Guideline (ICNG) (DECC, 2009)~~ and ***will*** 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 (Roads and	Construction Contractor	Detailed design / pre-construction	Section 4.6 of G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		Maritime, 2014) • A monitoring program to assess performance against relevant noise and vibration criteria • 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.			
NV2	Construction noise	Where feasible, use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; and consideration of site topography when situating plant.	Construction Contractor	Construction	Project specific control
NV3	Construction noise and vibration	All sensitive receivers likely to be affected will be notified of construction impacts at least seven calendar days prior to the commencement of any works that may generate noise levels above the Noise Management Level or high vibration impacts. The notification will provide details of: • The project • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information.	Construction Contractor	Pre-construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
NV4	Out of hours work	Out of hours works will be carried out in accordance with the *Construction Noise and Vibration Guideline* (Roads and Maritime 2016).	Construction Contractor	Construction	Project specific control
NV5	Works with high noise levels	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise levels should be scheduled during less sensitive time periods, such as after 8.00 am and before 6.00 pm.	Construction Contractor	Construction	Project specific control
NV6	Construction respite periods	High noise generating activities near receivers should be carried out in blocks that do not exceed three hours each, with a minimum respite period of one hour between each block. The duration of each block of work and respite should be flexible to accommodate the usage and amenity at nearby receivers. ***For high noise activities occurring out of hours, u~~U~~nless Duration Respite is*** negotiated with the community with consultation documented and approved by Roads and Maritime project manager or permitted under the licence there should be no more than: • Two consecutive evenings or nights per week • Three evenings or nights per week; and • Six evenings or nights per month. For night work these periods of work should be separated by not less than one week.	Construction Contractor	Construction	Project specific control
NV7	Construction noise and vibration	Shield stationary noise sources such as pumps, compressors, fans, etc.	Construction Contractor	Construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		Stationary noise sources should be enclosed or shielded where feasible and reasonable while ensuring that the occupational health and safety of workers is maintained. Appendix D of AS 2436:2010 lists materials suitable for shielding.			
NV8	Damage to structures	Attended vibration monitoring should be undertaken at sensitive receivers during works with potential for vibration to cause structural damage and human response in order to confirm appropriate site-specific minimum working distances. Site-specific minimum working distances should be determined whenever significant vibration generating plant will be working close to or within the recommended minimum working distances listed in Appendix D to the REF.	Construction Contractor	Construction	Project specific control
NV9	Damage to structures	Dilapidation surveys will be conducted at all residential and other vibration sensitive receivers within 50 metres of the construction site.	Construction Contractor	Pre-construction	Project specific control
NV10	Construction vibration	Notification of residences potentially affected by vibration by letterbox drop will be carried out for all occupied buildings within 100 metres of the construction site.	Construction Contractor	Pre-construction / Construction	Project specific control
NV11	Potential damage to heritage listed structures	Attended vibration monitoring will be carried out during periods where construction plant and equipment are operating within the minimum working distance for the heritage listed structures identified in Table 6-24 of the REF.	Construction Contractor	Pre-construction / Construction	Project specific control
NV12	Potential damage to	Vibration monitoring will be carried out during	Construction	Construction	Project specific

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
	rock shelters	periods where high vibration plant and equipment are operating in close proximity to the rock shelters to determine appropriate site-specific vibration levels.	Contractor		control
NV13	Operational noise mitigation	Operational noise mitigation requirements will be reviewed during detailed design. At-property treatments will be agreed upon and implemented in consultation with property owners.	Roads and Maritime, Designer	Detailed design	Project specific control
NV14	Operational noise mitigation	Where practical, operational noise treatments will be implemented at the start of the construction period.	Construction Contractor	Pre-construction	Project specific control
NV15	Operational noise	Post-construction noise monitoring will be undertaken in accordance with Noise Criteria Guideline (Roads and Maritime 2016) and Noise Mitigation Guideline (Roads and Maritime 2016) within 2−12 months of proposal completion, at selected representative locations along the proposal route.	Roads and Maritime	Post-construction	Project specific control
Aboriginal heritage					
AH1	Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) will be prepared in accordance with the Procedure for Aboriginal cultural heritage consultation and investigation (Roads and Maritime, 2012) and Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime, 2015) and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented for managing impacts on Aboriginal heritage. The	Construction Contractor	Pre-construction	Section 4.9 of *G36 Environment Protection*

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		AHMP will be prepared in consultation with all relevant Aboriginal groups.			
AH2	Unexpected finds	*The Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where Roads and Maritime does not have approval to disturb the object/s or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work will only re-commence once the requirements of that Procedure have been satisfied.	Construction Contractor	Construction	Section 4.9 of *G36 Environment Protection*
AH3	AHIP	An Aboriginal heritage impact permit (AHIP) will be sought for the overall proposal area, ~~including Nowra Bridge 1 (AHIMS ID 52-5-0852), Nowra Bridge 2 (AHIMS ID 52-5-0853), Nowra Bridge 6 (AHIMS ID 52-5-0872), Nowra Bridge 7 (AHIMS ID 52-5-0875), Nowra Bridge 8 (AHIMS ID 52-5-0876), Nowra Bridge 9 (AHIMS ID 52-5-0874), and Nowra Bridge 10 (AHIMS ID 52-5-0873).~~ Collection of surface artefacts and salvage excavations will be completed ***in accordance with an AHIP*** prior to any activities (including pre-construction activities) which may harm Aboriginal objects at these locations.	Roads and Maritime, Construction Contractor	Detailed design / Pre-construction	Cultural Heritage Assessment Report (CHAR), Artefact Heritage Services, 2018)
AH4	Aboriginal heritage	Where possible, all subsurface impact to Graham Lodge Aboriginal Artefact Scatter (AHIMS ID 52-5-0879) will be avoided. Where	Roads and Maritime, Construction	Detailed design / Pre-construction / Construction	Cultural Heritage Assessment

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		impacts are unavoidable, salvage excavations will be undertaken in accordance with an AHIP and a Section 60 permit.	Contractor		Report (CHAR), Artefact Heritage Services, 2018)
AH5	Aboriginal heritage	Collection of surface artefacts across Nowra Bridge 1 (AHIMS ID 52-5-0852) and Nowra Bridge 2 (AHIMS ID 52-5-0853) will be conducted prior to construction, in accordance with an AHIP.	Roads and Maritime, Construction Contractor	Detailed design / Pre-construction / Construction	Cultural Heritage Assessment Report (CHAR), Artefact Heritage Services, 2018)
AH6	Aboriginal heritage	Targeted salvage excavation will be conducted within Nowra Bridge 2 (AHIMS ID 52-5-0853), Nowra Bridge 7 (AHIMS ID 52-5-0875), Nowra Bridge 8 (AHIMS ID 52-5-0876), and Nowra Bridge 9 (AHIMS ID 52-5-0874) prior to construction in accordance with an AHIP.	Roads and Maritime, Construction Contractor	Detailed design / Pre-construction / Construction	Cultural Heritage Assessment Report (CHAR), Artefact Heritage Services, 2018)
AH7	Aboriginal heritage	Long term arrangements for the management of excavated artefacts, such as reburial or a keeping place, will be determined in accordance with the recommendations of registered Aboriginal stakeholders and OEH.	Roads and Maritime, Construction Contractor	Pre-construction / Construction / Post construction	Cultural Heritage Assessment Report (CHAR), Artefact Heritage Services, 2018)
AH8	Aboriginal heritage	Prepare and implement a Heritage Interpretation	Roads and	Pre-construction /	Cultural

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		Strategy that addresses the cultural significance of the proposal location within the Dharawal landscape and archaeological finds from the study area. Develop the strategy in consultation with the Registered Aboriginal Parties.	Maritime, Construction Contractor	Construction / Post construction	Heritage Assessment Report (CHAR), Artefact Heritage Services, 2018)
AH9	Aboriginal heritage	Maintain ongoing consultation with the Registered Aboriginal Parties during detailed design and construction.	Roads and Maritime, Construction Contractor	Pre-construction / Construction	Cultural Heritage Assessment Report (CHAR), Artefact Heritage Services, 2018)
Non-Aboriginal heritage					
NAH1	Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Non-Aboriginal heritage. The NAHMP will include • Provisions to appropriately protect and manage significant fabric during the proposed. • Provision of a heritage induction for all workers being carried out prior to commencement of works. • The induction will include values of the sites,	Construction Contractor	Detailed design / Pre-construction	Section 4.10 of G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		avoidance procedure, and contacts (site manager, Road and Maritime environment officer) for reporting unexpected archaeological finds, or inadvertent impact to heritage items.			
NAH2	Non-Aboriginal heritage	*The Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 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.	Construction Contractor	Detailed design / Pre-construction	Section 4.10 of G36 Environment Protection
NAH3	Non-Aboriginal heritage	Where practicable, impacts to Graham Lodge and curtilage ~~should~~***will*** be avoided. ***Where***~~Should~~ subsurface works which may impact significant archaeological remains with***in*** Graham Lodge are unavoidable and justifiable, an Archaeological Research Design will be prepared to support a section 60 application.	Roads and Maritime, Construction Contractor	Detailed design / Pre-construction	Statement of Heritage Impact (SoHI), Artefact Heritage Services, 2018
NAH4	Non-Aboriginal heritage	~~Determine a~~ ***Roads and Maritime will investigate the technical feasibility and*** suitable location for relocation of the pavilion structure associated with the Captain Cook Bicentennial Memorial, in consultation with Shoalhaven City Council. ***Subject to the feasibility and suitable location being determined for relocation, Roads and Maritime will meet all reasonable costs***	Roads and Maritime, Construction Contractor	Detailed design / Pre-construction	Statement of Heritage Impact (SoHI), Artefact Heritage Services, 2018

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		associated with its relocation.			
NAH5	Non-Aboriginal heritage	Where practicable, investigate opportunities to minimise impacts to the curtilage of 'Lynburn' (LEP No.130) ***and 'Illowra' (LEP No. 136)***. ~~The screening vegetation will be retained where possible or replanted after construction to minimise visual impact.~~ ***Wherever possible, natural screening adjacent to heritage items along the Princes Highway will be retained. Where impact to vegetation cannot be avoided new plantings will be considered.***	Roads and Maritime, Construction Contractor	Detailed design / Pre-construction / Post construction	Statement of Heritage Impact (SoHI), Artefact Heritage Services, 2018
NAH6	Non-Aboriginal heritage	***Consideration should be given to the preparation of a***~~A~~ heritage interpretation strategy ***as part of the proposal. An interpretation strategy would consider interpretation opportunities for heritage items located within the study area.*** ~~will be prepared including an interpretation of archaeological remains should any be uncovered. The interpretation strategy will include the history, associations and significance of the existing southbound bridge, interpretive signage, panels or displays at the entry points to the bridge or at locations along its span.~~ ***A heritage interpretation strategy for the existing southbound bridge will be addressed through the separate adaptive reuse assessment process.***	Roads and Maritime	Detailed design	Statement of Heritage Impact (SoHI), Artefact Heritage Services, 2018
NAH7	Non-Aboriginal heritage	An archival recording will be prepared for the Captain Cook Bicentennial Memorial, the Nowra Bridge over the Shoalhaven River, 'Illowra',	Roads and Maritime	Detailed design / Pre-construction	Statement of Heritage Impact (SoHI),

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		'Lynburn' and the potential unlisted heritage item 'M&M Guesthouse' prior to impacts occurring. The archival recording will be prepared in accordance with Photographic Recording of Heritage Items Using Film or Digital Capture (Heritage Council 2006).			Artefact Heritage Services, 2018
~~NAH8~~	~~Non-Aboriginal heritage~~	~~Wherever possible, natural screening adjacent to heritage items along the Princes Highway will be retained. This particularly relates to vegetation within the LEP listed 'Lynburn' heritage item (LEP No. 130) and Captain Cook Bicentennial Memorial heritage item (LEP No. 338). Where impact to vegetation cannot be avoided new plantings will be considered.~~	~~Construction Contractor~~	~~Detailed design / Pre-construction / Post construction~~	~~Statement of Heritage Impact (SoHI), Artefact Heritage Services, 2018~~
NAH9	Non-Aboriginal heritage	Consider options for relocation of the unlisted potential heritage item 'M&M Guesthouse' in consultation with Shoalhaven Council	Roads and Maritime	Prior to detailed design	Statement of Heritage Impact (SoHI), Artefact Heritage Services, 2018
NAH10	***Non-Aboriginal heritage***	***Potential impacts of the proposed noise barrier on State heritage listed Graham Lodge (SHR No. 01699) would be assessed during detailed design***	***Construction Contractor***	***Detailed design***	***Project specific control***
NAH11	***Maritime archaeology***	***A remote sensing survey using side-scan sonar of the project impact area will be conducted to confirm the presence or absence of submerged archaeological resources within the impact area. In the event that underwater archaeological***	***Roads and Maritime***	***Pre-construction***	***Maritime archaeological due diligence assessment, RPS, 2018***

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		resources are identified as a result of underwater surveys a diving inspection will be carried out by qualified commercial divers, supervised by a qualified maritime archaeologist, to confirm the nature and significance of the archaeological resource. If archaeological resources of State significance are identified, the Heritage Division, as Delegate of the NSW Heritage Council will be notified in accordance with Section 144 of the NSW Heritage Act 1977.			
NAH12	***Maritime archaeology***	***If the potential for additional impact of Nowra Wharf is identified, photographic recording will be carried out for the wharf and slip prior to impact in accordance with the Photographic Recording of Heritage Items using Film or Digital Capture (Heritage Council, 2006).***	***Roads and Maritime***	***Prior to construction Construction***	***Maritime archaeological due diligence assessment, RPS, 2018***
Landscape character and visual impact					
LV1	Landscape character and visual impact	An Urban Design and Landscape Plan (UDLP) will be prepared to inform detailed design and will form part of the CEMP. Development of the UDLP will draw on the Urban Design Report and Landscape and Visual Assessment prepared for the REF. The UDLP will present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The UDLP will include design treatments for:	Designer	Detailed design	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Location and identification of existing vegetation and proposed landscaped areas, including species to be used • Built elements including retaining walls, bridges, ~~and~~ noise walls***, and foreshore structures*** • Pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • Fixtures such as seating, lighting, fencing and signs • Details of the staging of landscape works taking account of related environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas. The UDLP will be prepared in accordance with relevant guidelines, including: • Beyond the Pavement urban design policy, process and principles (Roads and Maritime, 2014) • Landscape Guideline (RTA, 2008) • ***Environmentally Friendly Seawalls' (OEH, 2009)*** • Bridge Aesthetics (Roads and Maritime 2012) • Noise Wall Design Guidelines (RTA, 2006) • Shotcrete Design Guideline (RTA, 2005).Landscape Guideline (RTA, 2008)			

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Bridge Aesthetics (Roads and Maritime 2012) • Noise Wall Design Guidelines (RTA, 2006) • Shotcrete Design Guideline (RTA, 2005).			
LV2	Retention of existing vegetation	The proposal will be designed to avoid impact to prominent trees and vegetation communities as far as practicable possible. Water quality structures and drainage lines will be designed to avoid existing vegetation where practicable.	Designer	Detailed design	Project specific control
LV3	Bridge form	The proposed bridge design will aim to achieve a slender and less visually intrusive form and be visually harmonious with the existing bridges.	Designer	Detailed design	Project specific control
LV4	Impacts on existing vegetation	Investigate introducing retaining walls in the following locations to provide the opportunity to retain existing tree plantings, improve the visual and pedestrian amenity, and reduce the scale of the highway: • Either side of the Princes Highway between Bolong Road and Bomaderry Creek bridge. • The new northbound bridge approach road • Either side of the Princes Highway south of the Bridge Road intersection	Designer	Detailed design	Landscape Character and Visual Impact Assessment
LV5	Impacts on vegetation	Consider the proposed drainage swale design and location to minimise cutting as well as provide additional space for planting near the corner of the Princes Highway and Illaroo Road	Designer	Detailed design	Landscape Character and Visual Impact Assessment
LV6	Impact on Rotary Park	Consider the proposed footpath alignment and stair design of the path beneath the bridge	Designer	Detailed design	Landscape Character and

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		structures and in Rotary Park to better reflect its parkland setting			Visual Impact Assessment
LV7	Impacts on existing vegetation	Consider the alignment of the footpath on the north eastern corner of the existing southbound bridge, in consultation with adjacent land owners, to avoid impact to existing trees.	Designer	Detailed design	Landscape Character and Visual Impact Assessment
LV8	Active transport	Investigate the design of the entrance to properties on the north eastern corner of the existing southbound bridge to prioritise pedestrians and cyclists over vehicles and facilitate ease of travel.	Designer	Detailed design	Landscape Character and Visual Impact Assessment
LV9	Visual impact of piers	Consider the proposed pier designs to strengthen the complementary relationship between the proposed bridge piers and the piers of the existing northbound and southbound bridges. In particular, it will consider tapering the piers at their long elevation	Designer	Detailed design	Landscape Character and Visual Impact Assessment
LV10	Site restoration	Construction work sites and ancillary sites will be returned to at least their pre-construction state, unless otherwise detailed in the project design, once construction activities are complete or will be progressively remediated throughout the construction program where possible	Designer	Detailed design	Landscape Character and Visual Impact Assessment
LV11	Retention of existing vegetation	Existing trees to be retained within construction facilities areas will be identified, protected and maintained for the duration of the construction works	Designer	Detailed design	Landscape Character and Visual Impact Assessment
LV12	Light spill	Temporary lighting will be screened, diverted or	Designer	Detailed design	Landscape

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		minimised to avoid unnecessary light spill			Character and Visual Impact Assessment
LV13	Site restoration	Material used for temporary land reclamation will be removed once construction activities are complete.	Designer	Detailed design	Landscape Character and Visual Impact Assessment
Flooding and hydrology					
HY1	Hydrology	Temporary drainage structures will be designed and constructed in accordance with the Technical Guideline – Temporary Stormwater Drainage for Road Construction (Roads and Maritime 2011c).	Construction Contractor	Construction	Project specific control
HY2	Flooding	***As part of t***~~T~~he CEMP***, a flood management plan will be prepared and*** will include appropriate management measures to manage the risk and impacts of flooding including, but not limited to: • ***Steps to be taken in the event of a flood warning*** • Removal or securing of loose material • Storage or removal of plant and equipment • Storage of fuels and chemicals.	Construction Contractor	Pre-construction/ construction	Project specific control
HY3	***Property impacts***	***The flooding analysis will be reviewed as part of detailed design, particularly with regard to any changes to the design that could affect flooding behaviour and changes in flood levels from that presently existing. This will***	***Designer***	***Detailed design***	***Project specific control***

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		consider the incremental impact on residential properties and on other affected development. The review will include consultation with relevant stakeholders including Shoalhaven City Council and OEH.			
HY4	***Property impacts***	***Roads and Maritime will carry out a damage assessment during detailed design for affected properties related to the incremental impact of the proposal, and this will be used to inform consultation with affected residents.***	***Designer***	***Detailed design***	***Project specific control***
Property and land use					
PA1	Property acquisition and relocation issues	Roads and Maritime will continue to consult with directly affected property owners throughout the detail design phase.	Roads and Maritime	Detailed design	Project specific control
PA2	Property acquisition	All property acquisition will be carried out in accordance with the *Land Acquisition Information Guide* (Roads and Maritime, 2014b), the *Land Acquisition (Just Terms Compensation) Act 1991* and the NSW Government Land Acquisition Reform 2016.	Roads and Maritime	Detailed design, Pre-construction	Core standard safeguard PL1
PA3	Property acquisition	Acquisition of Crown land will be carried out in accordance with the *Crown Lands Management Act 2016*.	Roads and Maritime	Detailed design, Pre-construction	Project specific control
Socio-economic					
SE1	Project communications	A Community and Stakeholder Engagement Plan will be prepared and will include:	Roads and Maritime	Detailed design / pre-construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Procedures and mechanisms that will be implemented in response to the key social impacts identified for the proposal. • Procedures and mechanisms that will be used to engage with affected landowners, business owners, and the wider community to identify potential access, parking, business visibility, and other impacts and develop appropriate management measures. • Procedures to keep the community informed about construction and any associated changes to conditions (eg detours or lane closures) such as through advertisements in local media and advisory notices or variable message signs • Procedure for the management of complaints and enquiries, including a contact name and number for complaints. The plan will be prepared in accordance with the Community Involvement and Communications Resource Manual (RTA, 2008).			
SE2	Impacts on council infrastructure	Roads and Maritime will continue to consult with Council regarding impacts to council infrastructure.	Roads and Maritime	Detailed design	Project specific control
SE3	Impacts on social infrastructure – maritime activities	At least one of the two boat ramps within the proposal area will be available to the public at all times. The public would be notified in advance of any access restrictions during construction.	Roads and Maritime, Construction Contractor	Detailed design, Construction	Project specific control
SE4	Impact on Greys Beach Reserve	Use of the Greys Beach Reserve site for temporary construction activities ***will*** ~~should~~ be	Roads and Maritime,	Detailed design, Construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		planned to consider peak usage periods of the river for recreational users. **Access to the boat ramp at Greys Beach will be maintained at all times.** **Access to parking would be largely maintained between the September/October school holidays to the Monday after Anzac Day. Outside of these times about half of the existing parking area (about 50 spaces) will be available.**	Construction Contractor		
SE5	Impacts on social infrastructure – time capsule	Roads and Maritime will endeavour to identify the location of the time capsule in Moorhouse Park and establish an appropriate salvage and/or relocation of this object, in consultation with Council and relevant community members.	Roads and Maritime	Detailed design	
SE6	Impact on parking	Consultation will be carried out with Council to identify alternative parking arrangements to replace car parking lost during construction.	Roads and Maritime	Detailed design, Pre-construction	Project specific control
SE7	Impact on access to Shoalhaven River foreshore	The CEMP will include measures to ensure public access to the Shoalhaven River foreshore and pathways is maintained during construction, where possible given safety considerations.	Roads and Maritime, Construction Contractor	Detailed design, Construction	Project specific control
SE8	Construction staff parking	The construction contractor will provide suitable off-street parking to accommodate workers during construction. Construction vehicles would not occupy private parking including Nowra Aquatic Centre and Shoalhaven Entertainment Centre and Visitor Centre. The Construction TMP will include appropriate measures to prevent construction staff from	Construction Contractor	Pre-construction, Construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		utilising these public parking areas.			
SE9	Business and tourism impacts – operation	Existing businesses with authorised Tourist Attraction Signposting Assessment Committee (TASAC) approved signage will be consulted to develop revised signage if impacted by the proposal.	Roads and Maritime	Detailed design	Project specific control
SE10	***Impact on visual amenity***	***Roads and Maritime will consult with affected residents with regard to the proposed noise barrier on the eastern side of the Princes Highway south of the Shoalhaven River. This will include investigation and consideration of alternative options for noise mitigation.***	***Roads and Maritime***	***Detailed design***	***Project specific control***
SE11	***Parking during construction***	***Consultation with Council and the other property owners will be carried out to confirm the suitability of the identified areas proposed for temporary car parking and specific matters relating to their use.***	***Designer***	***Detailed design***	***Project specific control***
SE12	***Impact on Greys Beach Reserve***	***Consultation with boat ramp users, Council, and other relevant community groups would be undertaken regarding any changes to the availability of parking at Greys Beach.***	***Designer, Construction Contractor***	***Detailed design***	***Project specific control***
Biodiversity					
B1	General biodiversity	A Flora and Fauna Management Plan (FFMP) will be prepared as part of the Construction Environmental Management Plan (CEMP). The FFMP will be prepared in accordance with the Roads and Maritime Biodiversity Guidelines: Protecting and managing biodiversity on RTA	Construction Contractor	Prior to construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		projects (RTA 2011) (Biodiversity Guidelines) and Section 4.8 of Roads and Maritime Specification G36 Environment Protection and G40 Clearing and Grubbing. The FFMP will include, but not be limited to: • Pre-clearing process • Management of unexpected species finds • Delineation of exclusion zones • Process for weed management • Process for pathogen management • Requirements set out in the Landscape Guideline (RTA 2008).			
B2	Removal of native vegetation	Native vegetation removal would be minimised through detailed design.	Designer	Detailed design	Project specific control
B3	Impacts on fauna	Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011).*	Construction Contractor	Pre-construction	Project specific control
B4	Removal of vegetation	Vegetation removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)*.	Construction Contractor	Construction	Project specific control
B5	Removal of vegetation	Native vegetation will be re-established in accordance with *Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA*	Construction Contractor	Constriction / Post construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		projects (RTA 2011).			
B6	Threatened flora and fauna	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site	Construction Contractor	Construction	Project specific control
B7	Removal of vegetation	A mulch management plan will be prepared in accordance with the mulch order 2016 under the *Protection of the Environment Operations Act 1997* (POEO Act)	Construction Contractor	Pre-construction	Project specific control
B8	Removal of EEC	Exclusion zones will be placed around retained EECs in accordance with Guide 2: Exclusion Zones	Construction Contractor	Pre-construction	Project specific control
B9	Removal of aquatic habitat	Removal of aquatic habitat (seagrass) will be minimised through detailed design.	Construction Contractor	Pre-construction	Project specific control
B10	Removal of threatened species habitat and habitat features	Habitat will be replaced or re-instated in accordance with *Guide 5: Re-use of woody debris and bushrock* and *Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Project specific control
B11	Aquatic habitat 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*	Construction Contractor	Construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		guidelines for fish habitat conservation and management Update 2013 (DPI (Fisheries NSW) 2013).			
B12	Aquatic habitat impacts	DPI (Fisheries) will be consulted with regard to the need for a permit to harm marine vegetation	Construction Contractor	Construction	Project specific control
B13	Changes to hydrology	Changes to existing surface water flows will be minimised through detailed design.	Designer	Detailed design	Project specific control
B14	Injury and mortality of fauna	Fauna will be managed in accordance with *Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Project specific control
B15	Invasion and spread of weeds	Weed species will be managed in accordance with *Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Project specific control
B16	Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with *Guide ~~2~~**7**: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Project specific control
B17	Noise, light and vibration	Shading and artificial light impacts will be minimised through detailed design.	Designer	Detailed design	Project specific control
B18	***Aquatic habitats***	***Roads and Maritime will determine and implement a suitable offset for impacts to affected key fish habitat in accordance with the Guideline for Biodiversity Offsets (Roads and Maritime 2016) and the DPI's Policy and guidelines for fish habitat conservation and***	***Roads and Maritime***	***Pre-construction***	***Project specific control***

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		management (DPI 2013), in consultation with DPI (Fisheries).			
B19	***Aquatic pests and diseases***	***All machinery and vessels used within the waterway are to be verified as clean and free of potential weeds, pests and pathogens prior to arrival to site. Procedures to prevent the introduction or spread of aquatic pests, diseases and saltwater weeds will be developed in consultation with DPI Aquatic Biosecurity and implemented during construction.***	***Construction Contractor***	***Pre-construction Construction***	***Project specific control***
B20	***Fish kills***	***Roads and Maritime will immediately notify DPI Fisheries of any fish kills in the vicinity of the works.***	***Construction Contractor***	***Construction***	***Project specific control***
Water quality					
WQ1	Water quality	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction. The SWMP will contain as a minimum the following elements: • Site specific Erosion and Sedimentation Control Plans (ESCPs), including detailed consideration of staging and management at ancillary sites, in accordance with the Blue Book • Identification of site conditions or	Construction Contractor	Pre-construction	Section 2.1 of *G38 Soil and Water Management*

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		construction activities that could potentially result in erosion and associated sediment runoff • Methods to minimise potential adverse impacts of construction activities on the water quality within surrounding waterways • Details of measures to minimise any adverse impacts of sedimentation on the surrounding environment • Details of measures to minimise soil erosion caused by all construction works including clearing, grubbing and earthworks • Details of measures to make site personnel aware of the requirements of the SWMP by providing information within induction, toolbox and training sessions • Details of the roles and responsibilities of personnel responsible for implementing the SWMP • Details of measures for the inspection and maintenance of construction phase water treatment devices and structures • Details of water quality monitoring • Detailed construction methodology and environmental work method statement for the proposed bridge works and creek realignment within Shoalhaven River and Bomaderry Creek to minimise the potential for bank instability, scour, flooding, working over water and other adverse impacts of construction activities on the water quality.			

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		The SWMP will be reviewed by a soil conservationist on the Roads and Maritime list of Registered Contractors for Erosion, Sedimentation and Soil Conservation Consultancy Services. The SWMP will be revised as required to address the outcomes of the review.			
WQ2	Water quality	A site ESCP will be prepared and implemented as part of the SWMP. The ESCP will 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. Development of the ESCP will take into consideration: • Provision of sediment basins • Temporary surface drainage line controls • Bridge deck and bridge piles working with over water and alkaline waste water management • Over water sediment controls including: • Silt fences along areas of the foreshore that have been cleared • Silt curtains encompassing construction areas disturbing or releasing river bottom sediments (eg piling) • Silt booms surrounding barges to ensure leaks /spills are contained.	Construction Contractor	Pre-construction	Section 2.2 of *G38 Soil and Water Management*

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
WQ3	Water quality	The SWMP will identify the position of an on-site environmental representative to complete self-audits and monitor implementation of the SWMP.	Construction Contractor	Pre-construction / Construction	Project specific control
WQ4	Water quality	In the event of significant groundwater inflows, undertake further assessment and consultation with DPI (Water) in relation to any licencing requirements.	Construction Contractor	Construction	Project specific control
WQ5	Water quality	During detailed design implement best practice water sensitive urban design (WSUD) measures to provide dissipation of flows and prevent gross pollutants and contaminants entering the study area's waterways. WSUD measures are designed to provide treatment of nutrients and suspended solids prior to discharge to the existing receiving environment.	Designer	Detailed design	Project specific control
WQ6	Water quality	During detailed design, review the drainage design to identify and evaluate opportunities to meet the WSUD water quality objectives, including consideration of: • Improvements to the design of the southern basin to achieve better performance • Inclusion of grass swales on both sides of the highway in the vicinity of Bolong Road (subject to the acquisition area) • Provision of a grassed swale as part of rehabilitation of the ancillary site adjacent to Bridge Road / Scenic Drive.	Designer	Detailed design	Project specific control
WQ7	Water quality	Surface water quality monitoring will be	Roads and	Pre-construction	Project specific

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		undertaken prior to construction to establish baseline water quality and regularly during construction so that any impacts from the proposal construction phase can be identified and addressed. Sampling locations and monitoring methodology will be determined as part of the CEMP, but as a minimum will be undertaken upstream and downstream of creek crossings and in accordance with the Guideline for Construction Water Quality Monitoring (Roads and Maritime, 2003).	Maritime, Construction Contractor	Construction	control
WQ8	Water quality	Bulk storage of fuels or chemicals should be located greater than 100 metres from any watercourse or mapped EEC. In constrained areas where criteria cannot be achieved, additional risk assessment and additional mitigation measures may need to be considered and implemented to manage risk to sensitive receivers to an acceptable level.	Construction Contractor	Construction	Project specific control
WQ9	Water quality	Vehicles and machinery will be properly maintained to minimise the risk of fuel/oil leaks.	Construction Contractor	Construction	Project specific control
WQ10	Water quality	An Emergency Spill Plan will be developed and incorporated in the CEMP. This will include measures to avoid spillages of fuels, chemicals, and concrete wash or fluids into any waterways.	Construction Contractor	Construction	Project specific control
WQ11	Water quality	The storage, handling and use of fuels or chemicals will be undertaken in accordance with the *Occupational Health and Safety Act 2000* and WorkCover's Storage and Handling of Dangerous Goods Code of Practice (WorkCover,	Construction Contractor	Construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		2005).			
WQ12	Water quality	If any dewatering or other activities which will impact the local groundwater system are proposed, consultation with the DPI (Water) will be undertaken to determine the requirements for water extraction licenses and approvals.	Construction Contractor	Construction	Project specific control
WQ12	Water quality	Minimise direct and indirect impact to riparian vegetation	Designer, Construction Contractor	Detailed design Construction	Project specific control
WQ13	***Water quality***	***Split rock used in reclamation works in or adjacent to the waterway must be clean and free of fines.***	***Construction Contractor***	***Construction***	***Project specific control***
WQ14	***Water quality***	***The final detailed design plans for the new bridges at Shoalhaven River and Bomaderry Creek, and for water quality treatment devices will be provided to DPI Fisheries for review and comment. Roads and Maritime will consider all comments provided with regard to any further revisions to the final design.***	***Roads and Maritime, Construction Contractor***	***Detailed design***	***Project specific control***
WQ15	***Water quality***	***Operational spill containment of a minimum of 20,000 litres will be provided to ensure that spills on the new bridge and approaches can be captured before reaching sensitive environments.***	***Roads and Maritime, Designer***	***Detailed design***	***Project specific control***
WQ16	***Water quality***	***Management of water quality during construction will incorporate the following measures:***	***Construction Contractor***	***Construction***	***Project specific control***

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• ***Where practicable, water from construction sediment basins will be reused in preference to discharge*** • ***Construction sediment basin outlets will be rock armoured to meet Blue Book design requirements.*** • ***Basin dewatering activities will be carried out in accordance with Roads and Maritime's Environmental Management of Construction Site Dewatering.*** • ***Floating siphon devices will be used where practicable to minimise resuspension of sediment during dewatering operations.***			
WQ17	***Water quality***	***DPI Fisheries will be consulted with regard to the design and construction of any instream temporary working structures.***	***Construction Contractor***	***Construction***	***Project specific control***
Soils					
SO1	Contaminated land	A Contaminated Land Management Plan will be prepared in accordance with the *Guideline for the Management of Contamination* (Roads and Maritime, 2013) and implemented as part of the CEMP. The plan will include, but not be limited to: • Capture and management of any surface runoff contaminated by exposure to the contaminated land • Further investigations required to determine the extent, concentration and type of	Construction Contractor	Pre construction	Section 4.2 of *G36 Environment Protection*

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		contamination, as identified in the detailed site investigation (Phase 2) • Management of the remediation and subsequent validation of the contaminated land, including any certification required • Measures to ensure the safety of site personnel and local communities during construction.			
SO2	Contaminated land	If contaminated areas were encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or EPA.	Construction Contractor	Construction	Section 4.2 of *G36 Environment Protection*
SO3	Accidental spills	A site specific emergency spill plan will be developed, and include spill management measures in accordance with the Roads and Maritime *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 Roads and Maritime and EPA officers).	Construction Contractor	Detailed design / Pre construction	Section 4.3 of *G36 Environment Protection*
SO4	Acid sulfate soils	During geotechnical investigations, soil sampling	Designer	Detailed design	Project specific

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		and testing for ASS parameters will be carried out in areas of proposed ground disturbance where there is a low to high probability of encountering PASS/ASS. Assessment of the presence/absence of ASS will be made with reference to NSW *Acid Sulfate Soils Assessment Guidelines* (ASSMAC,1998).			control
SO5	Acid sulfate soils	During detailed design, the preferred management strategy for PASS/ASS is to avoid its disturbance wherever possible. Where disturbance of PASS/ASS is unavoidable, preferred design strategies are: • Minimisation of disturbance which may include avoiding/ minimising impact on areas with high levels of sulfides, limiting disturbances so that only shallow disturbances occur and minimising groundwater fluctuations. • Neutralisation with lime • Hydraulic separation of sulfides from the sediment either on its own or in conjunction with dredging • Strategic reburial (re-interment) where material can be permanently placed in anaerobic conditions, for example covered by water and compacted soil to keep it wet and free of oxygen. Other management measures may be considered during construction stage but must not pose unacceptably high risks.	Designer	Detailed design	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SO6	Acid sulfate soils	An ASS Management Plan (ASSMP) will be prepared to identify procedures for mitigation and management of known PASS/ASS areas during construction stage. The ASSMP will include details on: • Identification of specific areas where PASS/ASS are required to be managed • Determine liming rates for neutralisation of PASS/ASS within each area • Details on appropriate construction staging and methods used in relation to PASS/ASS on site • Specific mitigation measures to prevent disturbance of and/or acid generation from PASS/ASS to manage and control environmental issues • Procedures for handling, treatment (including acid neutralisation), containment and disposal of PASS/ASS associated with proposed excavation activities at the site. Additional testing will be required during construction to determine liming rates relevant to each area of ASS that will be disturbed. The plan will be prepared in general accordance with NSW *Acid Sulfate Soils Assessment Guidelines* (ASSMAC,1998).	Construction Contractor	Pre-construction	Project specific control
~~SO7~~	~~Hazard and risk management~~	~~A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP will include, but not be limited to:~~	~~Construction Contractor~~	~~Pre-construction~~	~~Project specific control~~

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		~~• 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 site, 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 HRMP 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.~~			
SO8	Hazardous materials	A Hazardous Materials (HAZMAT) survey will be carried out to assess the potential for lead-based paints and/or asbestos containing materials including: • Structures identified for demolition • Known buried utilities and service pits A Hazmat Register will identify the location of all known or suspected hazardous materials. Risk assessments will be carried out to quantify and control potential exposure to human and	Designer	Detailed design	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		ecological receptors during construction.			
~~SO9~~	~~Hazardous materials~~	~~A Hazardous Materials Management Plan applying to known areas of asbestos contamination / other hazardous materials will be developed in accordance with the Roads and Maritime Procedure Asbestos Related Work No. 066P25 (Roads and Maritime, 2013).~~	~~Construction Contractor~~	~~Pre construction~~	~~Project specific control~~
SO10	Hazardous materials	Any works requiring asbestos removal should be carried out in accordance with an Asbestos Removal Control Plan prepared in accordance with the relevant published guidelines and codes of practice: • Code of Practice. How to safely remove asbestos in the workplace (SafeWork NSW, 2016a) • Code of Practice. How to manage and control asbestos in the workplace (SafeWork NSW, 2016b) • Roads and Maritime Procedure Asbestos Related Work No. 066P25 (Roads and Maritime, 2013). Prior to works, notifications to SafeWork NSW will be carried out by the appropriate licensed asbestos removal contractor. At the completion of the asbestos removal, clearance certificates will be issued to the contractor confirming the effectiveness of asbestos removal.	Construction Contractor	Construction	Project specific control
SO11	Hazardous materials	An unexpected finds protocol will be employed if previously unidentified asbestos contamination is	Construction Contractor	Construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		discovered during construction. Work in the affected area will cease immediately, and an investigation must be undertaken and report prepared to determine the nature, extent and degree of the asbestos contamination. The level of reporting must be appropriate for the identified contamination in accordance with Guidelines for Consultants Reporting on Contaminated Sites (OEH, 2011), any relevant SafeWork NSW codes of practice and include the proposed methodology for the remediation of the asbestos contamination. Works may only recommence upon receipt of a validation report from a suitably qualified contamination specialist that the remediation activities have been undertaken in accordance with the investigation report and remediation methodology.			
SO12	Sedimentation and erosion	During detailed design, the potential impacts associated with bridge construction and operation will be further considered to minimise the likelihood of bank instability and scouring, flow alteration and potential increased risk of flooding. The design and construction methodologies should, wherever possible, minimise direct and indirect impacts to riparian vegetation, and implement best practice water sensitive urban design (WSUD) measures to provide dissipation of flows and prevent gross pollutants and contaminants entering the study area's waterways. WSUD measures are designed to	Designer	Detailed design	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		provide treatment of nutrients and suspended solids prior to discharge to the existing receiving environment.			
Waste management					
WA1	Waste management – general	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 project • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • 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 Roads and Maritime Waste Fact Sheets.	Construction Contractor	Pre-construction	Project specific control
WA2	Waste management - general	All wastes will be managed and disposed of in accordance with the POEO Act. ***All liquid and/or non-liquid waste generated on the site will be assessed and classified in accordance with Waste Classification Guidelines (Environment Protection Authority 2014), or any superseding***	Construction Contractor	Construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		document.			
WA3	Waste management – general	Noxious weeds removed during construction will be managed in accordance with Department of Primary Industries requirements and relevant legislation.	Construction Contractor	Construction	Project specific control
WA4	Waste management – general	Site inductions will include waste management and disposal requirements and facilities.	Construction Contractor	Construction	Project specific control
WA5	Waste management – general	Appropriate portable toilets with either pump out facilities or sewer connections will be provided for site personnel and sewage will disposed of appropriately and in accordance with relevant legislation.	Construction Contractor	Construction	Project specific control
WA6	Fill material	Excavated material will be reused on site where feasible and suitable for the intended reuse to reduce demand on resources. Where excavated material cannot be used on site, opportunities for reuse on nearby projects will be investigated.	Construction Contractor	Construction	Project specific control
WA7	Fill material	Any required additional fill material will be sourced from appropriately licensed facilities and/or other construction projects wherever possible. Additional fill material will be sourced and verified as suitable for use in accordance with relevant EPA and Roads and Maritime guidelines.	Construction Contractor	Construction	Project specific control
WA8	Green waste	Where practicable and suitable for use, cleared vegetation will be mulched for use on site.	Construction Contractor	Construction	Project specific control
WA9	Disposal of waste	Excavated material will be reused on-site where feasible and suitable for the intended reuse to	Construction Contractor	Construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		reduce demand on resources. Where excavated material cannot be used on site, opportunities for reuse on nearby projects will be investigated.			
WA10	Disposal of waste	All waste will be disposed of to an appropriate licensed facility. ***All waste materials removed from the site will only be directed to a waste management facility or premises lawfully permitted to accept the materials.***	Construction Contractor	Construction	Project specific control
WA11	Management of tannins	A tannin leachate management protocol will be developed in accordance with Roads and Maritime' Environmental Direction – Management of Tannins from Vegetation Mulch (Roads and Maritime, 2012) to manage the stockpiling of mulch and use of cleared vegetation and mulch filters for erosion and sediment control	Construction Contractor	Construction	Project specific control
WA12	***Waste generation***	***Waste generated outside the site will not be received at the site for storage, treatment, processing, reprocessing, or disposal on the site, except as expressly permitted by a licence under the Protection of the Environment Operations Act 1997, if such a licence is required in relation to that waste.***	***Construction Contractor***	***Construction***	***Project specific control***
Air quality					
AQ1	Air quality	An Air Quality Management Plan (AQMP) will be prepared ***by a suitably qualified and experienced person(s) in consultation with the EPA*** and implemented as part of the CEMP. The AQMP will include, but not be limited to:	Construction Contractor	Detailed design / pre-construction	Section 4.4 of G36 *Environment Protection*

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Potential sources of air pollution • Air quality management objectives consistent with any relevant published EPA and/or OEH guidelines • 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.			
AQ2	Dust emissions	Work will cease when levels of visible airborne dust become excessive.	Construction Contractor	Construction	Project-specific control
AQ3	Dust emissions	Works that disturb vegetation, soil or stockpiles will not be carried out during winds over 40 km/h when this may affect receivers.	Construction Contractor	Construction	Project-specific control
AQ4	Dust emissions	Stockpiled materials will be covered stabilised or stored in areas not exposed to high winds.	Construction Contractor	Construction	Project-specific control
AQ5	Dust emissions	All trucks will be covered when transporting materials to and from the site.	Construction Contractor	Construction	Project-specific control
Climate change and greenhouse gas emissions					
CC1	Greenhouse gas emissions	The use of alternative fuels and power sources for construction plant equipment will be investigated and implemented, where appropriate	Construction Contractor	Pre-construction	Project-specific control
CC2	Greenhouse gas emissions	The energy efficiency and related carbon emissions will be considered in the selection of	Construction Contractor	Pre-construction	Project-specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		vehicle and plant equipment			
CC3	Greenhouse gas emissions	Construction equipment, plant, and vehicles will be appropriately sized for the task	Construction Contractor	Construction	Project-specific control
CC4	Greenhouse gas emissions	Equipment will be serviced frequently to ensure they are operating efficiently	Construction Contractor	Construction	Project-specific control
CC5	Greenhouse gas emissions	Where possible, materials will be delivered as full loads and local suppliers would be used	Construction Contractor	Construction	Project-specific control
Cumulative impacts					
CU1	Cumulative construction impacts	Ongoing coordination and consultation will be undertaken between the project teams on Albion Park Rail Bypass, Berry to Bomaderry upgrade, and The Consultation Plan will include consultation with Project Managers of the Batemans Bay Bridge replacement , Berry to Bomaderry upgrade and the Far North Collector Road projects to ensure cumulative traffic impacts are appropriately assessed and managed, particularly during peak holiday periods:	Roads and Maritime, Construction Contractor	Pre-construction	Project specific control
CU2	Cumulative construction impacts	Consultation with Shoalhaven City Council will be undertaken regarding the Far North Collector Road to ensure cumulative traffic impacts are appropriately assessed and managed, particularly during peak holiday periods	Roads and Maritime, Construction Contractor	Pre-construction and construction	Project-specific control
CU3	Cumulative impacts	The CEMP will be reviewed regularly and revised as required to reflect surrounding development works as it becomes known.	Construction Contractor	Construction	Project specific control

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
~~HR1~~	~~Hazard and risk management~~	~~A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP 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 site, 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 HRMP 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.~~	~~Construction Contractor~~	~~Detailed design / pre-construction~~	~~Project specific control~~

6.3 Licensing and approvals

Table 6-2 outlines the licensing and approvals required for the project. As a result of submissions made and additional assessment undertaken, there are no further licences or approvals required.

Table 6-2: Summary of licensing and approvals required

Instrument	Requirement	Timing
Protection of the Environment Operations Act 1997 (s120)	Environment protection licence (EPL) for scheduled activities - extractive activity.	Prior to start of construction
Fisheries Management Act 1994 (s199)	Notification to the Minister for Primary Industries prior to any dredging or reclamation works.	Minimum of 28 days prior to the start of any dredging or reclamation works.
Fisheries Management Act 1994 (s205)	Permit to harm marine vegetation from the Minister for Primary Industries.	Prior to any works that could harm marine vegetation
Heritage Act 1977 (s60)	Should subsurface works which may impact significant archaeological remains with Graham Lodge are unavoidable and justifiable, an Archaeological Research Design will be prepared to support a section 60 application.	Prior to start of any construction activities affecting Graham Lodge
National Parks and Wildlife Act 1974 (s90)	Aboriginal heritage impact permit from the Chief Executive of OEH.	Prior to start of construction
Crown Land Management Act 2016 (s1.15)	Authorisation to occupy areas of Crown land.	Prior to start of construction

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[1] https://www.illawarramercury.com.au/story/5636699/rare-bird-sighting-in-nowra-has-birdwatchers-in-a-flap/

Glossary of terms and abbreviations

Term / Acronym	Meaning
AEP	Annual exceedance probability
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management Systems
AHIP	Aboriginal Heritage Impact Permit
AoS	Assessment of Significance
AQMP	Air Quality Management Plan
ARI	Average recurrence interval
ASS	Acid sulfate soils
BAR	Biodiversity Assessment Report
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BoM	Bureau of Meteorology
CEMP	Construction environmental management plan
CSEP	Community and Stakeholder Engagement Plan
CLM Act	*Crown Land Management Act 2016* (NSW)
DoS	Degree of saturation
DPI	Department of Primary Industries
EEC	Endangered ecological community
EIA	Environmental impact assessment
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.

Term / Acronym	Meaning
EPL	Environment Protection Licence
ESA	Environmental site assessment
ESCP	Erosion and Sedimentation 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
FFMP	Flora and Fauna Management Plan
FM Act	*Fisheries Management Act 1994* (NSW)
GDE	Groundwater dependent ecosystem
Heritage Act	*Heritage Act 1977* (NSW)
HML	Higher mass limit
HRMP	Hazard and Risk Management Plan
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
KTP	Key threatening process
LEP	Local Environmental Plan; a type of planning instrument made under Part 3 of the EP&A Act
LGA	Local government area
LoS	Level of Service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
MNES	Matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
NAHMP	Non-Aboriginal Heritage Management Plan
NCA	Noise Catchment Area
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NVMP	Noise and Vibration Management Plan
OEH	Office of Environment and Heritage

Term / Acronym	Meaning
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PAD	Potential archaeological deposits
PASS	Potential acid sulfate soil
PBS	Performance Based Standards
PCT	Plant community type
PEI	Preliminary environmental investigation
PMF	Probable maximum flood
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
REF	Review of environmental factors
Roads and Maritime	NSW Roads and Maritime Services
SCATS	Sydney Coordinated Adaptive Traffic System
SEIA	Socio-economic impact statement
SEPP	State Environmental Planning Policy; a type of planning instrument made under Part 3 of the EP&A Act
SIDRA	Signalised & unsignalised Intersection Design and Research Aid; a traffic engineering software suite used to assess/analyse intersection and network capacity, level of service and performance, and signalised intersection and network timing calculations.
SHR	State Heritage Register
SOHI	Statement of Heritage Impact
SWMP	Soil and Water Management Plan
TfNSW	Transport for NSW
TMP	Traffic Management Plan
TSS	Total Suspended Solids
VHT	Vehicle hours travelled

Term / Acronym	Meaning
VM	Value Management
WMP	Waste Management Plan
WQO	Water Quality Objective(s)
WSUD	Water sensitive urban design

Appendix A

Nowra Bridge Project Survey Review Final Report

Roads and Maritime Services

Nowra Bridge Project Survey Review Final Report

February 2019

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1. Introduction

Roads and Maritime Services has commissioned several companies to conduct Origin-Destination (OD) surveys to understand the traffic patterns within the Nowra Bomaderry region. These surveys were carried out in 2003, 2013, 2014 and 2018.

1.1 Purpose of this report

GHD Illawarra South Coast (GHD) was engaged by Roads and Maritime to review the O/D survey data previously conducted in the Nowra Bomaderry region. The survey methods were reviewed and the survey datasets and results were analysed to identify any key trends and limitations in the methodologies.

1.2 Assumptions and limitations

The evaluation undertaken by GHD considers only available information provided by Roads and Maritime and publicly available data from the Roads and Maritime website. GHD had no access to raw datasets from the survey companies that conducted the surveys.

1.3 Data sources

In developing this report, GHD has used the following data sources:

- AECOM's Nowra Bridge Project Strategic Traffic Assessment, 6 April 2014
- High Range Analytics Pty Ltd.'s Shoalhaven Origin-destination Survey – Comparison Final Report, 17 May 2015
- High Range Analytics Pty Ltd's Shoalhaven Origin-destination Survey – data analysis report draft 2, 10 January 2014
- MATRIX Traffic and Transport Data Pty Ltd.'s N3930 – Nowra Bomaderry OD Survey Report, March 2018
- Bitzios Consulting's Nowra Bridge Traffic Modelling Final Options Assessment Sensitivity Testing Report, 16 May 2016
- Traffic volume data a published on the Roads and Maritime Services Traffic Volumes website (http://www.rms.nsw.gov.au/about/corporate-publications/statistics/traffic-volumes/aadt-map/index.html#/?z=6)
- Australasian Traffic Surveys' OD spreadsheets (2003)
- Australasian Traffic Surveys' Intersection Data of Bridge Road, North Road and Berry (2003)
- Australasian Traffic Surveys' of Princes Highway and Illaroo Road (2003)
- Australasian Traffic Surveys' of Princes Highway, Bridge Road and Pleasant Way (2003)
- High Range Analytics Pty Ltd's OD spreadsheets (2013)
- Austraffic Traffic and Transport Data Specialists' OD spreadsheets (2014)
- MATRIX Traffic and Transport Data Pty Ltd.'s OD spreadsheets (2018)

2. Background

Nowra Bomaderry plays a significant role at both the state and regional levels. Nowra Bomaderry is the largest service centre to the south of Wollongong, providing regional services outside the greater Sydney metropolitan region. The South Coast is one of the most visited tourist areas in NSW outside of Sydney. It is linked to the Sydney, Canberra, Melbourne corridor through the Moss Vale Road link and is the focal point for another important link to the south-west. The Nowra Bomaderry region is the centre of one of the fastest growing local government areas in the state, having the largest growth in the Illawarra and South Coast Region and one of the highest growth rates outside the Newcastle-Sydney area.

The Princes Highway, on the NSW south coast, is the main road which connects Sydney with the Illawarra, Shoalhaven and other regional centres towards the Victorian border. It serves as the main transport corridor providing freight and passenger movements to and from the Illawarra and South Coast regions, and supports South Coast tourist travel demand, and connects towns on the South Coast with Wollongong and Sydney.

Figure 2-1: Existing Nowra Bridges (Source: Google Street View)

3. Traffic volumes and trends

3.1 AADT

Annual Average Daily Traffic (AADT) volumes were obtained from the Roads and Maritime Traffic Volume Viewer website for the Nowra Bridge permanent counting station for the period between 2007 and 2017. The count station is located on the Princes Highway 190 metres south of Illaroo Road, with Station ID 07.051 and is located within the Origin-Destination (OD) survey boundaries (see Figure 5-1, Figure 5-2 and Figure 5-3). Site 07.051, shown at Figure 3-1, was inactive between 2012 and 2014 and therefore AADT volumes are unavailable.

At this location, the AADT has increased from 43,599 vehicles in 2007 to 50,807 in 2017, with an Annual Average Growth Rate (AAGR) of 1.6 per cent. Northbound traffic volumes increased from 21,637 vehicles in 2007 to 25,950 vehicles in 2017, with an AAGR of 1.9 per cent. Southbound traffic volumes increased from 22,043 vehicles in 2007 to 24,857 vehicles in 2017, with an AAGR of 1.5 per cent. Average traffic volumes for all days between 2007 and 2017 are shown in Figure 3-2.

Figure 3-1: Location of count station 07.051 (source: RMS Traffic Volume Viewer)

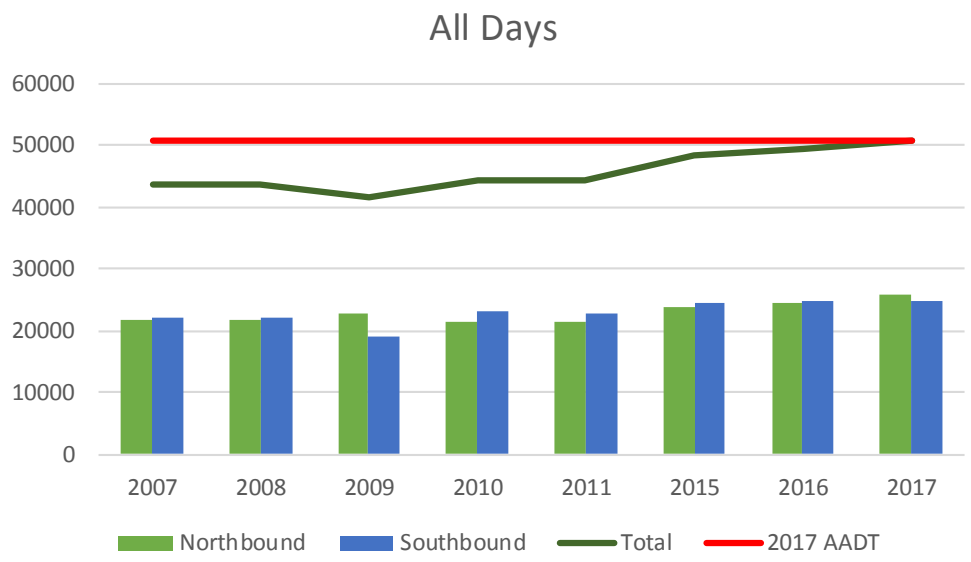

Figure 3-2: Princes Highway Annual Average Daily Traffic (2007-2017)

The Annual Average Traffic count on a weekday in 2017 was 52,614 vehicles, as shown in Figure 3-3, and 47,095 vehicles on weekends and public holidays as shown in Figure 3-4. Weekend traffic was 7.3 per cent lower than weekday traffic. A greater amount of traffic is observed on a Friday, 9.5 per cent more than the average weekday (Monday – Thursday). This increase in traffic has an impact on the local road network.

Sundays were observed to have about 9.9 per cent less traffic than on weekdays. This slight decrease in traffic volumes between weekday and weekend traffic may be attributed to fewer local journeys across the river (for work, shopping, education etc.) being offset by more through trips along the highway as holidaymakers return from the South Coast.

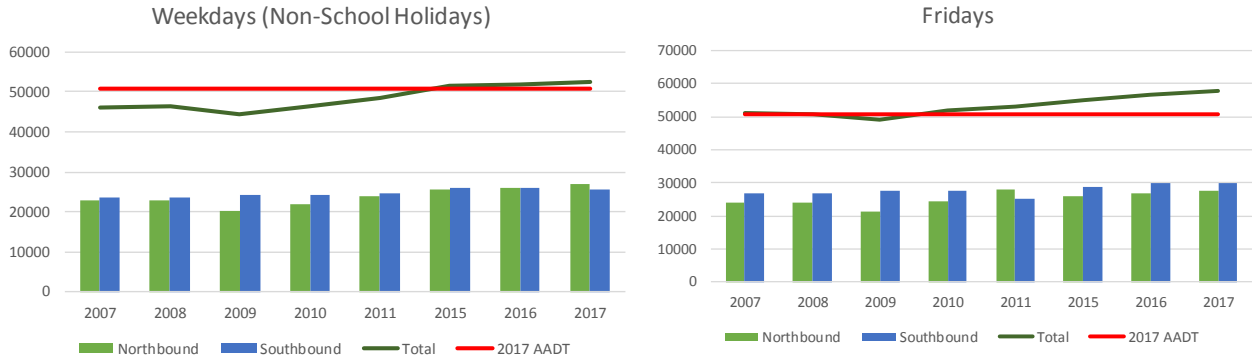

Figure 3-3: Princes Highway Annual Average Weekday and Friday Traffic (2007-2017)

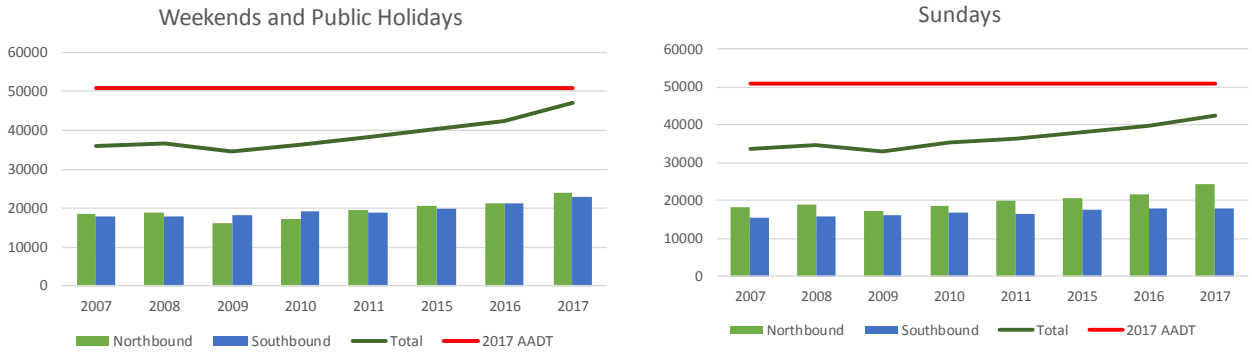

Figure 3-4: Princes Highway Annual Average Weekend and Public Holiday and Sunday Traffic (2007-2017)

3.2 Hourly volumes

In 2017, which is the most recent year with hourly traffic data available for both directions, the AADT volumes on the bridge was observed to peak between 11am-12pm, with 7.9 per cent of the total daily traffic and between 3-4pm, with 8.3 per cent share of the total daily traffic.

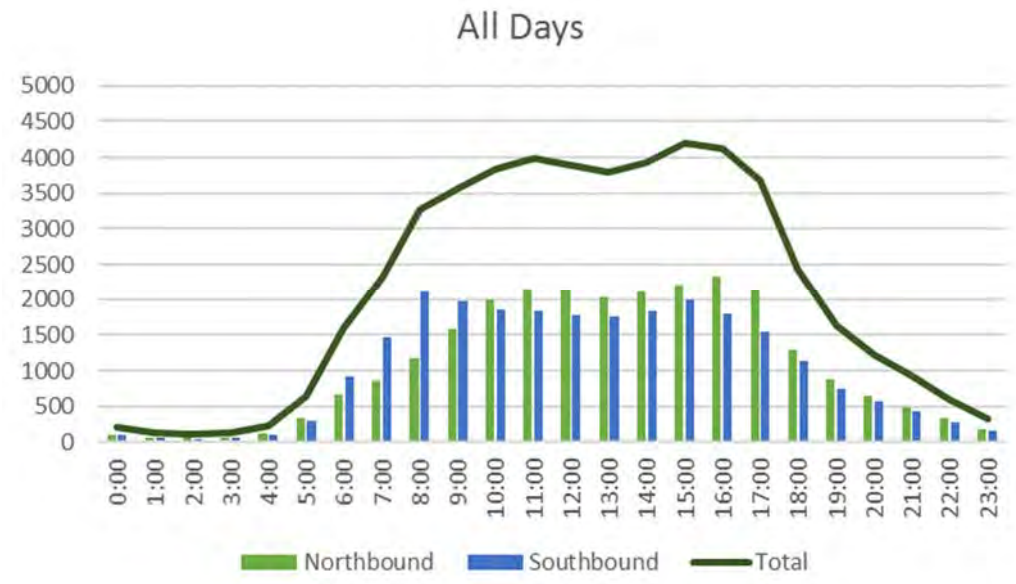

Figure 3-5: Princes Highway Average Hourly Traffic Volume on All Days for 2017

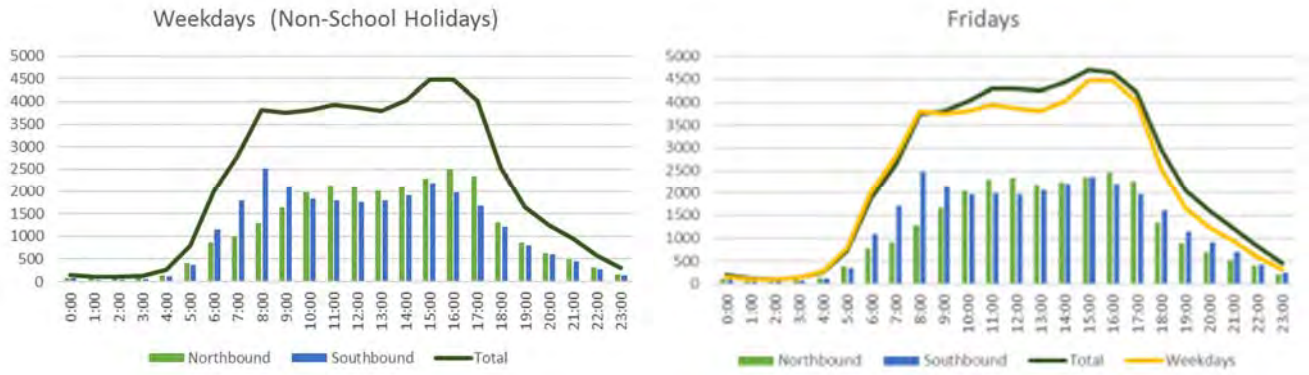

Figure 3-6: Princes Highway Average Hourly Traffic Volume on Weekdays (left) and Fridays (right) for 2017

Weekday traffic volumes were also observed to peak between 11am-12pm, with 7.8 per cent of the total daily traffic demand and between 3-4pm, with 8.8 per cent share of the total daily traffic demand. Fridays have the highest peak hour traffic recorded, with the PM period occurring between 1pm-7pm. Traffic in the southbound direction is generally higher than in the northbound direction, which could be associated with people travelling down to the South Coast from the north (including from Sydney).

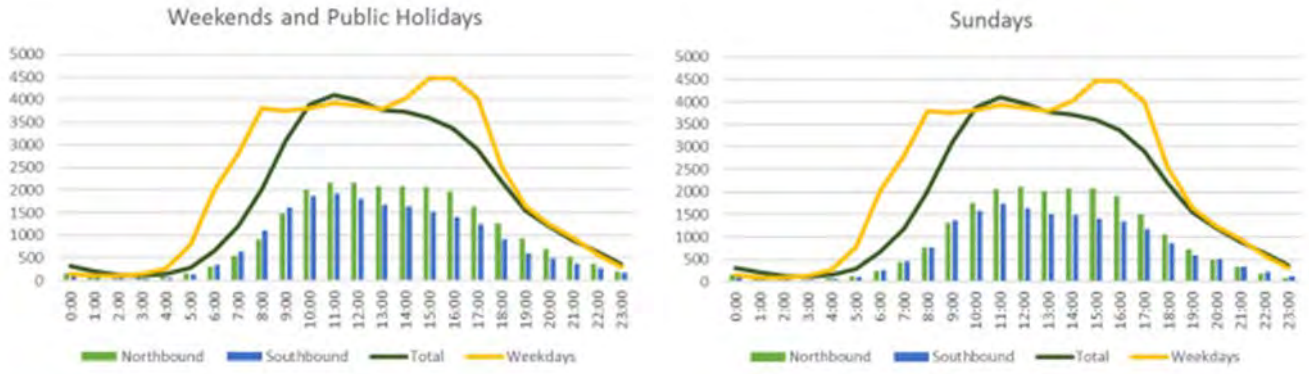

Figure 3-7: Princes Highway Average Hourly Traffic Volume on Weekends and Public Holidays (left) and Sundays (right) for 2017

On weekends, traffic volumes were observed to peak between 11am – 12pm, with 8.1 per cent of the total daily traffic demand. Traffic volumes on Sundays was observed to be approximately 11 per cent lower than compared with weekend (Saturday and Sunday combined) / public holiday periods. Sundays have a sustained northbound traffic flow peak, which occurs between 11am and 5pm.

As shown in Figure 3-8, Fridays have the highest daily traffic, with Sundays have the lowest traffic volumes.

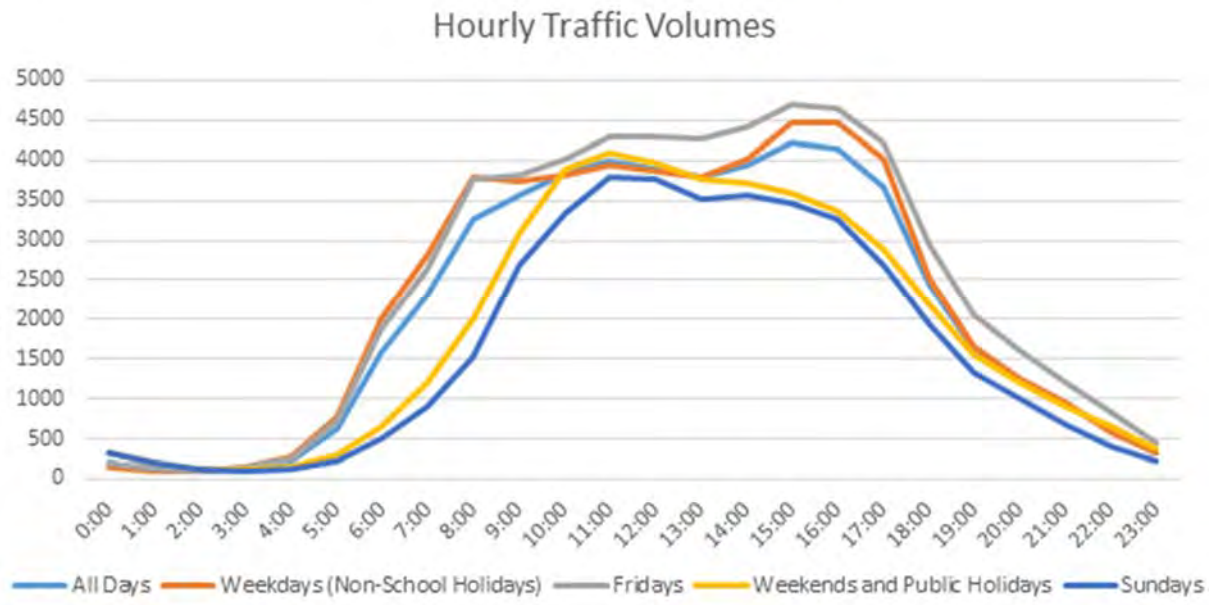

Figure 3-8: Comparison of Hourly Traffic Volumes

3.3 Traffic counts

Directional classified traffic surveys were conducted at the intersections of the Princes Highway with Bolong Road, Illaroo Road and Bridge Road / Pleasant Way on Thursday 25 September 2003, Friday 25 October 2013, and Friday 1 December 2017. These counts were used to represent a typical day to determine the existing traffic volumes within the vicinity of the Shoalhaven River crossings.

As each of these surveys were undertaken on weekdays, a factor was applied to determine average weekend and public holiday traffic, as shown in Table 3-1. These factors were derived from weekend and public holiday Annual Average values taken from the Roads and Maritime Traffic Volume Viewer website. It should be noted, however, that the 2003 and 2013 AADT volumes were extrapolated and interpolated respectively, due to the lack of available information. This means that these values may not reflect actual traffic trends during those years. The traffic trends discussed in the following sections would therefore be different should alternative daily traffic factors be applied.

Table 3-1 Factors applied to weekday traffic to determine weekend and public holiday traffic volumes

	2003	2013	2017
Weekend	0.744	0.785	0.895
Public Holiday	0.741	0.809	0.701

3.3.1 Comparison of traffic counts

Figure 3-9 summarises the weekday traffic count data for 2003 and 2017 for roads within the vicinity of the bridge. This indicates that while traffic originating from the Berry / Moss Vale direction has increased by around 17 per cent between 2003 and 2017, local traffic growth from Illaroo Road was around 30 per cent.

Figure 3-9: Weekday Directional Link Volumes for 2003 (left) and 2017 (right)

Figure 3-10 shows the weekend traffic counts for 2003 and 2017 for roads within the vicinity of the bridge.

Figure 3-10: Weekend Directional Link Volumes for 2003 (left) and 2017 (right)

Figure 3-11 shows the public holiday traffic counts for 2003 and 2017 for roads within the vicinity of the bridge.

Figure 3-11: Public Holiday Directional Link Volumes for 2003 (left) and 2017 (right)

3.4 Growth forecasts

Future traffic was estimated using an annual growth rate of 2.7 per cent, as identified in the Nowra Bridge Project – Preferred Option report (2018). However, it was identified that this growth rate might overestimate traffic growth in the region. Sensitivity tests were therefore undertaken using linear growth rates of 1.1 per cent and 1.7 per cent per annum. These growth rates were determined based on historical survey data from count stations located at the bridge and at Rose Valley Road, located to the north of the project area.

As discussed in Section 6, the AAGR along Princes Highway and annual traffic growth rate in the study corridor are within the range of the rates used in previous studies and are therefore considered acceptable and realistic.

4. Drivers of traffic demand

To be able to properly address the current and future traffic problems within a specific area, it is important to understanding the factors that drive traffic demand. It is essential in the formulation of strategies to alleviate, if not minimise, traffic problems and for planning an efficient and environmentally sustainable transportation system. These factors include changes in land use patterns and the development of new infrastructure.

4.1 Regional journeys

Nowra serves as the commercial and administrative centre of the region. Its major industry, aside from manufacturing, is tourism because of its proximity to many popular natural and cultural attractions. It also hosts many local, state and federal government offices. There's also a presence from Australian Navy in the area. Bomaderry, is the southernmost coastal link to the NSW rail system from Sydney (Nowra Shoalhaven Coast, 2018). These factors contribute to the increasing traffic demand in the area.

The Princes Highway is the major road linking Nowra and Bomaderry. It is also the link connecting the northern and south eastern regions of NSW. It serves as the main, and only, continuous transport corridor providing freight and passenger movements between these regions. High traffic demand is therefore observed along the corridor, especially within the Nowra and Bomaderry area.

The following figures illustrate the origin and destination of trips within the Nowra Bomaderry region across the four surveyed periods. As shown, most trips are between the north and the south of the region, generating traffic along the Princes Highway and Shoalhaven River bridges. Consequently, traffic volumes across the bridges are among the highest experienced on the NSW South Coast, with an AADT of 50,893 in 2017 (refer to Figure 3-2).

Within each figure, the lines represent traffic flows between the two points on the map while the colours represent the magnitude of the traffic demand, with green being the lowest number of trips and red being the highest number of trips.

The figures also compare 2003 to 2014 and 2018 for the OD patterns and flows.

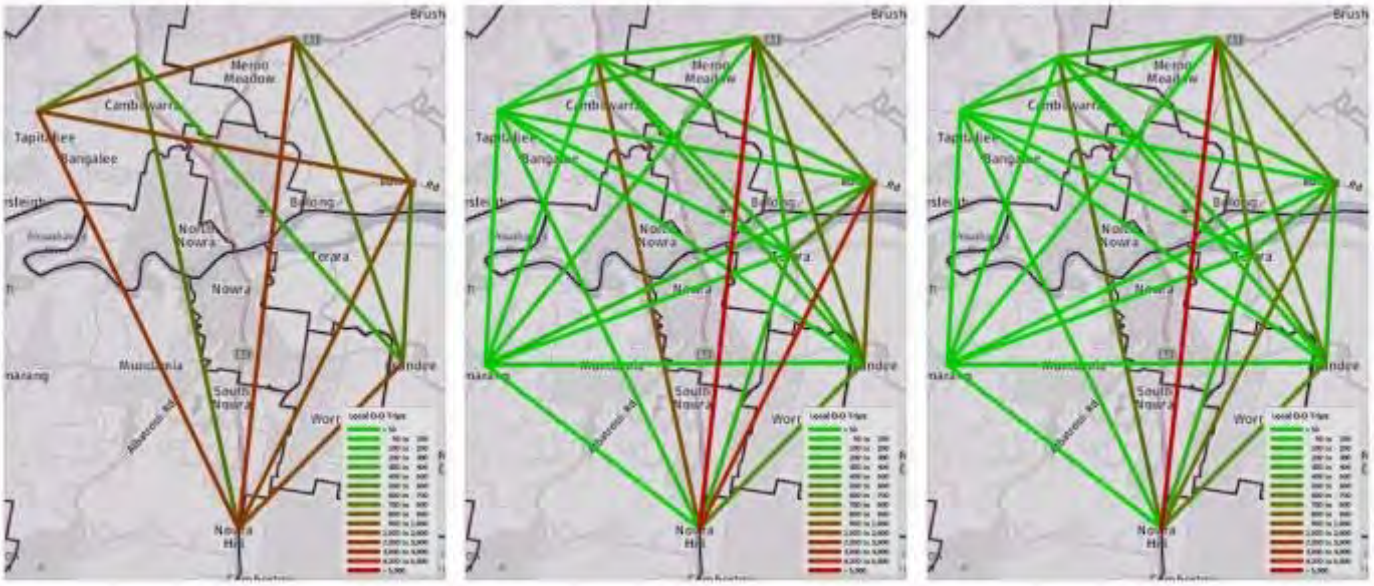

Figure 4-1: Surveyed OD trips for 2003 (left), 2014 (middle) and 2018 (right)

Figure 4-2: Vehicle trips per link for 2003 (left), 2014 (middle) and 2018 (right)

4.2 Local Journeys

Being the commercial and administrative centre in the region, Nowra attracts both regional and local trips. In 2013, around 89 per cent of trips in the area were local trips (i.e. people who live locally, accessing services and jobs within Nowra). In 2014, around 64 per cent of the total trips were local trips, with 71 per cent being local trips in 2018.

Table 4-1: Local journeys

Local Trip Type	2013	2014	2018
Local Trips	64,264	32,727	27,630
Total Trips	**71,996**	**51,325**	**39,001**

5. OD Survey methodology review

OD surveys are conducted to determine where a trip starts, what modes were used (e.g. walking, public transport, private vehicle), what route was taken, when and how often the trip was taken, and where the trip ends. Data gathered from OD surveys help easily identify travel patterns and the associated demands on the transportation network. This data is used as an input to transportation models to support the decision-making process and identify strategic recommendations and policies to address current transportation issues and plan for future infrastructure needs.

OD survey methods include but are not limited to roadside interviews, licence plate surveys, telephone surveys, mail/postcard surveys and GPS tracking. Conducting these surveys over long periods of time is not feasible, as this requires a lot of resources (eg manpower, equipment, etc.) and snapshot surveys are generally only carried out over a 24-hour period.

Several OD surveys were undertaken in 2003, 2013, 2014 and 2018. The purpose of this surveys was to determine trends in both through and local traffic, when crossing the bridges in the Nowra Bomaderry area.

5.1 2003 OD Survey

Manual classified traffic counts surveys were undertaken by Australasian Traffic Surveys on Wednesday 24 September 2003. The manual counts recorded the registration numbers of all white cars (light vehicles) and heavy vehicles at nine two-way count stations, which are summarised in Table 5-1 and Figure 5-1. The counts were undertaken during a 12 hour period, between 6am - 6pm.

Based on information provided by Shoalhaven City Council and the Bureau of Meteorology website, during the time the survey was conducted, there was no rainfall at Nowra and the maximum temperature was 23°C (recorded at HMAS Albatross, as cited in the High Range Analytics Pty Ltd report, 2015).

The data received from the Australasian Traffic Surveys was the raw data that was collected during the surveys. The following factors were applied in processing the survey data:

- 1.20 – to convert the 12-hour (6am-6pm) figures to 24-hour estimate
- 2.37 – to convert raw matches (just whites and heavies) to approximate all vehicles
- 1.23 – to account for 10 per cent errors made, as advised by Australasian Traffic Surveys

The manual traffic surveys may have included some errors, as staff resources were noted to be insufficient to process the surveys at some stations. Analysis of station to station movements was required to identify any errors and manual corrections applied to account for any specific errors.

Table 5-1: 2003 OD Survey Station Locations

Station	Description
Station 1	SH1, North of Meroo Road
Station 2	Bolong Road, East of Papermill
Station 3	Greenwell Point Road, west of Apperleys Lane
Station 4	SH1, South of BTU Road
Station 5	Illaroo Rd, East of Greys Beach Road
Station 6	Moss Vale Road, North of Barfield Road
Station 7	SH1 at Kiama Bends
Station 8	SH1, North of Wheelbarrow Road
Station 9	Moss Vale Road at Fitzroy Falls

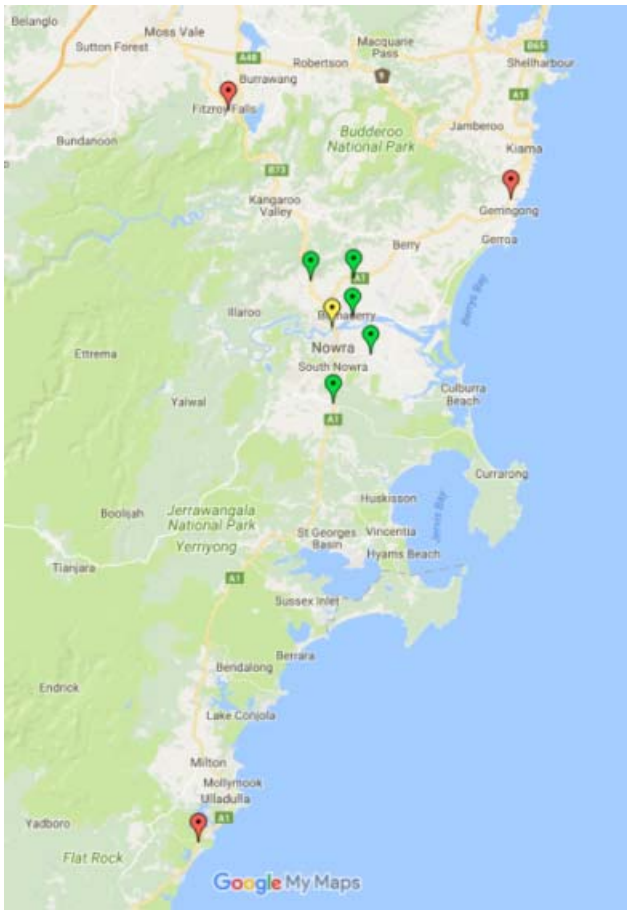

Figure 5-1: 2003 OD Survey Location (source: Google My Maps; Data from Australasian Traffic Surveys, September 2004)

5.2 2013 OD Survey

An OD survey was conducted for on behalf of Roads and Maritime and Shoalhaven City Council on Friday 25 October 2013. The survey used video capture techniques to record licence plates during four hour AM and PM peak periods (between 8am-9am and between 3pm-6pm) at 26 two-way stations, as shown in Table 5-2 and Figure 5-2. Licence plate observations were classified into five vehicle classes, including light vehicles (LV), light commercial, medium-heavy vehicles, large heavy vehicles and buses.

Based on information provided by Shoalhaven City Council and the Bureau of Meteorology website, there was no rainfall recorded during the times that the survey was conducted and the maximum temperature was 23° Celsius.

The OD survey captured 100 per cent of the vehicles passing through the traffic count stations. This data was encoded using the following fields: licence plate, vehicle class, time of observation and observation station. Obscure characters in licence plates were replaced by a hyphen '-' for easier data processing.

Based on the Shoalhaven OD Survey Comparisons report (2015), the survey data was processed using matching analysis with an expansion process applied to incomplete plates. Expansion factors for each survey station were calculated using the following approach:

- Expansion factor = total plates (including those with hyphens)/good plates [1]

- These expansion factors were applied multiplicatively for the first and last station observed e.g. for an observation I, passing from Station O to Station D, the expansion factor is computed using the following:
- Expansion Factor Observation I = Expansion Factor Station O * Expansion Factor Station D [2]
- Where Expansion Factors for Station O and D are calculated for origin and destination station, respectively using [1] above.

Table 5-2: 2013 OD Survey Station Locations

Station	Station Index	Station No	Road	Location
1N	1	1	Princes Highway	Between Kiama and Gerringong
1S	2	1		
2N	3	2	Moss Vale Road	Barrengary
2S	4	2		
3E	5	3	Princes Highway	Jaspers Brush
3W	6	3		
4N	7	4	Moss Vale Road	Cambewarra
4S	8	4		
5E	9	5	Illaroo Road	Tapitallee
5W	10	5		
6E	11	6	Bolong Road	Bolong
6W	12	6		
7N	13	7	Princes Highway	Bomaderry
7S	14	7		
8E	15	8	Bolong Road	Bomaderry
8W	16	8		
9E	17	9	Illaroo Road	North Nowra
9W	18	9		
10E	19	10	Bridge Road	Nowra
10W	20	10		
11N	21	11	Princes Highway	Nowra

Station	Station Index	Station No	Road	Location
11S	22	11		
12E	23	12	Comerong Island Road	Terrara
12W	24	12		
13E	25	13	Greenwell Point Road	Worrigee
13W	26	13		
14E	27	14	Yalwal Road	Bamarang
14W	28	14		
15E	29	15	Flinders Road	South Nowra
15W	30	15		
16E	31	16	Flinders Road	South Nowra
16W	32	16		
17E	33	17	Central Avenue	South Nowra
17W	34	17		
18N	35	18	Albatross Road	Nowra Hill
18S	36	18		
19N	37	19	Princes Highway	Nowra Hill
19S	38	19		
20E	39	20	BTU Road	Nowra Hill
20W	40	20		
21E	41	21	Forest Road	Comberton
21W	42	21		
22N	43	22	Princes Highway	Falls Creek
22S	44	22		
23N	45	23	Braidwood Road	Jerrawangala
23S	46	23		
24E	47	24	Turpentine Road	Tomerong
24W	48	24		

Station	Station Index	Station No	Road	Location
25N	49	25	Princes Highway	Yatte Yattah
25S	50	25		
26N	51	26	Princes Highway	Burrill Lake
26S	52	26		

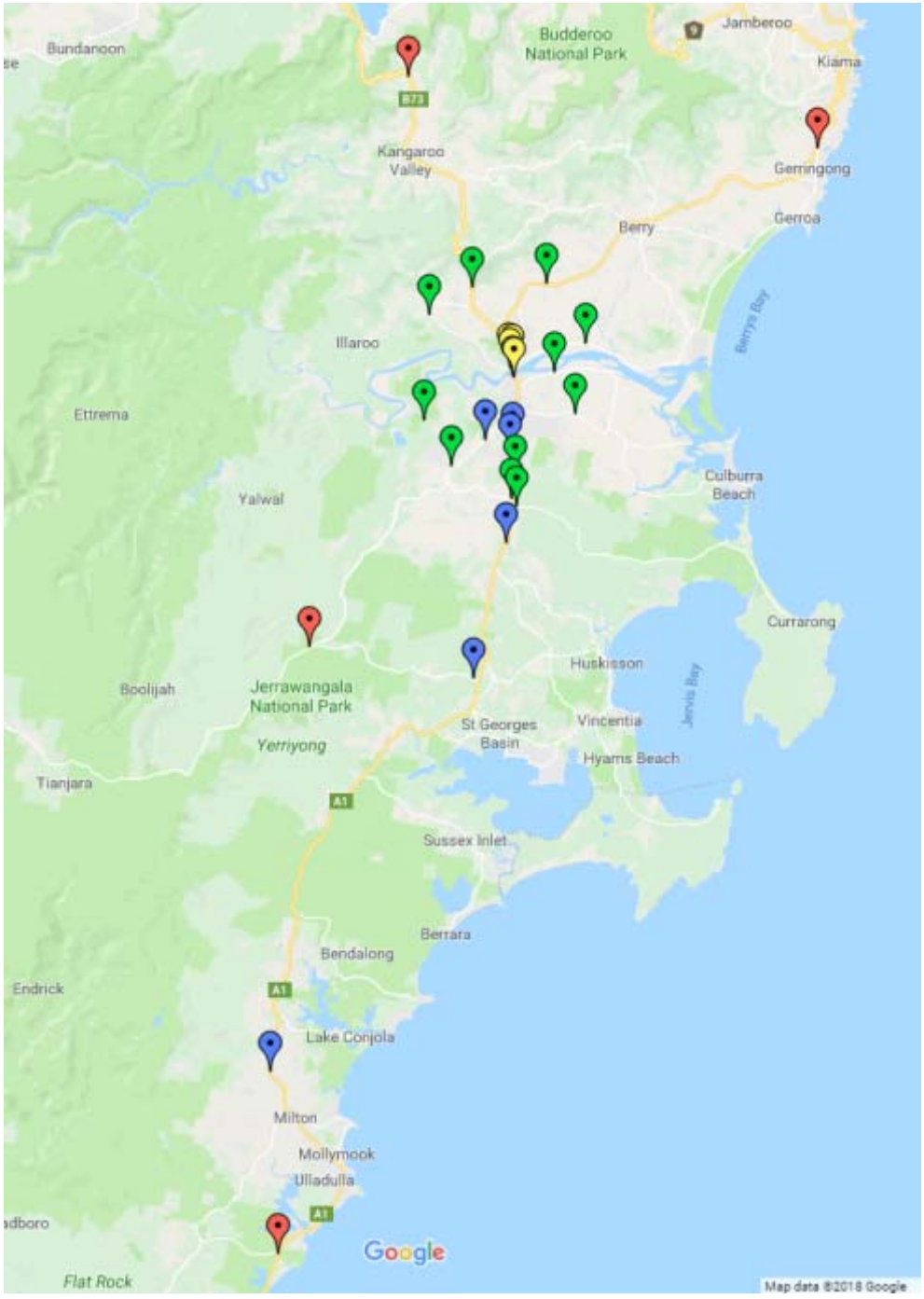

Figure 5-2: 2013 OD Survey Locations (Source: Shoalhaven Origin-destination Survey Final, High Range Analytics Pty Ltd, 2015)

5.3 2014 OD Survey

An OD survey was conducted on Friday 14 March 2014. Video capture techniques were used to record licence plates for a 24 hour period with the counts undertaken at the same locations as surveyed during the 2013 OD survey, shown in Table 5-2 and Figure 5-2. Licence plate observations were classified into three vehicle classes, including light and heavy vehicles and buses.

The survey also captured 100 per cent of the samples. Data encoding and processing was similar to the previous survey.

Based on the material provided by Shoalhaven City Council and Bureau of Meteorology website identified that there was no rainfall during the surveys and the maximum temperature was 23°C.

5.4 2018 OD Survey

Matrix Traffic and Transport Data were commissioned to undertake an OD survey around the Nowra Bomaderry area on Wednedsday 21 February 2018.

Similar to the previous OD surveys, video capture techniques were used to record licence plates at the same stations where the 2013 and 2014 surveys were conducted (refer to Table 5-3). OD count data was collected at seven count stations outlining the boundary of the Nowra Bomaderry study area for a 24 hour period, while a 13-hour OD survey was carried out from 6am-7pm at the remaining stations in the internal and wider network.

Unfortunately, the 24 hour cameras at stations 7 and 18 were stolen and vandalised, respectively. As such, only the 13 hour data was collected. The 13 hour OD data at station 23 replaced station 18. The table below shows the list of stations used in the analysis.

In order to calculate 24 hour traffic demands, an expansion factor of 1.108 was applied to the 13 hour traffic count data.

The survey also captured 100 per cent of the samples. Data encoding and processing was similar to the previous surveys. Licence plate observations were classified into two vehicle classes – light vehicles and heavy vehicles.

Table 5-3: 2018 OD Survey Stations Locations

Station	Direction	Road	Location
3E	Eastbound	Princes Highway	East of Devitts Lane / Morschels Lane
3W	Westbound		
4N	Northbound	Moss Vale Rd	North of Barfield Road
4S	Southbound		
5E	Eastbound	Illaroo Road	West of Tapitallee
5W	Westbound		
6E	Eastbound	Bolong Road	West of Jennings Lane
6W	Westbound		
7N	Northbound	Princes Highway	Bomaderry
7S	Southbound		
8E	Eastbound	Bolong Road	Bomaderry
8W	Westbound		
9E	Eastbound	Illaroo Road	North Nowra
9W	Westbound		
10E	Eastbound	Bridge Road	Nowra
10W	Westbound		

11N	Northbound	Princes Highway	Nowra
11S	Southbound		
12E	Eastbound	Comerong Island Road	East of Bryant Street
12W	Westbound		
13E	Eastbound	Greenwell Point Road	West of Apperleys Lane
13W	Westbound		
14E	Eastbound	Yalwal Road	West of Longreach Road
14W	Westbound		
19N	Northbound	Princes Highway	South of Warra Road
19S	Southbound		
23N	Northbound	Braidwood Road	North of Turpentine Road
23S	Southbound		

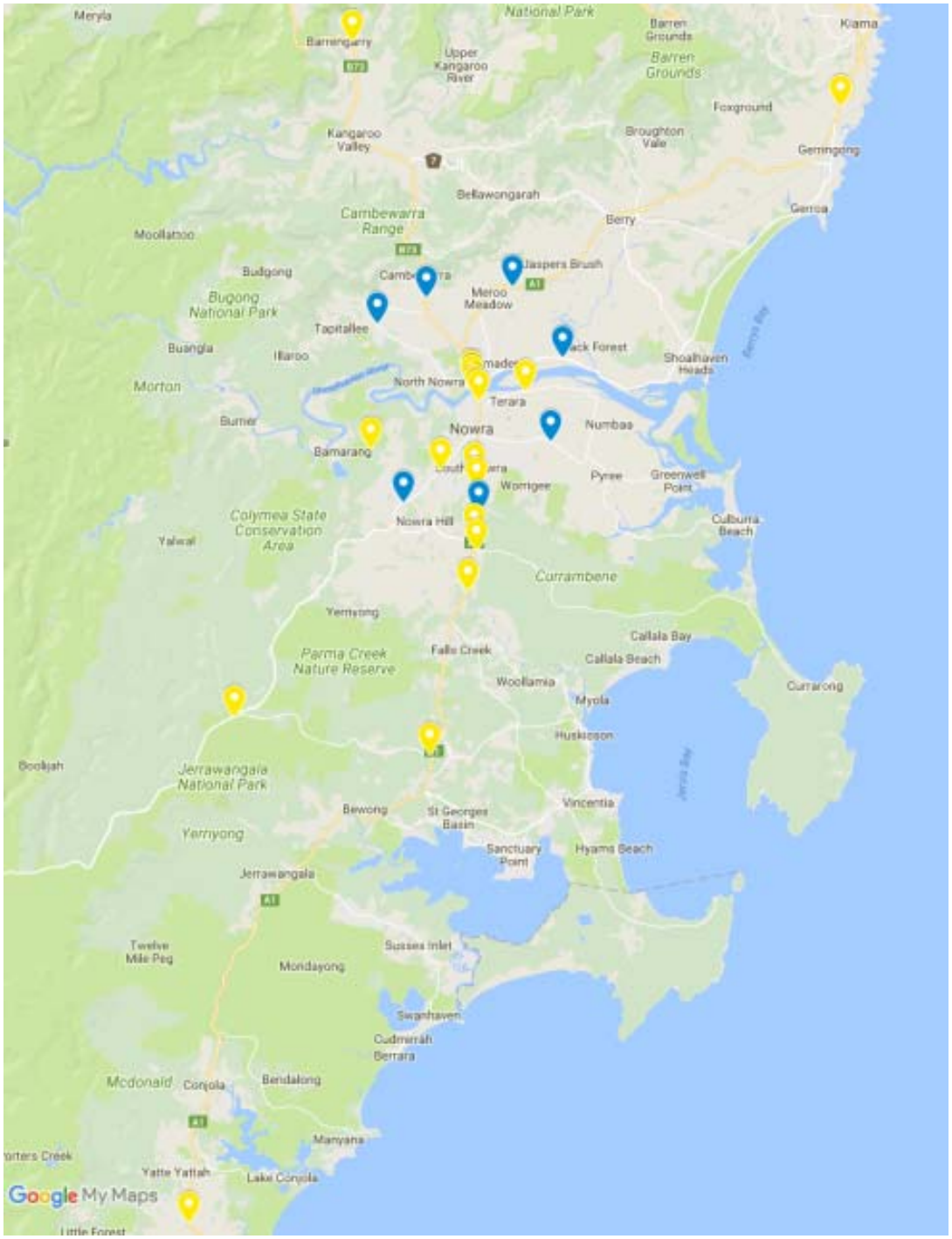

Figure 5-3: 2018 OD Survey Locations (source: Matrix Traffic and Transport Data, March 2018)

5.5 Summary of review findings

OD Surveys are fundamental in understanding travel patterns and their associated demands on the transportation network over a specific study area or an entire region. Therefore, choosing a survey method is quite crucial.

Since the 2003 OD survey was conducted manually with fieldworkers/surveyors recording licence plate numbers for vehicles passing the survey locations, there was potential for human error.

Video recording methods were applied during the 2013, 2014 and 2018 OD surveys to reduce human error and provide more accurate results. Licence plates were then counted in a controlled office environment. This method is more convenient compared to the 2003 survey but there is still a possibility that data can be lost if the video fails due to a damaged camera equipment, which is what occurred during the 2018 surveys.

There is still no perfect method for conducting OD surveys. Expansion factors have been applied by the survey companies to account for possible errors made (for example incomplete licence plates). These expansion factors also help to approximate all vehicles on an average weekday if surveys are carried out during peak hours only.

The data collected during the four surveys can be utilised to identify travel patterns and determine travel time and average travel speeds in the different segments of the road network.

6. OD survey travel patterns

Understanding travel patterns is important in efficiently planning transportation systems at local and regional levels. This information is useful in the development and provision of transportation infrastructure that can enable people in the surrounding community to easily travel from one place to another.

The travel patterns analysed in the following discussions are for through, local and regional trips:

- Through trips are defined as trips that are only passing through the Nowra Bomaderry region and their origins and destinations are outside the region.
- Local trips are defined as internal trips within the Nowra Bomaderry region, with their origin and destinations located within the region.
- Regional trips are defined as trips leaving the Nowra Bomaderry region to destinations outside the region and vice versa.

Figure 6-1 shows the locations surveyed in the OD surveys, conducted in 2013, 2014 and 2018. These serve as the basis for the analysis. Vehicles entering the green cordon, crossing the Shoalhaven River and leaving via the green cordon on the opposite side of the river are considered to be through trips (including trips between locations 3 to 6 on the northern side of the river to / from locations 13, 14, 15, 18 and 19 on the southern side of the river). Vehicles entering and leaving the green cordon are considered to be taking regional trips while vehicles entering and leaving the yellow cordon are considered to be taking local trips.

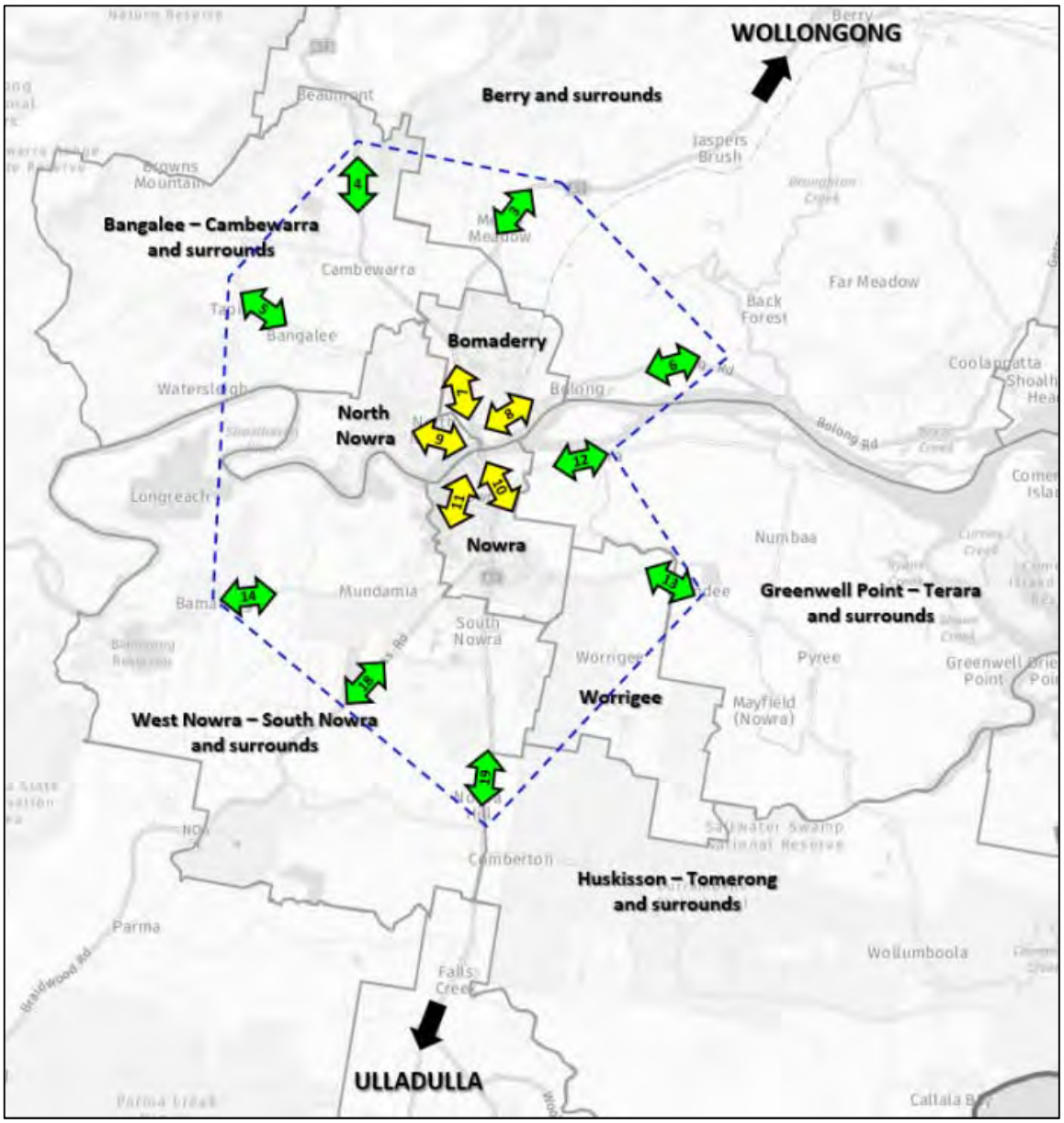

Figure 6-1: Common OD Survey Stations

Figure 6-2 shows a comparison of the total number of trips entering and leaving the region in 2003, 2014 and 2018. As shown, the stations along the Princes Highway have the highest number of trips recorded which enter and leave the Nowra Bomaderry region. It can therefore be concluded that most regional and through trips are via the Princes Highway.

The high number of trips observed at Tapitallee in 2003, on the other hand, is because survey counts in that year were taken at station 9, located near the Illaroo and Princes Highway intersection. Also, the large difference in numbers along Albatross Road in the years 2014 and 2018 is due to station 23 being substituted for station 18 (due to the camera being damaged). There was no survey conducted at stations 14 and 18 in 2003, so the trips entering and leaving the region via these stations were not recorded.

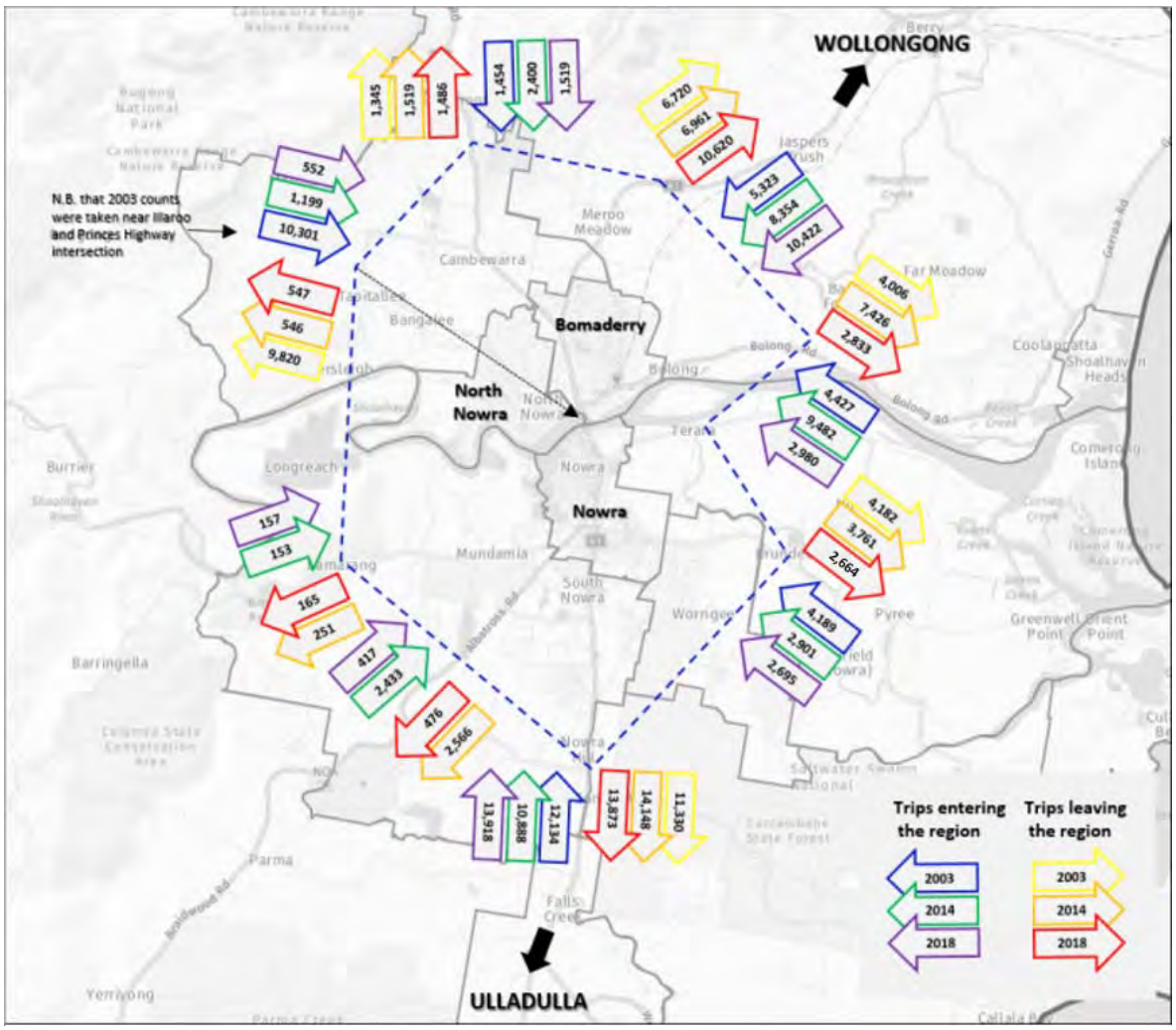

Figure 6-2: Trips Entering and Leaving the Region

6.1 Through trips

Through trips are defined as trips with origins and destinations outside the Nowra Bomaderry region with the origin on the north or south side of the bridge and the destination on the south or north side of the bridge, outside of the region.

Analysis of the through trips utilised the four data sets from the OD surveys conducted during the four survey periods (ie in 2003, 2013, 2014 and 2018). These are the trips coming from the south, southeast and southwest of the region going northwest (to Cambewarra and onwards) and northeast (to Berry onwards) and vice versa. These trips enter the Nowra Bomaderry region and subsequently leave the region in less than one hour.

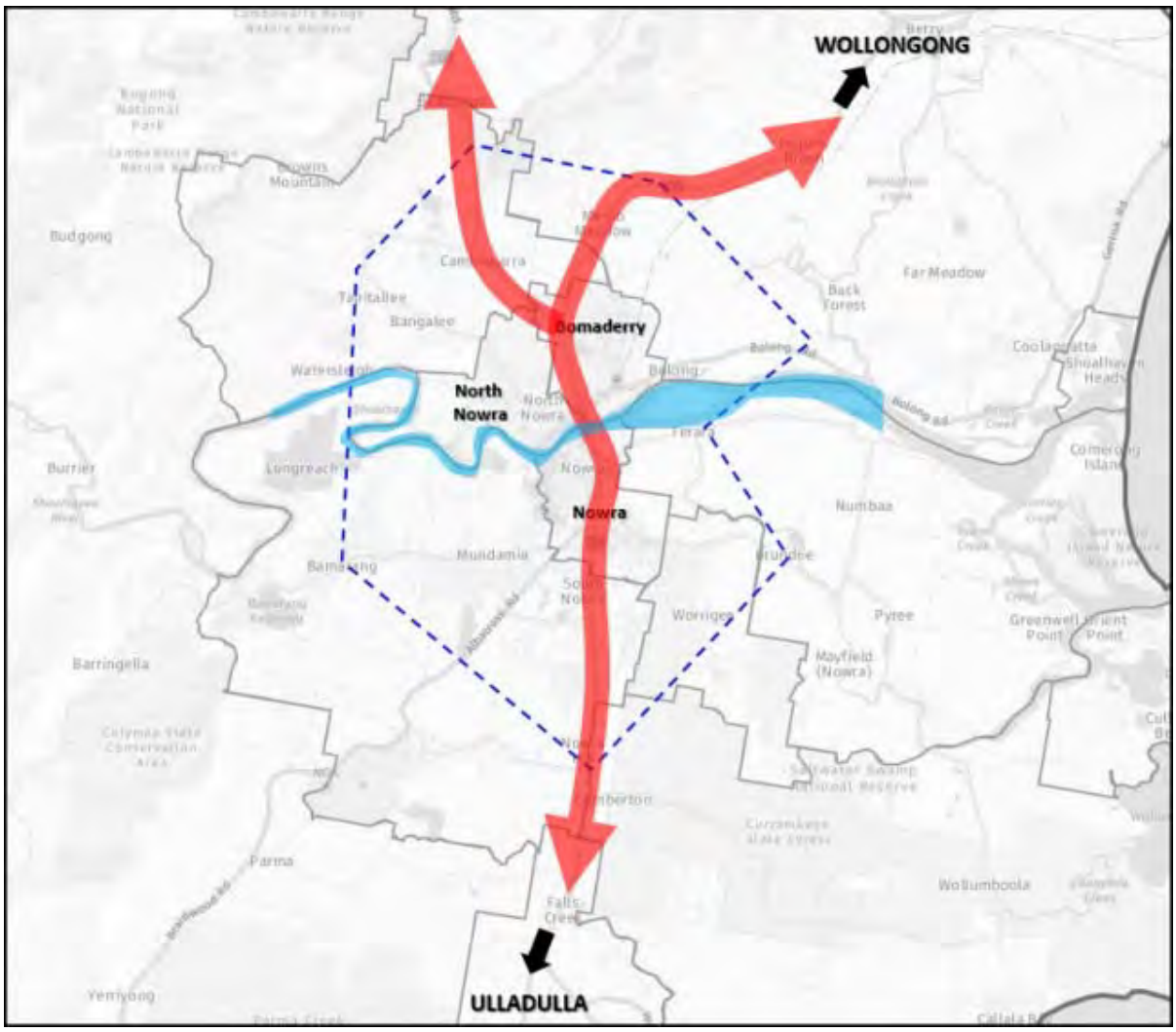

Figure 6-3: Through Trips

Table 6-1: Through Trips (Northbound)

	2003	2013	2014	2018
Light Vehicles	3,297	1,754	3,698	2,516
Heavy Vehicles	590	127	230	225
Total Vehicles	**3,887**	**1,881**	**3,928**	**2,741**

Table 6-2: Through Trips (Southbound)

	2003	2013	2014	2018
Light Vehicles	2,654	1,210	6,722	3,039
Heavy Vehicles	369	71	237	244
Total Vehicles	**3,023**	**1,280**	**6,959**	**3,283**

As shown in Table 6-1 and Table 6-2, the number of light and heavy vehicles passing through the region has generally decreased between 2003 and 2018. The decline in through traffic volumes in 2018 may also be attributed to the lost survey data, as previously discussed, and was not accurately represented by the replacement data (as the traffic passing through station 23 is significantly lesser than the traffic passing through station 18).

6.2 Local trips

Local trips are defined as the trip with both their origin and destination within the Nowra Bomaderry region. Local river crossing trips are those local trips which cross the Shoalhaven River and have their origin and destination with Nowra Bomaderry, as shown inFigure 6-4.

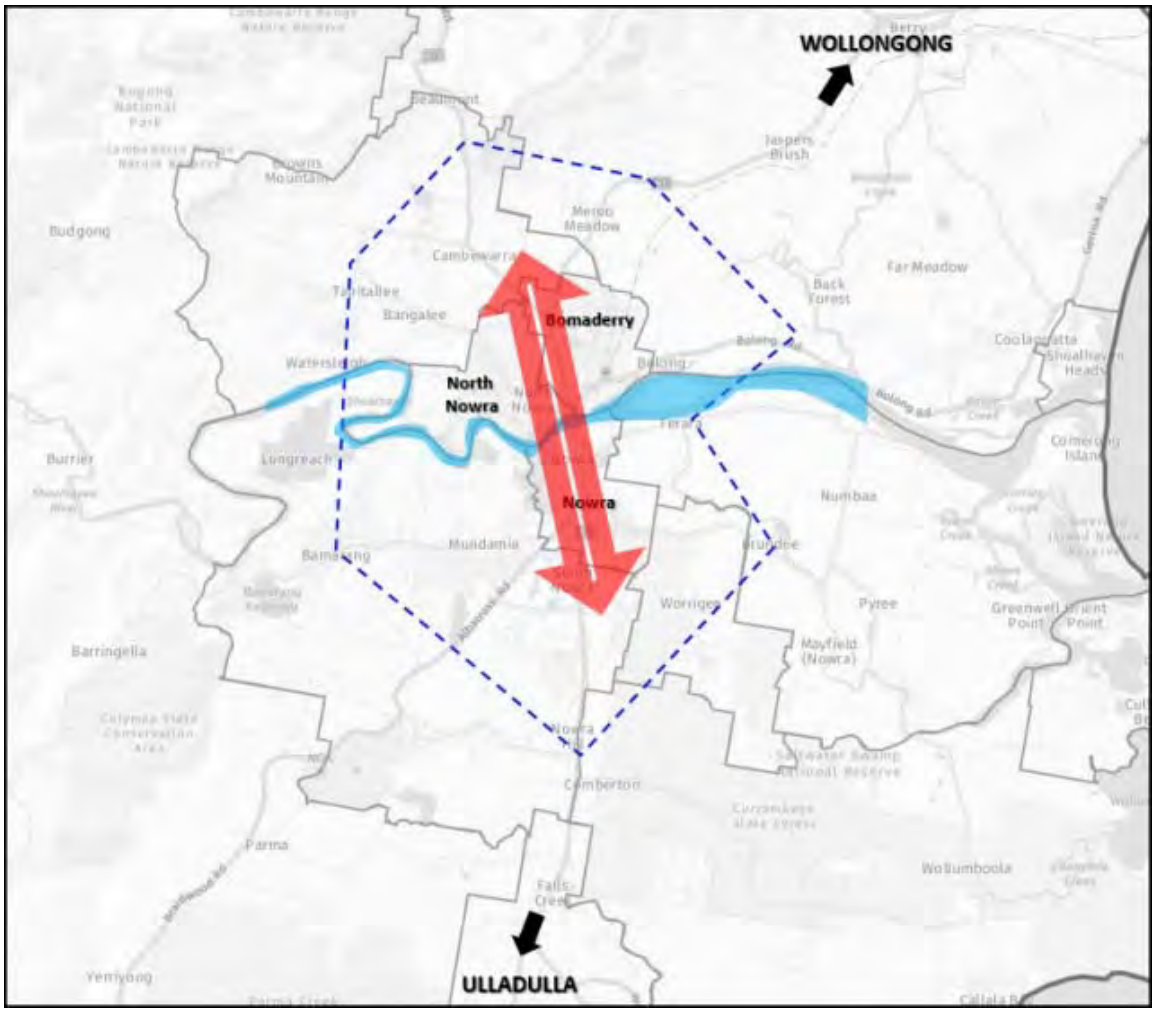

Figure 6-4: Local River Crossing Trips

As summarised in Table 6-3, the total local trips crossing the river has decreased in the northbound direction between 2013 and 2018.

In the southbound direction, summarised in Table 6-4, the number of vehicle trips has increased slightly between 2014 and 2018. However, the number of heavy vehicle trips has decreased, with a slight increase in light vehicle trips. These trips, along with other river crossing trips (ie regional and through trips), indicates an overall small decrease in traffic growth in the area, compared with increased AADT volumes at the bridge. However, this difference may be associated with the OD survey methods applied in the various surveys.

Table 6-3: Local River Crossing Trips (Northbound)

	2013	2014	2018
Light Vehicles	27,897	14,921	13,110
Heavy Vehicles	1,048	556	453
Total Vehicles	**28,945**	**15,477**	**13,563**

Table 6-4: Local River Crossing Trips (Southbound)

	2013	2014	2018
Light Vehicles	22,361	12,386	12,637
Heavy Vehicles	791	520	471
Total Vehicles	**23,153**	**12,906**	**13,108**

6.3 Regional trips

Regional trips have an origin inside and destination outside of the Nowra Bomaderry region, and vice versa. These are also further classified as river crossing and non-river crossing.

6.3.1 Regional river crossing trips

These are the trips that travel to/from outside the Nowra Bomaderry region from/to locations on the opposite side of the river. These trips include vehicles entering and leaving the cordon shown in Figure 6-5, minus the trips that are only passing through the region

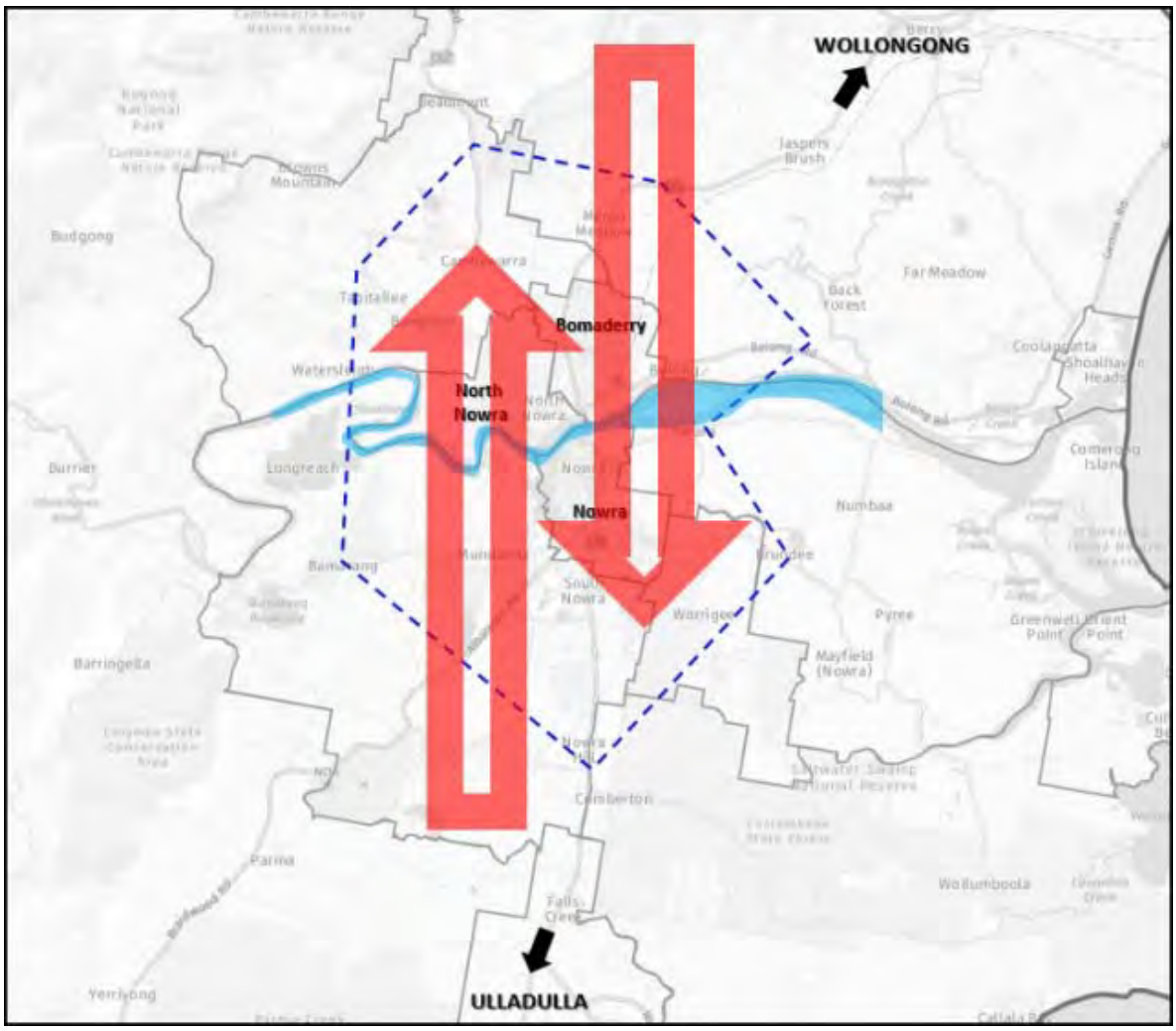

Figure 6-5: Regional River Crossing Trips

As shown in Table 6-5 and Table 6-6, regional river crossing trips have generally increased across the three survey periods.

Table 6-5: Regional River Crossing Trips (Northbound)

	2013	2014	2018
Light Vehicles	639	1,121	9,625
Heavy Vehicles	63	102	737
Total Vehicles	**702**	**1,223**	**10,362**

Table 6-6: Regional River Crossing Trips (Southbound)

	2013	2014	2018
Light Vehicles	2,519	1,715	9,250
Heavy Vehicles	60	127	1,314
Total Vehicles	2,580	1,842	10,564

6.3.2 Regional non river crossing trips

These are the trips that travel to/from outside the Nowra Bomaderry region from/to locations on the same side of the river, as shown in Figure 6-6.

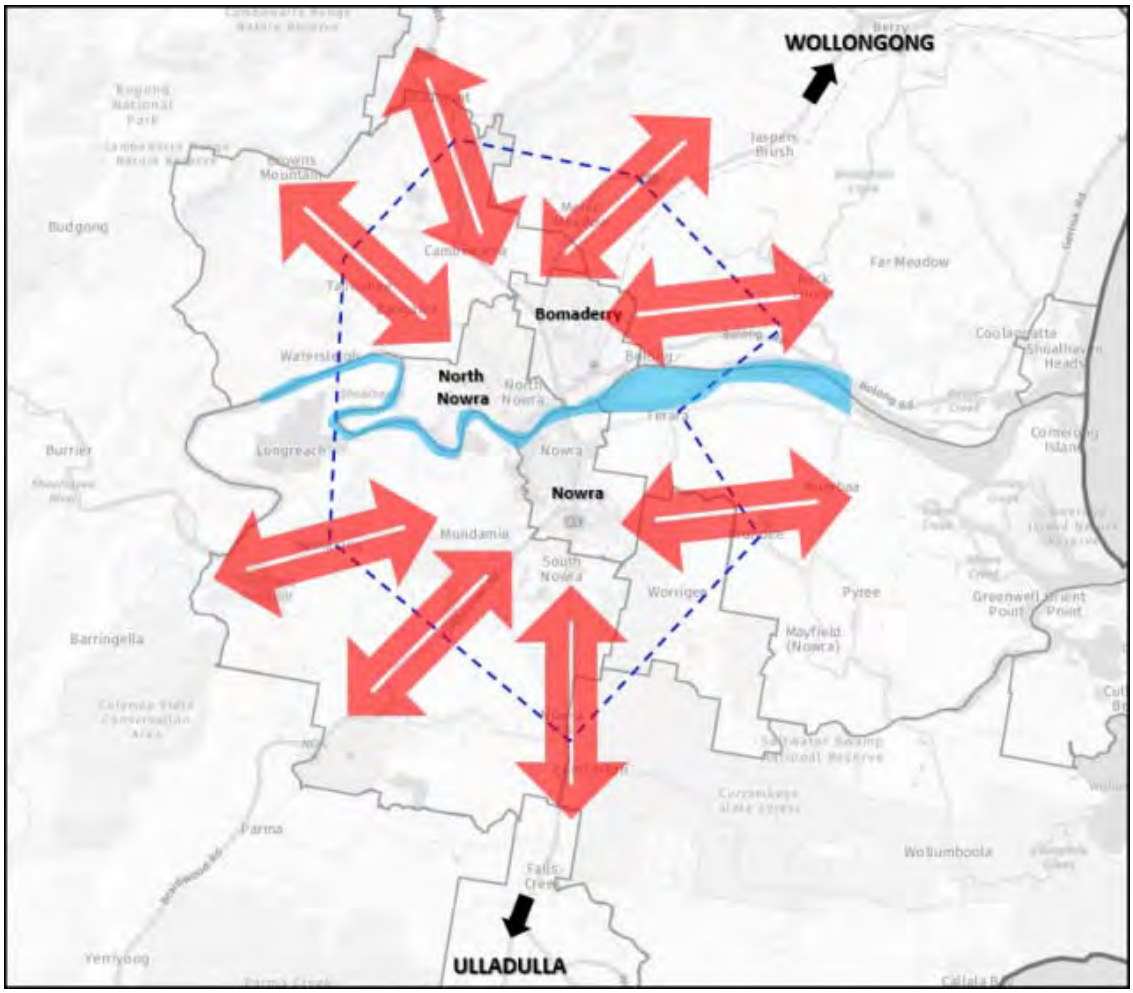

Figure 6-6: Regional Non River Crossing Trips

Regional non river crossing trips have generally increased betweem 2013 and 2018.

Table 6-7: Regional Non River Crossing Trips (North)

	2013	2014	2018
Light Vehicles	390	1,226	5,428
Heavy Vehicles	42	123	421
Total Vehicles	**432**	**1,349**	**5,849**

Table 6-8: Regional Non River Crossing Trips (South)

	2013	2014	2018
Light Vehicles	812	3,131	4,704
Heavy Vehicles	45	166	992
Total Vehicles	**857**	**3,297**	**5,696**

6.4 Summary of trip types

While the OD surveys have collected information at varying points within the study area, it is possible to draw some general trends on how the through, regional and local trips place demand on the bridges across the Shoalhaven River.

Traffic along the Princes Highway, especially in the Nowra Bomaderry region, has increased with an AAGR of 1.6 per cent over the last 10 years. However, the OD surveys data indicates that trips entering and leaving the Nowra Bomaderry region have decreased between 2013 and 2018 (with 71,996 trips in 2013 and 67,441 trips in 2018).

The proportion of the total river crossing trips for local, regional and through trips has varied between the 2013, 2014 and 2018 surveys. These could be attributed to the surveys conducted during different months of the year, accounting for seasonal variations, or on different days of the week, as summarised in Table 6-10.

As discussed in Section 3, Fridays were observed to have the highest weekday traffic volumes along the Princes Highway, particularly in the southbound direction which could be associated with people travelling to the South Coast from the north (including from Sydney) to visit the area for tourism. The 2013 and 2014 OD surveys were both undertaken on a Friday, would could reflected in higher traffic demands than observed during the 2018 surveys, which was undertaken on a Wednesday.

Table 6-9: Summary of OD Survey Trip Types (24 hours)

	2013	2014	2018
Through trips	3,161	10,887	6,024
Local river crossing trips	52,098	28,383	26,670
Regional river crossing trips	3,282	3,065	20,926
Total river crossing trips	58,541	42,335	53,620

Table 6-10: OD Survey Dates

	2003	2013	2014	2018
Survey Date	24 September 2003	25 October 2013	14 March 2014	21 February 2018
Day	Wednesday	Friday	Friday	Wednesday

The relative nature of each trip type in comparison other trip types is shown in Figure 6-7, Figure 6-8 and Figure 6-9 for the 2013, 2014 and 2018 surveys respectively.

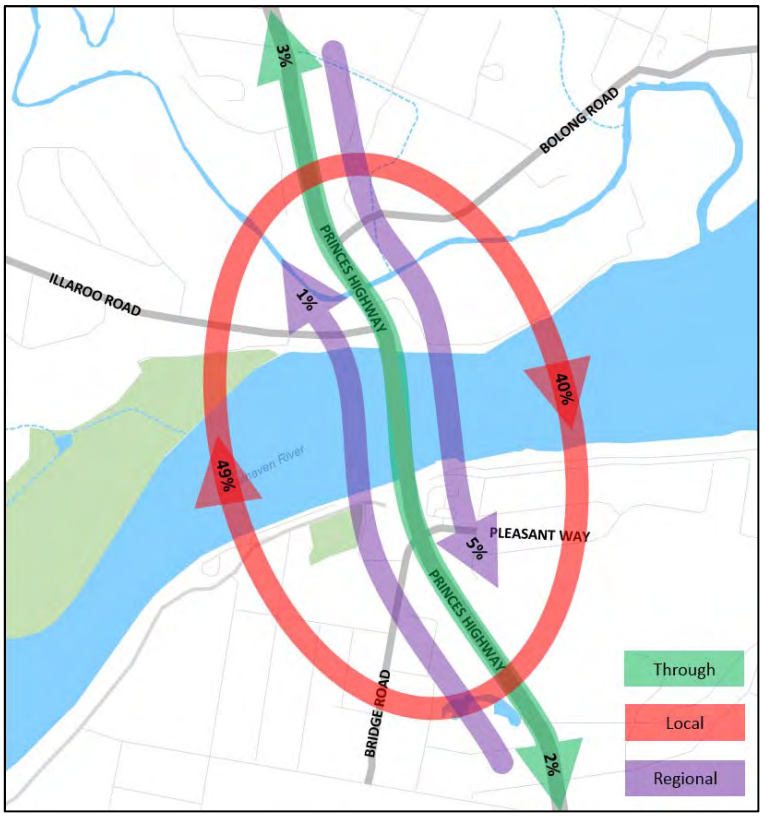

Figure 6-7: Percentage of Total River Crossing Trips in 2013

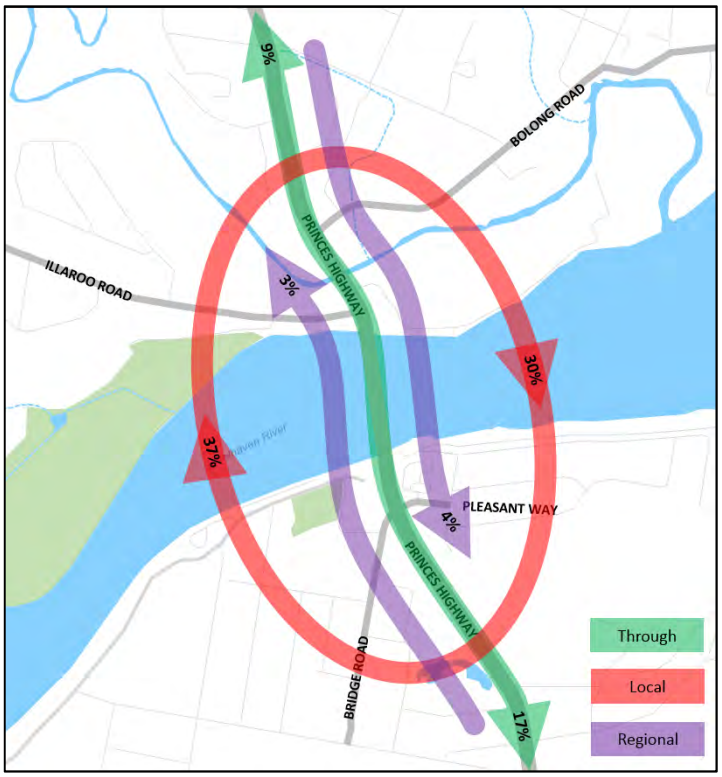

Figure 6-8: Percentage of Total River Crossing Trips in 2014

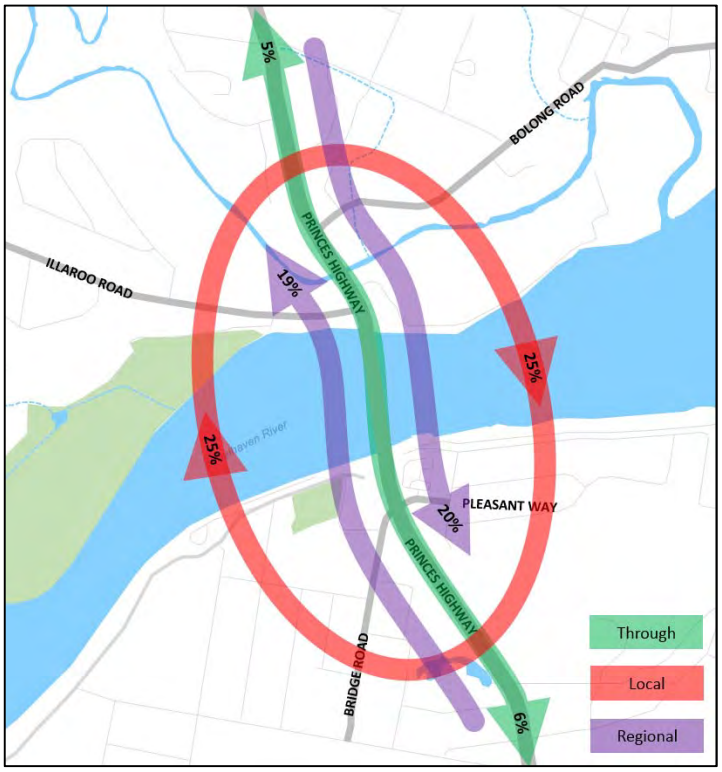

Figure 6-9: Percentage of Total River Crossing Trips in 2018

7. Conclusion

Although the data collected during the four surveys can be used to determine the volume of vehicles crossing the existing bridges, the data cannot be very helpful in understanding the changing travel behaviour within the study area.

The 2003 OD survey has a lower number of count stations compared with the surveys in 2013, 2014 and 2018, so the percentage of increase or decrease in trips from this year cannot be determined exactly. In addition, the 2013 survey does not reflect the actual daily trips, as the survey was only undertaken during peak hours, so expansion factors were applied.

During the 2018 OD survey, some data was not available as the station a camera was vandalised (at count station 18). In the analysis of trip patterns, data from this station was replaced by data recorded at station 23. Since the number of vehicles entering and leaving station 23 is significantly lower than those in station 18, a decrease in the total trips was observed in 2018, however this is unlikely to significantly increase the recorded number of through trips.

The 2014 survey provides the most complete survey data and considered to be the most reliable of the four surveys conducted. Inconsistencies in travel trends can be attributed to errors encountered when the surveys were undertaken.

A review of available traffic data indicates that traffic growth within the Nowra Bomaderry region and traffic growth across the Shoalhaven River are consistent with the 1.7 per cent per annum growth rate adopted by Roads and Maritime Services for the assessment of the project and developing designs.

The OD surveys indicate that the majority of the traffic crossing the Shoalhaven River in Nowra consist of trips with an origin and/or destination in the Nowra Bomaderry area, making up 88 per cent of all river crossing trips observed in the 2018 survey. The remaining 12 per cent of trips pass through the region and across the bridge without stopping.

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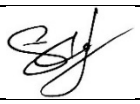
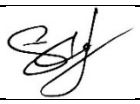
Rev 0	Y Escot / G McCabe	S Clark		S Clark		01/02/2019

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Appendix B

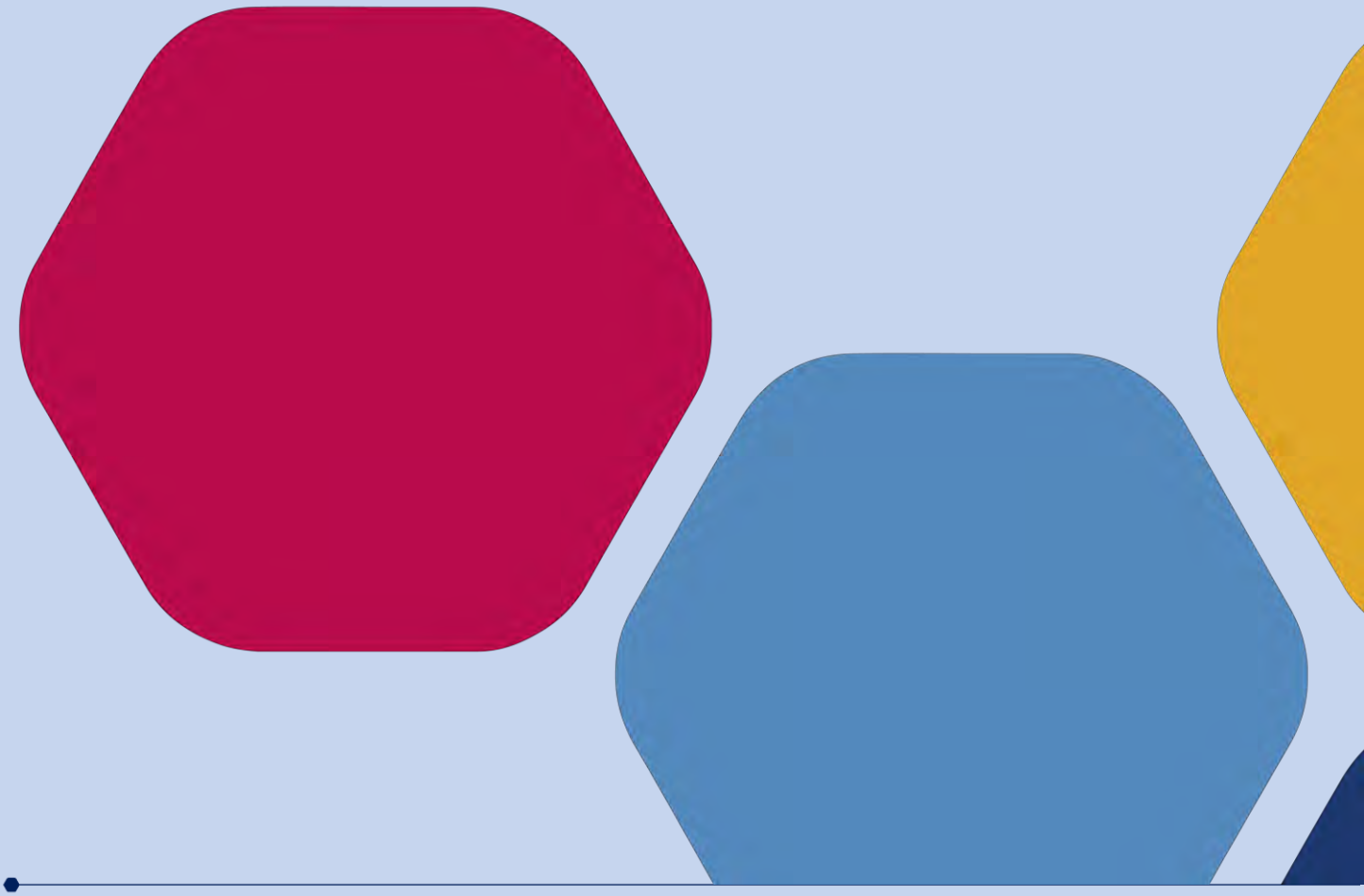
Maritime Archaeology Assessment

RPS

23 NOVEMBER 2018

Nowra Bridge

Maritime archaeological due diligence assessment



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1 Introduction

Roads and Maritime Services NSW (Roads and Maritime) proposes to construct a new four lane bridge over the Shoalhaven River. The proposed project would include the construction of the new four lane bridge to the west (upstream) of the existing Shoalhaven River crossing, the upgrade of the road and intersections, and other adjustments to the local road network. The proposed project would improve safety, capacity and efficiency across the Shoalhaven River and improve freight movement and access to the South Coast.

The proposed project would include the upgrade of about 1.6 kilometres of the Princes Highway from about 150 metres north of the Bolong Road intersection to about 75 metres north of the Moss Street intersection. The new bridge over the Shoalhaven River would be about 360 metres long and would accommodate four lanes of northbound traffic and a shared path.

Roads and Maritime commissioned RPS to prepare a maritime archaeological due diligence assessment for the proposed project. It addresses maritime archaeological constraints, adding to the Statement of Heritage Impact prepared for the proposed project (Artefact 2018). The purpose of the assessment is to identify and assess the significance of any maritime archaeological resources (both above and below water) that may be impacted by the proposed project and to provide strategies for the management of any maritime archaeological resources. The assessment forms part of a Review of Environmental Factors (REF) for the proposed project for approval under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.1 The project area

The project area is in Nowra in the Shoalhaven local government area, on the South Coast of NSW. It is based on the Roads and Maritime preferred option for the proposed project. It spans the Shoalhaven River incorporating the existing Shoalhaven River crossing and the road network at Bomaderry to the north and Nowra to the south (Figure 1.1). The existing Shoalhaven River crossing consists of a southbound iron truss bridge constructed in 1880 and a northbound concrete box girder bridge constructed to the west of it in 1980.

The project area including the river bed is about 26 hectares. The impact area including the river bed is about 10.6 hectares (Figure 1.1).

1.2 Description of the proposed project

The proposed project would include:

- Construction of a new bridge to the west (upstream) of the existing Shoalhaven River crossings including:
  - Four northbound lanes including a dedicated left turn only lane from Bridge Road to Illaroo Road;
  - A 3.5-metre-wide shared use path on the western side of the bridge connecting the Illaroo Road intersection to the Bridge Road intersection;
- Widening of the existing bridge over Bomaderry Creek;
- Minor lane adjustments on the existing northbound bridge to convert it to three lanes of southbound traffic;
- Removal of traffic and closure of the existing southbound bridge for adaptive reuse following the opening of the new northbound bridge. As part of the proposed project, shared paths and maintenance access would be constructed up to the existing southbound bridge and work to prevent unauthorised access would also be carried out. The rehabilitation and repurposing of the existing southbound bridge for adaptive reuse would be subject to a separate consultation and assessment process;

- Upgrading of the Princes Highway to provide three northbound and three southbound lanes from the Bolong Road intersection through to about 75 metres north of the Moss Street intersection;
- Widening of Illaroo Road over about 270 metres;
- Upgrading of the Princes Highway and Illaroo Road intersection to provide:
  - Two southbound right turn lanes from the Princes Highway into Illaroo Road;
  - Three dedicated right turn lanes and one dedicated left turn lane from Illaroo Road to Princes Highway;
  - An acceleration and merge lane for northbound traffic turning into Illaroo Road from Princes Highway;
- Upgrading of the Princes Highway and Bridge Road intersection to provide:
  - Two southbound right turn lanes from the Princes Highway into Bridge Road;
  - One left turn lane from Bridge Road to the Princes Highway;
- Local road adjustments including:
  - Closing the access between Pleasant Way and Princes Highway;
  - Restricting turning movements at the intersection of Bridge Road and Scenic Drive;
  - Construction of a new local road connecting Lyrebird Drive to the Princes Highway about 300 metres south of the existing Pleasant Way intersection;
- Provision of pedestrian facilities at all intersections;
- Dedicated off road shared paths along the length of the proposed project;
- Urban design and social amenity improvements, and landscaping;
- Relocation and/or protection of utility services;
- Drainage and water quality management infrastructure along the road corridor;
- Property work including acquisition, demolition, and adjustments to accesses; and
- Temporary ancillary facilities during construction including offices, construction compounds, and stockpiles.

1.3 Purpose and scope of the assessment

The purpose of the maritime archaeological due diligence assessment is to identify and assess the significance of any maritime archaeological resources (both above and below water) that may be impacted by the proposed project. The scope of the assessment is limited to:

- Identification of maritime archaeological resources including but not limited to any shipwreck, infrastructure or archaeological relic (both above and below water) within the project area;
- An overview of the development of Nowra to the north and Bomaderry to the south of the Shoalhaven River;
- An overview of the development of transport on the Shoalhaven River;
- Assessment of maritime archaeological potential;
- Assessment of the significance of any identified maritime archaeological resources;
- Assessment of impact of the proposed project;
- Recommendations and management strategies for identified maritime archaeological resources; and

- Recommendations and management strategies for unexpected maritime archaeological resources.

1.4 Approach to the assessment

The assessment addresses maritime archaeological constraints, adding to the Statement of Heritage Impact (Artefact 2018) prepared for the proposed project. RPS prepared the assessment with reference to the Australia ICOMOS *Burra Charter for the Conservation of Places of Cultural Significance* (the Burra Charter) and the Office of Environment and Heritage, *Statements of Heritage Impact* (NSW Heritage Office 2002) and Assessing Heritage Significance (Office of Environment and Heritage 2015).

RPS also considered the ICOMOS *Charter for the Protection and Management of Underwater Cultural Heritage* (1996) and the UNESCO *Convention for the Protection of the Underwater Cultural Heritage* (2001) as best practice for the assessment, protection and management of underwater archaeological resources as referred to in the assessment. The assessment did not include an inspection of the project area. It does not consider the impact to the State significant truss bridge across the Shoalhaven River. It is assessed in detail in the Statement of Heritage Impact for the proposed project (Artefact 2018).

1.5 Authorship

RPS Senior Heritage Consultant Georgia Wright prepared the report with input from RPS Senior Archaeologist Dr Dragomir Garbov and RPS Draftsperson Natalie Wood. RPS Newcastle Acting Heritage Manager Alexandra Byrne reviewed the report.

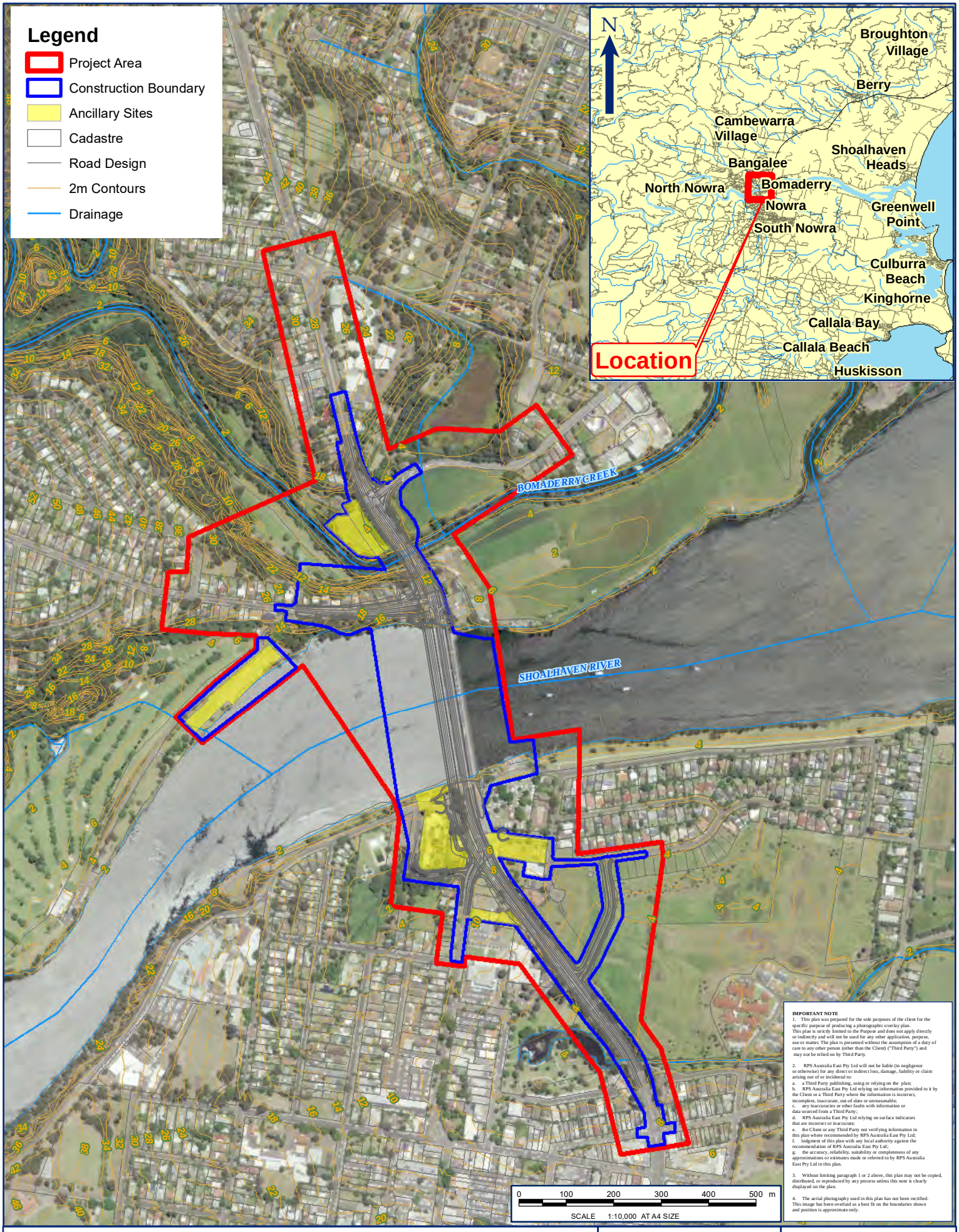

FIGURE 1:PROJECT AREA LOCATION

LOCATION: NOWRA	DATUM: GDA94 PROJECTION: MGA Zone 56
JOB NO.: **PR 142292** PURPOSE: HERITAGE Technician: Natalie.Wood Date: 30/10/2018	Data Sources: RPS, Client Land and Property 2015

CLIENT: NOT SPECIFIED

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2 Legislative context

In NSW, environmental heritage is protected and managed under the NSW *Heritage Act 1977* and the *Environmental Planning and Assessment Act 1979* (EP&A Act).

2.1 NSW Heritage Act 1977

The *Heritage Act 1977* identifies and protects NSW's environmental heritage. It establishes the State Heritage Register (SHR) and includes provisions for Interim Heritage Orders, Orders to Stop Work and archaeological relics (both on land and underwater within the limits of the State). It also requires government agencies to maintain a Heritage and Conservation Register.

To assist management of the State's environmental heritage, the Act distinguishes between assets of State and local significance:

- State significance refers to significance to the State in relation to the historical, archaeological, architectural, cultural, social, natural or aesthetic value of an item.
- Local significance refers to significance to an area in relation to the historical, archaeological, architectural, cultural, social, natural or aesthetic value of an item.

Items may be of State and local significance. Items of local significance may or may not be of significance to the State.

Amendments to the Act in 2001 incorporated specific reference to shipwrecks as protected items if over 75 years of age. The amendments also introduced the Register of Shipwrecks for NSW state protected shipwrecks.

2.1.1 State Heritage Register

The SHR identifies places and objects of importance to the people of NSW. There is one SHR item within the project area (Table 2.1).

Table 1 Items on the State Heritage Register within the project area

No.	Item	Significance
01699	Graham Lodge	State

2.1.2 Section 170 Heritage and Conservation Register

Section 170 of the *Heritage Act 1977* requires government agencies to establish a Heritage and Conservation Register that identifies all assets of environmental heritage that it owns or occupies. Government agencies are required to provide the NSW Heritage Council notice of any intention to remove an asset from a Section 170 Heritage and Conservation Register, transfer ownership of an asset included on a Section 170 Heritage and Conservation Register, cease to occupy an asset on a Section 170 Heritage and Conservation Register or demolish an item included on a Section 170 Heritage and Conservation Register and assets must be maintained with due diligence in accordance with the *State-Owned Heritage Management Principles* and NSW Heritage Council asset management document. Proposals to alter or demolish assets of State significance must be referred to the NSW Heritage Council through the Heritage Division.

The Roads and Maritime Section 170 Heritage and Conservation Register identifies the existing Shoalhaven River Bridge as an item of State significance (Table 2.2).

Table 2 Items on the Roads and Maritime Section 170 Heritage and Conservation Register within the project area

No.	Item	Significance
4301658	Nowra Bridge over the Shoalhaven River	State

2.1.3 Register of Shipwrecks

The NSW Heritage Council maintains the Register of Shipwrecks to record shipwrecks in NSW and protected under the NSW *Heritage Act 1977*. The Register of Shipwrecks also includes submerged aircraft and other maritime archaeological relics within NSW waters. Shipwrecks off the NSW coast are subject to the *Historic Shipwrecks Act 1976*.

There are no entries on the Register of Shipwrecks for the Shoalhaven River at Nowra.

2.1.3.1 Historic Shipwrecks Act 1976

The *Historic Shipwrecks Act 1976* protects shipwrecks and associated relics, that are more than 75 years old and in Commonwealth waters, extending from below the low water mark to the edge of the continental shelf. The NSW Heritage Act 1977 applies to shipwrecks in State waters, such as bays, harbours and rivers.

The assessment also included a search of the Australian National Shipwreck Database (ANSD) for the Shoalhaven River at Nowra. It identified one item at Greenwell Point (Item No. 10897, *SS Unique*), 12.6 kilometres east of the project area.

2.1.4 Relics provision

The NSW *Heritage Act 1977* includes provisions for archaeological relics. Section 4(1) of the Act (as amended 2009) defines a relic as:

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

Section 139 of the Act prevents the excavation or disturbance of land known or with the potential to contain archaeological relics, except in accordance with a permit issued by the NSW Heritage Council (or in accordance with an Exception to Section 139 of the Act). Exceptions under Section 139 relate to the excavation or disturbance of land with a minor impact on archaeological relics, or the excavation or disturbance of an area with no archaeological research potential.

2.2 Environmental Planning and Assessment Act 1979

The EP&A Act regulates a system of environmental planning and assessment for NSW. The EP&A Act requires an assessment of the environmental impact of a proposal, including the impact on heritage.

2.2.1 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State. Clause 94 of the ISEPP permits development on any land for a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

The proposed project is to be carried out on behalf of Roads and Maritime and assessed under Division 5.1 of the EP&A Act.

2.2.2 Shoalhaven Local Environmental Plan 2014

The proposed project is within the Shoalhaven local government area. The local planning instrument under the EP&A Act is the Shoalhaven Local Environmental Plan (LEP) 2014. The Shoalhaven LEP 2014 aims to conserve the environmental heritage of the Shoalhaven, the significance of items and heritage conservation areas, archaeological relics and Aboriginal objects and Aboriginal places of significance.

There are 13 items on the Shoalhaven LEP 2014 within the project area (Artefact 2018:8-9) (Table 2.4).

Table 3 Items on the Shoalhaven Local Environmental Plan 2014

No.	Item	Significance
389	Graham Lodge (former Greenhills Estate)	State
122	Greenleaves (59 Bylong Road, Bomaderry)	Local
123	Federation residence (67 Bolong Road, Bomaderry)	Local
130	Lynburn (Mattes Way, Bomaderry)	Local
136	Illowra (125 Brinwarr Street, Bomaderry)	Local
131	Kilsyth (33 Bridge Road, Nowra)	Local
332	Uuna (35 ridge Road, Nowra)	Local
338	Captain Cook Bicentennial Memorial	Local
369	Graham Family Cemetery	Local
376	Late Victorian weatherboard residence (29 Moss Street, Nowra)	Local
377	Late Victorian weatherboard residence (31 Moss Street, Nowra)	Local
402	Shoalhaven River Bridge	Local
407	Inter-war weatherboard building and timber wharf, Nowra	Local

2.3 The ICOMOS Charter on the Protection and Management of Underwater Cultural Heritage (1996)

The International Council of Monuments and Sites (ICOMOS) Charter on the Protection and Management of Underwater Cultural Heritage (herein referred to as *the Charter*) was adopted at the Council's global meeting at Sofia, Bulgaria in 1996. The Charter was adopted in response to the growing damage done by human activities endangering submerged archaeological sites.

Article 1 of the Charter sets out the fundamental principles concerning activities directed at underwater cultural heritage:

- The preservation of underwater cultural heritage *in situ* should be considered as a first option.
- Public access should be encouraged.

- Non-destructive techniques, non-intrusive survey and sampling should be encouraged in preference to excavation.
- Investigation must not adversely impact the underwater cultural heritage more than is necessary for the mitigatory or research objectives of the project.
- Investigation must avoid unnecessary disturbance of human remains or venerated sites.
- Investigation must be accompanied by adequate documentation.

As ICOMOS is a professional organisation *the Charter* has no binding nature and only a repercussive effects on national legislations. It is a best-practice document that formed the basis for the UNESCO Convention for the Protection of the Underwater Cultural Heritage (2001).

2.4 The UNESCO Convention for the Protection of the Underwater Cultural Heritage (2001)

The Convention on the Protection of the Underwater Cultural Heritage (UNESCO Convention) was devised by the UNESCO Member States in response to the growing anthropogenic damage to underwater archaeological resources including the damage that may arise from activities under their jurisdiction affecting underwater cultural heritage. These are for instance dredging, pipeline construction, mineral extraction, trawling and port work.

2.4.1 Annex

The Annex to *the Convention* contains the rules and fundamental set of principles concerning activities directed at underwater cultural heritage. The ICOMOS *Charter on the Protection and Management of Underwater Cultural Heritage 1996* formed the basis for the Annex.

Rules 1 to 4 of the *Annex* concern the proposed project:

> **Rule 1.** *The protection of underwater cultural heritage through in situ preservation shall be considered as the first option. Accordingly, activities directed at underwater cultural heritage shall be authorized in a manner consistent with the protection of that heritage, and subject to that requirement may be authorized for the purpose of making a significant contribution to protection or knowledge or enhancement of underwater cultural heritage.*
>
> **Rule 2**. *The commercial exploitation of underwater cultural heritage for trade or speculation or its irretrievable dispersal is fundamentally incompatible with the protection and proper management of underwater cultural heritage. Underwater cultural heritage shall not be traded, sold, bought or bartered as commercial goods.*
>
> *This Rule cannot be interpreted as preventing:*
>
> *(a) the provision of professional archaeological services or necessary services incidental thereto whose nature and purpose are in full conformity with this Convention and are subject to the authorization of the competent authorities;*
>
> *(b) the deposition of underwater cultural heritage, recovered in the course of a research project in conformity with this Convention, provided such deposition does not prejudice the scientific or cultural interest or integrity of the recovered material or result in its irretrievable dispersal; is in accordance with the provisions of Rules 33 and 34; and is subject to the authorization of the competent authorities.*
>
> **Rule 3**. *Activities directed at underwater cultural heritage shall not adversely affect the underwater cultural heritage more than is necessary for the objectives of the project.*
>
> **Rule 4**. *Activities directed at underwater cultural heritage must use non-destructive techniques and survey methods in preference to recovery of objects. If excavation or recovery is necessary for the purpose of*

> *scientific studies or for the ultimate protection of the underwater cultural heritage, the methods and techniques used must be as non-destructive as possible and contribute to the preservation of the remains.*

While the *UNESCO Convention* has not yet been ratified by the Commonwealth of Australia and cannot be regarded as a statutory document, it is accepted as a best practice document for the protection and management of underwater cultural heritage.

3 Historical context

The historical context is adapted from the Statement of Heritage Impact for the proposed project (Artefact 2018:12-29). Where necessary, additional information is included to inform the assessment.

3.1 Early exploration of the Shoalhaven River

Lieutenant William Kent and surveyor James Meehan explored the Shoalhaven River in 1805 and noted stands of cedar and other hardwoods. Cedar cutters followed, with the first recorded cargo of cedar in 1812 on the *Speedwell*. In 1813, the *Sydney Gazette and New South Wales Advertiser* (26 June) reported that "Cedar or other timber from Shoal Haven, or any other part of the Coast or Harbours of New South Wales... when not supplied by Government Labourers, for each solid Foot – One Shilling."

Cedar on the *Trial* was described as the "finest cargo ever produced in this Colony" (23 July 1814 *Sydney Gazette and New South Wales Advertiser*). The *Trial* carried twenty-six thousand feet of cedar worth £2,600.

In December 1814 the Government imposed a ban on the cutting and transport of all timber in the Shoalhaven:

> *There being Reason to believe that the Indulgence which had been occasionally granted to Masters and Owners of Vessels, to resort to and bring Timber from Shoal Haven, is subject to considerable Abuse; Notice is hereby given, that no Permission to resort thither will be granted in future; and all persons are hereby prohibited from cutting down or removing Timber from the Shoal Haven after the present Date, on Pain or Prosecution* (3 December 1814 *Sydney Gazette and New South Wales Advertiser*).

It is unclear when the ban was lifted.

3.2 Settlement on the Shoalhaven River

In 1822 Alexander Berry and Edward Wollstonecraft received 10,000 acres on both the north and south side of the Shoalhaven River. Berry had searched much of the Colony for an alternative settlement to areas such as the Hunter River and Bathurst, subject to competitive land settlement at the time.

Berry instructed his convict labour to cut a canal linking the Crookhaven and Shoalhaven River. The canal improved access to the Shoalhaven River. To avoid its bar, ships had entered the Crookhaven River and hauled their boat across the sand spit that divided the two rivers. He later stated that this instruction was given to keep his convicts occupied while he explored his land, correspondence between the partners proved that Berry was aware of the impact the canal would have, encouraging settlement in the area and increasing land value. Berry later sought concessions from the Government for cutting this canal, which he "improved at a heavy Expensive, until it became a regular Ship Canal" (Letter from Berry to the Colonial Secretary dated October 1850).

On the north side of the river at Berry's Bay, Coolangatta, Berry had cleared a road to the river and built a wharf by 1828 (Bridges 1992: 162). In 1829 Berry exchanged land at Brundee with William Elyard and set up a port at Greenwell Point. Outgoing cargoes consisted of agricultural produce and cedar. Berry capitalised on the demand for cedar. He established a "sawing establishment" on Broughton Creek, which operated from 1827. He also established a tannery at Broughton Creek (Navin Officer Heritage Consultants and AECOM 2010: 69).

In the 1830s Berry and Wollstonecraft had two ships sailing between Sydney and the Shoalhaven River. In peak times, and additional two other ships were charted (Bridges 1992: 165). Berry appointed an agent at his Greenwell Point wharf. No other regular services operated between Sydney and the Shoalhaven River. It is likely that much of the areas produce was purchased by Berry's agent and shipped to Sydney on his services.

Wollstonecraft died in 1832 and in 1836 Berry shared control of the Coolangatta Estate to his brother David. By 1840, Berry had acquired over 40,000 acres of land and grew maize, tobacco, wheat, barley and potatoes and used the land for grazing (Artefact 2018:14).

The Gold Rush of the 1850s had a major influence on Coolangatta, with much of the male population leaving. To make up for the decrease in population, Berry offered more liberal tenancies as well as entering into contracts with immigrated Chinese and German labourers. The population of Coolangatta quadrupled, reaching 1,700 by 1859 (Freeman 2003:20; Artefact 2018:14).

3.3 Shoalhaven Steam Navigation Company (later Illawarra Steam Navigation Company)

On 30 July 1852 the *Sydney Morning Herald* reported:

> The only drawback to the prosperity of the settlers here, is the want of a speedy and regular communication with the Sydney markets (some of the coasters were upwards of two months last trip, the distance only 120 miles) (30 July 1852 the *Sydney Morning Herald*).

Later that year the Shoalhaven Steam Navigation Company was formed. It set up a twice-weekly service; the steamship *Nora Creina* ran every Tuesday and Friday between Greenwell Point and Phoenix Wharf, Sydney (30 December 1854 *Sydney Morning Herald*).

In 1857 the company merged with its competitors, which formed the Illawarra Steam Navigation Company. Passengers and cargoes were carried to and from the Shoalhaven River and Sydney in record time. Overland travel to the Shoalhaven River took upwards of three days. It took only one day by steamship. In areas on the south coast where a regular steam communication existed, land values increased by at least fifty per cent (1 January 1858 *Illawarra Mercury*).

The Illawarra Steam Navigation Company had a store and an agent at Greenwell Point, who Petrie noted, was for some years Mr Mclean. He "purchased almost all of the produce of the farmers on the southern side of the river" (Wallis 1988: 74). In 1870 the *Maitland Mercury and Hunter River General Advertiser* reported a break in at the store:

> *On Friday last it was discovered that the stores of the Illawarra Steam Navigation Company at Greenwell Point were broken into, and the goods of various descriptions, belonging to different persons in the district, were stolen therefrom... On Thursday night or Friday morning, it is supposed that the burglars rowed quietly to the wharf, upon the edge of which stand the Company's stores, and when landed they appear to have broken in park of the window, with for panes of glass, making a hole sufficient to allow one man to enter the store; where in, it is supposed that the goods, which consisted of one bag of sugar, half chest of tea, one case of brandy, and one case of drapery, were handed out to the man or men outside, who at once placed them in the boat* (16 June 1870 *Maitland Mercury and Hunter River General Advertiser*).

3.4 Nowra

The land associated with Nowra was reserved in the early nineteenth century and surveyed by Thomas Mann in 1852. Terara and Numbaa to the east had been affected by repeated flooding. Nowra was set out on higher ground. In 1853, the land was advertised for sale; however the area was difficult to access, and settlement was gradual (Cousins 1994:253).

In 1904 the Government and Illawarra Steam Navigation Company removed an outcrop at the mouth of Bomaderry Creek. The outcrop had obstructed navigation of the Shoalhaven River to Nowra. The Illawarra Steam Navigation Company later leased the wharf at Nowra from Council. In March 1908, the *Shoalhaven Telegraph* reported:

> *From the Illawarra Steam Navigation Company, asking if Council would renew lease of Nowra wharf from 20 April, and if so on what terms, - Referred to Finance Committee* (4 March 1908 *Shoalhaven Telegraph*).

3.5 Nowra Bridge

In 1876, planning for the construction of a timber bridge over the Shoalhaven River began. The initial budget for the bridge was £1200, however additional funding was provided in 1878 and the timber bridge design was overturned in favour of an iron bridge. The bridge was designed by prominent Pittsburgh born bridge builder 'C Shaler Smith Engr'. The construction and planning of the bridge would be a significant engineering feat due to difficulties stabilising the footing into the riverbed. The through bridge design was also an essentially American form of design, which had been used since the 1840s (Artefact 2018:20).

The bridge was designed and built in America by the Delaware based Edge Moor Iron Works Company. The use of American bridge design was controversial as NSW. On completion, the bridge was considered an engineering innovation. The truss design of the bridge reflects the American tradition of using large pins at the joints of each diagonal, a practice that reduced the time to assemble and erect the bridge.

When the truss bridge was completed, it was the longest Public Works Department bridge, with an overall length of 309 metres (Plate 3.1). The truss bridge (known as the Shoalhaven Bridge) was opened in 1881, located 600 metres west of the Bomaderry Ferry Wharf. Over 6,000 people attended the opening (Artefact 2018:20).

Increased rail and road-based traffic from the north resulted in increasing subdivision and development. On the southern side, completion of the bridge resulted in decreased traffic on the ferries and refocused development away from Ferry Lane and township to the east.

By the mid-twentieth century, traffic demand had increased. By 1967, a proposed bypass of the city centre had been confirmed. The bypass connected with East Street at its junction with North Street, Nowra. In the 1980s, the bypass was carried out and a new bridge was opened alongside the truss bridge to ease traffic congestion. The new bridge was constructed from reinforced concrete and carried northbound traffic. The truss bridge was converted for southbound traffic only (Artefact 2018:26).

3.6 Navigation on the Shoalhaven River

The Illawarra Steam Navigation Company dominated trade on the south coast of NSW, but Berry also ran a competitive service between the Shoalhaven River and Sydney. The *Meeinderry* or *Coomonderry* called at all ports on the Shoalhaven River on Mondays and Fridays, and again at Berry on Thursdays (17 October 1888 *Sydney Morning Herald*).

3.6.1 Dredging

Steamships could not navigate the Shoalhaven River without dredging. *The Empire* (6 September 1862) reported in anticipation of the river's first dredge:

> *The unobstructed navigation of the Shoalhaven River is becoming of more importance; and there can be no doubt that this dredge will soon remove the obstacles which threaten to interrupt or interfere with the commerce which had of late so rapidly spreading itself along its shores* (6 September 1862 *Empire*).

The ladder dredge *Pluto* operated on the Shoalhaven River from 1863 to 1898 (3 January 1866 *Sydney Morning Herald*; DPW annual report 1896: 29; 1897: 40). It was used to deepen the Crookhaven and Shoalhaven River entrances and channels. It moved sediment from the riverbed to another location, deepening the river channel. Two hopper barges were built for use with a dredge on the Shoalhaven River in 1868 (31 January 1868 *Sydney Morning Herald*).

In 1863 pressure was placed on the Government to dredge the Shoalhaven River up to Nowra:

> *As sea-going steamers can now come up to Terara, it would be desirable to shift the dredge higher up above Terara, so that the river may be opened up without delay. It is the duty of the Government to open the river as far as Nowra without loss of time, not that we depend on the steam company, but on the sailing crafts; and the fact of a sea going steamer coming up to Terara, is sufficient ground to shift the dredge higher up, so that large sailing vessels may have a fair chance of intercourse with our district* (23 September 1863 *Empire*).

Navigation to Nowra however, remained limited until 1903, at which point the Government, with the Illawarra Steam Navigation Company removed an outcrop which blocked the river at Bomaderry Creek.

Where steamships could not navigate upriver, droghers and other river craft to collected and distributed cargoes. The Illawarra Steam Navigation Company built the *Coolangatta* in 1865 and the *Alexander Berry* in 1873 for the purpose (Plate 3.2). River craft had a shallow draught to navigate shallow waters and a large, open deck for cargoes.

Ladder dredge *Archimedes* replaced *Pluto* until 1903 (DPW annual report 1903: 92). Sand pump *Neptune*, *Antelon* and garb *Kappa* also worked on the Crookhaven and Shoalhaven River (DPW annual report 1910: 48).

3.6.2 Ferries

Ferries ran between the main settlements. Ferries catered for passengers, drays and stock. The service between Bomaderry and Nowra was set up in 1865 in response to local pressure. People complained of the increasing cost of travel on private services:

> *It is highly desirable that we here should be independent of the private ferries of the district, as incompetency and imposition appear to be the leadings features which characterise the said public desiderata, of which I shall give you an instance: - A horse and buggy crossed and re-crossed at Numbaa, the charge was six shillings; a few days after the said horse and buggy re-crossed again, the charge was ten shillings. Such exorbitant demands terrify the traveller, and prove the necessity of a public ferry* (13 February 1865 *Empire*).

In 1881 the service was replaced by Nowra Bridge.

3.6.3 The extension of the railway to Bomaderry

The railway between Bomaderry and Sydney opened on 2 June 1893. The Illawarra Steam Navigation Company passenger trade declined, and the Company focused on cargo trade with the Shoalhaven River. Steamships continued to call at all Shoalhaven River ports twice weekly.

In 1904 the Illawarra Steam Navigation Company again merged with its competitors and formed the Illawarra and South Coast Steam Navigation Company. Despite their losses, the Illawarra and South Coast Steam Navigation Company purchased three vessels for Shoalhaven River trade: *Uralla* in 1912 (1 February 1812 *Sydney Morning Herald*) and *Bendandra* and *Bodalla* in 1913 (4 August 1913 *Sydney Morning Herald*).

Between 1893 and 1919 river craft on the Shoalhaven increased. Dairies operated at Berry and Nowra. Produce was exported to Sydney by rail. The reliance on rail transport is reflected in the location of the Nowra Dairy Cooperative's siding at Bomaderry Station. The dairies however, used the produce of smaller suppliers in the district. Milk and other produce was transported between producers, separators and factories on the river. For example, the Back Forest Dairy Company sent cream on a steam craft up Broughton Creek to Berry wharf, where it was taken over land to the Berry Central Factory (10 February 1889 *Sydney Morning Herald*).

While the importance of the Shoalhaven River as a transport link to Sydney was in decline, it had been repurposed for the movement of local cargoes. In the absence of adequate roads, and a bridge linking only Nowra and Bomaderry, the river remained an important transport artery.

3.6.4 The decline of river transport

Improved road transport contributed to the decline of river transport. In 1920 an amendment to the Harbour and Tonnage Rates Act increased cost of river and port maintenance. Dredging on the Shoalhaven River declined, with a dredge sent from Sydney only in circumstances of consistent shoaling. Without dredging, it was not possible to navigate the Shoalhaven River and transport on the Shoalhaven River declined.

In 1936 a second bridge was built over Broughton Creek at Back Forest, at which time the ferry ceased. Other ferries closed including that between Back Forest and Numbaa, with all traffic diverted to Nowra Bridge.

Plate 3.1 Nowra Bridge

Plate 3.2 ***Alexander Berry*** **(background) on the Shoalhaven River**

4 Assessment of maritime archaeological potential

Maritime archaeological potential is the potential for an area (above or below water) to contain material evidence related to an earlier phase of interaction with waterbodies (oceans, seas and rivers) and associated archaeological resources, including but not limited to a shipwreck, shore-side facilities, port-related structures, cargoes or archaeological deposit. Maritime archaeological potential has been assessed based on an analysis of documentary and archaeological resources and potential disturbance. The assessment did not include an inspection of the project or impact area.

4.1 Analysis of documentary resources

The early exploration of the Shoalhaven River is unlikely to be identified in the archaeological record. When cutting beyond the navigable limit of the Shoalhaven River, cedar cutters would have rafted and floated logs downriver for transhipment. The ship would have waited at anchor, with logs floated to it and lifted aboard, or been beached at low tide, loaded and re-floated at high tide.

From 1822, the Shoalhaven River area developed. The cutting of the canal linking the Crookhaven and Shoalhaven River improved access to the Shoalhaven River. In 1829 Berry constructed a wharf at Greenwell Point. It acted as a distribution point, with cargo loaded and unloaded from larger ocean-going steamers and distributed on river craft. Infrastructure developed, with a wharf at each settlement or place of industry on the Shoalhaven River. Properties with access to the Shoalhaven River also had a wharf. In 1860 the *Sydney Morning Herald* reported Taylor's stone wharf and crane had washed away in the flood (28 February 1860 *Sydney Morning Herald*).

The Government wharf at Bomaderry and Nowra fall within the project area.

4.1.1 Bomaderry Wharf

The Government erected at wharf at Bomaderry in 1871 (18 May 1870 *Sydney Morning Herald*). The wharf consisted of piles and a platform (Plate 4.1 – Plate 4.3). It also included a loading apparatus and store.

Plate 4.1 Bomaderry Wharf, circa 1920 (Wollongong Library)

Plate 4.2 Bomaderry Wharf, undated (Wollongong Library)

Plate 4.3 Bomaderry Wharf, undated (Wollongong Library)

4.1.2 Nowra Wharf

The Government erected a wharf at Nowra in 1884 (3 April 1884 *The News*) with a store added in 1885 (18 February 1886 *Shoalhaven Telegraph*). Repeated flooding caused significant damage to the wharf. It was rebuilt in 1898, 1904 and 1935 (Simpson Dawbin Associates 2002:13).

The wharf consisted of piles and a horizontal platform (Plate 4.4 and Plate 4.5). The photograph of the wharf between 1898 and 1904 (Plate 4.4) includes a loading apparatus and store at the wharf. The later photograph (Plate 4.5) includes a retaining wall.

In addition to rebuilding in 1898, 1904 and 1935 after flooding damaged the wharf, infrastructure was repaired and replaced as needed. The existing wharf is a combination of piles and fill (Artefact 2018:53).

Plate 4.4 Nowra Wharf, circa 1900 (Shoalhaven Historical Society)

Plate 4.5 Nowra Wharf, undated (Shoalhaven Historical Society)

4.2 Integrity

4.2.1 Bomaderry Wharf

Water movement and scouring would affect the potential for an intact archaeological deposit consisting of artefacts discarded on the Shoalhaven River as part of the active use of the wharf. Water movement and scouring would affect structural fabric to a lesser extent.

4.2.2 Nowra Wharf

In 2018, an archaeological assessment prepared for Council assessed the potential for archaeological resources associated with the Nowra Wharf, apart from structural fabric associated with the footing, as unlikely due to water movement and scouring (Cosmos 2018). The Statement of Heritage Impact for the proposed project noted archaeological resources associated with the footing would be defined as a work and would not be protected under the archaeological relics provision of the NSW *Heritage Act 1977*.

Water movement and scouring would affect the potential for an intact archaeological deposit consisting of artefacts discarded on the river bed as part of the active use of the wharf at Nowra. Water movement and scouring would affect structural fabric to a lesser extent.

4.2.3 Underwater archaeological

Dredging of the Shoalhaven River since 1904 at Nowra would impact the potential for intact archaeological resources within the project and impact area. With the removal of the rock at the mouth of Broughton Creek in 1904, the Shoalhaven River was dredged to provide access for ocean-going steamers to Nowra (18 May 1904 *Newcastle Morning Herald and Miners' Advocate*). It is unlikely intact archaeological resources would be identified within areas subject to dredging.

4.3 Assessment of maritime archaeological potential

4.3.1 Bomaderry Wharf

The wharf at Bomaderry consisted of timber piles and a horizontal timber platform. It also included a loading apparatus and store set back from the water. Due to the impact of flooding, water movement and scouring, the potential for archaeological resources associated with the wharf would be limited to structural fabric such as but not limited to timber piles. It is unlikely that archaeological resources such as artefacts discarded as part of the active use of the wharf would be identified *in situ*.

The Statement of Heritage Impact for the proposed project (Artefact 2018:65) identified no surface expression of archaeological resources associated with the wharf on land. Undated photographs of the wharf identified a slope to the wharf (Plate 4.1 – Plate 4.3). The inspection of the area for the Statement of Heritage Impact for the proposed project (Artefact 2018:64) identified landscaping which would affect the potential for archaeological resources associated with infrastructure such as the loading apparatus or store. Due to the landscaping, it is unlikely archaeological resources associated with any land-based infrastructure would be identified.

4.3.2 Nowra Wharf

Nowra Wharf consisted of timber piles and a horizontal timber platform with a loading apparatus and store. Due to the impact of water movement and scouring, archaeological resources associated with the wharf's functioning would be limited to structural fabric such as the footing of the wharf (timber piles driven into the Shoalhaven River bed). It is unlikely any archaeological resources such as artefact deposits formed as part of the active use of the wharf, or associated with the loading apparatus, or store would be identified.

Flooding caused repeated damage to Nowra Wharf, with the wharf being rebuilt in 1898, 1904 and 1935 (Simpson Dawbin Associates 2002:13). There is potential for structural fabric associated with the three construction phases of the wharf to be identified. The structural fabric would consist of cut off timber piles or piles repaired and reused as part of the later wharf.

4.3.3 Underwater archaeological resources

The Government wharf at Bomaderry and Nowra formed part of a system of transport infrastructure on the Shoalhaven River. The inspection of the area as part of the Statement of Heritage impact for the proposed project (Artefact 2018) identified no surface expression of archaeological resources associated with other intertidal archaeological resources such as landing places.

Water movement and scouring would affect the potential for archaeological resources associated with infrastructure on the Shoalhaven River. It is unlikely additional archaeological resources associated with infrastructure would be identified.

There are no recorded shipwrecks on the Shoalhaven River at Nowra. The potential for unrecorded shipwrecks within the impact area is low. If identified, unrecorded shipwrecks within the impact area would be associated with river craft sunk at mooring near the river bank. The condition of such shipwrecks would likely be impacted by dredging, repeated flooding and scouring.

5 Significance assessment

In NSW significance is assessed against the criteria set by the NSW Heritage Council for assessing cultural and/or natural significance:

- Criterion (a): An item is important in the course, or pattern, of NSW's (or the local area's) cultural or natural history
- Criterion (b): An item has a strong or special association with the life or work of a person, or a group of persons, or importance in NSW's (or the local area's) cultural or natural history
- Criterion (c): An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area)
- Criterion (d): An item has strong or special association with a community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons
- Criterion (e): An item has the potential to yield information that will contribute to an understanding of NSW's (or the local area's) cultural or natural history
- Criterion (f): An item possesses uncommon, rare or endangered aspects of NSW's (or the local area's) cultural or natural history
- Criterion (g): An item is important in demonstrating the principle characteristics of a class of NSW's (the local area's) cultural or natural places; or cultural or natural environments.

Section 4A of the *Heritage Act 1977* distinguishes between items of local and State significance:

- State significance refers to significance to the State in relation to the historical, archaeological architectural, cultural, social, natural or aesthetic value of an item.
- Local significance refers to significance to an area in relation to the historical, archaeological, architectural, cultural, social, natural or aesthetic value of an item.

5.1 Significance assessment

5.1.1 Bomaderry Wharf

If identified, archaeological resources associated with the Government wharf at Bomaderry would be of local significance as part of a system of transport on the Shoalhaven River. If identified, archaeological resources associated with the wharf would provide an understanding of construction technologies.

Table 4 Significance assessment, Bomaderry Wharf

Criterion	Discussion
(a)	If identified, archaeological resources associated with the Government wharf at Bomaderry would be of local significance as part of a system of transport on the Shoalhaven River.
(b)	The wharf at Bomaderry is a Government wharf. It is not associated with a person of importance in the local area or NSW.
(c)	If identified, archaeological resources associated with the wharf at Bomaderry would not considered to be of aesthetic significance or significant for demonstrating creative or technical achievement in the local area or NSW.
(d)	If identified, it is unlikely archaeological resources associated with the wharf at Bomaderry would demonstrate a strong association with the local community.

Criterion	Discussion
(e)	If identified, archaeological resources associated with the wharf would provide an understanding of construction technologies.
(f)	If identified, archaeological resources associated with the wharf at Bomaderry would not be considered rare with archaeological resources associated with other landing places on the Shoalhaven River identified, such as the deep-water wharf at Back Forest (Wright 2012:50).
(g)	If identified, archaeological resources associated with the wharf at Bomaderry are unlikely to be considered representative.

5.1.2 Nowra Wharf

Nowra Wharf is of local significance as part of a system of transport on the Shoalhaven River. It demonstrates the relationship between Nowra and the Shoalhaven River and the importance of the Shoalhaven River for transport.

Flooding caused repeated damage to Nowra Wharf, with the wharf rebuilt in 1898, 1904 and 1935 (Simpson Dawbin Associates 2002:13). Fabric associated with the three phases of the wharf would provide an understanding of construction technologies and responses to advances in transport technologies such as the transition from sail to steam and the introduction of rail.

Table 5 Significance assessment, Nowra Wharf

Criterion	Discussion
(a)	Nowra Wharf is of local significance as part of a system of transport on the Shoalhaven River. It demonstrates the relationship between Nowra and the Shoalhaven River and the importance of the Shoalhaven River for transport.
(b)	Nowra Wharf is not associated with a person of importance in the local area or NSW.
(c)	Nowra Wharf is not considered to be of aesthetic significance or significant for demonstrating creative or technical achievement in the local area or NSW.
(d)	Nowra Wharf is not considered to demonstrate a strong association with the local community.
(e)	Flooding caused repeated damage to Nowra Wharf, with the wharf rebuilt in 1898, 1904 and 1935 (Simpson Dawbin Associates 2002:13). Fabric associated with the three phases of the wharf would provide an understanding of construction technologies and responses to advances in transport technologies such as the transition from sail to steam and the introduction of rail.
(f)	Nowra Wharf is not rare with archaeological resources associated with other landing places on the Shoalhaven River identified, such as the deep-water wharf at Back Forest (Wright 2012:50).
(g)	Nowra Wharf is representative of a landing place on the Shoalhaven River. It is important in demonstrating construction technologies and responses to advances in transport technologies such as the transition from sail to steam and the introduction of rail.

5.1.3 Underwater archaeological resources

No underwater archaeological resources are recorded within the project area. While the potential for such archaeological resources is low, should such archaeological resources be identified, there is potential for the archaeological resources to be of local significance.

If identified, underwater archaeological resources associated with the navigation on the Shoalhaven River including but not limited to shipwrecks would be of local significance as part of a system of transport on the Shoalhaven River. If identified, archaeological resources associated with an understanding of the technologies and patterns of navigation on the Shoalhaven River.

Table 6 Potential significance of underwater archaeological resources

Criterion	Discussion
(a)	If identified, archaeological resources associated with navigation on the Shoalhaven river would be of local significance as part of a system of transport on the Shoalhaven River.
(b)	If identified, underwater archaeological resources associated with navigation on the Shoalhaven River may be associated with merchant and settler, Alexander Berry.
(c)	If identified, it is unlikely underwater archaeological resources associated with navigation on the Shoalhaven river would be of aesthetic significance or significant for demonstrating creative or technical achievement in the local area or NSW.
(d)	If identified, it is unlikely underwater archaeological resources associated with navigation on the Shoalhaven River would demonstrate a strong association with the local community.
(e)	If identified, underwater archaeological resources associated with navigation on the Shoalhaven river would provide an understanding of maritime technologies and patterns of navigation on the Shoalhaven River.
(f)	If identified, underwater archaeological resources associated with navigation on the Shoalhaven River would be considered rare as no such resources have been recorded on the river.
(g)	If identified, underwater archaeological resources associated with navigation on the Shoalhaven River may be representative of the craft or cargoes used or distributed on the Shoalhaven River.

6 Impact assessment

The impact of the proposed project is assessed based on the information provided and archaeological potential and significance. The impact assessment is specific to maritime archaeological potential and significance, with the impact to all other archaeological resources assessed as part of the Statement of Heritage Impact (Artefact 2018) or Aboriginal cultural heritage assessment for the proposed project.

6.1 The proposed project

Roads and Maritime proposes to construct a new four lane bridge over the Shoalhaven River. The proposed project would include the construction of the new four lane bridge to the west (upstream) of the existing Shoalhaven River crossing, the upgrade of the road and intersections, and other adjustments to the local road network. The proposed project would improve safety, capacity and efficiency across the Shoalhaven River and improve freight movement and access to the South Coast.

The proposed project would include the upgrade of about 1.6 kilometres of the Princes Highway from about 150 metres north of the Bolong Road intersection to about 75 metres north of the Moss Street intersection. The new bridge over the Shoalhaven River would be about 360 metres long and would accommodate four lanes of northbound traffic and a shared path.

6.2 Impact assessment

There is potential for archaeological resources within the project area associated with the Government wharf at Bomaderry and Nowra, and unrecorded underwater archaeological resources within the project area. Due to the impact of water movement and scouring, archaeological resources associated with wharf at Bomaderry and Nowra would be limited to structural fabric. The potential for artefacts associated with the active use of the wharf or archaeological resources associated with infrastructure such as a loading apparatus or store is low. The potential for unrecorded underwater archaeological resources such as, but not limited to shipwrecks is low.

6.2.1 Bomaderry Wharf

Land based infrastructure associated with the wharf at Bomaderry would fall outside the impact area for the proposed project (Figure 1.1). The wharf would be on the boundary of the impact area which spans the Shoalhaven River. The proposed project may impact archaeological resources such as piles associated with the wharf within the impact area.

6.2.2 Nowra Wharf

Nowra Wharf is within the impact area for the proposed project (Figure 1.1). Impact would include use of the slip 20 metres west of the wharf for access to the Shoalhaven River. It would not require direct impact on archaeological resources (above or below water) associated with the wharf.

6.2.3 Underwater archaeological resources associated with navigation on the Shoalhaven River

The potential for underwater archaeological resources associated with navigation on the Shoalhaven River is low. While the potential for such resources within the project area is low, impact to such resources if identified would be detrimental to significance.

7 Recommendations

The recommendations of the report act as strategies for the management of maritime archaeological potential and significance. The recommendations are based on advice from the Heritage Division of the Office of Environment and Heritage dated 29 August 2018, assessed maritime archaeological potential and significance, and the impact of the proposed project.

The assessment identified the potential for archaeological resources within the project area associated with the Government wharf at Bomaderry and Nowra. Due to the impact of water movement and scouring, archaeological resources associated with wharf at Bomaderry and Nowra would be limited to structural fabric. The potential for artefacts associated with the active use of the wharf or archaeological resources associated with infrastructure such as a loading apparatus or store is low. Structural fabric associated with the wharf at Bomaderry or Nowra would be of local significance.

Land-based infrastructure associated with the wharf at Bomaderry is outside the impact area. The assessment identified the potential for impact to fabric associated with the wharf within the Shoalhaven River. Nowra Wharf is within the impact area of the proposed project.

No underwater archaeological resources are recorded within the project area. While the potential for such archaeological resources is low, should such archaeological resources be identified, there is potential for the archaeological resources to be of local significance.

It is therefore recommended:

Recommendation 1

A remote sensing survey using side-scan sonar of the project impact area is recommended to confirm the presence or absence of submerged archaeological resources within the impact area. Side-scan sonar is a form of remote sensing and would be used to detect archaeological resources on the bed of the Shoalhaven River.

Recommendation 2

In the case that underwater archaeological resources are identified within the impact area as a result the remote sensing survey, diving inspection by qualified commercial divers, supervised by a qualified maritime archaeologist is recommended to confirm the nature and significance of the archaeological resource.

Recommendation 3

If no archaeological resources are identified as part of the remote sensing survey, the proposed project should proceed with caution. If archaeological resources are identified above or below water, work must cease, and the area cordoned off. The Roads and Maritime *Standard Management Procedure: Unexpected Heritage Items* should be applied. If archaeological resources of State significance are identified, the Heritage Division, as Delegate of the NSW Heritage Council should be notified in accordance with Section 144 of the NSW *Heritage Act 1977*.

Recommendation 4

Nowra Wharf is within the impact area for the proposed project. Impact however, would be limited to use of the slip 20 metres west of the wharf for access to the Shoalhaven River. If the potential for additional impact is identified, photographic recording is recommended for the wharf and slip prior to impact in accordance with *Photographic Recording of Heritage Items using Film or Digital Capture* (Heritage Council 2006).

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Appendix C

Assessments of significance for the Regent Honeyeater

Regent Honeyeater (*Anthochaera phrygia*)

The Regent Honeyeater inhabits dry open forest and temperate woodland particularly Box-Ironbark woodland and riparian forests at scattered locations in south-eastern and eastern Australia (Higgins *et al*. 2001). Key tree species include Mugga Ironbark (*Eucalyptus sideroxylon*), Yellow Box (*E. melliodora*), White Box (*E. albens*), Broad-leaved Apple (*Angophora floribunda*) Swamp Mahogany (*E. robusta*) and Spotted Gum (*Corymbia maculata*). The total current population comprises approximately 350-400 individuals following substantial, long-term decline (Commonwealth of Australia 2016). There are less than five known key breeding areas within the Regent Honeyeater's current distribution (Commonwealth of Australia 2016, Crates *et al*. 2018). The loss, fragmentation and degradation of breeding and foraging habitat for agriculture and residential development is the main threat to the Regent Honeyeater.

An individual Regent Honeyeater was observed at the intersection of Keft Avenue and Hyam Street in September 2018, less than 100 metres from the study area and construction footprint (Hanscombe 2018).

1. TSC Act Assessment

(a) in the case of a threatened species, whether the action proposed 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

A Regent Honeyeater was recently sighted in Nowra; in a flowering eucalypt, less than 100 metres from the study area. There are no other recent records of Regent Honeyeater sightings in the Nowra area, suggesting that it is not part of their usual range.

Within the Regent Honeyeater's current distribution there are less than five key breeding areas (Commonwealth of Australia 2016, Crates *et al*. 2018). None of these breeding areas occur within the Nowra area, with the closest being in the lower Blue Mountains.

The vegetation to be removed is part of a small patch that occurs adjacent to a major highway, and is likely to only providing foraging habitat in isolated trees on rare occasions. Therefore, the removal of this habitat is unlikely to place a local population of Regent Honeyeater at risk of extinction.

(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

Not applicable to a threatened 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 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

Not applicable to a threatened species.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposal would result in the removal of 4.68 hectares of vegetation that provides at best only occasional foraging and sheltering habitat for the Regent Honeyeater when suitable eucalyptus species are in flower. No breeding habitat is known or expected to occur in the study area.

(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

The landscape surrounding the study area is already fragmented through historical vegetation clearing for various land uses including farming and residential development. Remnant open forest occurs in small patches surrounded by roads, residential properties of agricultural land.

While Regent Honeyeaters are known to exhibit a degree of breeding site fidelity when conditions allow, the species is highly mobile and depends on a network of breeding habitat patches that they exploit irregularly in space and time (Commonwealth of Australia 2016).

Removal of vegetation along the existing Princes Highway is unlikely to further fragment or isolate areas of suitable habitat for the Regent Honeyeater.

(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 habitat to be removed is along the edge of a major highway is unlikely to be important habitat for the Regent Honeyeater. Records of this species in the Nowra area are extremely rare. This vegetation would not provide sufficient foraging, nesting and sheltering habitat to support the entire life cycle of this species and does not include a key breeding area.

The habitat to be removed is not considered important to the long-term survival of the Regent Honeyeater in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

As identified in the National Recovery Plan for the Regent Honeyeater (Commonwealth of Australia 2016), habitat critical to the species survival includes:

- Any breeding or foraging areas where the species is likely to occur
- Any newly discovered breeding or foraging locations.

The Regent Honeyeater was recently observed foraging in a tree in central Nowra, less than 100 metres from the study area. As this is a newly discovered foraging location, it is considered significant by standards set in the National Recovery Plan. However, it was for only one individual.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

A National Recovery Plan has been prepared for the Regent Honeyeater (Commonwealth of Australia 2016). None of the recovery strategies identified in the plan are considered relevant to the proposal.

(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

The only key threatening process considered relevant to the Regent Honeyeater within the study area is 'Clearing of native vegetation'. The proposed actions would result in the clearing of native vegetation.

Conclusion

The Regent Honeyeater was not identified in targeted surveys, however, a recent observation published in the media has been noted. One individual was observed in September 2018 less than 100 metres from the study area. The record was not in the study area. The proposal would require the removal of 4.68 hectares of vegetation that provides potential foraging habitat for this species when suitable feed trees are in flower. Given the small area of habitat to be removed from next to a major highway and the absence of any breeding sites, the proposal is not expected to have a significant impact on the Regent Honeyeater.

2. EPBC Act Assessment

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- **lead to a long-term decrease in the size of a population**

All Regent Honeyeaters are part of a single population, with interactions of individuals between regularly used areas (Commonwealth of Australia 2016). Records of this species in the Nowra area are extremely rare; only two records have been documented in the past four decades. The habitat to be removed is along the edge of a major highway is unlikely to be important habitat for the Regent Honeyeater and only used occasionally by vagrant individuals. This vegetation would not provide sufficient foraging, nesting and sheltering habitat to support the entire life cycle of this species and does not include a key breeding area.

Removal of this habitat is not likely to lead to the long-term decrease in the Regent Honeyeater population.

- **reduce the area of occupancy of the species**

The distribution of the Regent Honeyeater is patchy through its extent from Victoria through to southern Queensland. Different areas are used from year to year for foraging depending on the availability of food resources.

The removal of a small area of habitat along a major highway in the centre of their known north-south distribution is unlikely to reduce the area of occupancy of the Regent Honeyeater.

- **fragment an existing population into two or more populations**

Regent Honeyeaters are known to move long distances seasonally in response to the availability of food resources. The removal of a small area of vegetation along the edge of a major road is unlikely to fragment any existing population of Regent Honeyeaters.

- **adversely affect habitat critical to the survival of a species**

As identified in the National Recovery Plan for the Regent Honeyeater, habitat critical to the species survival includes:

  - Any breeding or foraging areas where the species is likely to occur
  - Any newly discovered breeding or foraging locations.

A single Regent Honeyeater was recently observed foraging in a tree in central Nowra, less than 100 metres from the study area, but not in the study area. As this is a newly discovered foraging location, it is considered significant by standards set in the National Recovery Plan.

- **disrupt the breeding cycle of a population**

There are less than five key breeding areas within the Regent Honeyeater's current distribution (Commonwealth of Australia 2016, Crates *et al*. 2018). The closest known breeding area occurs about 85 kilometres north-west of the study area.

- **modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The Regent Honeyeater has rarely been observed in the Nowra area and is therefore likely to be only an occasional visitor. Removal of 4.68 hectares of vegetation is unlikely to result in the decline of the species given their tendency to move large distances across the landscape in response to the availability of food resources.

- **result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat**

The proposed development is unlikely to result in the introduction of invasive species that are harmful to the Regent Honeyeater becoming established in Regent Honeyeater habitat.

- **introduce disease that may cause the species to decline, or**

The study area lies within a developed regional centre. The proposed actions are unlikely to introduce any disease that may cause the decline of the Regent Honeyeater given that it is only an occasional visitor.

- **interfere with the recovery of the species**

A National Recovery Plan has been prepared for the Regent Honeyeater (Commonwealth of Australia 2016). None of the recovery strategies identified in the plan are considered relevant to the proposal.

Conclusion

Considering the small area of vegetation to be removed and the rare occurrence of the Regent Honeyeater in the Nowra area and that the record was not in the study area, the proposed actions are unlikely to have a significant impact on the Regent Honeyeater.

References

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Appendix D

Construction Water Quality Assessment

SEEC

Strategic Environmental & Engineering Consulting

NSW WATER QUALITY OBJECTIVES:

ASSESSMENT OF IMPACTS OF PROPOSED CONSTRUCTION-PHASE SEDIMENT BASINS ON CONSTRUCTION WATER QUALITY

Nowra Bridge Project

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18 February 2019

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.

Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the site at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this report does not contain any incomplete or misleading information.

Andrew Macleod B.Sc (Hons) CPESC CPSS
Director and Principal Soil Conservationist
SEEC

18 February 2019

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Version Register

Version	Date	Author	Reviewer	Notes	Other
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01	8/1/2019	AM/BJ	MP	Final - Issued to RMS	
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1 INTRODUCTION

1.1 Proposal Identification

NSW Roads and Maritime Services (Roads and Maritime) proposes to construct a new bridge for the A1 Princes Highway over the Shoalhaven River at Nowra.

The Nowra Bridge project (the proposal) includes a new four lane bridge to the west (upstream) of the existing bridge crossings and the removal of vehicular traffic from the existing southbound bridge. The proposal would also include the upgrade of about 1.6 kilometres of the Princes Highway in the vicinity of the bridge, as well as providing key intersection upgrades and modifications to the local road network.

This report supports the environmental assessment for the proposal and specifically assesses water quality issues associated with discharge from sediment control structures to be constructed as part of the main construction works. Note that this report does not assess water quality issues associated with the operational stage of the project and a separate assessment report has been completed for the operational stage of the project.

1.2 Proposal Location and Setting

The proposal is located at the A1 Princes Highway crossing of the Shoalhaven River at Nowra (refer to Figure 1). The works include the upgrading of the Princes Highway to provide three northbound and three southbound lanes from the Bolong Road intersection through to about 75 metres north of the Moss Street intersection.

The proposal would improve access between North Nowra/Bomaderry and Nowra and the surrounding areas, improve southbound access for large freight vehicles, and improve traffic flows.

The proposal is located on land mapped as 'coastal environment area' and 'coastal use area'. Development consent within this area must be in accordance with clause 13 of the Coastal Management SEPP, which includes consideration by the consent authority that the proposal will not cause adverse impacts to coastal processes, water quality of a marine estate, Aboriginal heritage and that the proposal incorporates water sensitive urban design.

1.3 Key Features of the Proposal

Key features of the proposal include:

- Construction of a new bridge over the Shoalhaven River on a different alignment to the west of the existing bridge, with four northbound lanes and a 3.5 metre wide shared use path;
- Widening of the existing bridge over Bomaderry Creek to the west (upstream);

- Minor lane adjustments on the existing northbound bridge to convert it to three lanes of southbound traffic;
- Removal of vehicular traffic and closure of the existing southbound bridge to undertake investigation, rehabilitation and repurposing work for adaptive reuse following opening of the new northbound bridge;
- Upgrading of the Princes Highway to provide three northbound and three southbound lanes from the Bolong Road intersection through to about 75 metres north of the Moss Street intersection;
- Widening of Illaroo Road over a distance of about 270 metres;
- Upgrading of the Princes Highway and Illaroo Road intersection;
- Upgrading of the Princes Highway and Bridge Road intersection;
- Local road adjustments including:
    - Closing the access between Pleasant Way and Princes Highway
    - Restricting turning movements at the intersection of Bridge Road and Scenic Drive
    - Construction of a new local road connecting Lyrebird Drive to the Princes Highway about 300 metres south of the existing Pleasant Way intersection.
- Provision of pedestrian facilities at all intersections;
- Dedicated off-road shared paths and footpaths along the length of the proposal;
- Urban design and social amenity improvements, and landscaping including pedestrian links to the existing southbound bridge;
- Relocation and/or protection of utility services;
- Drainage and water quality infrastructure along the road corridor; and
- Property works including acquisition, demolition, and adjustments to accesses.

The key features of the proposal are shown in Figure 1.

1.4 Purpose of This Report

The purpose of this report is to assess the impacts of proposed construction-phase sediment basin discharge limits against the NSW Water Quality Objectives (WQOs) at this location. As previously noted, a separate report provides an assessment of water quality issues associated with the operational stage of the project.

This report should be read in conjunction with the following reports and Erosion and Sediment Control Plans (ESCPs) developed for the project:

- SEEC (2019). *Erosion and Sediment Management Report: Nowra Bridge Project*. Strategic Environmental and Engineering Consulting (SEEC) Pty Ltd.
- SEEC (2019c). *NSW Water Quality Objectives: Assessment of Operational Water Quality Nowra Bridge Project.* Strategic Environmental and Engineering Consulting (SEEC) Pty Ltd.

  Note that the above report is under revision as part of the design process. The most up-to-date version should be referenced when reading this report.

- Roads and Maritime Services (2018). *Nowra Bridge Project; Review of Environmental Factors*. August 2018.

1.5 Assumptions Used In This Report

Figure 1 shows the proposal, including the study area that environmental assessments have focused on. For the purpose of the assessment of Water Quality Objectives in this report, the entire Shoalhaven River catchment upstream of this location will be considered.

The sizing and positioning of construction-phase sediment basins, as well as the proposed discharge limits for de-watering of construction-phase sediment basins, are based on ESCPs and the ESMR prepared by SEEC (2019). Basin sizing and discharge criteria have been prepared in accordance with the NSW Blue Book (Landcom, 2004 and DECC, 2008).

It was originally considered not to include any environmental flows from the Tallowa Dam located around 60km upstream of the bridge. However, a check of the Water NSW website https://www.waternsw.com.au/supply/Greater-Sydney/greater-sydneys-dam-levels highlighted the dam has a significant environmental flow release component. Daily flow discharges are not available but the website indicates the past year's environmental flow releases totaled 64,411 ML. This equates to an average daily flow release of greater than 170 ML and so this has been adopted in the models.

Roads and Maritime provided a table of landuses and areas for the catchment between the Nowra Bridges and Tallowa Dam used in flood modelling for the project. The data was initially adopted but, on closer inspection, it was not found to represent the pervious nature of the catchments. The provided descriptions are more reflective of the roughness characteristics of the catchment which is more relevant to the flood modelling aspect of the project. A review of an aerial photo and Council's land use planning scheme indicated a different arrangement as shown in Table 1. These areas better reflect the input data required for MUSIC water quality modelling.

Table 1 – Catchment Landuses

Landuse	Supplied Areas (ha)	Adopted Areas (ha)
Heavy Vegetation	506	-
In-bank	2,531	-
Roads	87	87
Isolated High Rough Areas	271	-
Riparian Areas	1,184	-
Low Vegetation / Forest	175,869	167,264
Urban Development	687	863
Agriculture	-	9,113
Rural	-	3,808
TOTAL AREA	**181,135**	**181,135**

Figure 1 – Proposal area (supplied by SMEC and RMS).

2 BACKGROUND

2.1 Environmental Values

Environmental values are those values or uses of water that are desired by the community to be protected. These include, but are not limited to, protection of aquatic ecosystems, drinking water, primary and secondary recreation, visual amenity, and agricultural water for irrigation, livestock and growing aquatic foods.

For each environmental value, the ANZECC guidelines (ANZG, 2018) and (ANZECC/ARMCANZ, 2000) identify particular water quality characteristics or 'indicators' that are used to assess whether the condition of the water supports that value.

The NSW Water Quality Objectives are the environmental values and long-term goals for consideration when assessing and managing the likely impact of activities on waterways. As noted in DECC (2006) they are not intended to be applied directly as regulatory criteria, limits or conditions but are one factor to be considered by industry, the community, planning authorities or regulators when making decisions affecting the future of a waterway.

Environmental values for each catchment in NSW are provided by the Office of Environment and Heritage (OEH). The proposed Nowra Bridge project is within the Shoalhaven River catchment. The NSW Government has not formally adopted water quality objectives for the Shoalhaven River catchment.

Based on the National Water Quality Management Framework described in ANZECC (2018), locally derived water quality guideline values are most appropriate for the protection of aquatic ecosystems. However, where they are not available, default guideline values (DGVs) are suitable for some community values. ANZECC 2018 does not currently include DGVs for inland waters at this location; therefore, the ANZECC 2000 values have been adopted to determine if any impact is likely from the proposed works.

As per Step 8 of the framework, predictive catchment modelling has been adopted to derive flows from rainfall runoff and simulate associated pollutant loads which can be assessed against typical water quality objectives for estuaries in New South Wales which include:

- Aquatic ecosystems
- Visual amenity
- Secondary contact recreation (short term objective, within 5 years)
- Primary contact recreation (assess opportunities for a longer term objective 10 years or more)
- Aquatic foods (cooked). Note that ANZECC (2000) Guidelines list this environmental value as “Aquaculture and human consumption of aquatic foods.” Therefore, it covers shellfish such as oysters.

2.2 General Water Quality Impacts of Road Construction

Water quality impacts associated with road construction activities are predominantly associated with the mobilisation of sediment as a result of rainfall run-off over soils exposed during construction activities.

Nutrients and other pollutants potentially generated from rainfall runoff over exposed soils (such as phosphorus, heavy metals and organic chemicals) often utilise sediment as the medium for transportation in runoff. The deposition of sediment can result in the release of these nutrients or pollutants at a later time when the ambient conditions related to the redox potential of the sediment and water column becomes favourable for their release. This mechanism provides the opportunity for pollutant re-mobilisation in later flow events enhancing the risk of further environmental degradation of downstream aquatic ecosystems (Wong *et al*., 2000).

Consequently, the capture and retention of sediment on site using the best practice management principles outlined in the Blue Book (Landcom, 2004 and DECC, 2008) decreases the potential for a range of other pollutants degrading the receiving environment.

2.3 Typical Water Quality Management During Road Construction

A conceptual construction-phase Erosion and Sediment Control Plan (ESCP) has been prepared by SEEC (SEEC, 2019) for the main works associated with the Nowra Bridge project. In addition, a series of recommendations and commitments are included in the Erosion and Sediment Management Report (ESMR) (SEEC, 2019b), which should be read in conjunction with the ESCP. The ESCP has been prepared to accord with the guidelines and recommendations in Volumes 1 and 2D of the Blue Book (Landcom, 2004 and DECC, 2008 respectively). The plan also accords with Roads and Maritime specification for soil and water management (*G38 – Soil and Water Management)*.

The ESMR and ESCP for the main construction phase of the project include a range of recommendations to minimise erosion and maximise the retention of sediment on the site. These include:

- Soil and Water Management Plan (SWMP) and ESCP should be prepared in accordance with Volume 2D of the Blue Book (DECC, 2008) and the conditions of any Environment Protection Licence (EPL).
- A certified soil conservationist should be engaged for the duration of the project. The soil conservationist undertakes regular inspections (e.g. fortnightly during the initial earthworks establishment period and then monthly) and provides advice on erosion and sediment control design, installation, and maintenance in accordance with Volumes 1 and 2D of *Managing Urban Stormwater* (Landcom, 2004 and DECC, 2008)
- Works should be programmed to minimise the extent and duration of disturbance to vegetation/groundcover.

- Sediment barriers should be installed downslope of all disturbed areas.
- Clean water diversions should be installed to minimise clean water from entering site from upslope.
- Temporary construction water quality basins should be designed and installed in accordance with the Blue Book (Landcom, 2004 and DECC, 2008). Basins should typically incorporate:
  - Inlet flow control structures (i.e. baffles, forebays) to control the velocity of water entering the basin and to allow settling of some material at the inlet,
  - Internal baffles if the length-to-width ratio of the basin is less than 3:1,
  - Liquid flocculants that comply with the requirements of RMS Specification G38 (predominantly ecotoxicity requirements),
  - Floating siphon devices that decant by siphoning water from the top of the water column,
  - An overflow outlet or spillway,
  - Outlet protection to reduce erosion downstream, and
  - Compacted earth embankments or a rock filled wire basked wall with geofabric lining.
- Sediment basins and associated drainage should be installed and commissioned prior to the commencement of earthworks in that catchment, and must remain active until their contributing catchments are adequately stabilised or rehabilitated.
- In areas where it is not possible to direct dirty water to sediment basins, other sediment controls should be implemented in accordance with Blue Book e.g. check dams, sediment sumps, earth/mulch bunds, sediment fence, rock dissipaters etc. and should be augmented by an increased focus on erosion control.
- Clean and dirty water runoff should be adequately separated to avoid mixing through the use of diversions, clean water drains, and batter chutes.
- The velocity of water flow over the construction site should be minimised by implementation/construction of slope breaks, level spreaders, check dams, bank and channel linings.
- Land should be shaped to minimise slope lengths and gradients and to improve drainage.
- Long term stockpiles, fill under settlement, access tracks, and disturbed areas should be stabilised by:
  - Seeding with cover crops, or
  - Placement of hardstand material, or
  - Application of soil binder, or
  - Covering with geotextile fabric.

- Cut and fill batters should be created at a maximum of 2:1 (H:V) slope unless otherwise agreed during detailed design stage.
- Active work areas should be temporarily stabilised prior to forecast inclement weather by applying ground covers, grading, smooth drum rolling, installing slope breaks or similar.
- Hardstand material, rumble grids or similar should be provided at exit points to minimise mud tracking.
- Scour protection should be installed at drainage outlets.
- Drainage works should be stabilised against erosion by appropriate selection of channel dimensions, slope and lining, and the inclusion of drop structures and energy dissipaters.
- Disturbed areas should be progressively stabilised during the construction phase e.g. with a cover crop, hydromulch, hydroseeding, topsoil and/or mulch.
- Rainfall forecasts should be monitored daily.
- Erosion and sediment controls should be inspected at least weekly (with maintenance and/or modifications made as necessary).

Note that the ESMR and accompanying ESCP are conceptual only, and are subject to change as the design and construction methodology is refined. However, these documents together demonstrate the feasibility to employ best-practice environmental controls during construction.

For most major road construction projects, the installation and operation of construction sediment basins in key catchments provides the most effective control of sediment from the site. Operation of the basins typically involves capture of sediment laden water up to the basin design rainfall event (as determined by Landcom, 2004), treatment (i.e. flocculation) following the cessation of the rainfall event to remove sediment in suspension, and discharge of the treated water from licensed discharge points.

The Blue Book (Landcom, 2004) suggests that special erosion and sediment control measures should apply to any works below the 2-year average recurrence interval (ARI) flood level. This includes:

- Sediment controls should be placed above the 2-year ARI flood level (e.g. basins, sediment fences etc.) wherever possible.
- Requirements to stabilise lands using temporary ground cover whenever rain is falling or imminent.
- Scheduling works for lower-risk times of year, based on historical rainfall figures.

The ESMR (SEEC, 2019) and the ESCP (SEEC, 2019b) take these requirements into account.

2.4 Blue Book Discharge Limits

Landcom (2004) proposes recommended water quality standards for site de-watering and discharges from sediment basins. These are noted in Table 2. The purpose of this assessment is to determine whether the recommended standards in Table 2 are appropriate for this site or if need to be amended to account for the WQOs in the receiving environment.

Table 2 – Water quality standard for site dewatering as recommended in Landcom (2004)

Parameter	Recommended standard during construction
Total suspended solids (TSS)	50mg/L
pH	6.5 to 8.5
Oils and greases	None visible

Generally, the proposed construction sediment basin discharges consist of water generated by rainfall run-off over soil exposed during road construction activities, and typically they are treated to meet the nominated discharge criteria.

Where water detained in a construction sediment basin exceeds the nominated TSS limit to enable it to be discharged, the basin is treated with a flocculent or coagulant to reduce the amount of suspended solids in the basin supernatant. Roads and Maritime specifies the use of gypsum for the flocculation of basins and does not permit the use of alternative flocculants without the completion of site-specific testing of the nominated product to determine potential ecotoxicity, in consultation with the NSW EPA. Use of any alternative flocculants or coagulants is required to comply with standard EPL conditions relating to their use.

The Blue Book (Landcom, 2004) suggests that water discharged from construction sites should not contain more than 50mg/L of suspended sediment and notes that "the actual discharge load should be considerate of the loads normally carried in the receiving waters, including those during and following storm events." This is generally considered acceptable for most locations because:

- The construction period is relatively short-term so long-term impacts are unlikely;
- A more stringent water quality requirement can add significantly to the cost of site dewatering, and most likely couldn't be achieved within a reasonable timeframe using safe flocculants.

IECA (2008) notes that 50mg/L equates to 50 kg, or approximately three and half domestic buckets of soil evenly distributed in an Olympic swimming pool (1,000m^3). It also notes that setting a design target TSS concentration of 50mg/L would, in most regions of

Australia, limit soil loss rates from construction sites to less than the commonly-adopted natural soil loss rate of 0.5 to 1.0 t/ha/yr (the "geological erosion rate").

The purpose of this assessment is to consider the potential impacts of discharging water from sediment basins against the NSW WQOs and environmental values of the receiving environment.

2.5 Site Conditions for Impact Assessment

In conducting an assessment of potential impacts against the WQOs, site, soil and catchment conditions have been taken into account. Climate, topography, soils (including acid sulfate soils) and catchment conditions are described in detail in the ESMR (SEEC, 2019) so are not repeated here.

2.6 Shoalhaven River Catchment Characteristics

All drainage from the proposal site flows into the Shoalhaven River which discharges into the Tasman Sea via a wave-dominated barrier estuary with an open entrance. At the proposal site, waters are tidal and brackish. The Shoalhaven River has four main tributaries, the Mongarlowe, Corang, Endrick and Kangaroo Rivers. The catchment contains the major water storage of Tallowa Dam which is part of the Greater Sydney water supply system owned and operated by WaterNSW. Key water management issues in the catchment include:

- Water sharing with Greater Sydney.
- Water quality, associated with pollution and weed growth.
- Riverbank management, associated with rural development.
- Environmental water, related to ensuring sufficient flows and refreshes to maintain river health.

According to SMEC (2018) there are some sensitive environmental features that could potentially be affected by operational (and construction) water quality impacts associated with the proposal. These are:

- Several areas of seagrass (Zostera muelleri) within the proposal study area.
- Mangrove stands which occur along the banks of the Shoalhaven River east and west of the existing bridges, but with very limited occurrence within the proposal study area.

There are no coastal wetlands or littoral rainforest listed under the Coastal Management SEPP that occur in the proposal study area.

There are numerous oyster leases in the lower reaches of the Shoalhaven River estuary, about 11.5 kilometres downstream from the Project.

2.7 Water Quality Data

2.7.1 Shoalhaven City Council

Shoalhaven City Council conducts regular monitoring of water quality within the Shoalhaven River estuary which are published on the Aqua Data Shoalhaven water quality information website. Previously, they produced Estuary Health Report Cards between 2000 and 2012.

Figure 2 shows the location of monitoring location E-148 which was used to provide historical water quality data from 1992 to 2018 for the catchment just downstream of the bridge.

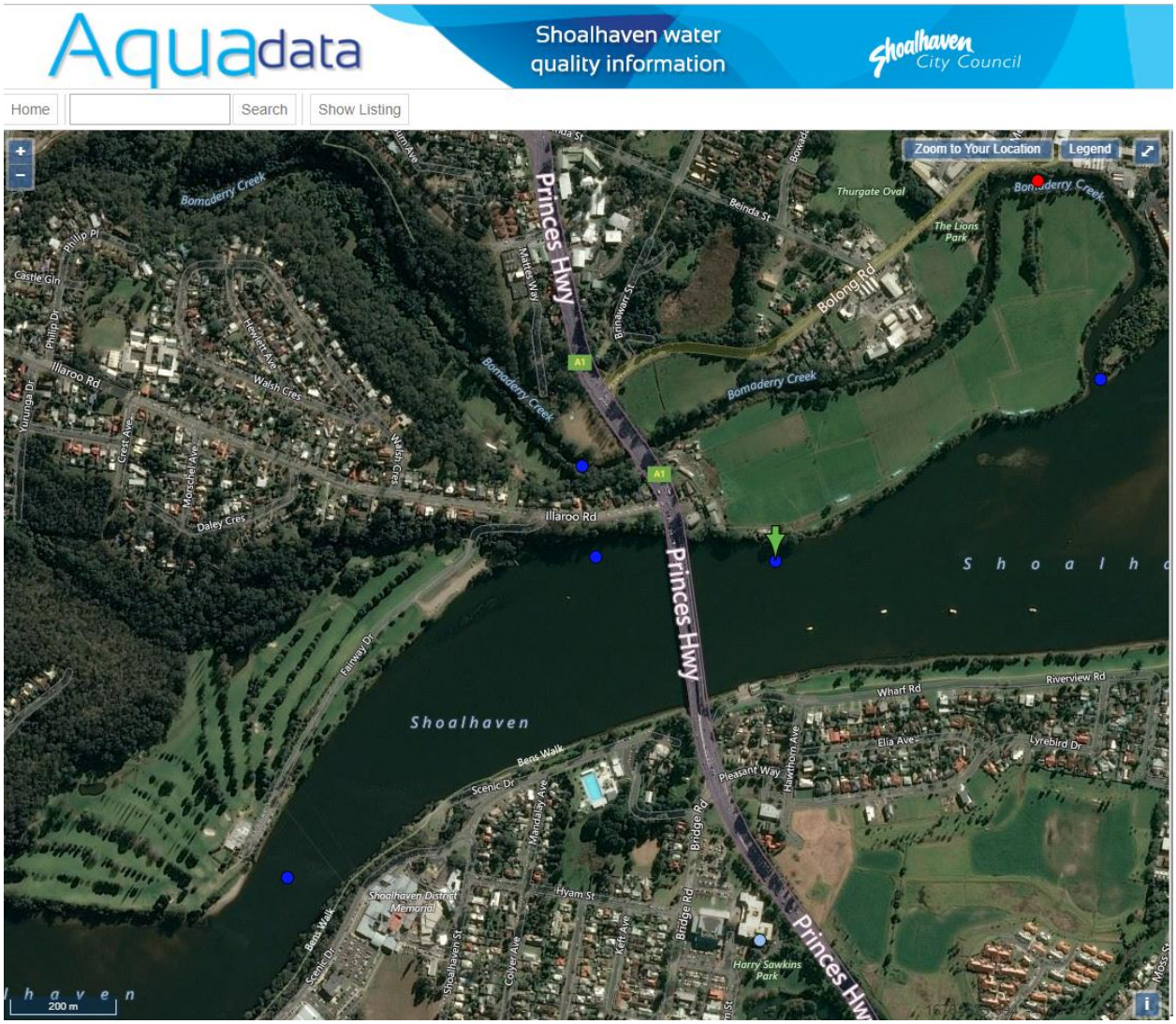

Figure 2 – Shoalhaven River monitoring location E-148 (https://webreports.esdat.net/SCC#results-map).

A review of the historical Turbidity, Total Nitrogen and Phosphorus results are provided in Table 3.

Table 3 – Summary of water quality data from Shoalhaven City Council Aqua Data website (1992-2018) for Site E-148, which is just downstream of the Nowra bridge.

Parameter	No of samples	Average (mg/L)	Median (mg/L)	10%ile (mg/L)
Turbidity	95	13.6 NTU	3.8 NTU	0.5 NTU
Total Nitrogen	98	0.30	0.25	0.07
Phosphorous	95	0.04	0.025	0.001
Total Suspended Solids	13	43.4	40	13.0

Unfortunately, there were only eight days that had both turbidity and TSS measurements making it impossible to accurately calibrate these parameters. The highest recorded turbidity reading was 152.5 NTU and the highest recorded TSS reading was 143mg/L which were recorded on different days. A correlation of TSS and turbidity was based on recent studies as described in Section 3.3.2.

3 STORMWATER MODELLING

3.1 Introduction

The Model for Urban Stormwater Improvement Conceptualisation (MUSIC) was used to assess the impacts of proposed construction sediment basin discharge limits on the receiving environment of the Nowra Bridge project. MUSIC is a water quality decision support tool for stormwater managers. It aids the planning and design (to a conceptual level) of appropriate stormwater management systems from an individual development to a catchment level. The MUSIC modelling software was developed by researchers and practitioners of the former Cooperative Research Centre (CRC) for Catchment Hydrology and the current eWater CRC, and represents an accumulation of the best available knowledge and research into urban and rural stormwater management in Australia.

MUSIC estimates stormwater pollutant generation and simulates the performance of stormwater treatment devices individually and as part of a treatment train (individual devices connected in series to improve overall treatment performance). By simulating the performance of stormwater quality improvement measures, MUSIC provides information on whether a proposed stormwater management system conceptually would achieve water quality targets.

Utilisation of the model has involved a three step process:

1. Development of a MUSIC model of the existing catchment;
2. Calibration of the developed MUSIC model against observed water quality data;
3. Modelling of the impact of proposed discharge limits on the receiving environment.

Each of these stages is outlined in more detail below. In conducting this modelling, we have focused on the three pollutants of concern for the construction-phase of the project (TSS, TP and TN).

3.2 Model Development

In order to consider the stormwater discharge characteristics of the existing Shoalhaven River and its tributaries, the forest, rural, residential and urban areas within these catchments were identified (see
Figure 3 and Table 1). The runoff parameters and pollutant generation parameters were applied to these areas as per the draft CMA MUSIC guidelines (CMA, 2010).

Following identification of land use, run-off and pollutant generation parameters, the MUSIC model was run to generate water quality pollutant loads for the relevant catchments. The model was developed to include all rainfall events from a representative climatic timeframe (in this case, from January, 2000 to December, 2005).

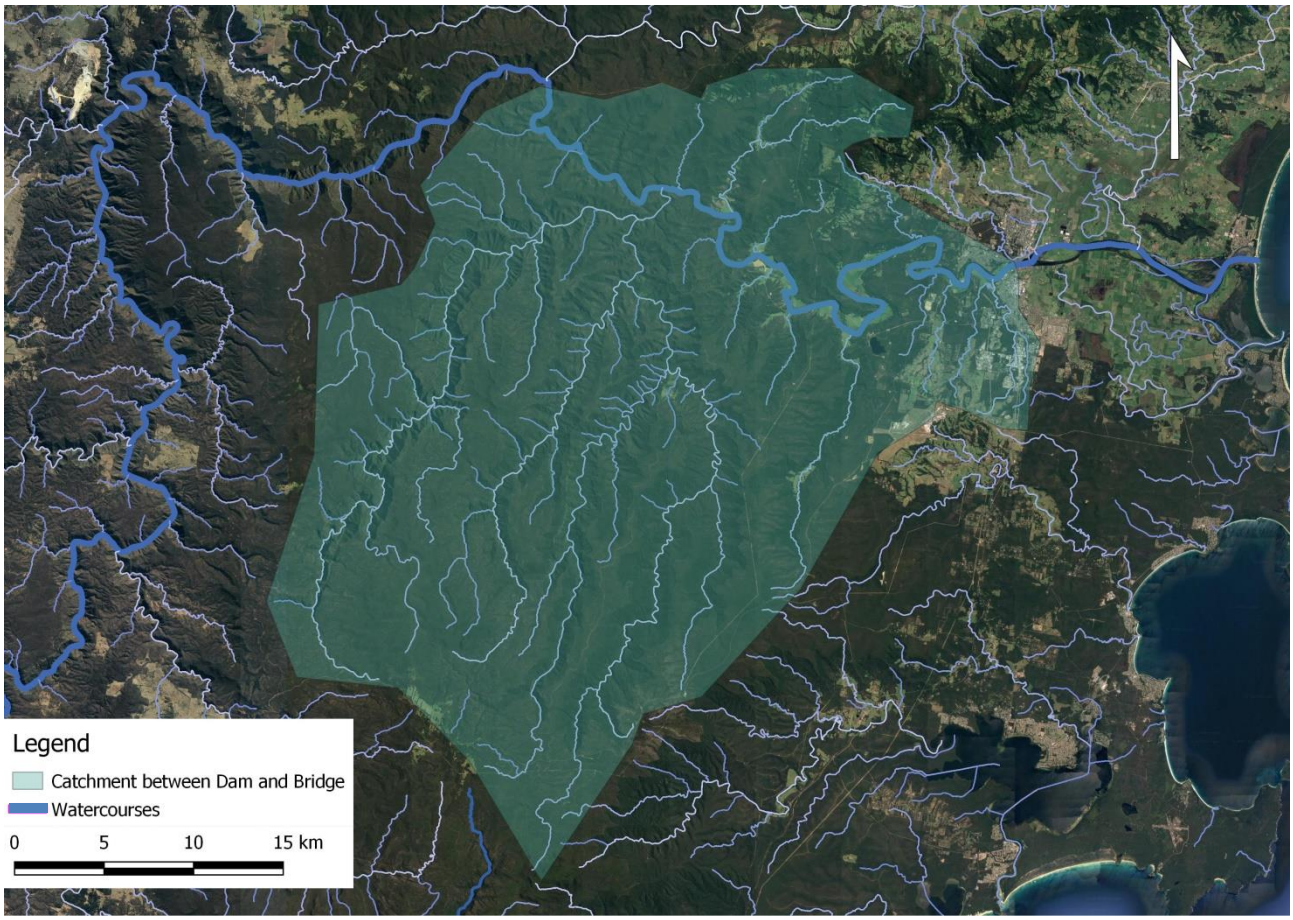

Figure 3 – Shoalhaven River Catchment Map upstream of the bridge and downstream of the Tallowa Dam.

3.3 Model Calibration

Calibration of the MUSIC model involved the following steps:

3.3.1 Collection of Historical Water Quality Monitoring

There is historical water quality monitoring data available within the Shoalhaven River at location E-148 (just downstream of the bridge) which was sourced from the Aqua Data website. The data includes Turbidity, Phosphorus and Total Nitrogen generally measured 3-4 times each year from 1992.

3.3.2 Correlation of Total Suspended Solids and Turbidity

The water quality objectives include turbidity rather than TSS. As the MUSIC model does not provide a turbidity output, the TSS to turbidity correlation is based on the Environment Protection Licence (EPL) for the recent Foxground and Berry Bypass (FBB) project north of Nowra which converted historical turbidity values to TSS. This correlation was based on over 400 samples taken during the construction of the FBB project. The adopted TSS:Turbidity ratio is 1:2. The recent Berry to Bomaderry Upgrade project adopted the same correlation for water quality assessments.

This project is relatively close to the FBB project with the soil landscapes identified as being quite similar, with both sites showing the following:

- Areas of coastal plains dominated by interbedded sands and silts;
- Residual siltstones and sandstones on hills and rises forming duplex soils with a sandy clay B horizon.

A more detailed description of the soils at the Nowra Bridge project site is contained in the ESMR SEEC (2019).

To allow for a comparison of MUSIC model outputs against NSW Water Quality Objectives, the relevant turbidity objectives (0.5-10 NTU for estuaries) have been converted to TSS using the above correlation to give a TSS objective of 0.25-5mg/L for estuaries.

3.3.3 Comparison of Historical Water Quality Monitoring with the Model

As noted in Section 2.7, there is limited historical water quality monitoring records around the project location. However, the available statistics in downstream sections of the river were compared against the MUSIC model outputs to verify the patterns of water quality modelling during the sampling periods. The MUSIC results for TSS (in mg/L) have been converted to turbidity (NTU) to match the historical water quality data and the WQOs using the nominated ratio of 1:2.

The following graphs indicate the MUSIC model generally over-estimates pollutant concentrations when compared to historical water quality data. This is to be expected,

given that the model does not account for tidal influence. Salinity within the river typically leads to settlement of suspended sediment and lowers the turbidity and the associated particulate nitrogen and phosphorus levels.

The average turbidity level of the historical data was approximately 13.6 NTU compared to the average MUSIC turbidity level of 63 NTU and a median of 24 NTU. As noted above, these inherent over-estimations are due to limitations in the capacity of MUSIC to account for tidal influence and have been taken into account when analyzing the results. This approach is considered to be appropriate as the relative change in the MUSIC model results has been reviewed as well as the predicted loads and concentrations. Note that several turbidity results predicted by MUSIC exceeded 100 NTU and have been excluded from Figure 4 below to focus in on the majority of results. The few outliers that are not shown have still been included in all tables of results they have simply just been excluded from the chart.

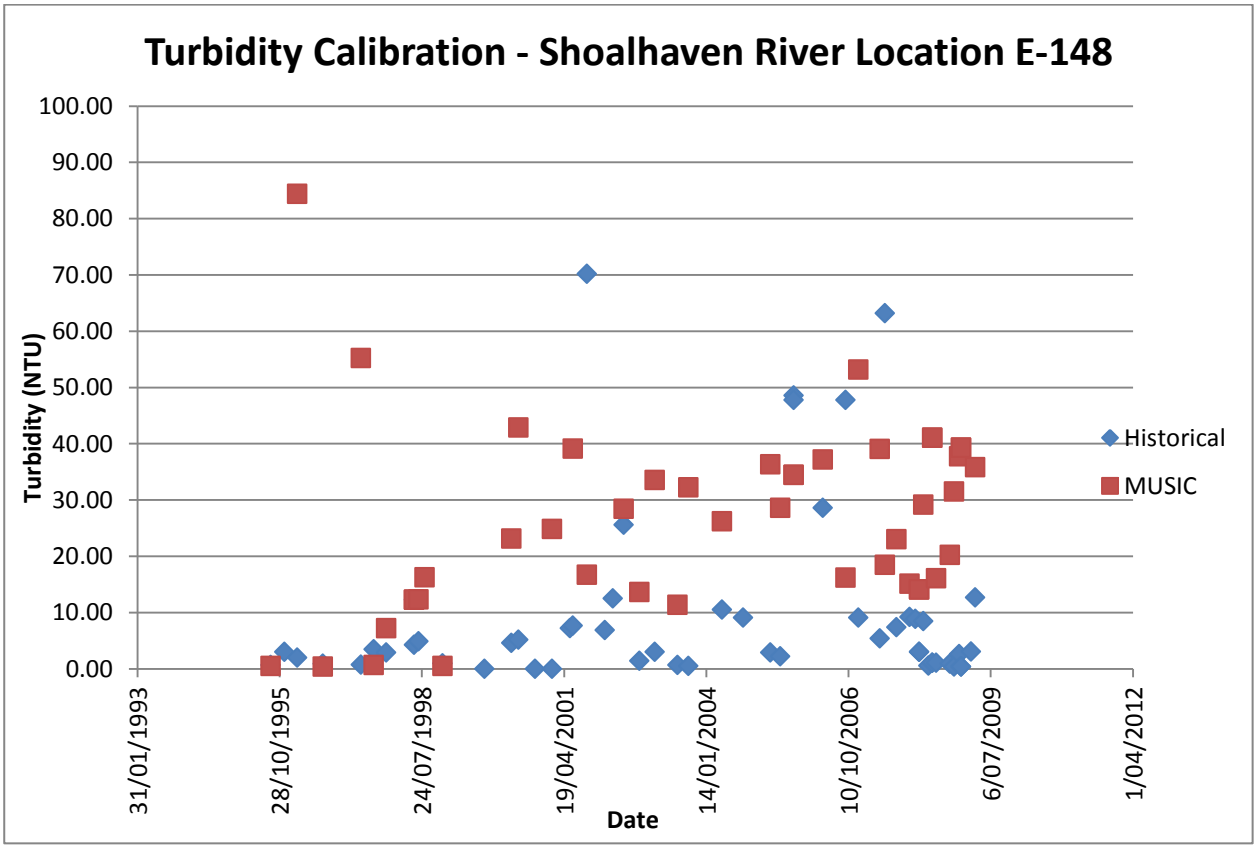

Figure 4 – Turbidity Calibration.

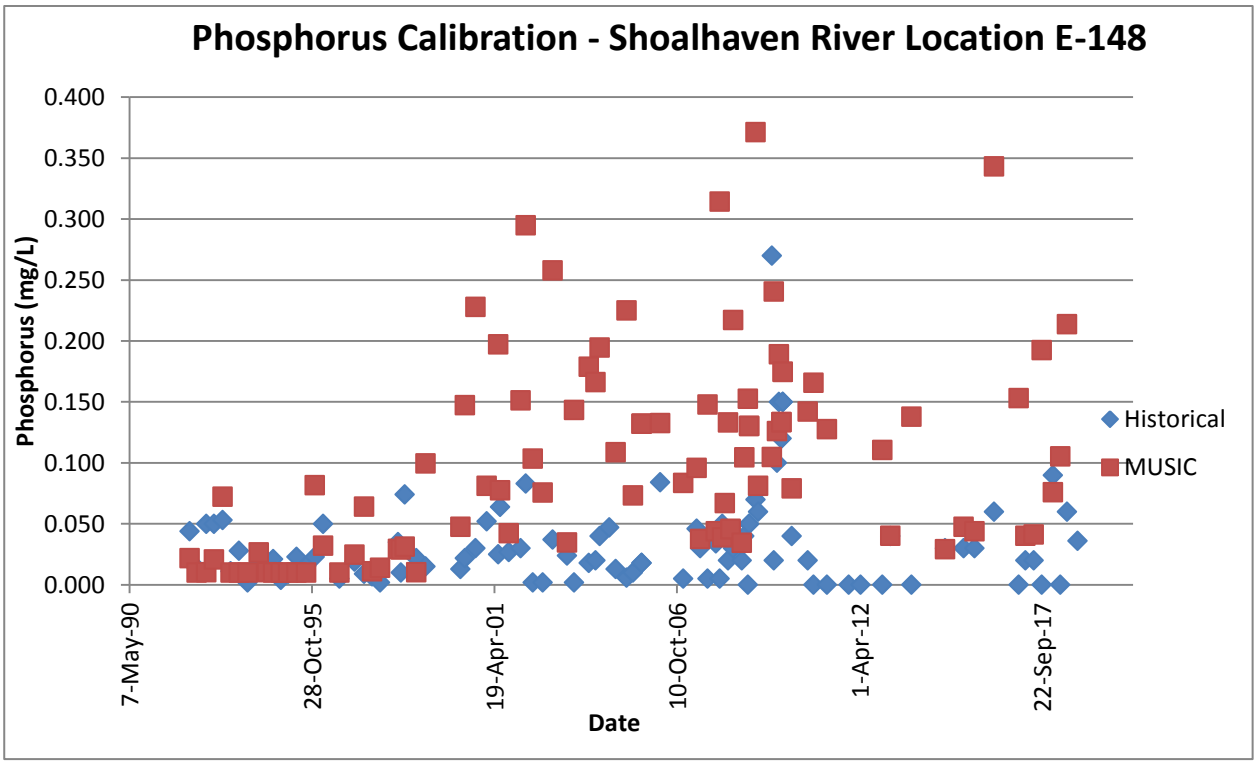

Figure 5 – Total Phosphorus Calibration.

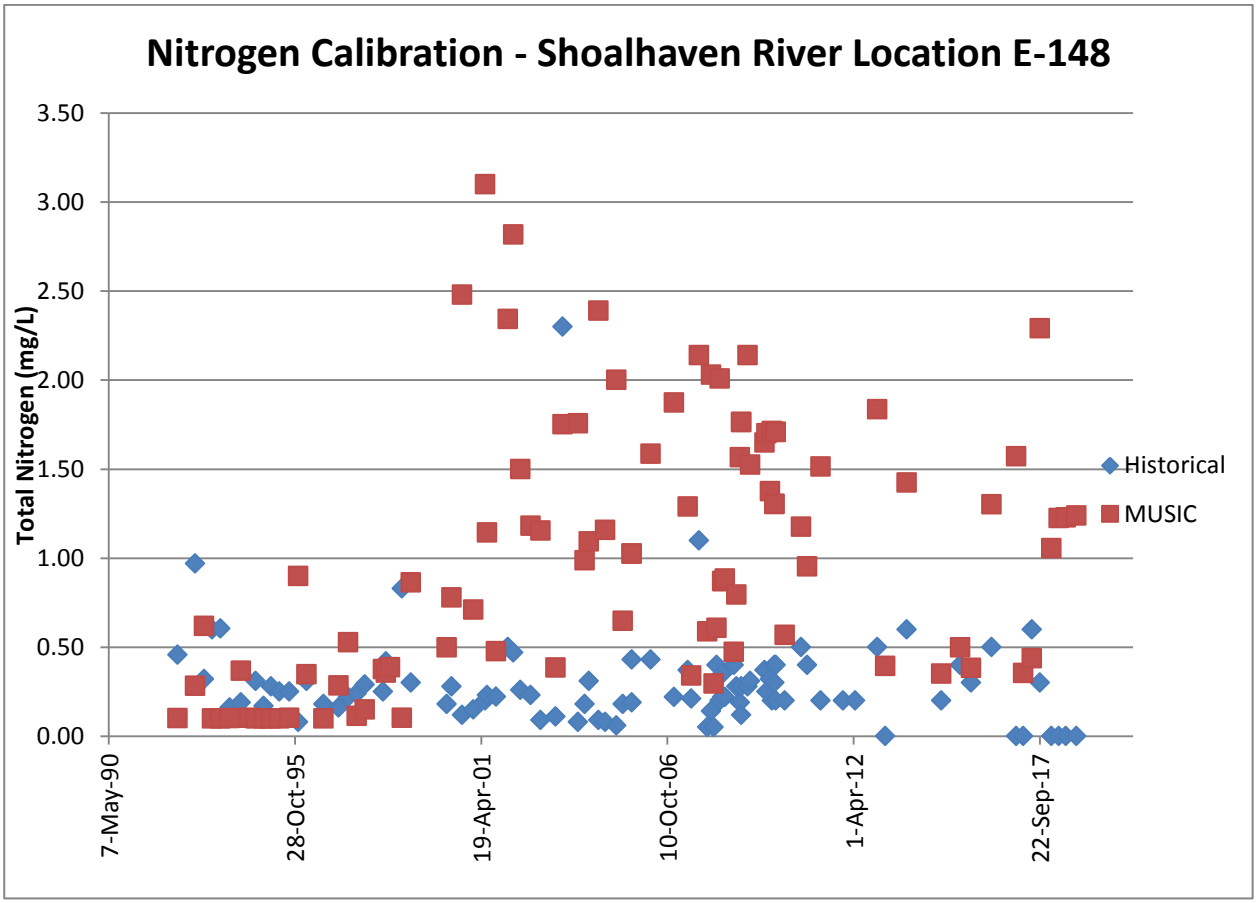

Figure 6 – Total Nitrogen Calibration.

3.4 Results of Modelling

To demonstrate the effect of proposed discharge limits, and assess these against the relevant NSW WQOs, refinement of the MUSIC model focused only on the time periods where controlled discharge from construction-phase sediment basins is likely to occur when the Shoalhaven River water quality is at (or below) the proposed discharge limit of 50mg/L (i.e. basin de-watering after treatment, not overflows from rainfall in excess of the basin design event). The construction-phase sediment basins are assumed to be discharged within five days of the cessation of a rainfall event. The construction-phase basin discharge has been assumed to be completed using a nominal pump rate over a 24-48 hour period.

The model results have been refined to exclude all days from the original model except the days of discharge to demonstrate the short-term effect of the project on the indicators on the days of discharge. Figure 7 and Figure 8 highlight the various TSS concentrations predicted by the model for the discharge conditions described above.

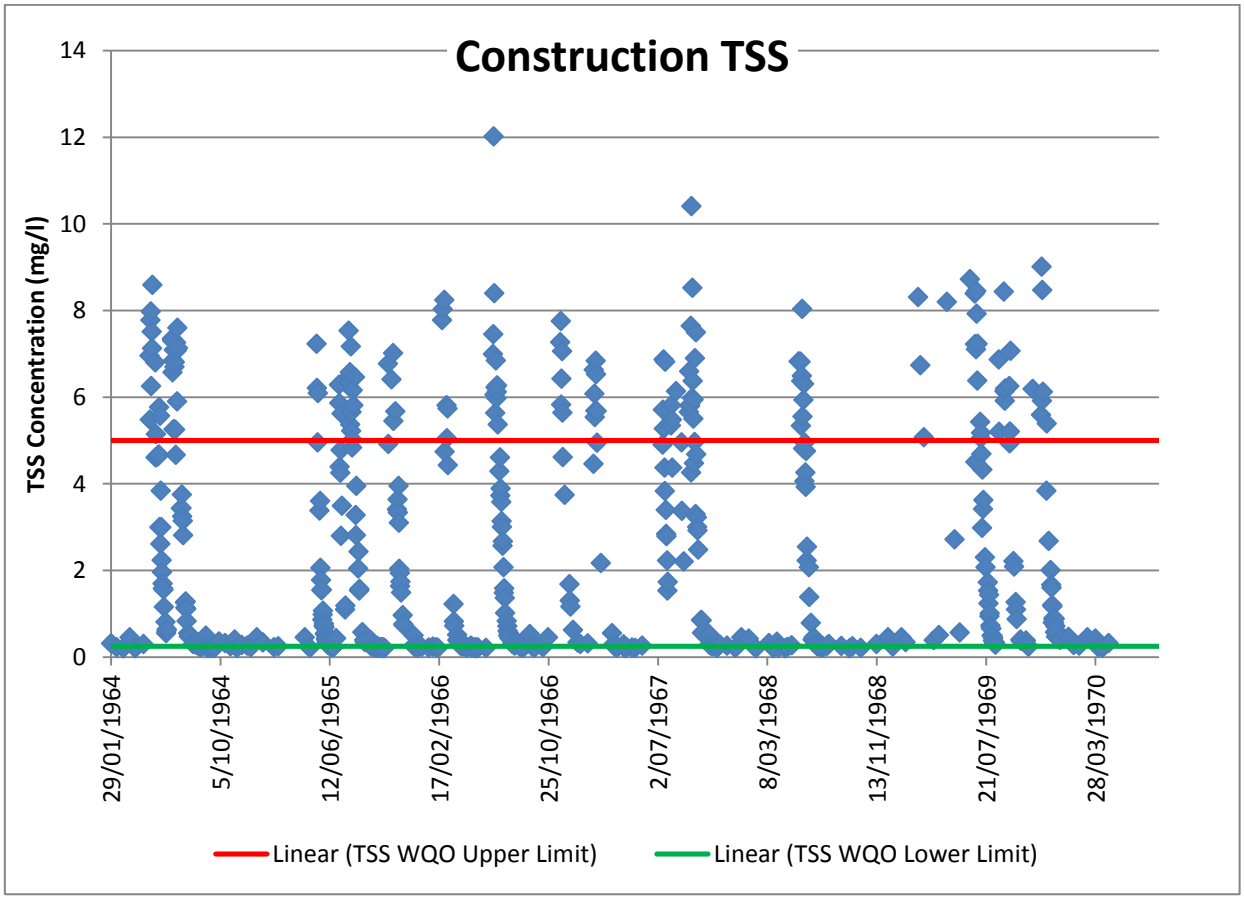

Figure 7 – MUSIC total suspended solids modelling of the short-term (24 hour) effect of construction-phase sediment basin discharges on the Shoalhaven River immediately downstream of the project alignment.

MUSIC predicts the average TSS concentration in the Shoalhaven River would be 2.40mg/L during periods of discharge from the construction-phase sediment basins. This is a 2.21% decrease from the existing case which has an average TSS concentration in the Shoalhaven River of 2.45mg/L on the same days. It should be noted, however, that the

median value increased 1.5% from 0.71 to 0.72mg/L. As discussed previously, the MUSIC model over-estimates TSS levels, but it can be assumed that the relative percentage impacts predicted by the model are representative. The median turbidity level of the historical data is 3.8 NTU (1.9mg/L). Increasing the median historical turbidity level of the Shoalhaven River by 1.5%, as estimated by MUSIC, would result in a median turbidity level of 3.86NTU.

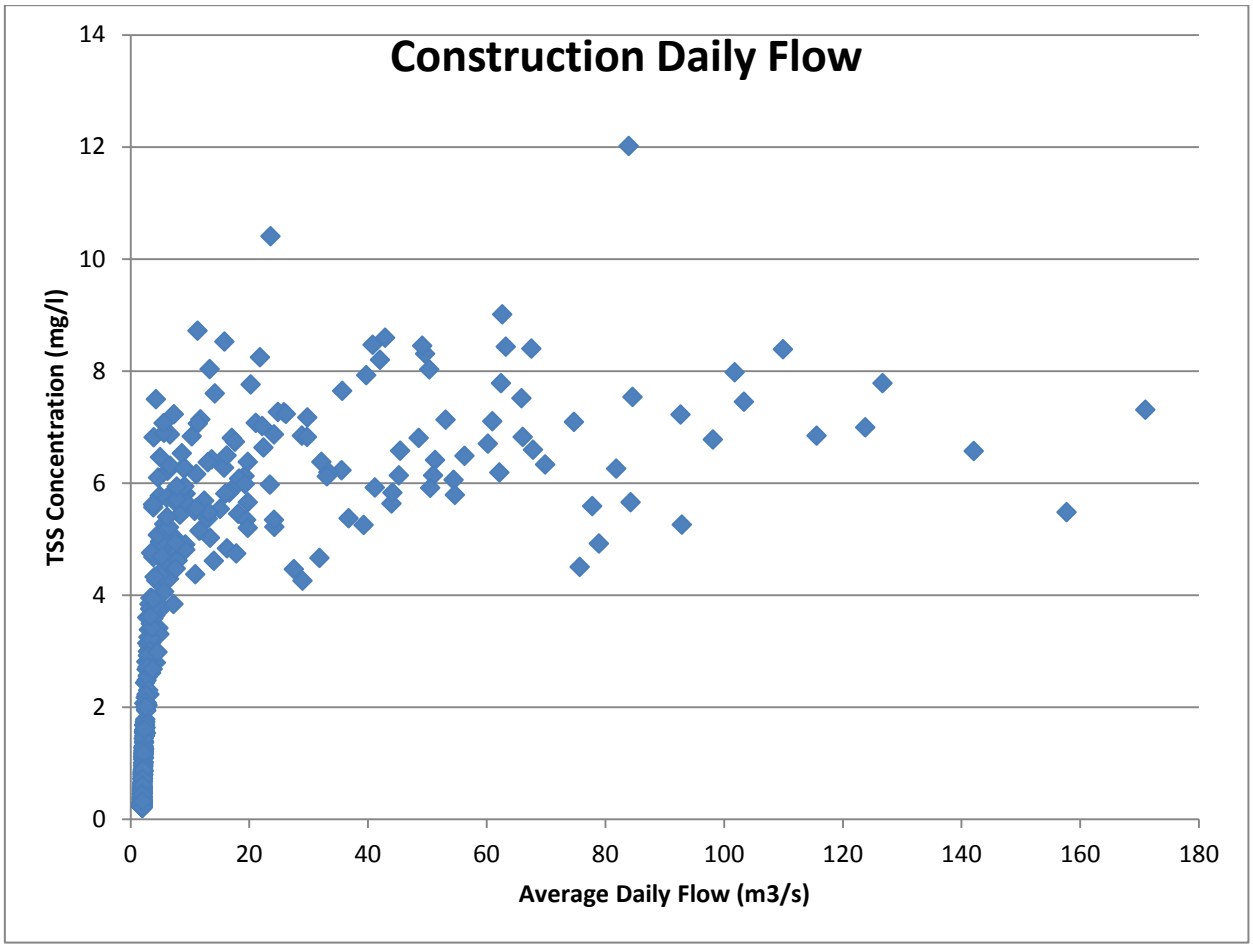

Figure 8 – Correlation of short-term (24 hour) MUSIC-modelled water TSS against catchment flow of the Shoalhaven River immediately downstream of the project alignment following discharge of construction-phase sediment basins.

Figure 8 plots the modelled TSS results in the Shoalhaven River on days where the construction-phase sediment basin discharges against the modelled catchment flow conditions. It highlights that the majority of modelled peak estimates of TSS are correlated with low flow catchment conditions. This is not dissimilar from Figure 9 which shows the existing scenario which also has a higher TSS / Turbidity concentration during lower flows.

Both plots are expected to be conservative, with the MUSIC model over-estimating TSS concentrations. However the plots highlight that sediment basin discharges should not significantly impact the TSS concentration levels in the Shoalhaven River.

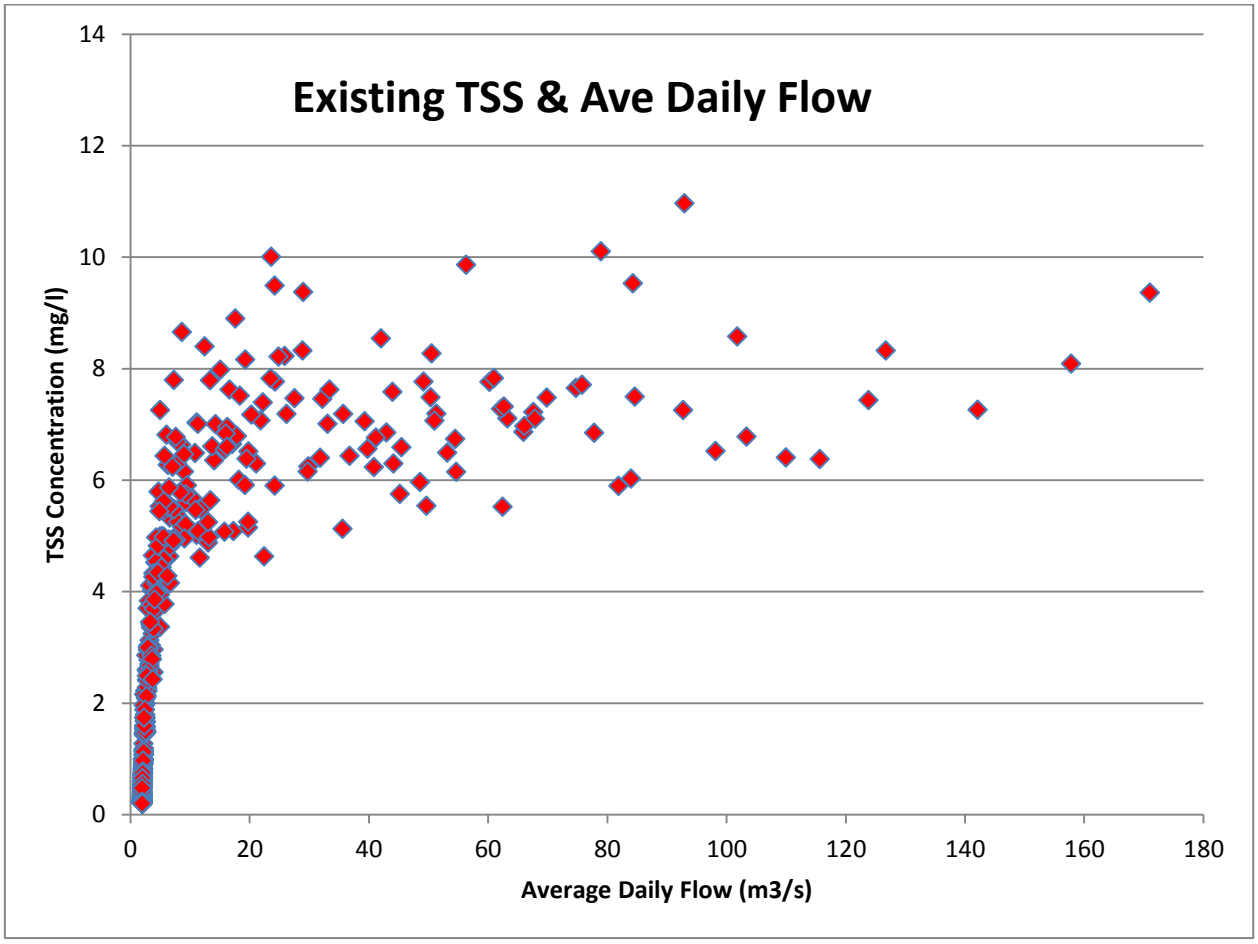

Figure 9 – Existing scenario of short-term (24 hour) MUSIC-modelled water TSS against catchment flow of the Shoalhaven River immediately downstream of the project alignment on the same days construction-phase sediment basins would discharge.

MUSIC predicts that TP concentrations in the Shoalhaven River are expected to be slightly increased by 1.14% on days when the construction-phase sediment basins discharge. However, there is a slight reduction in TP of less than 0.6% when all days are reviewed. The average TP concentration in the Shoalhaven River is expected to be around 18.5µg/L during days when the construction-phase sediment basins discharge.

The model predicts that TN concentrations will decrease slightly by around 0.44% when the construction-phase sediment basins discharge. The average TN concentration is expected to be around 189µg/L.

4 ASSESSMENT OF POTENTIAL IMPACTS

Table 4 provides a list of the key indicators and water quality objectives for each relevant environmental value for the receiving environment. Table 4 includes a description of the potential impact associated with the proposed construction-phase sediment basin discharge limits and a discussion on the expected likelihood of the impact. In undertaking the assessment in Table 4, site and soil conditions have been considered, as summarised in the ESMR (SEEC, 2019).

As noted in Section 2.1, for the purposes of this assessment, the environmental values for Shoalhaven River have been based on **estuaries** from ANZECC 2018 and 2000. These include:

- Aquatic ecosystem protection
- Visual amenity
- Secondary contact recreation (short term objective, within 5 years)
- Primary contact recreation (assess opportunities for a longer term objective 10 years or more)
- Aquatic foods (cooked). Note that ANZECC (2000) Guidelines list this environmental value as "Aquaculture and human consumption of aquatic foods." Therefore, it covers shellfish such as oysters.

Table 4 – Assessment of the impacts of the Nowra Bridge project on environmental values and associated indicators of NSW WQOs.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from proposed discharge limits
Total Phosphorus	Estuaries: 30 µg/L (for aquatic ecosystem protection).	Excessive phosphorus could lead to stimulation of the growth of nuisance plants which could dominate and change the dynamics of the aquatic ecosystem (e.g.eutrophication, algae and macrophytes). Eutrophication occurs when excessive plant growth deprives the water column of oxygen thereby killing other forms of aquatic biota. The growth of algae is also stimulated by excessive nutrients and may result in a build-up of toxins in the water column. The availability of inorganic phosphorus from soil is strongly controlled by pH. Maximum phosphate availability occurs in the pH range of 6.0-7.0. The soils are expected to have a pH range of around 5.0-6.5.	MUSIC modelling indicated an average existing TP concentration of approximately 25.2 µg/L for the existing catchment. The majority of TP organic material is expected to be present in topsoil. Road construction programming typically involves the clearing of vegetation and stripping of topsoil as one of the first activities, with the subsoils only exposed for the majority of the construction period. Local controls are provided for topsoil stockpiles (e.g. cover crops, bunds) and excess run-off from disturbed topsoil areas would be captured by construction sediment basins with expected reductions in TP associated with retention, settlement and removal of deposited sediment. TP is further reduced by the flocculation of remaining colloidal material prior to discharge. MUSIC modelling has predicted the main construction works would result in a relatively unchanged mean TP concentration of 25.0 µg/L within the receiving waterways during the entire construction period. More specifically for the construction-phase sediment basin discharges, modelling has predicted the proposed discharge limit would result in a mean TP concentration of 18.6 µg/L within the receiving waterways, This is generally a slight increase of 1.14% from existing conditions of 18.4 µg/L on the days of the discharge. Modelling also provides TP loads from the construction-phase sediment basin discharges to the receiving environment. The proposed discharge limit would result in a small increase of annual TP loads of 6.8%, for the construction period. While there are modelled exceedances of the trigger value for this indicator, these exceedances are characteristic of the prevailing catchment conditions rather than the impacts of the proposed construction-phase sediment basin discharge limits. As such, the proposed discharge limits would have minimal impacts on this indicator.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from proposed discharge limits
Total Nitrogen	Estuaries: 300 µg/L (for aquatic ecosystem protection).	Excessive nitrogen could lead to stimulation of the growth of nuisance plants which could dominate and change the dynamics of the aquatic ecosystem. (e.g. algae and macrophytes). Most nitrogen in surface soils is immobilised, bound as organic nitrogen associated with humus. A small proportion is steadily turned into inorganic (mineralised) forms such as nitrate compounds through nitrification that can be released to groundwater or soil water. Direct addition of fertiliser can increase the levels of nitrate in a soil.	Limited historical water quality monitoring in this location indicates that TN is highly variable with TN levels recorded between 50 and 2300 µg/L. MUSIC modelling indicates an average existing TN concentration of approximately 226.7 µg/L for the existing catchment. The majority of TN at the Project is expected to be present in topsoil. Road construction programming typically involves the clearing of vegetation and stripping of topsoil as one of the first activities, with the subsoils only exposed for the majority of the construction period. Local controls are provided for topsoil stockpiles (e.g. cover crops, bunds) and excess run-off from disturbed topsoil areas would be captured by construction sediment basins with expected reductions in TN associated with retention, settlement and removal of deposited sediment. TN is further reduced by the flocculation of remaining colloidal material prior to discharge. Modelling predicts that the project would result in a mean TN concentration of approximately 227.2 µg/L within the receiving waterway, generally an increase of less than 0.2% above existing levels. More specifically for the construction-phase sediment basin discharges, modelling has predicted that the proposed discharge limit would result in a mean TN concentration of 189 µg/L within the receiving waterways, generally a decrease of around 0.4% on the days of the discharge. Modelling also provides TN loads from the construction-phase sediment basin discharges to the receiving environment. The proposed discharge limit would result in a small decrease of annual TN loads of around 1.2%. While there are modelled exceedances of the trigger value for this indicator, these exceedances are characteristic of the prevailing catchment conditions rather than the impacts of the proposed construction sediment basin discharge limits. As such, the proposed discharge limits would have minimal impacts on this indicator.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from proposed discharge limits
Chlorophyll-a	Estuaries: 4 µg/L (for aquatic ecosystem protection).	Chlorophyll a (chl a) concentration is often used as a general indicator of plant biomass as nutrients alone cannot indicate whether a waterbody actually has a nuisance plant problem. Increased chl a in the water indicates that plants, algae or cyanobacteria are actually growing. Chl a is usually measured in a waterbody so is not a typical stormwater pollutant.	None expected, as Chlorophyll-a is not expected to be present in construction-phase sediment basin discharges.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from proposed discharge limits
Turbidity	Estuaries: 0.5-10 NTU (for aquatic ecosystem protection). A 200 mm diameter black disc should be able to be sighted horizontally from a distance of more than 1.6 m (approximately 6 NTU) (for primary contact recreation). Suspended solids: less than 40 micrograms per litre (freshwater) (for aquatic foods, cooked).	Turbidity is the presence of suspended particulate and colloidal matter consisting of suspended clay, silt, phytoplankton and detritus measured by a technique called nephelometry, which measures the fraction of light scattered at right angles to the light path of water. Increased turbidity can reduce light penetration through the water column and therefore reduce the level of photosynthetic activity. Turbidity increases with sediment load.	Turbidity and Total Suspended Solids (TSS) are the principle pollutant of concern associated with road construction projects. Detailed modelling has been completed to assess the turbidity impacts of the proposed discharge limits on the receiving environment. The MUSIC modelling generally indicates that the trigger value is exceeded in the Shoalhaven River. The model results are expected to be conservative as the model cannot account for the impact of naturally saline water that would result in a lower turbidity level as observed in the historical water quality data. The average TSS level as observed with the historical sampling is 6.3mg/L compared with the modelled average concentration of 26.7mg/L. The MUSIC model predicts an increase of 3.9% in the TSS loads for the entire period modelled. TSS concentrations are expected to decrease on the days of basin discharge by 2.2% with the average TSS levels decreasing from 2.45 to 2.40mg/L. However the median values increased 1.5% from 0.71 mg/L to 0.72mg/L. Assuming that the MUSIC concentrations are conservative (refer to Section 3.3.3 for discussion regarding MUSIC over-estimation of TSS levels in tidal waters) and that the increase of the concentration is relative, the observed median TSS concentration would be expected to increase from 3.8 NTU to 3.86 NTU. There is predicted to be minimal impact on this indicator as any impacts above trigger values are short-term in nature, are similar to the existing turbidity levels, and only experienced for the duration of construction. A number of mitigation measures typically implemented for road construction projects would also be implemented, such as those detailed in the ESMR and the ESCP (SEEC, 2019) (SEEC, 2019b)

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from proposed discharge limits
Dissolved Oxygen	Estuaries: 80-110% (for aquatic ecosystem protection).	The dissolved oxygen concentration in a waterbody is highly dependent on temperature, salinity, biological activity (microbial, primary production) and rate of transfer from the atmosphere.	No significant change is expected as a result of the proposed construction-phase sediment basin discharge limits providing sediment is adequately managed to limit changes to salinity and nutrients (microbial activity). It is anticipated that the construction-phase sediment basin discharges could improve dissolved oxygen levels in some circumstances through increased catchment flow.
pH	Estuaries: 7.0-8.5 (for aquatic ecosystem protection). 5.0-9.0 (for primary contact recreation).	pH is a measure of the acidity or alkalinity of water and has a scale from 0 (extremely acidic) to 7 (neutral), through to 14 (extremely alkaline).	The proposed construction sediment basin discharge limits are expected to be consistent with the trigger values for this indicator for all WQOs except for estuaries (6.5 vs 7.0). However, the proposed discharges are consistent with the pH of natural stormwater runoff of fresh water into the Shoalhaven River estuary and, given the small quantities relative to the river flows, are not expected to impact on this objective.
Temperature	Iterative (for aquatic ecosystem protection). 15 – 35^{o}C (for primary contact recreation). Less than 2 degrees Celsius change over one hour (for aquatic foods, cooked).	Aquatic ecosystem functioning is very closely regulated by temperature. Temperature changes can occur naturally as part of normal diurnal (daily) and seasonal cycles, or as a consequence of human activities (anthropogenic).	The water temperature in the construction-phase sediment basins is not expected to be significantly different from local waterways as the depth is relatively shallow – less than 2m. Cold water pollution isn't expected in dams less than 15m deep. No impacts are expected.
Chemical contaminants	Iterative (for aquatic ecosystem protection and primary contact recreation). Waters containing chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreation (for primary and secondary contact recreation).	Chemical contaminants are likely to be sourced either from spills that may occur during construction or from naturally contaminants or toxicants made soluble when run-off occurs over disturbed soils.	Chemical contamination from spills is likely to be restricted to oil spills from plant and machinery or from uncontrolled concrete washout activities. Both spill occurrences are readily cleaned up as part of routine construction activities and addressed by the proposed construction-phase sediment basin discharge limits (pH criteria and visible oils and grease). While there is potential for some mobilisation of chemical contaminants from run-off over naturally occurring soils, these contaminants are largely removed from discharges following treatment to remove sediment within the supernatant. There is not considered to be a potential impact from the proposed construction-phase sediment basin discharge limits that would result in an exceedance of these trigger values.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from proposed discharge limits
Biological assessment indicators	Iterative (for aquatic ecosystem protection)	Refer to comments on blue-green algae, faecal coliforms, enterococci, protozoans and nuisance organisms.	Refer to comments on blue-green algae, faecal coliforms, enterococci, protozoans and nuisance organisms.
Visual clarity and colour	Natural visual clarity should not be reduced by more than 20% (for visual amenity and primary and secondary contact recreation). Natural hue of the water should not be changed by more than 10 points on the Munsell Scale (for visual amenity and primary and secondary contact recreation). The natural reflectance of the water should not be changed by more than 50% (for visual amenity and primary and secondary contact recreation).	Clarity is a measure of how clear or transparent water is. It indicates how much light is available for photosynthesis at different depths.	This indicator is largely assessed above in relation to turbidity and TSS. There is limited baseline information on the natural visual clarity, hue and reflectance of the receiving environments to determine whether there is likely to be a predicted change in the nominated indicator. However, given the minor change in TSS concentrations and loads, it is unlikely that construction-phase sediment basin discharge would adversely impact on this environmental value.
Toxicants (as applied to aquaculture activities)	For aquatic foods (cooked) the following applies: Metals: • Copper: less than 5 µgm/L. • Mercury: less than 1 µgm/L. • Zinc: less than 5 µgm/L. Organochlorines: • Chlordane: less than 0.004 µgm/L (saltwater production) • PCB's: less than 2 µgm/L.	Heavy metals and organochlorines can accumulate in aquatic foods to toxic levels.	None expected, as construction-phase sediment basin discharges are not predicted to be outside the triggers values nominated for this indicator.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from proposed discharge limits
Faecal coliforms	Median bacterial content in fresh and marine waters of < 1000 faecal coliforms per 100 mL, with 4 out of 5 samples < 4000/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month) (for secondary contact recreation). For primary contact recreation, Beachwatch considers waters are unsuitable for swimming if: • the median faecal coliform density exceeds 150 colony forming units per 100 millilitres (cfu/100mL) for five samples taken at regular intervals not exceeding one month, or • the second highest sample contains equal to or greater than 600 cfu/100mL (faecal coliforms) for five samples taken at regular intervals not exceeding one month. For primary contact recreation, ANZECC 2000 Guidelines recommend: • Median over bathing season of < 150 faecal coliforms per 100 mL, with 4 out of 5 samples < 600/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month). For aquatic foods (cooked), guideline in water for shellfish: • The median faecal coliform concentration should not exceed 14 MPN/100mL; with no more than 10% of the samples exceeding 43 MPN/100 mL. For aquatic foods (cooked), standard in edible tissue: • Fish destined for human consumption should not exceed a limit of 2.3 MPN E Coli /g of flesh with a standard plate count of 100,000 organisms /g.	Coliforms are bacteria present in the digestive tracts of animals including humans and are found in their wastes and are used as an indicator of faecal contamination.	None expected from the release of construction-phase sediment basin discharges.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from proposed discharge limits
Enterococci	Median bacterial content in fresh and marine waters of < 230 enterococci per 100 mL (maximum number in any one sample: 450-700 organisms/100 mL) (for secondary contact recreation). For primary contact recreation, Beachwatch considers waters are unsuitable for swimming if: • the median enterococci density exceeds 35 cfu/100mL for five samples taken at regular intervals not exceeding one month, or • the second highest sample contains equal to or greater than 100 cfu/100mL (enterococci) for five samples taken at regular intervals not exceeding one month. For primary contact recreation, ANZECC 2000 Guidelines recommend: • Median over bathing season of < 35 enterococci per 100 mL (maximum number in any one sample: 60-100 organisms/100 mL).	Intestinal enterococci are a functional group of organisms from the *Enterococcus* and *Streptococcus* genera that are excreted in human and animal waste and are used as an indicator of faecal contamination.	None expected from the release of construction-phase sediment basin discharge.
Protozoans	Pathogenic free-living protozoans should be absent from bodies of fresh water. (Note, it is not necessary to analyse water for these pathogens unless temperature is greater than 24 degrees Celsius) (for primary contact recreation)	Protozoans are waterborne pathogens that indicate water contaminated with human or animal waste.	None expected from the release of construction-phase sediment basin discharge.
Algae and Blue-green algae	< 15 000 cells/mL (for primary contact recreation). No guideline is directly applicable for aquatic foods (cooked), but toxins present in blue-green algae may accumulate in other aquatic organisms.	Blue-green algae are a type of bacteria known as Cyanobacteria. They photosynthesise using sunlight to produce oxygen. Low levels of blue-green algae are present in freshwater all the time. However a series of favourable environmental factors including warm water temperatures, sunny days and nutrients can lead to a blue-green algae bloom. Blooms lead to environmental and visual impacts.	Refer to comments on temperature, Total Phosphorus and Total Nitrogen.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from proposed discharge limits
Nuisance organisms	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, sewage fungus and leeches should not be present in unsightly amounts (for visual amenity and primary contact recreation).	The presence of macrophytes, algal mats etc will be impacted by the amount of nutrients / organic matter in the waterway. Refer to discussion on Total Phosphorus, Total Nitrogen and Chlorophyll a.	None expected from the release of construction-phase sediment basin discharge.
Surface films and debris	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour (for visual amenity and primary and secondary contact recreation). Waters should be free from floating debris and litter (for visual amenity and primary and secondary contact recreation).	Refer to discussion on chemical contaminants.	Refer to discussion on chemical contaminants.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The results can be summarised as follows:

(i) The MUSIC model is conservative in predicting TSS concentrations in tidal environments. However, it is assumed the predicted increase in loads and concentrations from the proposed construction phase works is relative and can be proportionally applied.

(ii) TSS loads are expected to increase marginally by 3.9% with the adopted construction-phase basin discharge criteria during the main construction period.

(iii) Following construction-phase sediment basin discharge events, average TSS levels are predicted to decrease by around 2.2% however median values will increase by 1.5%. Historical monitoring results indicate that the average TSS concentration is around 6.8mg/L (13.6 NTU) which is higher than the trigger value of 10 NTU and would include periods following heavy rain when turbidity is expected to be higher in the river. The historical median concentration is 1.9mg/L (3.8 NTU). Increasing the historical median value by 1.5% results in a turbidity level of 3.86 NTU which is still well below the trigger value of 10 NTU.

(iv) The predicted TN concentrations are expected to decrease by up to 0.44% on days of discharge.

(v) The predicted TP concentrations are expected to increase by up to 1.1% on days of discharge.

(vi) TSS, TP and TN concentrations are predicted to be close to, or above, the trigger values for these indicators, but do not increase significantly over the background catchment conditions. Given the small loads associated with proposed construction-phase basin discharge limits, it is considered these exceedances are representative of the prevailing catchment conditions rather than any impacts associated with the main construction phase of this project.

5.2 Recommendations for This Project

Notwithstanding the above conclusions, for this project a range of management measures are recommended to reduce the potential environmental impacts associated with construction-phase sediment basin discharges. These are outlined in Section 2.3 and are detailed in the REF (Roads and Maritime, 2018), and in the ESMR and the ESCP (SEEC (2019) and SEEC (2019b))

In addition, the following management measures are recommended for the construction-phase works component of this project:

- Re-use of water in construction-phase sediment basins in preference to discharge. Road construction is an activity that requires considerable water volumes for earthworks compaction and dust control. During dryer periods, construction sediment basin water would typically be utilised for this purpose rather than discharged.
- All construction-phase sediment basin outlets would be rock armoured to meet Blue Book design requirements. Where nominated discharge points are located away from waterways, the rock armouring provides an opportunity for infiltration of discharged water into the underlying soil prior to discharge into the receiving environment.
- Basin dewatering activities are required to be undertaken in accordance with Roads and Maritime's document titled *Environmental Management of Construction Site Dewatering*, which requires the following:
    - Preparation of site specific environmental work method statement for dewatering activities,
    - Dewatering methods that will minimise potential environmental impacts,
    - Reuse opportunities and any limitations,
    - Discharge locations and adequate energy dissipation,
    - Water quality criteria for discharge and/or reuse,
    - Treatment techniques required to meet the water quality criteria,
    - Water sampling and testing requirements.
- Use of floating siphon devices where possible to minimise resuspension of sediment during dewatering operations. Floating siphon devices remove water from the top of the water column where the supernatant is likely to be the best quality.

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Appendix E

Operational Water Quality Assessment

SEEC

Strategic Environmental & Engineering Consulting

NSW WATER QUALITY OBJECTIVES:

ASSESSMENT OF OPERATIONAL WATER QUALITY

Nowra Bridge Project

Prepared by:

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18 February 2019

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.

Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the site at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this report does not contain any incomplete or misleading information.

Andrew Macleod B.Sc (Hons) CPESC CPSS
Director and Principal Soil Conservationist
SEEC

18 February 2019

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Version Register

Version	Date	Author	Reviewer	Notes	Other
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01	8/1/2019	AM/BJ	MP	Final-Issued to RMS	
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1 INTRODUCTION

1.1 Proposal Identification

NSW Roads and Maritime Services (Roads and Maritime) proposes to construct a new bridge for the A1 Princes Highway over the Shoalhaven River at Nowra.

The Nowra Bridge project (the proposal) includes a new four lane bridge to the west (upstream) of the existing bridge crossings and the removal of vehicular traffic from the existing southbound bridge. The proposal would also include the upgrade of about 1.6 kilometres of the Princes Highway in the vicinity of the bridge, as well as providing key intersection upgrades and modifications to the local road network.

This report supports the environmental assessment for the proposal.

1.2 Proposal Location and Setting

The proposal is located at the A1 Princes Highway crossing of the Shoalhaven River at Nowra (refer to Figure 1). The works include the upgrading of the Princes Highway to provide three northbound and three southbound lanes from the Bolong Road intersection through to about 75 metres north of the Moss Street intersection.

The proposal would improve access between North Nowra/Bomaderry and Nowra and the surrounding areas, improve southbound access for large freight vehicles, and improve traffic flows.

The proposal is located on land mapped as 'coastal environment area' and 'coastal use area'. Development consent within this area must be in accordance with clause 13 of the Coastal Management SEPP, which includes consideration by the consent authority that the proposal will not cause adverse impacts to coastal processes, water quality of a marine estate, Aboriginal heritage and that the proposal incorporates water sensitive urban design.

1.3 Key Features of the Proposal

Key features of the proposal include:

- Construction of a new bridge over the Shoalhaven River on a different alignment to the west of the existing bridge, with four northbound lanes and a 3.5 metre wide shared use path;
- Widening of the existing bridge over Bomaderry Creek to the west (upstream);
- Minor lane adjustments on the existing northbound bridge to convert it to three lanes of southbound traffic;

- Removal of vehicular traffic and closure of the existing southbound bridge to undertake investigation, rehabilitation and repurposing work for adaptive reuse following opening of the new northbound bridge;
- Upgrading of the Princes Highway to provide three northbound and three southbound lanes from the Bolong Road intersection through to about 75 metres north of the Moss Street intersection;
- Widening of Illaroo Road over a distance of about 270 metres;
- Upgrading of the Princes Highway and Illaroo Road intersection;
- Upgrading of the Princes Highway and Bridge Road intersection;
- Local road adjustments including:
    - Closing the access between Pleasant Way and Princes Highway
    - Restricting turning movements at the intersection of Bridge Road and Scenic Drive
    - Construction of a new local road connecting Lyrebird Drive to the Princes Highway about 300 metres south of the existing Pleasant Way intersection.
- Provision of pedestrian facilities at all intersections;
- Dedicated off-road shared paths and footpaths along the length of the proposal;
- Urban design and social amenity improvements, and landscaping including pedestrian links to the existing southbound bridge;
- Relocation and/or protection of utility services;
- Drainage and water quality infrastructure along the road corridor; and
- Property works including acquisition, demolition, and adjustments to accesses.

The key features of the proposal are shown in Figure 1.

1.4 Purpose of This Report

The purpose of this report is to assess the impacts of the stormwater discharges from the operational new bridge (i.e. post-completion) against the NSW Water Quality Objectives at this location. For assessment of potential water quality issues associated with the main construction-phase works, refer to the separate reports listed below:

This report should be read in conjunction with the following:

- SEEC (2018). *Erosion and Sediment Management Report: Nowra Bridge Project*. Strategic Environmental and Engineering Consulting (SEEC) Pty Ltd.

- Roads and Maritime Services (2018). *Nowra Bridge Project; Review of Environmental Factors*. August 2018.

- SEEC (2018c). *NSW Water Quality Objectives: Assessment of Impacts of Proposed Construction-Phase Sediment Basins Nowra Bridge*. Strategic Environmental and Engineering Consulting (SEEC) Pty Ltd.

1.5 Assumptions Used In This Report

Figure 1 shows the proposal, including the study area that environmental assessments have focused on. For the purpose of the assessment of Water Quality Objectives (WQOs) in this report, the entire Shoalhaven River catchment upstream of this location will be considered.

The upstream area includes Tallowa Dam located around 60km upstream of the bridge that discharges environmental flows to the Shoalhaven River. The Water NSW website https://www.waternsw.com.au/supply/Greater-Sydney/greater-sydneys-dam-levels highlights that the dam has a significant environmental flow release component. Daily flow discharges are not available but the website indicates the past year's environmental flow releases totaled 64,411 ML. This equates to an average daily flow release of greater than 170 ML and so this has been adopted in the models.

Roads and Maritime provided a table of landuses and areas for the catchment between the Nowra Bridges and Tallowa Dam used in flood modelling for the project. The data was initially adopted but, on closer inspection, it was not found to represent the pervious nature of the catchments. The provided descriptions are more reflective of the roughness characteristics of the catchment which is more relevant to the flood modelling aspect of the project. A review of an aerial photo and Council's land use planning scheme indicated a different arrangement as shown in Table 1. These areas better reflect the input data required for MUSIC water quality modelling.

Table 1 – Catchment Landuses

Landuse	Supplied Areas (ha)	Adopted Areas (ha)
Heavy Vegetation	506	-
In-bank	2,531	-
Roads	87	87
Isolated High Rough Areas	271	-
Riparian Areas	1,184	-
Low Vegetation / Forest	175,869	167,264
Urban Development	687	863
Agriculture	-	9,113
Rural	-	3,808
TOTAL AREA	**181,135**	**181,135**

Figure 1 – Proposal area (supplied by SMEC and RMS).

2 BACKGROUND

2.1 Environmental Values

Environmental values are those values or uses of water that are desired by the community to be protected. These include, but are not limited to, protection of aquatic ecosystems, drinking water, primary and secondary recreation, visual amenity, and agricultural water for irrigation, livestock and growing aquatic foods.

Environmental values for each catchment in NSW are provided by the Office of Environment and Heritage (OEH). The proposed Nowra Bridge is within the Shoalhaven River catchment. The NSW Government has not formally adopted water quality objectives for the Shoalhaven River catchment.

Based on the National Water Quality Management Framework described in ANZECC (2018), locally derived water quality guideline values are most appropriate for the protection of aquatic ecosystems. However, where they are not available, default guideline values (DGVs) are suitable for some community values. ANZECC 2018 does not currently include DGVs for inland waters at this location; therefore, the ANZECC 2000 values have been adopted to determine if any impact is likely from the proposed works. For each environmental value, the ANZECC guidelines (ANZG, 2018) and (ANZECC/ARMCANZ, 2000) identify particular water quality characteristics or 'indicators' that are used to assess whether the condition of the water supports that value.

The ANZECC and NSW Water Quality Objectives (WQOs) are the environmental values and long-term goals for consideration when assessing and managing the likely impact of activities on waterways. As noted in DECC (2006) they are not intended to be applied directly as regulatory criteria, limits or conditions but are one factor to be considered by industry, the community, planning authorities or regulators when making decisions affecting the future of a waterway. The WQOs are long term pollutant concentration values within the receiving water required to protect the desired environmental values.

As per Step 8 of the framework, predictive catchment modelling has been adopted to derive flows from rainfall runoff and simulate associated pollutant loads which can be assessed against typical water quality objectives for estuaries in New South Wales which include:

- Aquatic ecosystem
- Visual amenity
- Secondary contact recreation (short term objective, within 5 years)
- Primary contact recreation (assess opportunities for a longer term objective 10 years or more)

- Aquatic foods (cooked). Note that ANZECC (2000) Guidelines list this environmental value as "Aquaculture and human consumption of aquatic foods." Therefore, it covers shellfish such as oysters.

The modelling has also been used to estimate the effectiveness of proposed mitigation measures to confirm they meet the discharge criteria for stormwater from the site (provided in Table 2) in the form of pollutant reductions.

2.2 General Water Quality Impacts of Stormwater Runoff From Roads

Water quality impacts associated with stormwater runoff from roads are predominantly associated with the mobilisation of various pollutants ranging from gross pollutants to particulate and soluble contaminants (e.g. trace metals and hydrocarbons, especially polycyclic aromatic hydrocarbons), which are transported when rainfall washes these off the road surface (Wong *et al*., 2000).

2.3 Existing Stormwater Management – Existing Nowra Bridges

According to RMS (2018), neither of the two existing bridges across the Shoalhaven River or the existing bridge over Bomaderry Creek have and form of treatment and drain stormwater directly to the waterways via scuppers. Road runoff north and south of the Shoalhaven River is directed into the Council stormwater system and can therefore drain unattenuated and untreated to the river. Any spillage could impact water quality and affect sensitive aquatic and riparian receptors within the river.

2.4 Proposed Stormwater Management – New Nowra Bridge

RMS (2018) notes that stormwater runoff from the new bridge and its approaches would be captured and treated prior to discharge. This will include spill containment. A variety of operational water quality treatment structures will be included in the detailed design, giving consideration of the Roads and Maritime Water Sensitive Urban Design Guidelines (2017).

The proposal includes a grassed basin/swale on the northern side of Illaroo Road adjacent to the highway, and a water quality treatment basin on the southern side of the Shoalhaven River (refer RMS 2018 for additional details). These have capacities of 80,000 litres and 600,000 litres respectively. The northern basin/swale captures runoff from the northern section of the new north bound bridge and drainage from a portion of the upgraded section of Illaroo Road. The southern basin captures runoff from the southern section of the new north bound bridge and drainage from a portion of the upgraded approaches. Both treatment facilities would contain bioretention soil media with underlying subsoil pipes discharging to pipe outfalls, both of which would include a catchpit overflow mechanism.

RMS (2018) notes that the proposed operational water quality infrastructure would aim for pollutant reductions as noted in Table 2.

Table 2 – Summary of proposed pollutant reductions for operational water quality (from RMS, 2018).

Pollutant	Proposed reduction criteria
Total suspended solids (TSS)	85% retention of the annual average load
Total nitrogen (TN)	45% retention of the annual average load
Total phosphorus (TP)	65% retention of the annual average load

2.5 Site Conditions for Impact Assessment

In conducting an assessment of potential impacts against the WQOs, site, soil and catchment conditions have been taken into account. Climate, topography, soils (including acid sulfate soils) and catchment conditions are described in detail in the ESMR (SEEC, 2018) so are not repeated here.

2.6 Shoalhaven River Catchment Characteristics

All drainage from the proposal site flows into the Shoalhaven River, which discharges into the Tasman Sea via a wave-dominated barrier estuary with an open entrance. At the proposal site, waters are tidal and brackish. The Shoalhaven River has four main tributaries, the Mongarlowe, Corang, Endrick and Kangaroo Rivers. The catchment contains the major water storage of Tallowa Dam which is part of the Greater Sydney water supply system owned and operated by WaterNSW. Key water management issues in the catchment include:

- Water sharing with Greater Sydney.
- Water quality, associated with pollution and weed growth.
- Riverbank management, associated with rural development.
- Environmental water, related to ensuring sufficient flows and refreshes to maintain river health.

According to RMS (2018) there are some sensitive environmental features that could potentially be affected by operational water quality impacts associated with the proposal. These are:

- Several areas of seagrass (Zostera muelleri) within the proposal study area.
- Mangrove stands which occur along the banks of the Shoalhaven River east and west of the existing bridges, but with very limited occurrence within the proposal study area.

There are no coastal wetlands or littoral rainforest listed under the Coastal Management SEPP that occur in the proposal study area.

There are numerous oyster leases in the lower reaches of the Shoalhaven River estuary, about 11.5 kilometres downstream from the Project.

2.7 Water Quality Data

Shoalhaven City Council conducts regular monitoring of water quality within the Shoalhaven River estuary which are published on the Aqua Data Shoalhaven water quality information website. Previously, they produced Estuary Health Report Cards between 2000 and 2012.

Figure 2 shows the location of monitoring location E-148 which was used to provide historical water quality data from 1992 to 2018 for the catchment just downstream of the bridge.

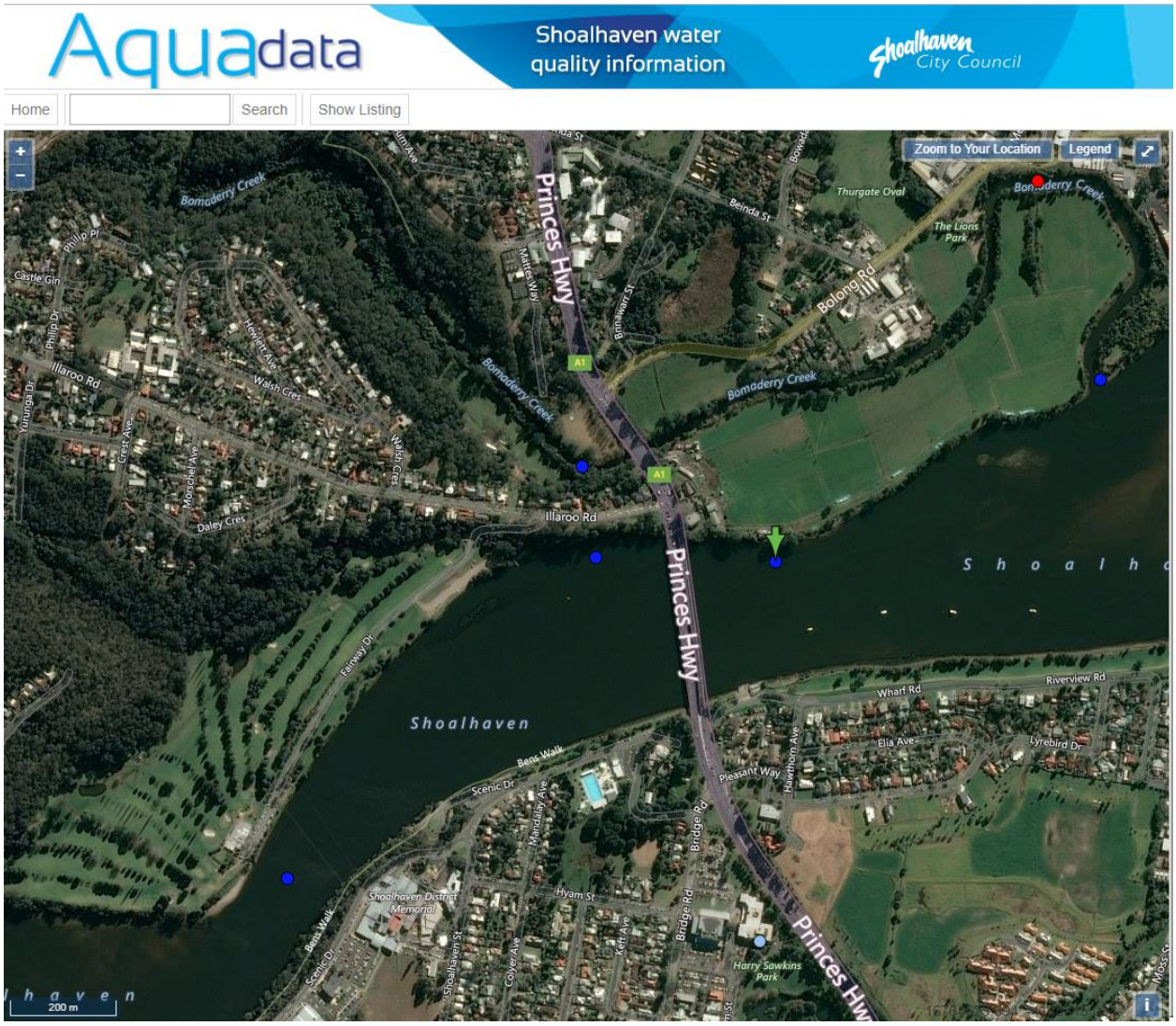

Figure 2 – Shoalhaven River monitoring location E-148 (https://webreports.esdat.net/SCC#results-map).

A review of the historical Turbidity, Total Nitrogen and Phosphorus results are provided in Table 3.

Table 3 – Summary of water quality data from Shoalhaven City Council Aqua Data website (1992-2018) for Site E-148, which is just downstream of the Nowra bridge.

Parameter	No of samples	Average (mg/L)	Median (mg/L)	10%ile (mg/L)
Turbidity	95	13.6 NTU	3.8 NTU	0.5 NTU
Total Nitrogen	98	0.30	0.25	0.07
Phosphorous	95	0.04	0.025	0.001
Total Suspended Solids	13	43.4	40	13.0

3 STORMWATER MODELLING

3.1 Introduction

The Model for Urban Stormwater Improvement Conceptualisation (MUSIC) was used to assess the impacts of stormwater runoff from the proposed bridge compared to the existing scenario as part of justifying the project's consistency with the NSW WQOs. MUSIC is a water quality decision support tool for stormwater managers. It aids the planning and design (to a conceptual level) of appropriate stormwater management systems from an individual development to a catchment level. The MUSIC modelling software was developed by researchers and practitioners of the former Cooperative Research Centre (CRC) for Catchment Hydrology and the current eWater CRC, and represents an accumulation of the best available knowledge and research into urban and rural stormwater management in Australia.

MUSIC estimates stormwater pollutant generation and simulates the performance of stormwater treatment devices individually and as part of a treatment train (individual devices connected in series to improve overall treatment performance). By simulating the performance of stormwater quality improvement measures, MUSIC provides information on whether a proposed stormwater management system conceptually would achieve water quality targets.

Utilisation of the model is a three step process:

1. Development of a MUSIC model of the existing catchment conditions;
2. Development of a MUSIC model of the proposed catchment conditions and stormwater quality improvement devices using the same catchment extent as the model of the existing conditions;
3. Comparison of the model outputs: existing vs proposed.

Each of these stages is outlined in more detail below. In conducting this modelling, we have focused on the pollutants of concern for the operational-phase of the project (TSS, TP, TN and gross pollutants). Note that MUSIC does not model oils and greases but comments regarding these are included in Table 9 in Section 4.

3.2 Existing Conditions Model

In order to consider the stormwater discharge characteristics of the existing Shoalhaven River and its tributaries, the forest, rural, residential and urban areas within these catchments were identified (see Figure 3 and Table 4). The runoff parameters and pollutant generation parameters were applied to these areas as per the draft CMA MUSIC guidelines (CMA, 2010).

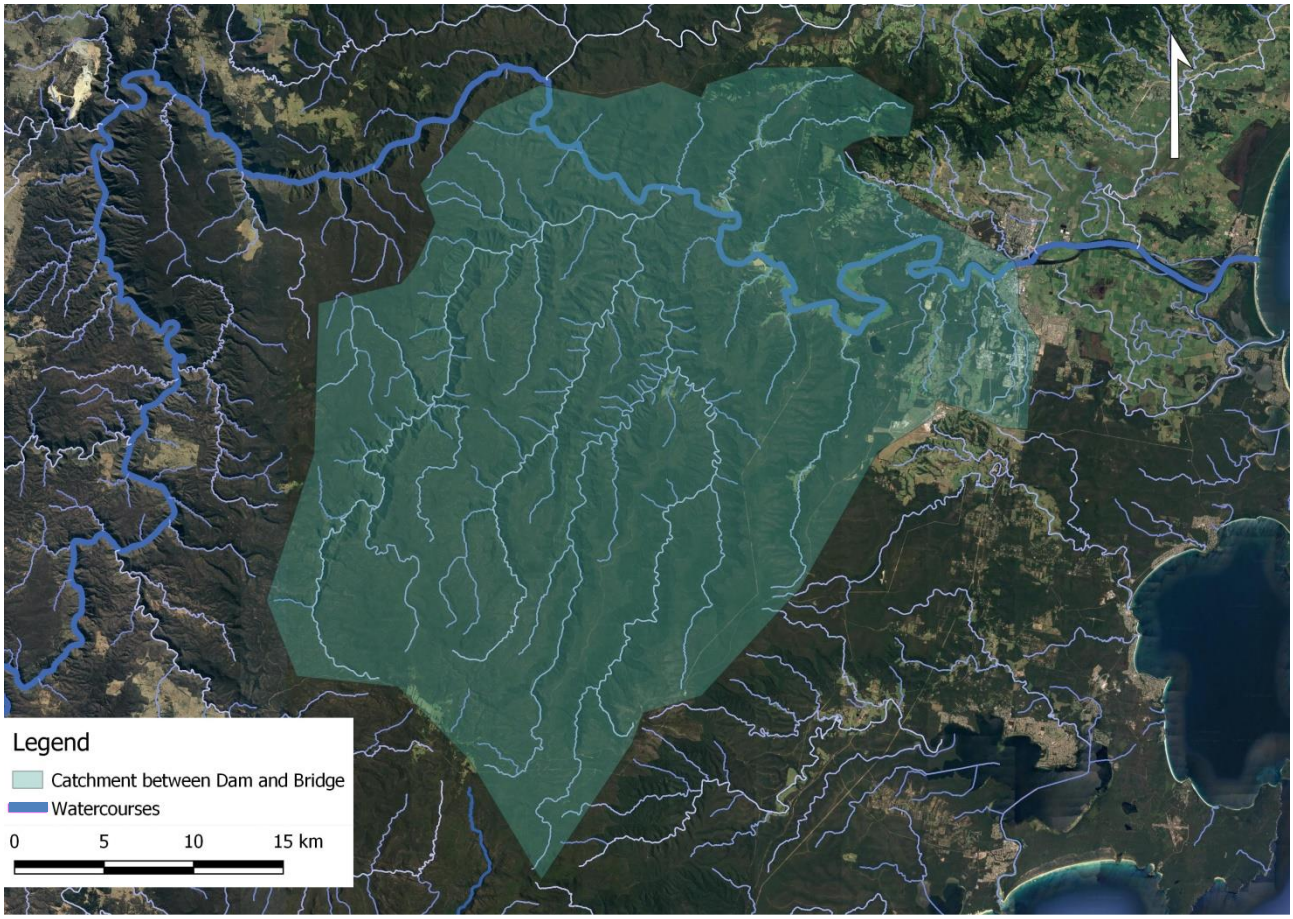

Figure 3 – Shoalhaven River Catchment Map upstream of the bridge and downstream of the Tallowa Dam.

A summary of the sub-catchment areas is provided in Table 4.

Table 4 – Summary of sub-catchment areas.

Landuse Type	Zoning Surface Type	Total Area (ha)
Forest	Forest	167,264
Urban Development	Residential	863
Agriculture	Agriculture	9,113
Rural	Rural	3,808
Roads (including existing bridge)	Roads	87
	Total	**181,135**

The model includes all rainfall events from a representative climatic timeframe (January, 2000 to December, 2005). The mean annual rainfall for the modelled timeframe is 920mm and the mean annual evapotranspiration is 1284mm.

The adopted runoff and pollutant parameters are provided in Table 5.

Table 5 – Summary of MUSIC Runoff and Pollutant Parameters

Parameter	Residential	Agricultural	Rural	Forest	Road
Field Capacity (mm)	70	80	80	80	80
Pervious Area Infiltration Capacity coefficient - a	210	175	175	175	175
Pervious Area Infiltration Capacity exponent - b	4.7	3.1	3.1	3.1	3.1
Impervious Area Rainfall Threshold (mm/day)	1	1	1	1	1.5
Pervious Area Soil Storage Capacity (mm)	170	210	175	175	175
Pervious Area Soil Initial Storage (% of Capacity)	30	30	30	30	30
Groundwater Initial Depth (mm)	10	10	10	10	10
Groundwater Daily Recharge Rate (%)	50	35	35	35	35
Groundwater Daily Baseflow Rate (%)	5	20	20	20	20
Groundwater Daily Deep Seepage Rate (%)	0	0	0	0	0
Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	1.95	1.6	2.43
Stormflow TSS Standard Deviation (log mg/L)	0.32	0.31	0.32	0.2	0.32
Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.22	-0.66	-1.1	-0.3
Stormflow Total Phosphorus Standard Deviation (log mg/L)	0.25	0.3	0.25	0.22	0.25
Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.48	0.3	-0.05	0.34
Stormflow Total Nitrogen Standard Deviation (log mg/L)	0.19	0.26	0.19	0.24	0.19
Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.3	1.15	0.78	1.2
Baseflow TSS Standard Deviation (log mg/L)	0.17	0.13	0.17	0.13	0.17
Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-1.05	-1.22	-1.52	-0.85
Baseflow Total Phosphorus Standard Deviation (log mg/L)	0.19	0.13	0.19	0.13	0.19
Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.04	-0.05	-0.52	0.11
Baseflow Total Nitrogen Standard Deviation (log mg/L)	0.12	0.13	0.12	0.13	0.12

3.3 Proposed Conditions Model

The existing MUSIC model was updated to include various water quality treatment measures such as biofiltration basins. A schematic of the model is provided in Figure 4.

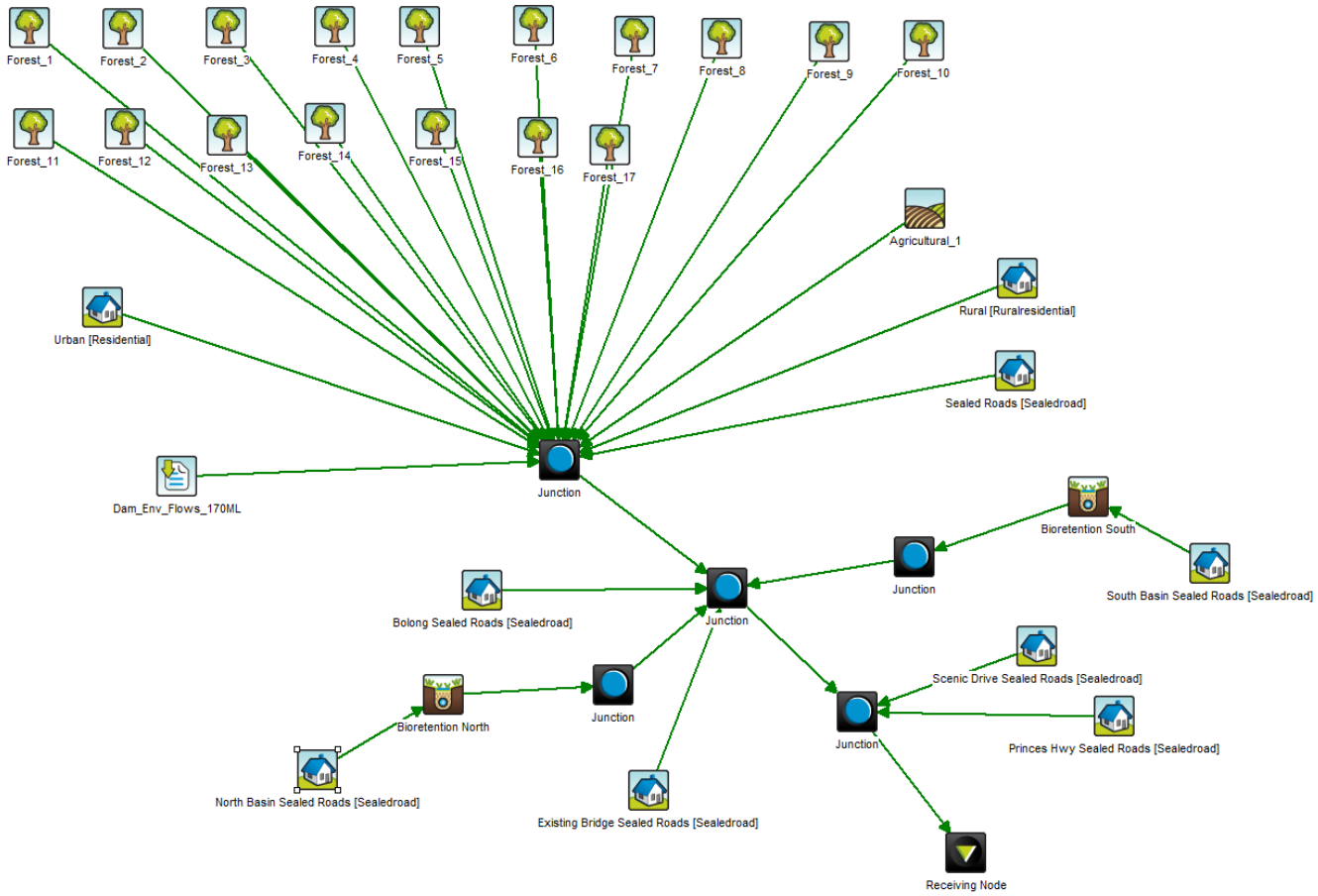

Figure 4 – MUSIC Model schematic

The characteristics of the proposed water quality treatment systems are provided in Table 6. No additional water quality treatment has been included in the MUSIC model.

Table 6 – Summary of Bio-filtration Basin Parameters

Parameters	North Bio-filtration	South Bio-filtration
Upstream Catchment Area (ha)	1.23	0.57
Lo-flow bypass rate (cum/sec)	0	0
Hi-flow bypass rate (cum/sec)	100	100
Surface Area (sqm)	1000	220
Extended detention depth (m)	0.3	0.3
Overflow weir width (m)	2	2
Filter area (sqm)	200	200
Filter perimeter (m)	108	50
Filter depth (m)	0.3	0.3
Saturated Hydraulic Conductivity (mm/hr)	50	50
Infiltration Media Porosity	0.36	0.36
Vegetation Type	Vegetated with Effective Nutrient Removal Plants	Vegetated with Effective Nutrient Removal Plants
Total Nitrogen Content in Filter (mg/kg)	600	600
Orthophosphate Content in Filter (mg/kg)	50	50
Is Base Lined?	No	No
Is Underdrain Present?	Yes	Yes
Is Submerged Zone Present?	No	No

3.4 Results of Modelling

Results from the MUSIC model have been provided at the outlet of each basin and are included in Table 7 and Table 8.

Table 7 – MUSIC Model Results for North Basin CH77040 MCNO

Parameters	Source Load	Residual Load	Removal Efficiency North Basin	Water Quality Objective / Target Reductions
Total Suspended Solids (kg/yr)	3250	37.5	98%	85%
Total Phosphorus (kg/yr)	4.88	0.866	82%	65%
Total Nitrogen (kg/yr)	18.7	5.73	69%	45%
Gross Pollutants (kg/yr)	228	0	100%	Litter greater than 50mm & sediment coarser than 0.125mm for flows up to 25% of the 1-year ARI flow

Table 8 – MUSIC Model Results for South Basin CH7750 MCNO

Parameters	Source Load	Residual Load	Removal Efficiency North Basin	Water Quality Objective
Total Suspended Solids (kg/yr)	1370	13.1	99%	85%
Total Phosphorus (kg/yr)	2.73	0.384	86%	65%
Total Nitrogen (kg/yr)	9.32	2.37	74%	45%
Gross Pollutants (kg/yr)	106	0	100%	Litter greater than 50mm & sediment coarser than 0.125mm for flows up to 25% of the 1-year ARI flow

MUSIC modelling indicates that the proposed water quality treatment systems will reduce the expected pollutant loads draining to the river and exceed the required objectives for all pollutants. A review of the long term water quality objectives is provided in Section 4.

4 ASSESSMENT OF POTENTIAL IMPACTS

Table 9 provides a list of the key indicators and water quality objectives for each relevant environmental value for the receiving environment. Where the environmental values have different trigger levels for the same WQO, all objectives have been listed. Table 9 includes a description of the potential impact associated with the proposed stormwater runoff from the new bridge and a discussion on the expected likelihood of the impact. In undertaking the assessment in Table 9, site layout, proposed mitigation measures and soil conditions have been considered, as summarised in the ESMR (SEEC, 2018).

As noted in Section 2.1, for the purposes of this assessment, the combined environmental values for Shoalhaven River for **estuaries** have been adopted. These include:

- Aquatic ecosystem protection
- Visual amenity
- Secondary contact recreation (short term objective, within 5 years)
- Primary contact recreation (assess opportunities for a longer term objective 10 years or more)
- Aquatic foods (cooked). Note that ANZECC (2000) Guidelines list this environmental value as "Aquaculture and human consumption of aquatic foods." Therefore, it covers shellfish such as oysters.

Table 9 – Assessment of the operational impacts of the Nowra Bridge replacement project on environmental values and associated indicators of NSW WQOs.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
Total Phosphorus	Estuaries: 30 µg/L (for aquatic ecosystem protection).	Excessive phosphorus could lead to stimulation of the growth of nuisance plants which could dominate and change the dynamics of the aquatic ecosystem (e.g.eutrophication, algae and macrophytes). Eutrophication occurs when excessive plant growth deprives the water column of oxygen thereby killing other forms of aquatic biota. The growth of algae is also stimulated by excessive nutrients and may result in a build-up of toxins in the water column. The availability of inorganic phosphorus from soil is strongly controlled by pH. Maximum phosphate availability occurs in the pH range of 6.0-7.0. The soils are expected to have a pH range of around 5.0-6.5.	As noted in Section 2.3, stormwater from the existing bridges drains directly into the receiving environment without treatment. The proposal will incorporate treatment for stormwater runoff, which will reduce the Total Phosphorus (TP) loads and concentrations in the receiving environment. The proposal will improve the levels of TP in stormwater runoff, thereby improving compliance with the WQO. The MUSIC model indicates that the average TP concentration downstream of the bridge is 24 µg/L.
Total Nitrogen	Estuaries: 300 µg/L (for aquatic ecosystem protection).	Excessive nitrogen could lead to stimulation of the growth of nuisance plants which could dominate and change the dynamics of the aquatic ecosystem. (e.g. algae and macrophytes). Most nitrogen in surface soils is immobilised, bound as organic nitrogen associated with humus. A small proportion is steadily turned into inorganic (mineralised) forms such as nitrate compounds through nitrification that can be released to groundwater or soil water. Direct addition of fertiliser can increase the levels of nitrate in a soil.	As noted in Section 2.3, stormwater from the existing bridges drains directly into the receiving environment without treatment. The proposal will incorporate treatment for stormwater runoff, which will reduce the Total Nitrogen (TN) loads and concentrations in the receiving environment. The proposal will improve the levels of TN in stormwater runoff, thereby improving compliance with the WQO. The MUSIC model indicates that the average TN concentration downstream of the bridge is 230 µg/L.
Chlorophyll-a	Estuaries: 4 µg/L (for aquatic ecosystem protection).	Chlorophyll a (chl a) concentration is often used as a general indicator of plant biomass as nutrients alone cannot indicate whether a waterbody actually has a nuisance plant problem. Increased chl a in the water indicates that plants, algae or cyanobacteria are actually growing. Chl a is usually measured in a waterbody so is not a typical stormwater pollutant.	None expected, as Chlorophyll-a is not expected to be present in operational stormwater runoff in significant quantities.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
Turbidity	Estuaries: 0.5-10 NTU (for aquatic ecosystem protection). A 200 mm diameter black disc should be able to be sighted horizontally from a distance of more than 1.6 m (approximately 6 NTU) (for primary contact recreation). Suspended solids: less than 40 micrograms per litre (freshwater) (for aquatic foods, cooked).	Turbidity is the presence of suspended particulate and colloidal matter consisting of suspended clay, silt, phytoplankton and detritus measured by a technique called nephelometry, which measures the fraction of light scattered at right angles to the light path of water. Increased turbidity can reduce light penetration through the water column and therefore reduce the level of photosynthetic activity. Turbidity increases with sediment load.	As noted in Section 2.3, stormwater from the existing bridges drains directly into the receiving environment without treatment. The proposal will incorporate treatment for stormwater runoff, which will reduce the sediment loads and concentrations in the receiving environment. The proposal will improve the turbidity in stormwater runoff. The MUSIC model indicates that the average TSS concentration downstream of the bridge will decrease from 7.70mµg/L to 7.68 mg/L. The median TSS concentration decreases from 0.35mg/L(0.7 NTU) to 0.36 mg/L (0.66 NTU)
Dissolved Oxygen	Estuaries: 80-110% (for aquatic ecosystem protection).	The dissolved oxygen concentration in a waterbody is highly dependent on temperature, salinity, biological activity (microbial, primary production) and rate of transfer from the atmosphere.	No significant change is expected as a result of runoff from the proposal. However, dissolved oxygen concentrations might improve slightly as a result of improved sediment retention in runoff compared to the existing conditions.
pH	Estuaries: 7.0-8.5 (for aquatic ecosystem protection). 5.0-9.0 (for primary contact recreation).	pH is a measure of the acidity or alkalinity of water and has a scale from 0 (extremely acidic) to 7 (neutral), through to 14 (extremely alkaline).	None expected, as the runoff from the proposal is unlikely to have significantly different pH to that from the existing bridge.
Temperature	Iterative (for aquatic ecosystem protection). 15 – 35^{o}C (for primary contact recreation). Less than 2 degrees Celsius change over one hour (for aquatic foods, cooked).	Aquatic ecosystem functioning is very closely regulated by temperature. Temperature changes can occur naturally as part of normal diurnal (daily) and seasonal cycles, or as a consequence of human activities (anthropogenic).	None expected, as the runoff from the proposal is unlikely to have significantly different temperature to that from the existing bridges.
Chemical contaminants	Iterative (for aquatic ecosystem protection and primary contact recreation). Waters containing chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreation (for primary and secondary contact recreation).	Chemical contaminants are likely to be sourced either from spills that may occur during construction or from naturally contaminants or toxicants made soluble when run-off occurs over disturbed soils.	As noted in Section 2.3, stormwater from the existing bridges drains directly into the receiving environment without treatment and with no spill containment present. The proposal will incorporate treatment for stormwater runoff, as well as spill containment. This significantly reduces the potential for chemical contaminants to be washed into the receiving environment, thereby improving compliance with the WQO.
Biological assessment indicators	Iterative (for aquatic ecosystem protection)	Refer to comments on blue-green algae, faecal coliforms, enterococci, protozoans and nuisance organisms.	Refer to comments on blue-green algae, faecal coliforms, enterococci, protozoans and nuisance organisms.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
Visual clarity and colour	Natural visual clarity should not be reduced by more than 20% (for visual amenity and primary and secondary contact recreation). Natural hue of the water should not be changed by more than 10 points on the Munsell Scale (for visual amenity and primary and secondary contact recreation). The natural reflectance of the water should not be changed by more than 50% (for visual amenity and primary and secondary contact recreation).	Clarity is a measure of how clear or transparent water is. It indicates how much light is available for photosynthesis at different depths.	This indicator is largely assessed above in relation to turbidity and Total Suspended Sediment (TSS). Given the likely improvements in TSS concentrations and loads (refer to comments above regarding Turbidity), it is likely that visual clarity and colour would also improve.
Toxicants (as applied to aquaculture activities)	For aquatic foods (cooked) the following applies: Metals: • Copper: less than 5 µgm/L. • Mercury: less than 1 µgm/L. • Zinc: less than 5 µgm/L. Organochlorines: • Chlordane: less than 0.004 µgm/L (saltwater production) • PCB's: less than 2 µgm/L.	Heavy metals and organochlorines can accumulate in aquatic foods to toxic levels.	As noted in Section 2.3, stormwater from the existing bridges drains directly into the receiving environment without treatment and with no spill containment present. The proposal will incorporate treatment for stormwater runoff, as well as spill containment. This significantly reduces the potential for toxicants to be washed into the receiving environment, thereby improving compliance with the WQO.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
Faecal coliforms	Median bacterial content in fresh and marine waters of < 1000 faecal coliforms per 100 mL, with 4 out of 5 samples < 4000/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month) (for secondary contact recreation). For primary contact recreation, Beachwatch considers waters are unsuitable for swimming if: • the median faecal coliform density exceeds 150 colony forming units per 100 millilitres (cfu/100mL) for five samples taken at regular intervals not exceeding one month, or • the second highest sample contains equal to or greater than 600 cfu/100mL (faecal coliforms) for five samples taken at regular intervals not exceeding one month. For primary contact recreation, ANZECC 2000 Guidelines recommend: • Median over bathing season of < 150 faecal coliforms per 100 mL, with 4 out of 5 samples < 600/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month). For aquatic foods (cooked), guideline in water for shellfish: • The median faecal coliform concentration should not exceed 14 MPN/100mL; with no more than 10% of the samples exceeding 43 MPN/100 mL. For aquatic foods (cooked), standard in edible tissue: • Fish destined for human consumption should not exceed a limit of 2.3 MPN E Coli /g of flesh with a standard plate count of 100,000 organisms /g.	Coliforms are bacteria present in the digestive tracts of animals including humans and are found in their wastes and are used as an indicator of faecal contamination.	None expected from stormwater runoff from the proposal.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
Enterococci	Median bacterial content in fresh and marine waters of < 230 enterococci per 100 mL (maximum number in any one sample: 450-700 organisms/100 mL) (for secondary contact recreation). For primary contact recreation, Beachwatch considers waters are unsuitable for swimming if: • the median enterococci density exceeds 35 cfu/100mL for five samples taken at regular intervals not exceeding one month, or • the second highest sample contains equal to or greater than 100 cfu/100mL (enterococci) for five samples taken at regular intervals not exceeding one month. For primary contact recreation, ANZECC 2000 Guidelines recommend: • Median over bathing season of < 35 enterococci per 100 mL (maximum number in any one sample: 60-100 organisms/100 mL).	Intestinal enterococci are a functional group of organisms from the *Enterococcus* and *Streptococcus* genera that are excreted in human and animal waste and are used as an indicator of faecal contamination.	None expected from stormwater runoff from the proposal.
Protozoans	Pathogenic free-living protozoans should be absent from bodies of fresh water. (Note, it is not necessary to analyse water for these pathogens unless temperature is greater than 24 degrees Celsius) (for primary contact recreation)	Protozoans are waterborne pathogens that indicate water contaminated with human or animal waste.	None expected from stormwater runoff from the proposal.
Algae and Blue-green algae	< 15 000 cells/mL (for primary contact recreation). No guideline is directly applicable for aquatic foods (cooked), but toxins present in blue-green algae may accumulate in other aquatic organisms.	Blue-green algae are a type of bacteria known as Cyanobacteria. They photosynthesise using sunlight to produce oxygen. Low levels of blue-green algae are present in freshwater all the time. However a series of favourable environmental factors including warm water temperatures, sunny days and nutrients can lead to a blue-green algae bloom. Blooms lead to environmental and visual impacts.	Refer to comments on temperature, Total Phosphorus and Total Nitrogen.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential project impact from stormwater runoff
Nuisance organisms	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, sewage fungus and leeches should not be present in unsightly amounts (for visual amenity and primary contact recreation).	The presence of macrophytes, algal mats etc will be impacted by the amount of nutrients / organic matter in the waterway. Refer to discussion on Total Phosphorus, Total Nitrogen and Chlorophyll a.	None expected from stormwater runoff from the new bridge.
Surface films and debris	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour (for visual amenity and primary and secondary contact recreation). Waters should be free from floating debris and litter (for visual amenity and primary and secondary contact recreation).	Refer to discussion on chemical contaminants.	As noted in Section 2.3, stormwater from the existing bridges and its approaches drains directly into the receiving environment without treatment and with no spill containment present. The proposal will incorporate treatment for stormwater runoff, as well as spill containment. This significantly reduces the potential for contaminants such as oils, gross pollutants and petrochemicals to be washed into the receiving environment, thereby improving compliance with the WQO.

5 CONCLUSIONS

Section 3 contains modelling that demonstrates the effectiveness of the proposed operational stormwater quality improvement measures for the Nowra Bridge proposal. Further, Section 4 includes an assessment of the potential operational impacts of the project on various Water Quality Objectives. This assessment shows that, overall, the project has a net positive impact on water quality for the following parameters:

- Turbidity (and TSS, visual clarity and colour)
- Total Phosphorus
- Total Nitrogen
- Chemical contaminants
- Toxicants
- Surface films and debris
- Spill containment.

This is mainly due to the inclusion of stormwater treatment and spill containment structures as part of the proposal. Presently, water draining from the existing bridges and their approaches drains directly into the Shoalhaven River without treatment. By including treatment for operational-phase stormwater, the proposal can demonstrate a clear positive impact on water quality, thereby improving compliance with the Water Quality Objectives for the Shoalhaven River estuary.

Detailed design and construction of the operational water quality elements should consider that vegetative systems require time to establish and adequate measures such as additional watering and bypassing of large stormwater flows may be required during the establishment phase. Treatment measures need to be inspected and maintained regularly to ensure the expected performance is maintained. Adequate access should be provided for inspection and maintenance activities.

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Appendix F

Erosion and Sediment Management Report

SEEC

Strategic Environmental & Engineering Consulting

Erosion and Sediment Management Report:

Nowra Bridge

Prepared for:

NSW Roads and Maritime Services

Prepared by:

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7 February 2019

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.

Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the site at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this report does not contain any incomplete or misleading information.

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SEEC

7 February 2019

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Version Register

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Draft B	29/01/2019	AT	AM	Updates following RMS comments.	Final draft.
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1 INTRODUCTION

1.1 Proposal Identification

NSW Roads and Maritime Services (Roads and Maritime) propose to construct an additional bridge for the A1 Princes Highway crossing of the Shoalhaven River at Nowra (the proposal). The proposal includes the construction of a new bridge to the west (upstream) of the existing twin bridges and the removal of vehicular traffic from the existing southbound bridge. The proposal also includes the upgrade of about 0.4 kilometres of the Princes Highway north of the new bridge, 0.7 kilometres to the south, plus intersection upgrades and modifications to the local road network. The proposal would improve access to Nowra and the surrounding areas, improve southbound access for large freight vehicles, and improve traffic flows.

This report supports the environmental assessment and concept design for the proposal.

1.2 Proposal Location and Key Features

Key features of the proposal include:

- Construction of a new bridge to the west (upstream) of the existing twin bridges over the Shoalhaven River, dedicated to northbound traffic;
- Widening of the existing bridge over Bomaderry Creek;
- Lane adjustments to the existing northbound bridge to convert it to the southbound bridge;
- Removal of vehicular traffic from the existing southbound bridge;
- Upgrade and widening of the existing Princes Highway for about 0.4 kilometres to the north and 0.7 kilometres to the south of the bridge crossings;
- Upgrades to the local road network and intersections.

The key features of the proposal are shown in Figure 1.

A number of temporary ancillary facilities and road diversions would be established for the proposal. These features would be removed and the relevant sites rehabilitated at completion of the proposal. These are also shown in Figure 1.

The A1 Princes Highway is the primary link between the Sydney and Illawarra region and the Far South Coast. The Princes Highway bridge at Nowra is the only crossing of the Shoalhaven River on the NSW South Coast.

A number of inherent site constraints potentially limit the potential for installing the erosion and sediment control structures that are typically used for major highway construction. These include the surrounding urbanised lands, areas of flood-prone land, and construction in and over open water (the Shoalhaven River).

1.3 Purpose of This Report

A Preliminary Erosion and Sedimentation Assessment for the proposal identified that it is inherently high risk due to:

- Moderate to high rainfall (refer to Section 3.1);
- Project complexity and traffic staging in a highly urbanised area;
- Working in and around an estuarine environment;
- Construction in areas that are flood-prone;
- A sensitive receiving environment;
- Site constraints that limit the amount of available land during construction; and
- Construction on low-lying or tidal lands with an inherent risk of acid sulfate soils.

SEEC were engaged by Roads and Maritime to prepare this Erosion and Sedimentation Management Report (ESMR) in accordance with Roads and Maritime QA Specification PS 311, Clause 2.3.2.

The purpose of this report is to:

- Identify proposed measures for major erosion and sediment control devices such as up-gradient stormwater diversions, cross-drainage and sediment basins.
- Assess constraints to the installation and operation of major erosion and sediment controls during construction in accordance with Volumes 1 and 2D of the NSW Blue Book (Landcom, 2004 and DECC, 2008).
- Propose methods to eliminate, substitute or manage potential erosion and sediment control hazards during construction.

This ESMR and the accompanying Concept ESCPs have been prepared based on the concept road and drainage designs. The Concept ESCPs will need to be updated prior to construction to reflect any road and/or drainage design changes.

1.4 Structure of This Report

This report includes the following sections:

- Section 2 provides background regarding document preparation against Roads and Maritime procedural guidelines;
- Section 3 provides an assessment of the potential constraints and opportunities that might impact on construction-phase erosion and sediment control;
- Section 4 identifies design considerations for erosion and sediment control measures;
- Section 5 summarises a series of recommendations to manage or mitigate potential impacts relating to construction-phase erosion and sediment control.

Section 5 is accompanied by a series of Concept Erosion and Sediment Control Plans (ESCPs) which are included as Appendix 2, also by SEEC. These ESCPs show conceptually the setup of key erosion and sediment control measures such as sediment basins.

Figure 1 – Proposal area including construction boundary and location of proposed ancillary sites.

2 DOCUMENTATION, REVIEW AND LIAISON

2.1 Design Documentation

A series of Concept ESCPs prepared by SEEC accompany this ESMR and are included in Appendix 2. They show the setup of key erosion and sediment control measures such as sediment basins, and have been developed iteratively as the final road design was progressed. These ESCPs have been prepared based on the concept road and drainage designs. They will need to be updated prior to construction to reflect any changes to the road and/or drainage design.

2.2 Review of Existing Design

As part of preparing this ESMR, SEEC conducted a review of:

- The 80% road designs prepared by SMEC (2018), to determine if any inherent design issues might impact on constructability and effective implementation of erosion and sediment controls;
- Likely traffic and construction staging, to determine how these aspects would influence the constructability of structures such as sediment basins, and the management of clean offsite water and dirty onsite water at each stage;
- The land available during construction to determine if space constraints are likely to impact on the effective implementation and establishment of erosion and sediment controls; and
- The site topography and setting, to determine if these aspects will restrict the effective implementation of erosion and sediment controls.

Constraints identified in this process have been taken into account in preparing the Concept ESCPs (Appendix 2) and comments regarding this are included in Section 5 of this ESMR.

2.3 Site Inspection

A site inspection was conducted by Alyssa Thomson from SEEC in November 2018 to identify and confirm soil and topographical conditions and how they might influence erosion and sediment control during construction.

2.4 Environmental Design and Compliance Checklist

Table 1 details the requirements for this ESMR as described in Section 2.3.2 of Roads and Maritime PS311 Specification (Environmental Design and Compliance) and where each is addressed.

Table 1 – Roads and Maritime Specification PS311 Compliance Checklist

Item reference	ESMR requirement	Location where this is addressed in this ESMR
2.3.2 (i)	Identify road corridor and surrounding catchments.	Section 3.5 and ESCPs (Appendix 2)
2.3.2 (ii)	Identify road construction boundary catchments and their associated erosion hazard.	ESCPs (Appendix 2)
2.3.2 (iii)	Identification of site constraints that limit the implementation of appropriate erosion and sediment control measures.	Section 3, Section 5.3 and ESCPs (Appendix 2)
2.3.2 (iv)	Identification of any sensitive receiving environments that will receive stormwater discharge from the construction project, including but not limited to: (a) lands protected under environmental planning instruments such as SEPP 14 (Coastal Wetland) or SEPP 26 (Littoral Rainforest); and (b) land reserved or protected under nation parks legislation such as Marine Parks, National Park estates or State Forests.	Section 3.5
2.3.2 (v)	Major erosion and sediment control measures, including but not limited to: (a) Up-gradient stormwater diversion to ensure clean water does not enter the construction site; (b) Temporary cross drainage to transfer clean water through and/or around the site through all construction phases; (c) Sedimentation basins, as required, designed in accordance with the sizing criteria in Blue Book Vol 2D.	Section 3.12, Section 4, Section 5, Appendix 1, ESCPs (Appendix 2).
2.3.2 (vi)	Water flow paths and direction for the construction area and adjacent property i.e. off site and on site water flow	ESCPs (Appendix 2)
2.3.2 (vii)	Calculation of work area and soil loss for each road catchment (Refer Department of Housing's Publication Managing Urban Stormwater - Soils and Construction).	ESCPs (Appendix 2) and Section 3.12
2.3.2 (viii)	Basin calculation for each road catchment that exceeds the soil loss equation in accordance with the Department of Housing's Publication Managing Urban Stormwater - Soils and Construction	Appendix 1 and ESCPs (Appendix 2)
2.3.2 (ix)	Construction basin location and measures to direct on site runoff into the basin	ESCPs (Appendix 2)
2.3.2 (x)	A risk assessment of the effective installation, operation or maintenance of major controls, including but not limited to: (a) Timing of installation of the major controls, with reference to the construction staging of the project, including traffic and earthworks staging;	Section 5 and ESCPs (Appendix 2)

	(b) Availability of land to install major controls, with reference to any property acquisition requirements or environmental restrictions on environmentally sensitive area.	
2.3.2 (xi)	Measures to mitigate or eliminate identified risks, through design changes, construction methodology and additional land acquisition and/or leasing. Where risks cannot be eliminated, mitigation measures for managing the specific sub-catchment must be designed and documented in a summary table.	Section 5, specifically Table 7.

3 ASSESSMENT OF CONSTRAINTS AND OPPORTUNITIES

3.1 Climate

Bureau of Meteorology rainfall statistics for Nowra are contained in Table 2.

Table 2 – Monthly rainfall for Nowra RAN Air Station (BoM station 068072) as at November 2018.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann-ual
Rainfall (mm)	63.2	132.6	111.5	64.6	49.4	114.8	58.1	67.2	41.2	65.3	70.1	76.6	901.5
Mean no of days with rain >1mm	7.6	9.0	9.2	7.5	5.1	7.4	5.3	5.2	6.2	7.0	8.5	7.7	85.7

The Bureau of Meteorology reports the 2-year, 6-hour rainfall event as 11.6mm/hr for Nowra. This translates to a Revised Universal Soil Loss Equation (RUSLE) R-Factor of 2910 which is moderate. However, Appendix B of the NSW Blue Book (Landcom, 2004) notes the R-factor for Nowra at 4250. The latter value has been adopted (refer to Section 3.12) as a conservative approach.

Rainfall sufficient to cause runoff and erosion can occur at any time of year. As such, it is considered to be a constraint for construction-phase erosion and sediment control on this proposal.

As a coastal area, winds can be strong at any time of year. Prevailing summer winds are from the north-east, and from the south-east in winter.

3.2 Topography

Site topography includes undulating rises and flood-prone terraces. The banks of the Shoalhaven River are steep to precipitous cliffs at the location of the northern abutment, and short, rolling rises at the location of the southern abutment. Topography around the northern abutment is considered to be a significant constraint for this proposal and will impact the feasibility for constructing structures such as sediment basins.

The recommendations in Section 5 include proposed management and mitigation measures for topography-related constraints. Also refer to the accompanying ESCP (Appendix 2).

3.3 Soils - General

Soil Landscape Mapping for the Kiama 1:100,000 mapsheet (Hazelton, 1992) shows the proposal lies on several different soil types. Figure 2 shows the soil landscapes (sourced from NSW Office of Environment and Heritage eSpade portal) with the proposal boundary. A site inspection (including soil observations) by SEEC staff confirmed the accuracy of the soil landscape mapping, although noted that the upper metre of soil has been disturbed in most of the proposal area as a result of past urban development.

Table 3 contains a summary of soil landscape descriptions, key features and potential constraints that might influence erosion and sediment control during construction.

Table 3 – Soil landscape summary (from Hazelton, 1992 and Landcom, 2004).

Soil landscape name	Approximate occurrence along the proposal route	Soil landscape description	Dominant K-factor	Key landscape constraints for erosion and sediment control
Nowra	85%	Moderately to gently undulating rises on Nowra Sandstone. Slopes typically greater than 5%. Soils are Yellow and Brown Podzolic Soils on ridges, crests and around drainage lines, with some Soloths and Yellow Earths in midslope positions.	0.047	Localised rock outcrop Localised shallow soils Hardsetting surfaces Sodicity Low permeability Low wet bearing strength Acidic soils Low available water-holding capacity
Shoalhaven	15%	Level to gently undulating river banks, floodplains, levees and backswamps. Slopes are typically less than 3%. Soils are alluvial on floodplains, with some profile development (Red Earths, Prairie Soils and Yellow Podzolic Soils) on terraces and levees.	0.039	Flood hazard Seasonal waterlogging High water tables Hardsetting surfaces Acid sulfate potential Acidic soils Sodicity

A conservative K-factor of 0.047 is recommended for erosion hazard calculations based on typical soil data presented in Hazelton (1992) and Landcom (2004).

Sodicity is noted on both the Nowra and Shoalhaven Soil Landscapes. As such, there is the potential for dispersible layers within soils to be exposed by earthworks during construction.

All soils were identified as acidic, which can be a significant constraint for revegetation following construction unless properly ameliorated.

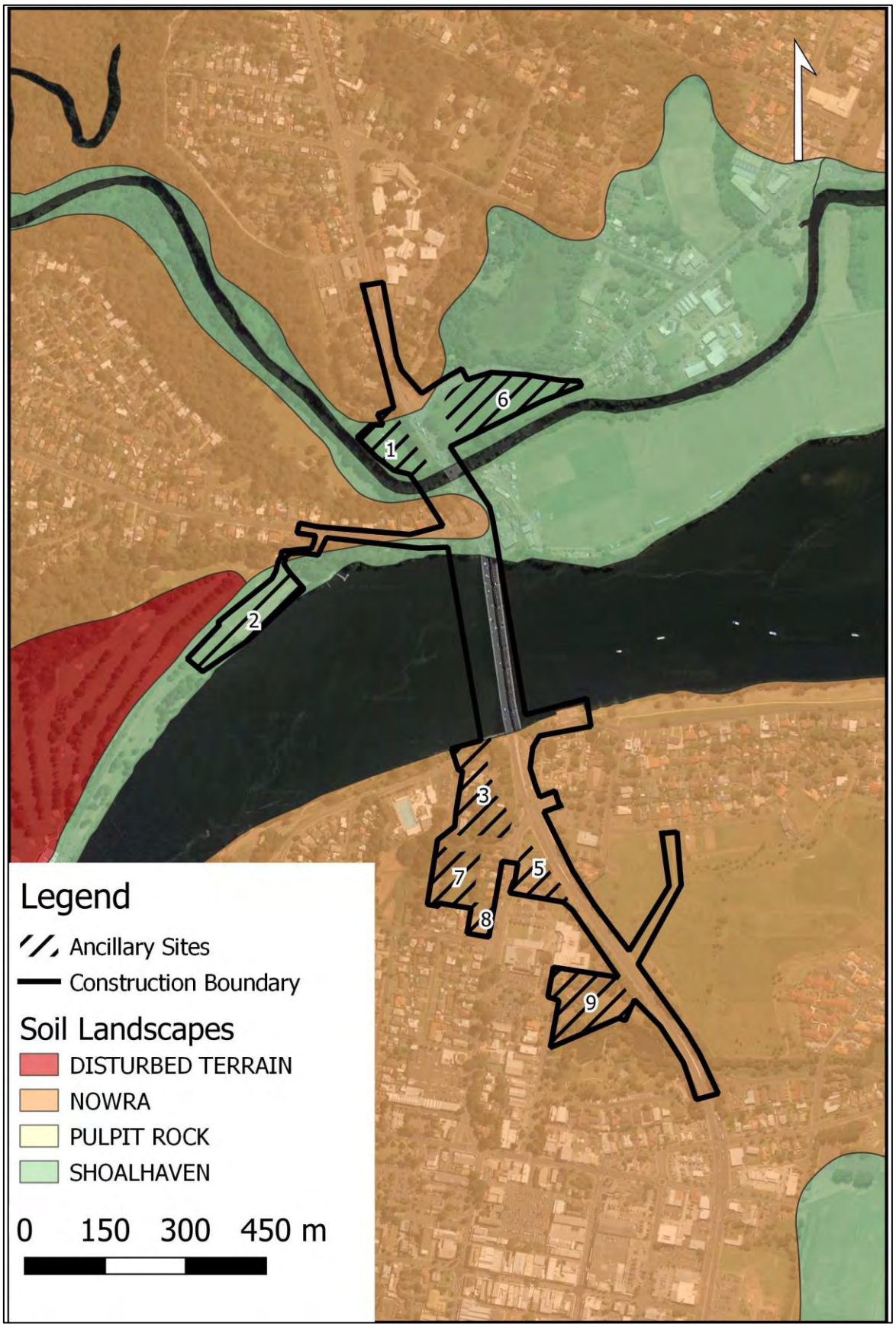


Figure 2 – Soil landscape mapping (Hazelton, 1992) with the proposal boundary and ancillary facilities.

The recommendations in Section 5 include proposed management and mitigation measures for soils-related constraints.

3.4 Acid Sulfate Soils

Acid Sulfate Soil Risk Mapping (DLWC, 1997) identified several locations where the proposal crosses lands with Potential Acid Sulfate Soils (PASS) (Figure 3).

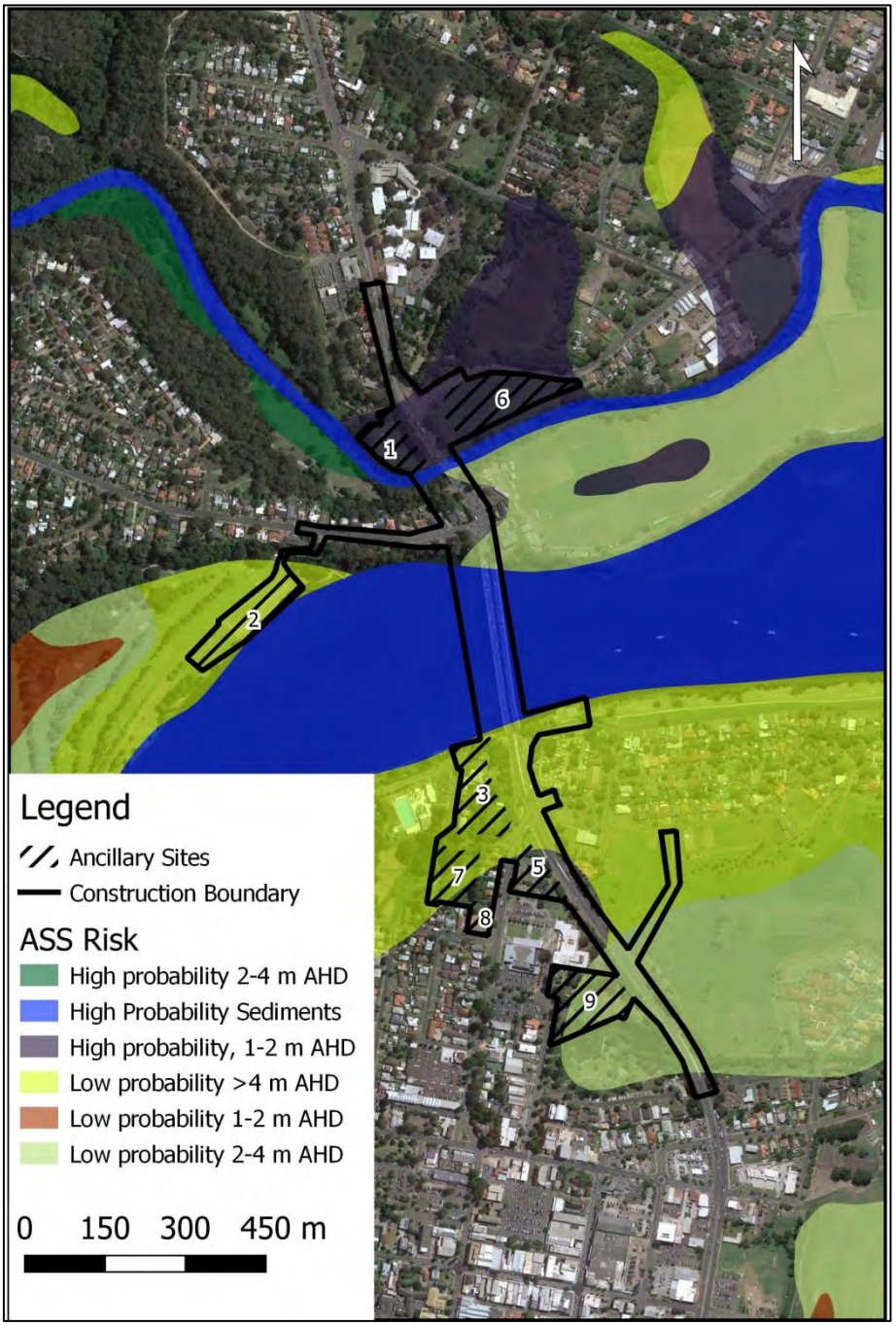


Figure 3 – Acid Sulfate Risk (DLWC, 1997) with construction boundary and ancillary facilities.

As identified in Figure 3, the proposed works in and around Bomaderry Creek present the highest risk of intercepting PASS. Additionally, PASS occurs at depth in the southern portion of the proposal, but at depths unlikely to impact on or be impacted by construction activities other than piling.

3.5 Catchments and Receiving Waters

3.5.1 Shoalhaven River

All drainage from the proposal site drains into the Shoalhaven River, an open-mature wave-dominated barrier estuary that flows into the Tasman Sea. At the proposal site, waters are brackish and tidal. Although the Shoalhaven River has been subject to human development along its shores, it is considered to be a sensitive receiving environment and its waters are used for a variety of recreational, industrial and agricultural purposes.

A pocket of seagrass bed occurs within the proposal footprint adjacent to the southern bank of the Shoalhaven River. Additional seagrass beds occur along both banks of the Shoalhaven River both upstream and downstream of the proposal. Mangroves occur along the northern banks of the Shoalhaven River near its confluence with Bomaderry Creek.

As reported in SMEC (2018), water quality monitoring in the Shoalhaven River by Shoalhaven City Council noted the following:

- Good to excellent water quality index;
- Dissolved oxygen levels (per cent saturation) between 70 and 110 (good);
- Faecal coliform counts generally below ANZECC 2000 trigger values for swimming;
- Phosphorus levels below ANZECC 2000 trigger values;
- Total nitrogen levels below ANZECC 2000 trigger values.

3.5.2 Bomaderry Creek

The proposal crosses Bomaderry Creek, a tributary of the Shoalhaven River which joins the main river channel about 500 metres downstream of the proposed location of the new bridge. Bomaderry Creek is a brackish or fresh water stream (depending on rainfall and flow) which experiences some tidal influence at the location where the Princes Highway crosses it. As reported in SMEC (2018), water quality monitoring in Bomaderry Creek by Shoalhaven City Council noted the following:

- Medium to good water quality index;
- Dissolved oxygen levels (per cent saturation) of about 140 (poor);
- Faecal coliform counts above ANZECC 2000 Guidelines for swimming;
- Phosphorus levels below ANZECC 2000 trigger values;
- Total nitrogen levels below ANZECC 2000 trigger values.

3.5.3 Built Stormwater Networks

Drainage from the catchments around the proposal is mainly via piped stormwater networks within roads or reserves. Some of the pipe networks will be modified, added to or replaced as part of the construction of this proposal.

The recommendations in Section 5 include proposed management and mitigation measures for constraints relating to management of stormwater quality during construction.

3.6 Flooding

Mapping data available from Shoalhaven City Council (WMA Water, 2011) identifies part of the proposal area lies within the 1% Average Exceedance Probability (AEP) for flooding (i.e. within the area inundated in the 100-year Average Recurrence Internal (ARI) flood) (Figure 4).

The Blue Book (Landcom, 2004) suggests that special erosion and sediment control measures should apply to any works below the 2-year average recurrence interval (ARI) flood level. This includes:

- Sediment controls should be placed above the 2-year ARI flood level (e.g. basins, sediment fences etc).
- Requirements to stabilise lands using temporary ground cover whenever rain is falling or imminent.
- Scheduling works for lower-risk times of year, based on historical rainfall figures.

Recommendations regarding flood hazard are included in Section 5 of this report.

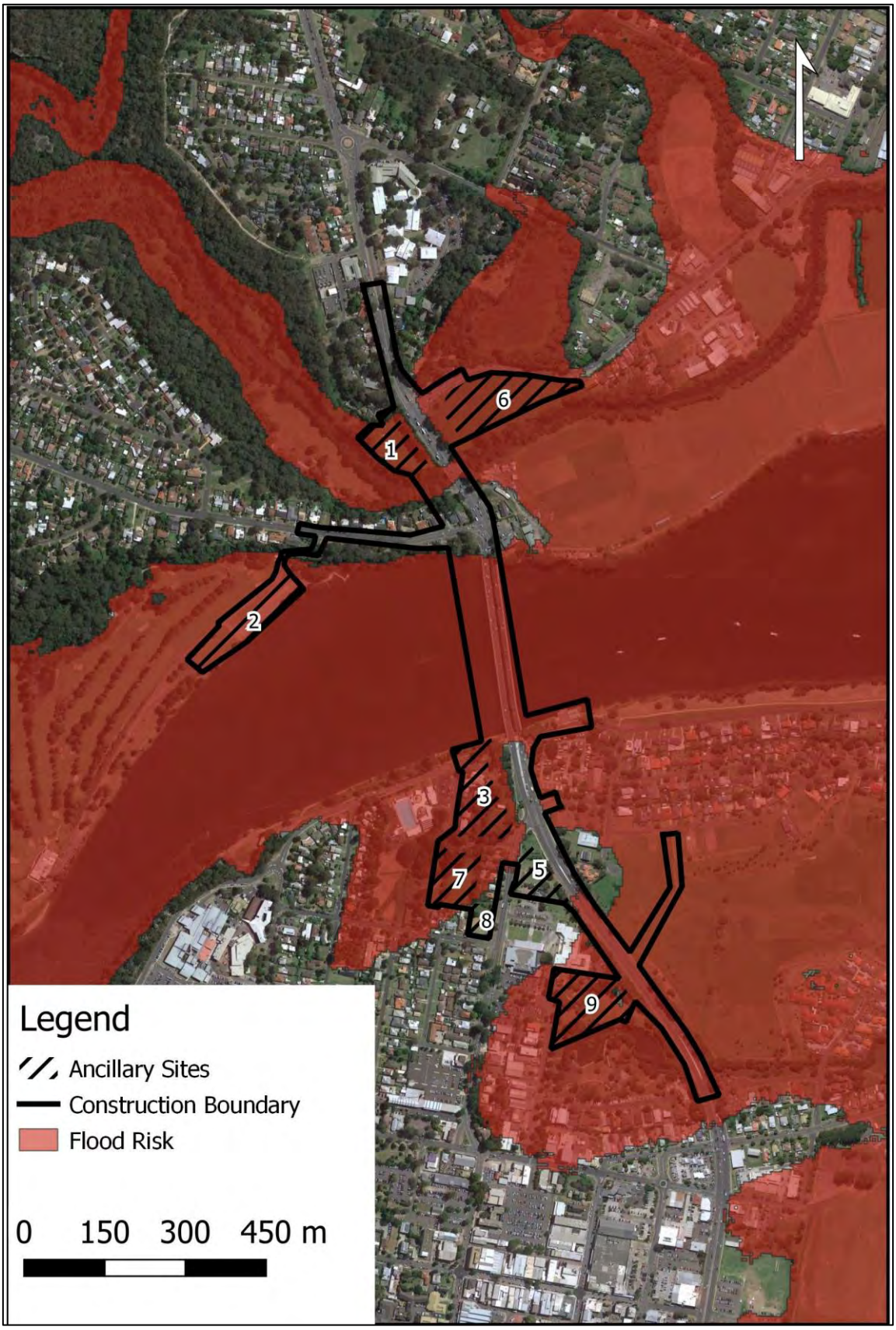


Figure 4 – 1-year AEP (i.e. 100-year ARI) flood levels around the proposal.

3.7 Existing and Future Drainage

During construction, there is a risk of offsite (clean) and onsite (dirty) water mixing at various locations due to existing urbanised catchments and existing stormwater drainage. This can limit the ability to install effective drainage for offsite (clean) water, and can constrain the use of sediment traps in narrow road corridors.

Where necessary, existing stormwater drainage infrastructure (i.e. culverts, pits and pipes) will need to be replaced or extended in a manner that minimises the risk of offsite (clean) and onsite (dirty) water mixing. In many cases, this will necessitate scheduling works for dry weather and to occur quickly. Recommendations regarding this are included in Section 5 and on the accompanying ESCPs (Appendix 2).

3.8 Ecology

Under the Roads and Maritime Biodiversity Guidelines (2011), avoiding or minimising ecological impacts is recommended. This has been considered in the selection and positioning of erosion and sediment control measures, especially those that typically involve disturbing land outside the earthworks footprint during construction (e.g. sediment basins).

The ESCPs in Appendix 2 show the conceptual positioning of construction-phase sediment basins and traps. In locating these structures, local ecology has been considered.

3.9 Existing Services

Existing services and utilities will be a significant constraint for this proposal. The type and size of erosion and sediment control structures must be considerate of existing services, and this has been taken into account in developing the ESCPs in Appendix 2, with comments included in Section 5.

3.10 Land Availability

Land availability is a common constraint for major road projects during construction, especially for:

- Managing traffic during construction works;
- Establishing stockpiles; and
- Constructing sediment basins.

Limited availability of land presents a significant constraint for the construction of sediment basins on this proposal, and also for the effective separation of offsite (clean) and onsite (dirty) water.

The accompanying ESCPs (Appendix 2) identify the proposed locations for sediment basins/traps and offsite (clean) and onsite (dirty) water drains, along with recommendations for alternative management where appropriate structures cannot reasonably be constructed.

Further, Section 5 includes recommendations regarding alternative management and mitigation measures where land availability constrains the potential to install structures such as sediment basins.

3.11 Design and Construction Constraints

3.11.1 Tie-Ins and Interface

The proposal includes modifying and widening the existing roadway footprint in immediate proximity to the existing roadway. Live traffic flow would need to be maintained during construction, although temporary short-term road closures, traffic switches, and reduced lane widths are assumed to be necessary. Separating offsite (clean) and onsite (dirty) water and providing adequate sediment controls will be difficult due to the restricted working areas and progressive nature of the works. This has been taken into account when preparing the ESCPs (Appendix 2) and in the recommendations contained in Section 5 of this ESMR.

3.11.2 Piling

Piling will be required in several locations throughout the works including for bridge abutments, pylons and retaining walls. A piling rig would be required for these works and would necessitate establishing piling platforms for the safe working of the rig.

The piling platforms will likely encroach into the waterways so would risk stirring up aquatic sediments and without proper management could lead to sediment entering downstream waters.

Piling for the new bridge across the Shoalhaven River would be mostly from a floating barge excluding the most southern piles near the south bank of the river where a piling pad will be required. However, also note that in-stream piling also has the potential to stir up bottom sediments.

3.11.3 Sediment Tracking onto Surrounding Roads

The proposal includes construction interactions with existing live traffic on the Princes Highway and numerous local roads. As such, there is a risk of sediment tracking onto existing sealed live roadways from construction areas.

Refer to Section 5 for an assessment of the potential to manage sediment tracking during construction, along with recommendations for any identified constraints.

3.12 Erosion Hazard

An evaluation of the erosion hazard was made using the approach in Chapter 4 of the Blue Book (Landcom, 2004). This process involves calculating the predicted annual average soil loss using the Revised Universal Soil Loss Equation (RUSLE) as follows:

$$A = R \times K \times LS \times P \times C$$

Table 4 details the above equation and the values used in assessing erosion hazard.

Table 4 – RUSLE definitions and assumptions – typical conditions

Parameter	Definition	Assumed or adopted value for this site		
		Gently sloped areas	Typical slope conditions	Steeper areas
A	Total calculated soil loss (t/ha/yr)	50 t/ha/yr.	237 t/ha/yr.	373 t/ha/yr.
R	Rainfall erosivity factor (refer to Section 3.1)	4250	4250	4250
K	Soil erodibility factor (Refer to Section 3.3)	0.047.	0.047	0.047
LS	Slope length and gradient factor	1% and 80m (LS of 0.19)	4% and 80m (LS of 0.91)	10% and 30m (LS of 1.44)
P	Conservation practice factor	Maximum of 1.3 assumed	Maximum of 1.3 assumed	Maximum of 1.3 assumed
C	Ground cover factor	Maximum of 1.0 assumed	Maximum of 1.0 assumed	Maximum of 1.0 assumed
Erosion hazard (from Landcom, 2004)		Very low	Low-moderate	Moderate
Catchment size trigger for sediment basins		4.0 ha	0.84 ha	0.54 ha

Included in Table 4 is an assessment of the construction catchment size that would trigger the need for constructing a sediment basin for that catchment, in compliance with Landcom (2004) and DECC (2008). This has been taken into account in positioning and sizing the sediment basins shown on the concept ESCPs in Appendix 2, and calculations for each catchment are contained in Appendix 1. Where a sediment basin is triggered but cannot reasonably be provided, alternatives will need to be proposed including enhanced erosion controls. This is discussed further in Section 5.

4 DESIGN STANDARD FOR EROSION AND SEDIMENT CONTROL

4.1 Sediment Basins

The Blue Book (Landcom, 2004 and DECC, 2008) notes that a sediment basin should be included in catchments where the erosion hazard exceeds 150 m^3/year (200 tonnes/year assuming a bulk density of 1.3 for saturated sediment) of soil loss. It is standard practice that each affected catchment on a road construction project be assessed against this requirement.

Following on from the erosion hazard assessment in Section 3.12 and the calculations in Table 4, an assessment of all catchments (existing catchments and future catchments once earthworks are complete) has been undertaken. It was identified that sediment basin(s) will be required for several catchments disturbed during construction.

Sediment basins have been sized based on the following criteria (from Landcom, 2004 except as noted):

- Design rainfall depth: 38.6 mm (5-day, 85th percentile for Nowra)[1];
- Basins designed for Type F/D (dispersible) sediment;
- Volumetric runoff coefficient (Cv): 0.64 (Hydrologic Group D).

The size of the basin(s) will vary depending on catchment size and conditions. Conceptual sizing of basins is included in the ESCPs in Appendix 2.

Note there are several site, soil and drainage constraints to constructing sediment basins, so alternative measures will be implemented instead in locations where basins are theoretically required but cannot be provided.

For all catchments where sediment basins are not feasible, undersized sediment basins, sediment sumps, rock filter dams/bunds, mulch bunds, sediment fences or similar should be used. However, to offset the lower level of sediment control, these catchments must be subject to enhanced erosion control, mainly in the form of temporary ground cover over high-risk areas (i.e. steep (>20%) batters and concentrated flowpaths) whenever significant rainfall is imminent. This is discussed further in Section 5 and is noted on the concept ESCPs in Appendix 2.

4.2 Onsite and Offsite Water Separation

The permanent design includes drainage to divert upslope ('offsite' or 'clean') water away from completed batters. As much as is practicable, these drains will be installed early to aid efficient construction and minimise the risk of erosion. This is detailed on the ESCPs (Appendix 2).

[1] The 5-day, 85th percentile value for Nowra was derived for Nowra by collating 100 years of five-day rainfall totals from the Bureau of Meteorology, and taking the 85th percentile value (excluding all zero totals).

In addition, temporary drainage will be required in some locations to ensure that:

- Offsite ('clean') water is bypassed through or around work areas and away from sediment control structures; and
- Onsite ('dirty') water is diverted to sediment control structures such as sediment basins.

Details are provided on the ESCPs (Appendix 2).

As much as possible, cross-formation culverts will be installed or extended early to assist with separating onsite (dirty) and offsite (clean) water during construction. In some locations temporary cross-drainage will be required to achieve adequate separation due to the prevailing topography and design of the road. Those locations are marked on the ESCPs (Appendix 2).

4.3 Construction-Phase De-watering

The Blue Book (Landcom, 2004) suggests that water discharged from construction sites should not contain more than 50mg/L of suspended sediment.

Water Quality Objectives (WQOs) have not been established for the Shoalhaven River. However, using typical data for adjacent catchments, a system such as the Shoalhaven River includes "waterways affected by urban development" and "uncontrolled waterways." As such, an assumed objective to protect aquatic ecosystems would dictate a turbidity trigger of 6 to 50 NTU (for low and high flow conditions).

Given the potential for dilution of construction-phase de-watering with natural waterway flows, the typical Blue Book limit of 50mg/L (equivalent to roughly 65 NTU) is unlikely to exceed this trigger unless the waterways are already significantly polluted.

Table 5 contains the default Blue Book water quality standard recommended for site dewatering from sediment basins. A more stringent water quality requirement is not necessary because:

- The construction period is relatively short-term (estimated at 36 months) so long-term impacts are unlikely;
- The use of enhanced erosion controls (refer to Section 3.12) reduces the potential for sediment generation;
- A more stringent water quality requirement would add significantly to the cost of site dewatering, and most likely couldn't be achieved within a reasonable timeframe using safe flocculants in a brackish receiving environment.

Table 5 - Recommended water quality standard for site dewatering

Parameter	Recommended standard during construction
Total suspended solids (TSS)	50mg/L
pH	6.5 to 8.5
Oils and greases	<10mg/L and none visible

5 PROPOSED EROSION AND SEDIMENT CONTROL MEASURES

5.1 Assessment of Applicability of Erosion and Sediment Controls

In preparing the ESCP drawings (Appendix 2), a review was conducted of the road design to determine if the inherent design would impact on effective implementation of erosion and sediment control during construction. Numerous constraints were identified that limit the establishment of features such as sediment basins in a number of locations.

Table 6 provides details of the principles of erosion and sediment control typically adopted on major road projects, along with an assessment of whether each can be effectively implemented on this project.

Where constraints to the effective implementation of typical erosion and sediment controls are identified in Table 6, details of proposed mitigation and/or management measures for each are contained in Table 7 and also on the ESCPs in Appendix 2.

Table 6 – Assessment of Typical Erosion and Sediment Control Measures

No.	Erosion and Sediment Control Principle	Can this be fully applied on this project?	Location(s), Details or Comments
1	Assess constraints and opportunities for erosion and sediment control during the planning/design phase.	Yes – this report demonstrates this process.	N/A
2	Plan early for erosion and sediment control.	Yes – this report and the accompanying ESCPs (Appendix 2) demonstrate early planning. The requirement to keep an up-to-date register of ESCPs during construction is typically included in Roads and Maritime QA G38 specification.	Typical G38 requirements will suffice.
3	Minimise the extent and duration of disturbance.	Yes, this has been taken into account in establishing clearing limits.	A greater disturbance footprint typically occurs as a result of flattening batters (i.e. not too steep) and from the inclusion of sediment basins. This has been taken into account and balanced with the need to minimise the extent of disturbance.
4	Manage soils, including conserving topsoil for later reuse in rehabilitation.	No. Potential Acid Sulfate Soils occur in several locations within the proposal area.	Typical G38 and Blue Book requirements for stockpiling will apply, however additional requirements will need to be included to address the risk of encountering Acid Sulfate Soils.

No.	Erosion and Sediment Control Principle	Can this be fully applied on this project?	Location(s), Details or Comments
5	Control water flow on, through and off the site.	No. The following issues were identified: • Temporary drainage will be necessary in numerous locations to achieve adequate separation of clean offsite and dirty onsite water, or to ensure dirty onsite water is directed to sediment traps. • Some cross-formation culverts will need to be constructed early or alternatives provided to allow for the flow of clean offsite water through the work area. • Some temporary extension of existing culverts will be required. • Some culverts will need to be constructed or modified progressively to allow for traffic staging. Alternative temporary clean water flowpaths will be required. • Replacement or modification of existing pit and pipe stormwater system will lead to high risk of clean and dirty water mixing. • In some locations it will not be possible to divert clean water around the works. Particularly where works are occurring online with the existing road and the stormwater drainage system. • Flooding could impact on construction activities.	Refer to Table 7 and the ESCPs in Appendix 2 for locations and details.
6	Minimise erosion as much as possible.	No. The following issues were identified: • Rock sawing or breaking at the northern abutment of the new bridge will require pro-active dust suppression and containment.	Refer to Table 7 and the ESCPs in Appendix 2 for locations and details.
7	Maximise sediment retention onsite.	No. The following issues were identified: • There are a number of locations where the erosion hazard assessment calculations indicate a sediment basin is required to comply with Blue Book, except these can't be constructed due to flooding, topographical or space constraints. • Floating silt curtains will be required to contain any sediments stirred up as a result of in-stream works. The presence of seagrasses near the southern bank of the Shoalhaven River could constrain curtain installation. • Flooding could impact on construction activities.	Refer to Table 7 and the ESCPs in Appendix 2 for locations and details of alternatives, plus mitigation and management measures to offset constraints to basin construction.

No.	Erosion and Sediment Control Principle	Can this be fully applied on this project?	Location(s), Details or Comments
8	Rehabilitate disturbed lands progressively, ensuring rehabilitation is effective to reduce the erosion hazard.	No. The following issues were identified: • Soils are inherently acidic. This could limit the success of revegetation unless effectively ameliorated. • Steep topography can limit the potential for effective rehabilitation. • Rehabilitation will need to take into account the flood risk.	Refer to Table 7 for details.
9	Conduct regular inspections of the site to identify potential problems and allow for rectification or repair.	Yes. The requirement for documented inspections is typically included in Roads and Maritime QA G36 and G38 specifications.	Typical G36 and G38 requirements will suffice.
10	Maintain all erosion and sediment controls, including cleaning out sediment traps, until the upslope catchments are effectively rehabilitated.	Yes. The requirement to maintain and/or clean out erosion and sediment controls until the upslope catchments are rehabilitated is typically included in Roads and Maritime QA G36 and G38 specifications.	Typical G36 and G38 requirements will suffice.

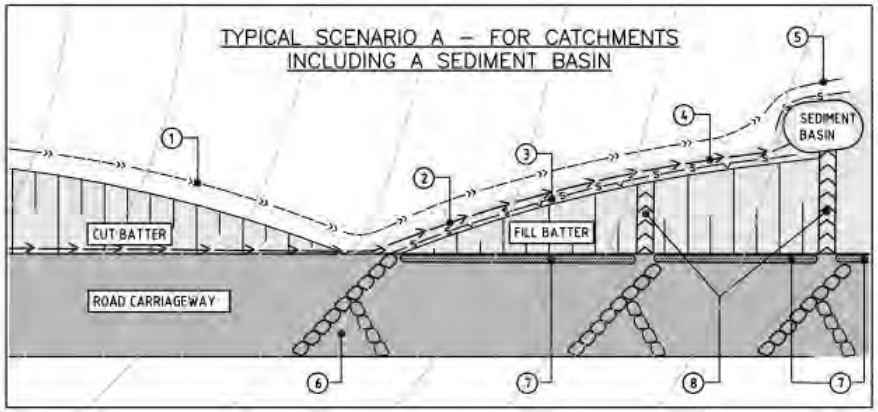
5.2 Typical Details for Erosion and Sediment Control

See following pages for typical details. These details show the typical setup for erosion and sediment control on major road projects such as this, especially for culvert works. The ESCPs (Appendix 2) are based on these typical details.

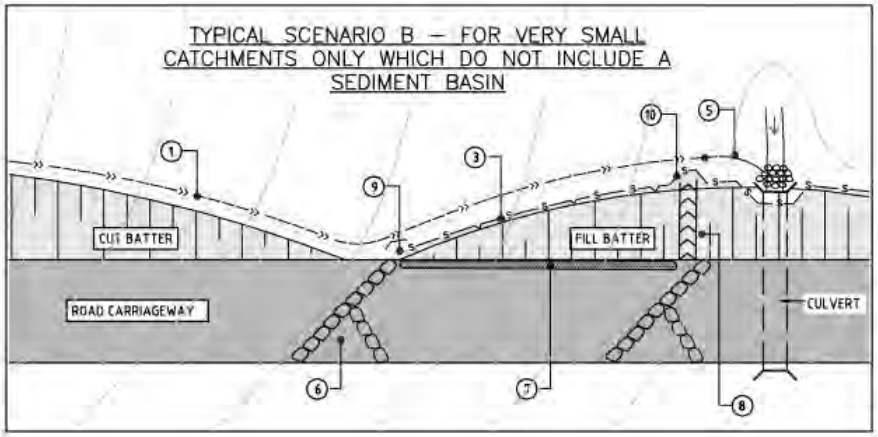
These typical details are contained in a Roads and Maritime Technical Guideline 11.068 (Roads and Maritime, 2011) so will be used to help inform the preparation of Progressive ESCPs during construction.

CUT / FILL BATTER WATER MANAGEMENT

TYPICAL SCENARIO A – FOR CATCHMENTS INCLUDING A SEDIMENT BASIN



TYPICAL SCENARIO B – FOR VERY SMALL CATCHMENTS ONLY WHICH DO NOT INCLUDE A SEDIMENT BASIN



LEGEND

- OFFSITE WATER DIVERSION DRAIN (SD 5-6)
- ONSITE WATER DRAINS (SD 5-8)
- SURFACE CONTOURS
- ROCK STABILISED OUTLET/INLET (SD 5-8)
- CUT / FILL BATTER
- DIVERSION BERM (SD 5-5)
- CREEK / PIPE FLOW ROUTE
- SPILLWAY
- SEDIMENT FENCE (SD 6-8)

CONSTRUCTION NOTES

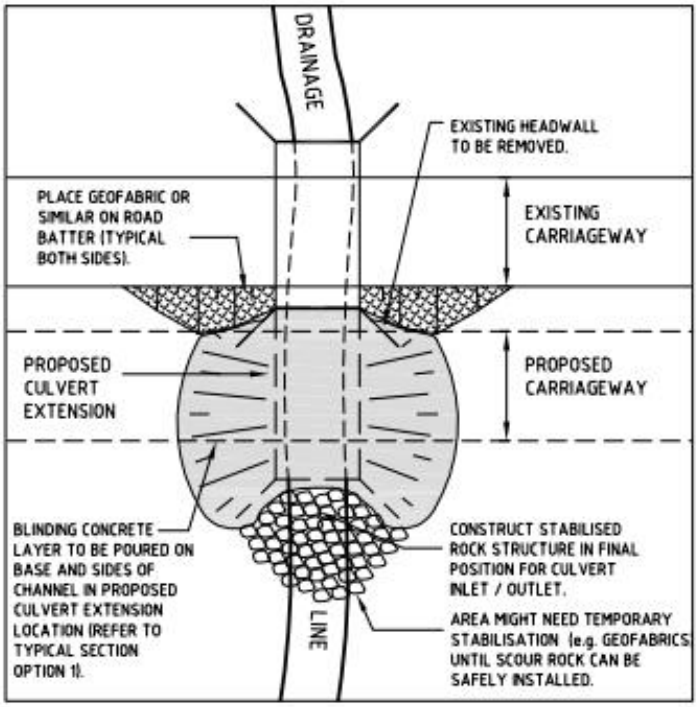
THE FOLLOWING WORKS ARE TO BE UNDERTAKEN AS SHOWN ON THE RELEVANT DIAGRAMS

1. Lined permanent diversion drains to be used as 'offsite' water drains during construction. Must convey water all the way to a watercourse or depression and onto a stabilised outlet point.
2. Provide sufficient room between toe of fill and 'offsite' water drain for management of 'onsite' water. 'Onsite' water diversion (temporary drain) – to drain to sediment basin.
3. Sediment fence at toe of batter. Include returns at 20m intervals.
4. 'Onsite' water diversion (temporary drain) – to drain to sediment basin.
5. Ensure 'offsite' water drain extends all the way to drainage line and onto a stabilised outlet point.
6. Use earth bank or sandbags to divert runoff at cut / fill line to onsite drain or sediment trap. Do not mix with 'offsite' water in cut-off drain. Use arrowhead shape if water is being shed from both sides of formation. It is only required at end of day or when rain is imminent.
7. Earth or sandbag windrow for directing water into drop-down flume. To be installed at end of day or when rain is imminent.
8. Lined drop-down chute to carry 'onsite' water to basin or trap. Only required when rain is imminent.
9. Install sediment trap at cut/fill line if runoff is not flowing to a basin.
10. Install sediment trap at base of drop-down flume if runoff is not flowing to a basin. This can simply be formed as a section of the sediment fence with returns both sides.

AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.

CONTINUOUS CULVERT EXTENSION (ONLINE) OPTION 1



SITE STABILISATION PROCEDURE

CONSTRUCTION NOTES

WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW

Prior to undertaking any construction or earthworks ensure suitable temporary groundcover materials (e.g. geofabric or black plastic) are located on site for rapid stabilisation of exposed soils if an unexpected rain or flow event occurs.

1. Watch the weather forecast for a dry period (a period longer than the time required to complete earthworks up to the required level).
2. When a dry period is forecast, undertake earthworks quickly (preferably in less than three days).
3. Pour blinding concrete layer and lay rock inlet / outlet.
4. Lay geofabric (or similar) on existing road batter.

(Ensure steps 2, 3 and 4 occur within the forecast period of dry weather and no flow)

5. Complete culvert construction works over the top of the blinding concrete layer.
6. Maintain the blinding layer until the culvert extension is complete and stabilised. once flows are secure within the new culverts, excess blinding can be removed if desired.

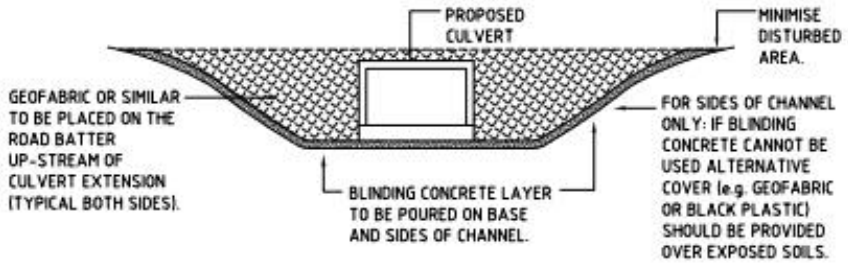
At any time during steps 1 – 4 where a significant rain or flow event is forecast or if the site is left unattended for prolonged periods temporary groundcover should be applied to all exposed soils in the works area.

OTHER NOTES

- For divided culvert extensions this stabilisation method could also be applied or alternatively the flows could be diverted as for a new online culvert.
- Note that this method is not suitable for perennial creeks unless additional measures (e.g. pumping or coffer dams) can be reliably included as well.
- This method might not be appropriate where there is a significant depth of unsuitable soil material to be removed.
- For systems with very minor flows in dry periods, temporary damming of flows might be required to hold water back for the nominated work period until the blinding concrete layer and rock is placed.
- Note that not all onsite water management and sediment controls are shown here.

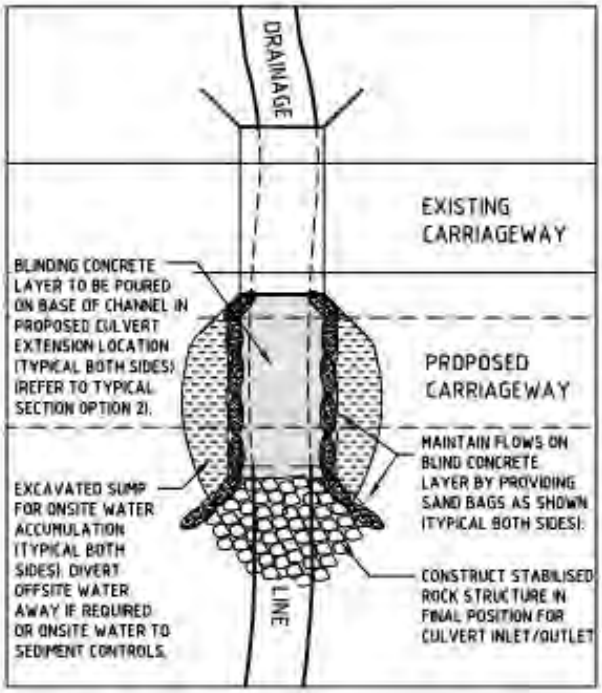
ENSURE THAT 'OFFSITE' CREEK FLOWS DO NOT COME INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

NOTE: MAINTAIN OR INSTALL TEMPORARY GROUND COVER THROUGH FLOW AREA ANYTIME FLOWS ARE IMMINENT.



TYPICAL SECTION – OPTION 1

CONTINUOUS CULVERT EXTENSION (ONLINE) OPTION 2



SITE STABILISATION PROCEDURE

CONSTRUCTION NOTES

WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW

Prior to undertaking any construction or earthworks ensure suitable temporary groundcover materials (e.g. geofabric or black plastic) are located on site for rapid stabilisation of exposed soils if an unexpected rain or flow event occurs.

1. Watch the weather forecast for a dry period (a period longer than the time required to complete earthworks up to the required level).
2. When a dry period is forecast, undertake earthworks quickly (preferably in less than three days).
3. Pour blinding concrete layer and lay rock inlet / outlet.
4. Position sand bags on the blind concrete layer.

(Ensure steps 2, 3 and 4 occur within the forecast period of dry weather and no flow)

5. Complete culvert construction works over the top of the blinding concrete layer. Take care not to disturb the integrity of the blinding layer.
6. Maintain the sandbag walls on the base slab if a flow event occurs.

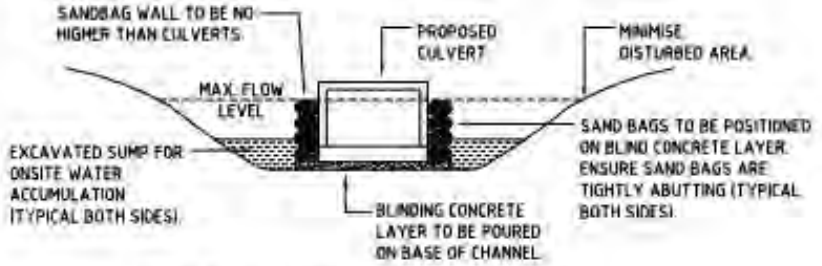
At any time during steps 1 – 4 where a significant rain or flow event is forecast or if the site is left unattended for prolonged periods temporary groundcover should be applied to all exposed soils in the works area.

OTHER NOTES

- For divided culvert extensions this stabilisation method could also be applied or alternatively the flows could be diverted as for a new online culvert.
- Note that this method is not suitable for perennial creeks unless additional measures (e.g. pumping or coffer dams) can be reliably included as well.
- This method might not be appropriate where there is a significant depth of unsuitable soil material to be removed.
- For systems with very minor flows in dry periods, temporary damming of flows might be required to hold water back for the nominated work period until the blinding concrete layer and rock is placed.
- Note that not all onsite water management measures and sediment controls are shown here.

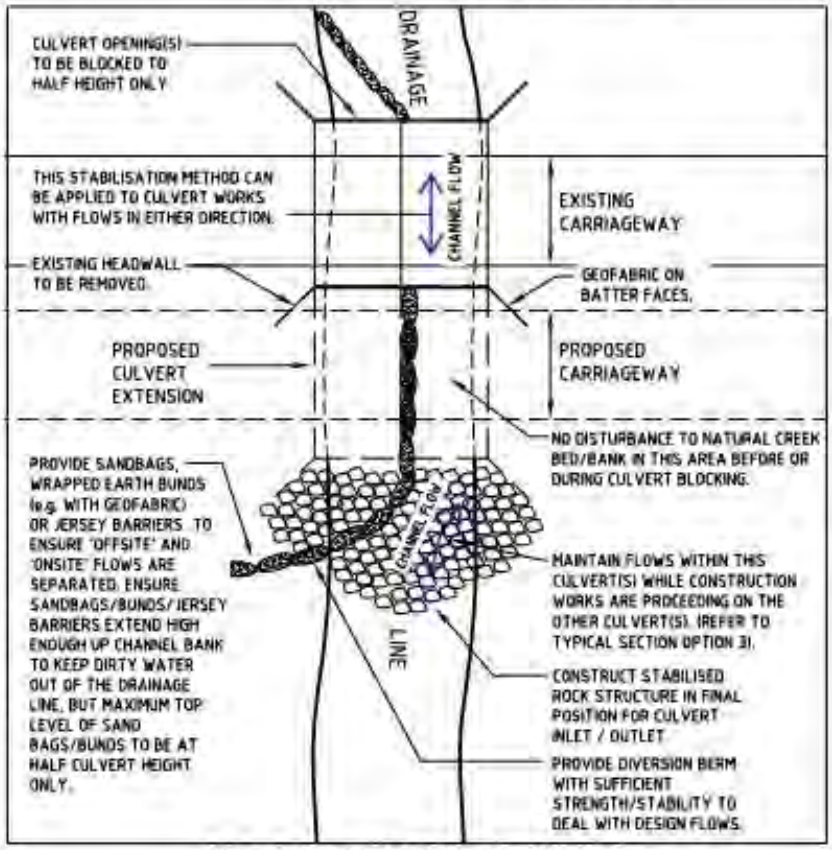
ENSURE THAT 'OFFSITE' CREEK FLOWS DO NOT COME INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

NOTE: MAINTAIN OR INSTALL TEMPORARY GROUND COVER THROUGH FLOW AREA ANYTIME FLOWS ARE IMMINENT.



TYPICAL SECTION – OPTION 2

CONTINUOUS CULVERT EXTENSION (ONLINE)
OPTION 3



SITE STABILISATION PROCEDURE

OTHER NOTES

- This option will only work when existing ground surface level can be maintained in at least one culvert cell. Therefore this method might not work for deep excavations requiring benching.
- Suitable for use in perennial streams providing in-stream works are conducted when flows are minimal.
- However, regardless of scheduling and timing the adopted controls need to be considerate of the risk of significant flows at any time.
- Note that not all water management and sediment controls are shown here.

AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

CONSTRUCTION NOTES

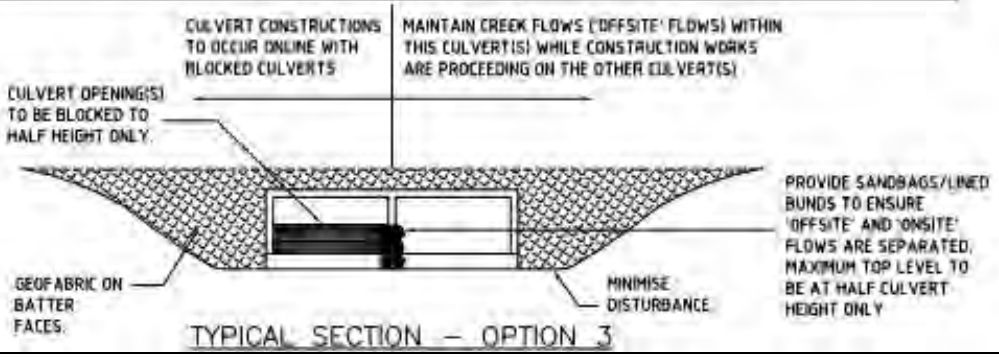
WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW

Prior to undertaking any construction or earthworks ensure suitable temporary groundcover materials (e.g. geofabric or black plastic) are located on site for rapid stabilisation of exposed soils if an unexpected rain or flow event occurs.

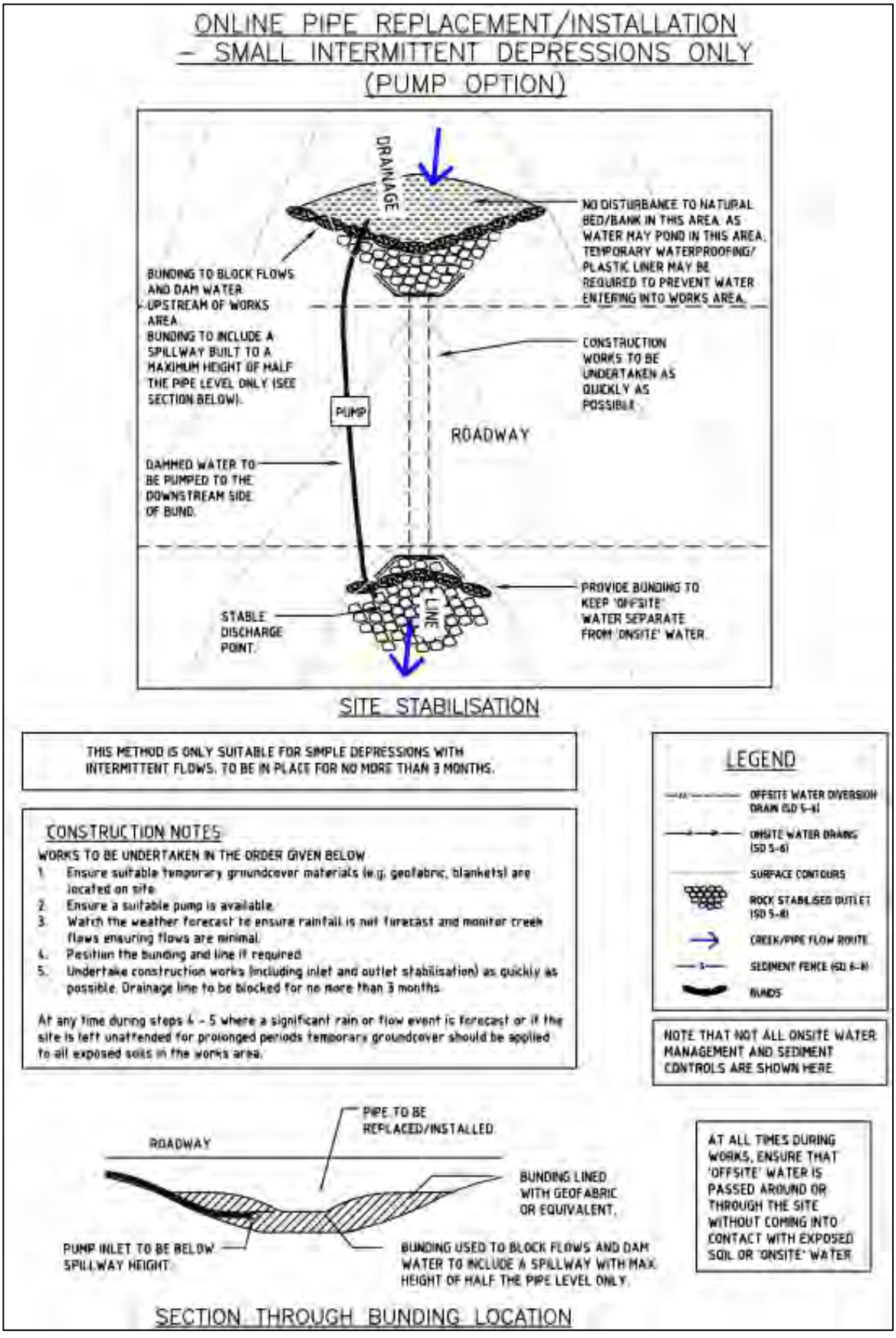
Stage 1:
1. Monitor creek flows ensuring flows levels are not too high.
2. Position sandbags/bunds around culvert works area and block existing culvert end to half culvert height only.
3. Undertake culvert extension construction works only on the blocked side of the culvert(s).
4. Complete inlet/outlet protections.

Stage 2
5. Divert the creek flows into the newly constructed culvert extension by blocking off the alternate side using a half-height wall/bund.
6. Complete the culvert extension on the other side including the stabilised inlet/outlet.

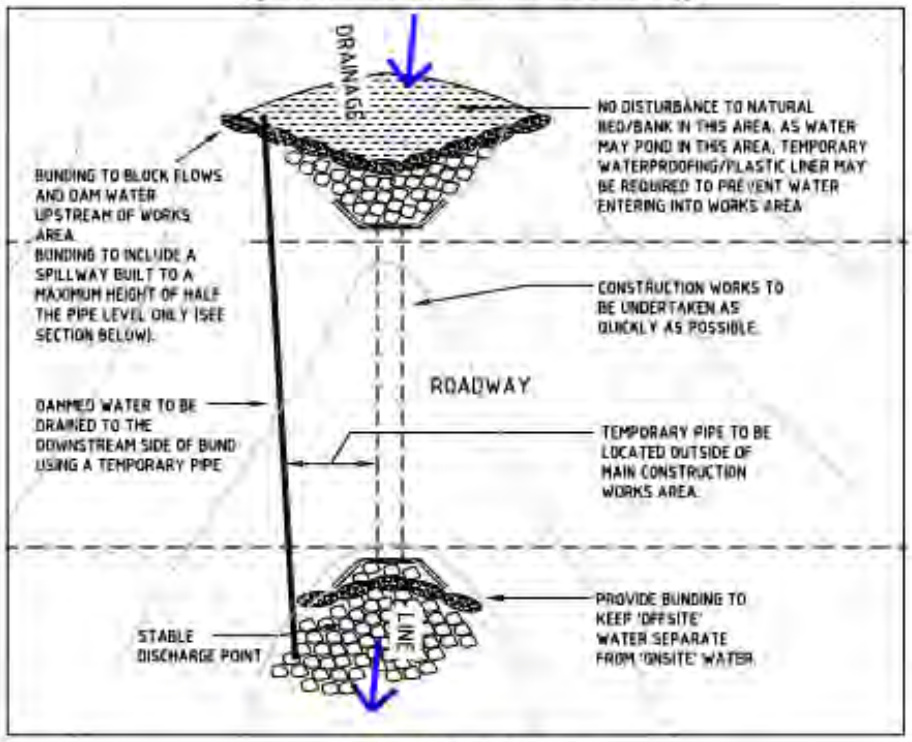
At any time where a significant rain or flow event is forecast or if the site is left unattended for prolonged periods temporary groundcover should be applied to all exposed soils in the works area.



TYPICAL SECTION – OPTION 3


ONLINE PIPE REPLACEMENT/INSTALLATION
– SMALL INTERMITTENT DEPRESSIONS ONLY
(PUMP OPTION)
DRAINAGE
NO DISTURBANCE TO NATURAL BED/BANK IN THIS AREA. AS WATER MAY POND IN THIS AREA, TEMPORARY WATERPROOFING/ PLASTIC LINER MAY BE REQUIRED TO PREVENT WATER ENTERING INTO WORKS AREA.
BUNDING TO BLOCK FLOWS AND DAM WATER UPSTREAM OF WORKS AREA.
BUNDING TO INCLUDE A SPILLWAY BUILT TO A MAXIMUM HEIGHT OF HALF THE PIPE LEVEL ONLY (SEE SECTION BELOW).
CONSTRUCTION WORKS TO BE UNDERTAKEN AS QUICKLY AS POSSIBLE.
PUMP
ROADWAY
DAMMED WATER TO BE PUMPED TO THE DOWNSTREAM SIDE OF BUND.
PROVIDE BUNDING TO KEEP 'OFFSITE' WATER SEPARATE FROM 'ONSITE' WATER.
STABLE DISCHARGE POINT.
LINE
SITE STABILISATION
THIS METHOD IS ONLY SUITABLE FOR SIMPLE DEPRESSIONS WITH INTERMITTENT FLOWS. TO BE IN PLACE FOR NO MORE THAN 3 MONTHS.
CONSTRUCTION NOTES
WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW
1. Ensure suitable temporary groundcover materials (e.g. geofabric, blankets) are located on site.
2. Ensure a suitable pump is available.
3. Watch the weather forecast to ensure rainfall is not forecast and monitor creek flows ensuring flows are minimal.
4. Position the bunding and line if required.
5. Undertake construction works (including inlet and outlet stabilisation) as quickly as possible. Drainage line to be blocked for no more than 3 months.
At any time during steps 4 - 5 where a significant rain or flow event is forecast or if the site is left unattended for prolonged periods temporary groundcover should be applied to all exposed soils in the works area.
LEGEND
OFFSITE WATER DIVERSION DRAIN (SD 5-6)
ONSITE WATER DRAINS (SD 5-6)
SURFACE CONTOURS
ROCK STABILISED OUTLET (SD 5-8)
CREEK/PIPE FLOW ROUTE
SEDIMENT FENCE (SD 6-8)
BUNDS
NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.
PIPE TO BE REPLACED/INSTALLED
ROADWAY
BUNDING LINED WITH GEOFABRIC OR EQUIVALENT.
PUMP INLET TO BE BELOW SPILLWAY HEIGHT.
BUNDING USED TO BLOCK FLOWS AND DAM WATER TO INCLUDE A SPILLWAY WITH MAX. HEIGHT OF HALF THE PIPE LEVEL ONLY.
AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER.
SECTION THROUGH BUNDING LOCATION

ONLINE PIPE REPLACEMENT/INSTALLATION – SMALL INTERMITTENT DRAINAGE LINES (TEMPORARY PIPE OPTION)



SITE STABILISATION

THIS METHOD IS ONLY SUITABLE FOR SMALL CHANNELS WITH INTERMITTENT FLOWS.

TEMPORARY PIPE TO BE SIZED TO AT LEAST HALF THE PERMANENT PIPE.
e.g. - PERMANENT: 600ø
- TEMPORARY: MINIMUM 300ø

THIS METHOD (TEMPORARY PIPE SYSTEM) WILL NOT BE SUITABLE IN STEEP LOCATIONS WHERE TEMPORARY PIPE CANNOT BE LOCATED OUTSIDE OF WORKS AREA.

CONSTRUCTION NOTES

WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW

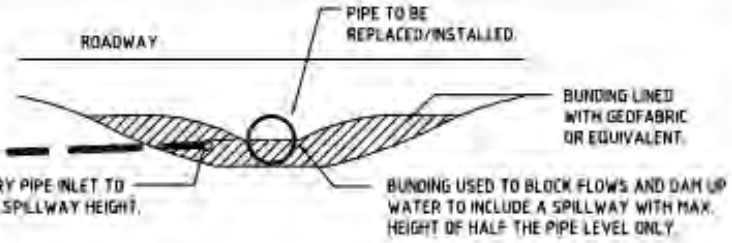
1. Ensure suitable temporary groundcover materials (eg. geofabric, blankets) are located on site.
2. Ensure a temporary pipe is available. Install temporary pipe to ensure flow, preferably by providing continuous fall.
3. Watch the weather forecast to ensure rainfall is not forecast and monitor creek flows ensuring flows are minimal.
4. Position the bunding within the channel to secure the site.
5. Undertake construction works (including inlet outlet stabilisation) as quickly as possible.

At any time during steps 4 – 5 where a significant rain or flow event is forecast or if the site is left unattended for prolonged periods temporary groundcover should be applied to all exposed soils in the works area.

LEGEND

- OFFSITE WATER DIVERSION DRAIN (SD 5-6)
- ONSITE WATER DRAINS (SD 5-6)
- SURFACE CONTOURS
- ROCK STABILISED OUTLET (SD 5-8)
- CREEK/PIPE FLOW ROUTE
- SEDIMENT FENCE (SD 6-8)
- BUNDS

NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.



AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

5.3 Project-Specific Recommendations

Table 7 contains a summary of those locations and aspects that are considered high-risk or that are outside of typical best-practice for a major road construction project, as identified in Table 6.

Table 7 – Summary of project-specific recommendations.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
1.	Whole project	Risk of intercepting Potential Acid Sulfate Soils during earthworks and piling.	4	• Include in G36 and/or G38 specification a requirement to prepare an Acid Sulfate Soil Management Procedure, including a procedure for dealing with unexpected encounters with PASS. • An Acid Sulfate Soil treatment pad is to be established in one of the ancillary facility areas above the 2-year ARI (39.5% Average Exceedance Probability, AEP) flood level. It is to be lime-treated hardstand and must be fully bunded. • Lime treatment of piling mud from river bottom sediments, unless testing demonstrates that material is not PASS so does not warrant lime treatment. • Lime treatment for all material excavated in the high-risk zone within 40m on the north side of Bomaderry Creek, unless testing demonstrates that material is not PASS so does not warrant lime treatment. • Lime treatment of any material excavated (or brought up by piling) below 2.0m below ground level south of the new bridge over the Shoalhaven River, unless testing demonstrates that material is not PASS so does not warrant lime treatment.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
2.	Bridges over the Shoalhaven River and Bomaderry Creek	Close proximity to sensitive receiving environment (Shoalhaven River, Bomaderry Creek) with limited sediment controls feasible downslope. Potential acid sulfate soils limit the potential for excavating or installing sediment traps at Bomaderry Creek.	6 and 7	• Offset the limited sediment controls by enhancing the proposed erosion control. This applies in all catchments where sediment basins are theoretically required but cannot feasibly be constructed, and to all works within 20m of the banks of a watercourse. • ESCPs include an instruction "During construction, exposed batters are to be temporarily ground-covered prior to forecast rainfall of >50% chance of 10mm or more in 24 hours with a biodegradable soil binder, fabric or similar and progressively stabilised as works are complete in each area." This has been included on the ESCP in Appendix 2. • Silt curtains are to be placed around the banks of the river and creek where any instream works or disturbance will occur. This has been included on the ESCP in Appendix 2. • Silt curtains are to be placed around piling works that occur within the river and creek. This has been included on the ESCP in Appendix 2.
3.	Northern bridge abutment, Shoalhaven River.	Risk of dust from rock sawing, breaking or blasting.	6	• During rock sawing or blasting, dust suppression is to be actively undertaken to minimise dust generation and dust drift. This must be included as an additional requirement in G38 and/or the SWMP for the Project. This has been included on the ESCP in Appendix 2.
4.	Whole project	Risk of revegetation failures or poor growth due to localised steep slopes, flood hazard and soil constraints. Soils are inherently acidic and have low waterholding capacity. This could limit the success of revegetation unless effectively ameliorated.	8	• Lime-treat topsoils to address acidity unless in situ testing indicates that lime treatment to address acidity is not necessary. • Blend topsoils with compost to improve nutrient status and waterholding capacity. Alternatively, use compost blanket to rehabilitate steep batters. • Consider the inclusion of water holding crystals during rehabilitation. • Select vegetation species and landscaping materials that are adapted to coastal soils and potential flood inundation. • The above four points should be included as an additional requirement in R178 and/or G38 and/or the SWMP for the Project.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
5.	New bridge over the Shoalhaven River	Works in and around the Shoalhaven River and in areas where seagrasses occur. Potential acid sulfate soils limit the potential for excavating or installing sediment traps.	7	• Floating silt curtain required. This is noted on the ESCPs. • Silt curtain must be positioned at least 20m out from (and parallel to) the southern bank of the Shoalhaven River when piling works are occurring in that area to avoid seagrasses. • ESCPs include an instruction "During construction, prior to forecast rainfall of >50% chance of 10mm or more in 24 hours, all exposed batters (excluding rock faces) are to be temporarily ground-covered using fabric, polymer or similar." • Include in G36 and/or G38 specification a requirement to prepare an Acid Sulfate Soil Management Procedure, including a procedure for dealing with unexpected encounters with PASS.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
6.	Whole project	Controlling flows to separate clean and dirty water will be necessary. However, in some locations it may be challenging or may not be possible (e.g. replacement and modification of stormwater drainage systems and works online with the existing roadway and drainage system).	5	• The existing stormwater system (e.g. pipes/culverts and kerb and gutter) will be utilised where possible to convey clean water flows around/through the works without coming into contact with disturbed lands. • Where the existing stormwater system cannot be used to divert clean water flows, temporary diversions will be required in the form of diversion drains/bunds, temporary pipes or lined/covered surfaces. Construction stage Progressive ESCPs will need to detail exact locations. • The existing stormwater system is to remain in place for as long as possible until the proposed stormwater system is connected to minimise the transition period from when the existing system is disconnected until the proposed system is active. Temporary diversions (as noted above) will be required during any transition period to facilitate the stormwater flows. Construction stage Progressive ESCPs will need to detail exact locations. • In locations where upslope clean water flows cannot be diverted around the works, sediment controls and drainage throughout the work area will need to be appropriately designed to accommodate the additional clean water throughout the works (e.g. the existing highway pavement works north of Bomaderry Creek, Illaroo Road, the existing highway shoulder widening and pavement works south of Pleasant Way on eastern side of highway). Construction stage Progressive ESCPs will need to detail exact locations and provide detail.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
7.	Flood prone lands north of Bomaderry Creek from ch76840 to 76960, lands south of Shoalhaven River from ch77460 to 77700 including Scenic Drive, the lands at the southern end of the project from ch77840 south including the proposed Paper Road and ancillary areas 1, 2, 3, 6, 7 & 9.	Flooding may impact on construction activities and limit the ability to install and operate sediment controls.	5	• Ancillary areas surfaces within flood prone lands are to be maintained stable at all times using aggregate, gravel, DGB or a heavy duty trafficable soil stabiliser. • Stockpiling of raw materials is not to occur below the 2-year ARI (39.5% AEP) level. • Exposed batters within flood prone areas are to be ground-covered prior to forecast rainfall of >50% chance of 10mm or more in 24 hours with a biodegradable soil binder, fabric or similar and progressively stabilised as works are complete in each area. • Sediment basin walls (i.e. SB 76900E and SB76900W) to be built up so the inlet and outlet points are above the 2yr ARI (39.5% AEP) flood level. However, ensure drainage into these basins is still possible. If sediment basin construction cannot be achieved due to this constraint, enhanced erosion controls (e.g. temporary stabilisation prior to rainfall, increased slope breaks, check dams and timing of works to low erosion hazard periods) will be required for the disturbed basin catchments and alternative sediment trap type device/s provided. • Sediment basin outer walls within flood prone areas are to be armoured with rock or similar to ensure stability during a flood event.
8.	North of Bomaderry Creek (both sides of highway).	The erosion hazard assessment calculations indicate a sediment basin is required to comply with Blue Book, except basin construction may be problematic and may not be able to be constructed due to flooding, acid sulphate soils or high ground water.	7	• Where possible basin walls to be built up so the inlet and outlet points are above the 2yr ARI flood level. However, ensure drainage into the basin is still possible. • If high ground water or acid sulphate soils are present, the basins may need to be formed as shallow linear type devices to minimise excavation. • If basin construction cannot be achieved due to the above constraints, enhanced erosion controls (e.g. temporary stabilisation prior to rainfall, increased slope breaks, check dams and timing of works to low erosion hazard periods) will be required for the disturbed basin catchments and alternative sediment trap type device/s provided.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
9.	Illaroo Road	The erosion hazard assessment calculations indicate a sediment basin is required to comply with Blue Book, except basin construction is not possible here due to space, construction and topographical constraints.	7	• Online sediment traps in conjunction with enhanced erosion controls (e.g. temporary stabilisation prior to rainfall, increased slope breaks, check dams and timing of works to low erosion hazard periods) will be required for the disturbed area of Illaroo Road.
10.	Princes Highway shoulder works south of ch77680 on the western side of the highway.	The erosion hazard assessment calculations indicate a sediment basin is required to comply with Blue Book, except basin construction is not possible here due to space, construction and topographical constraints.	7	• Online sediment traps in conjunction with enhanced erosion controls (e.g. temporary stabilisation prior to rainfall, increased slope breaks, check dams and timing of works to low erosion hazard periods) will be required for the disturbed area of this catchment.

6 CONCLUSION AND RECOMMENDATIONS

NSW Roads and Maritime Services (Roads and Maritime) propose to construct an additional bridge for the A1 Princes Highway crossing of the Shoalhaven River at Nowra (the proposal). The proposal includes the construction of a new bridge to the west (upstream) of the existing twin bridges and the removal of vehicular traffic from the existing southbound bridge. The proposal also includes the upgrade of about 0.4 kilometres of the Princes Highway north of the new bridge, 0.7 kilometres to the south, plus intersection upgrades and modifications to the local road network. The proposal would improve access to Nowra and the surrounding areas, improve southbound access for large freight vehicles, and improve traffic flows.

The purpose of this report is to determine management issues for construction-phase erosion and sediment control.

- Section 3 identifies site conditions and identifies any potential constraints to construction-phase erosion and sediment control;
- Section 4 identifies design considerations for erosion and sediment control measures;
- Section 5 assesses the feasibility for constructing typical erosion and sediment control structures such as sediment basins, with a series of recommendations to manage or mitigate potential impacts relating to construction-phase erosion and sediment control.

Section 5 is accompanied by a set of concept ESCP drawings (Appendix 2) showing the setup of key erosion and sediment control measures such as sediment basins and up-gradient water diversions.

In preparing the ESCP drawings (Appendix 2), a review was conducted of the road design to determine if the inherent design would impact on effective implementation of erosion and sediment control during construction. The design itself does not necessarily preclude the effective implementation of erosion and sediment control but the site conditions do, particularly the lack of available space. In several locations, there is insufficient space for large-scale controls such as sediment basins. Table 7 contains a series of alternatives and mitigation measures to address this, and these are also identified on the ESCPs in Appendix 2.

Providing the recommendations in Section 5 of this report and the ESCPs (Appendix 2) are adopted during construction, the risk of pollution from erosion and subsequent sediment runoff can be managed in accordance with recognised best-practice in NSW (i.e. Landcom 2004 and DECC, 2008).

Table 7 in Section 5 details a series of erosion and sediment control recommendations for high-risk areas or where typical controls cannot be included. Note that alternative options

could feasibly be developed but should be based on consultation with an expert soil conservationist.

It is recommended that Roads and Maritime specifications (G36, G38 and R178) be modified to ensure that the recommendations in Table 7 are incorporated and thus carry through to the construction-phase of the project.

7 REFERENCES

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8 APPENDICES

8.1 Appendix 1: Sediment Basin Calculations

See overpage.

1. Erosion Hazard and Sediment Basins

Site Name/Location/Stage:

Basin/Structure Details										
Basin Number/Name	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10
Basin Type			AC1						AC3	
Basin Chainage	76800	76900E	76900W	AC6	77010W	77120W	77000E	77140E	77500W	77480W
Site Area										
Total catchment area (ha)	0.21	1	1.3	1.23	1.75	0.8	0.15	0.09	1.4	0.18
Disturbed catchment area (ha)	0.21	1	1.3	1.23	1	0.8	0.15	0.09	1.4	0.18
Soil analysis (enter sediment type if known, or laboratory particle size data)										
Sediment Type (C, F or D) if known:	D	D	D	D	D	D	D	D	D	D
% sand (fraction 0.02 to 2.00 mm)										
% silt (fraction 0.002 to 0.02 mm)										
% clay (fraction finer than 0.002 mm)										
Dispersion percentage										
% of whole soil dispersible										
Soil Texture Group	D	D	D	D	D	D	D	D	D	D
Rainfall data										
Design rainfall depth (no of days)	5	5	5	5	5	5	5	5	5	5
Design rainfall depth (percentile)	85	85	85	85	85	85	85	85	85	85
x-day, y-percentile rainfall event (mm)	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6
Rainfall R-factor (if known)	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250
IFD: 2-year, 6-hour storm (if known)										
RUSLE Factors										
Rainfall erosivity (*R*-factor)	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250
Soil erodibility (*K*-factor)	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047
Slope length (m)	10	25	25	80	20	10	5	25	10	20
Slope gradient (%)	25	25	25	2	33	50	90	20	50	25
Length/gradient (*LS*-factor)	1.88	3.84	3.84	0.41	4.22	3.33	2.37	3.02	3.33	3.23
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover (*C*-factor)	1	1	1	1	1	1	1	1	1	1
Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)										
Storage (soil) zone design (no of months)	2	2	2	2	2	2	2	2	2	2
Cv (Volumetric runoff coefficient)	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Calculations and Type D/F Sediment Basin Volumes										
Soil loss (t/ha/yr)	488	997	997	106	1095	863	617	784	863	838
Soil Loss Class	4	6	6	1	6	6	5	6	6	6
Soil loss (m^3/ha/yr)	375	767	767	81	842	664	474	603	664	644
Sediment basin storage (soil) volume (m^3)	13	128	166	17	140	89	12	9	155	19
Sediment basin settling (water) volume (m^3)	52	247	321	304	432	198	37	22	346	44
Sediment basin total volume (m^3)	65	375	487	321	572	287	49	31	501	63
Other Information/Comments										
Soil Loss	102.443	997.014	1296.12	130.062	1094.79	690.787	92.5074	70.605	1208.88	150.79
Is a basin required	NO	YES	YES	NO	YES	YES	NO	NO	YES	NO

														Basin/Struc
	CA12	CA13	CA14	CA15	CA16	CA17	CA18	CA19	CA20	CA21	22	23	24	25
		AC5												
	SD	77680W	78060W	77920E	78160E	PR	AC7	AC8	AC9	AC2				
	0.52	0.65	0.77	0.3	0.4	1	0.72	0.25	1.2	0.95				
	0.52	0.65	0.77	0.3	0.4	1	0.72	0.25	1.2	0.95				
D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6
4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250
4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250
0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047
	80	80	10	10	80	80	40	50	40	10				
	5	4	30	30	4	3	6	8	3	10				
	1.19	0.91	2.23	2.23	0.91	0.65	0.97	1.51	0.47	0.68				
1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
	308	237	578	578	237	169	251	392	122	176				
	3	3	5	5	3	2	3	4	1	2				
	237	182	445	445	182	130	193	302	94	136				
	21	20	57	22	12	22	23	13	19	21				
	128	161	190	74	99	247	178	62	296	235				
	149	181	247	96	111	269	201	75	315	256				
	160.298	154.091	445.098	173.415	94.8251	169.029	180.767	98.1088	145.988	167.516				
NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

8.2 Appendix 2: Concept Erosion and Sediment Control Plans (ESCPs)

See overpage.

NOWRA BRIDGE PROJECT

CONCEPT EROSION AND SEDIMENT CONTROL PLANS

FINAL

NOT FOR CONSTRUCTION

DRAWING SCHEDUE

DRAWING NUMBER	DRAWING TITLE
18000363_P01_ESCP000	ESCP - COVER SHEET, LOCALITY PLAN AND DRAWING SCHEDULE
18000363_P01_ESCP001	ESCP - GENERAL NOTES - SHEET 1 OF 2
18000363_P01_ESCP002	ESCP - GENERAL NOTES - SHEET 2 OF 2
18000363_P01_ESCP003	ESCP - PHOTO EXAMPLES
18000363_P01_ESCP004	ESCP - BLUE BOOK STANDARD DRAWINGS
18000363_P01_ESCP005	ESCP - IECA STANDARD DRAWINGS
18000363_P01_ESCP006	ESCP - IECA STANDARD DRAWINGS
18000363_P01_ESCP007	ESCP - TYPICAL DETAILS AND PHOTO EXAMPLES
18000363_P01_ESCP101	EROSION AND SEDIMENT CONTROL PLAN SHEET 1 OF 8
18000363_P01_ESCP102	EROSION AND SEDIMENT CONTROL PLAN SHEET 2 OF 8
18000363_P01_ESCP103	EROSION AND SEDIMENT CONTROL PLAN SHEET 3 OF 8
18000363_P01_ESCP104	EROSION AND SEDIMENT CONTROL PLAN SHEET 4 OF 8
18000363_P01_ESCP105	EROSION AND SEDIMENT CONTROL PLAN SHEET 5 OF 8
18000363_P01_ESCP106	EROSION AND SEDIMENT CONTROL PLAN SHEET 6 OF 8
18000363_P01_ESCP107	EROSION AND SEDIMENT CONTROL PLAN SHEET 7 OF 8
18000363_P01_ESCP108	EROSION AND SEDIMENT CONTROL PLAN SHEET 8 OF 8
18000363_P01_ESCP201	EROSION AND SEDIMENT CONTROL PLAN - ANCILLARY AREA 1
18000363_P01_ESCP202	EROSION AND SEDIMENT CONTROL PLAN - ANCILLARY AREA 2
18000363_P01_ESCP203	EROSION AND SEDIMENT CONTROL PLAN - ANCILLARY AREA 3
18000363_P01_ESCP204	EROSION AND SEDIMENT CONTROL PLAN - ANCILLARY AREAS 5, 7 & 8
18000363_P01_ESCP205	EROSION AND SEDIMENT CONTROL PLAN - ANCILLARY AREA 6
18000363_P01_ESCP206	EROSION AND SEDIMENT CONTROL PLAN - ANCILLARY AREA 9

LOCALITY PLAN

N.T.S.

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
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PROJECT TITLE

NOWRA BRIDGE PROJECT

DRAWING TITLE

CONCEPT ESCP
COVER SHEET, LOCALITY PLAN
AND DRAWING SCHEDULE

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GENERAL REQUIREMENTS

EROSION AND SEDIMENT CONTROL DESIGN

The details shown on this drawing are Concept Primary stage erosion and sediment control requirements only. Only major primary controls are shown. All minor controls and progressive controls will need to be detailed on Progressive Erosion and Sediment Control Plans. These Construction Stage Progressive Erosion and Sediment Control Plans (PESCPs) will need to be developed prior to construction.

This Erosion and Sediment Control Plan (ESCP) has been prepared in accordance with Blue Book Volume 1 (Landcom, 2004) and Volume 2D - Main Road Construction (DECC,2008) and project approval conditions. This Erosion and Sediment Control Plan has been prepared to accompany the Erosion and Sediment Management Report by SEEC.

An erosion hazard assessment has been completed for all areas within the proposed work zone. The predicted soil loss across all site areas has been determined in accordance with the following:

A = R x K x LS x C x P

Where

A = Annual soil loss due to erosion (t/ha/yr)
R = Rainfall erosivity factor
K = Soil erodibility factor
LS = Topographic factor derived from slope length (SL) and slope gradient (S)
C = Cover and management factor
P = Erosion control practice factor

The following values have been used:

R : 4250
K : 0.047 (Assumed K-factor based on soil data presented in Hazelton (1992) and Landcom (2004))
SL : Up to 80m MAX.
S : Varies from 1 - 8% (excluding existing embankments adjacent to the creek and river where slopes are up to 90% and batters where slopes are up to 33%)
LS : Varies from 0.19 to 4.22
C : 1.0 (Construction stage - i.e. no soil surface protection or ground cover applied)
P : 1.3 (for general construction areas)

Based on the above data, the potential soil loss varies from 50 to 1095 t/ha/yr

Under Blue Book standards, sediment basins are required if the soil loss is > 200 t/yr for any catchment. Therefore, sediment basins are required for some catchments within this project.

STAGING AND ACCESS REQUIREMENTS

- Before commencement of works in any area, a Progressive ESCP is to be prepared and approved for use.
- As much as possible, erosion and sediment control measures are to be installed prior to ground disturbance. These will be detailed on the Progressive ESCPs.
- Barrier fencing, tape, flagging, sediment fence or similar will be installed to define no-go zones and to minimise the extent of disturbance as much as possible to only that required for safe and efficient construction.
- The soil erosion hazard on the site will be kept as low as practicable by minimising land disturbance. Some ways of doing this are outlined in Table 2.

SITE ENTRY AND EXIT POINTS

- Establish stabilised site access points anywhere where construction vehicles enter or exit a work area from a sealed public road. Refer to Standard Drawing SD 6-14 from Landcom (2004).
- Ensure that all vehicles entering and leaving work areas from a sealed public road pass over a stable access point to minimise bogginess in these areas and to minimise mud tracking onto public roads.
- Refer to the notes on Site Inspection, Monitoring and Maintenance regarding street sweeping.
- The use of wheel-wash systems will be considered where standard construction exits are deemed ineffective or there is a significant risk of mud tracking onto sealed public roads.

SOIL STRIPPING AND STOCKPILING

- Ideally, strip topsoil when it is moist, not too wet or too dry.
- Stockpile areas are to be established within approved locations and as specified by the site manager. Refer to Progressive ESCPs for details.
- Wherever possible, stockpiles are to be established and maintained in accordance with Standard Drawing SD 4-1 (Landcom, 2004).
- Sediment fencing is to be installed around the lower edge of stockpiles as per Standard Drawing SD 4-1, unless the stockpile is immediately adjacent to a suitable alternative sediment control.
- Stockpiles are not to be positioned within 5m of possible concentrated water flow (includes road gutters and table drains) unless that flow directs water to a sediment basin.
- Stockpiles are to be sited at least 50m from a Class 1 or Class 2 fish habitat waterway or a waterway used for human consumption.
- Stockpiles sites are to be located above the 100yr ARI flood level where possible, but may be located above the 20yr ARI flood level if essential (use rock bridging or bunds to achieve this).
- Wherever possible, site stockpiles on gently-sloped lands.
- As much as is feasible, mulched vegetation, topsoil and subsoil (if applicable) are to be stockpiled separately.
- Inactive stockpile faces are to be provided with at least 60% cover (i.e. RUSLE C-factor of 0.1) within 10 days of formation. Stabilisation measures on stockpiles must be employed as per the requirements set out in Table 1.
- Stockpiles of topsoil or mulch should be constructed to no more than 2 meters in height wherever possible (note this only applies to topsoil and mulch).
- Stockpile should be formed to be no steeper than 2:1 (H:V).

DRAINAGE MANAGEMENT

- Offsite (clean) water will be mostly diverted around the works within the existing stormwater system.
- Offsite (clean) water diversion drains or bunds and/or temporary pipes will also be installed where necessary as early as possible to divert any additional offsite flows away from work areas that cannot be controlled with the existing stormwater system. Details are to be provided on the Progressive ESCPs for each stage.
- Onsite (dirty) water will be conveyed to sediment control structures such as basins and sediment traps using diversion channels, bunds and/or temporary pipes. Details are to be provided on the Progressive ESCPs for each stage.
- Wherever possible, place gypsum (or floc-blocks) in dirty water diversions or at the inlets into the sediment control devices to help pre-load water with coagulant prior to it reaching the sediment controls. This will greatly aid the quick settlement of sediment.

DUST SUPPRESSION

- Dust suppression using water carts should be carried out whenever necessary to minimise sediments becoming air borne due to wind erosion.
- The water for dust suppression can be sourced from the sediment basins or traps. However, an alternative water source must be identified prior to starting construction works for periods when the sediment basins/traps are dry. Wherever possible, non-potable water sources will be used for dust suppression.
- Biodegradable soil stabilisers (e.g. Vital Stonewall or Gluon 240) can be used for dust suppression to help reduce the use of water.

STABILISATION AND REHABILITATION

- Undertake progressive stabilisation of disturbed ground surfaces as they are completed rather than at the end of the works program (Refer to Table 1).
- Final stabilisation is to achieve the C-factors (ground cover) detailed in Table 1 in the nominated timeframes.
- Areas to be revegetated are to be topsoiled first. Refer to Standard Drawing SD 4-2 for instructions regarding topsoil replacement.
- Appropriate seedbed preparation should be carried out when revegetating lands (See Standard Drawing SD 7-1).
- Diversion drains and table drains are to be stabilised as detailed in Table 1, using products or materials able to withstand concentrated flows.
- Refer to the Soil Stripping and Stockpiling notes for stabilisation requirements on stockpiles. Also refer to Table 1 and Standard Drawing SD 4-1.
- Sediment basin and culvert outlets are to be stabilised in accordance with Table 1 and energy dissipaters are to be provided as per Standard Drawing SD 5-8.
- As surfaces are stabilised and permanent drainage measures are installed, temporary water management structures can be removed (e.g. diversion drains).
- Wherever possible, re-use cleared/mulched vegetation for either temporary or permanent stabilisation of disturbed areas.
- Re-vegetating or stabilising is to be undertaken progressively as works are completed in each section.
- Prior to forecast heavy rainfall, forecast high winds or site shutdown (e.g. Christmas/New Year), high erosion hazard areas will be 'locked down' as much as is feasible and practical using temporary ground covers such as rock (rip-rap), biodegradable matting, geotextile matting, hydromulch, soil binders or similar. Refer to the plans for locations.

GENERAL REQUIREMENTS NOTES CONTINUE ON THE FOLLOWING PAGE

TABLE 1 MAXIMUM ACCEPTABLE C-FACTORS AT NOMINATED TIMES

LANDS	MAXIMUM C-FACTOR	REMARKS
All lands below the 2yr ARI flood level, all lands within potentially acid sulfate soil areas and all lands within 50m of a watercourse not draining to a sediment basin.	0.05 (i.e. 70% cover)	Applies after ten working days from completion of formation.
Waterways and other areas subjected to concentrated flows (e.g. table drains), post construction and during operation	0.05 (i.e. 70% cover)	Applies after ten working days from completion of formation and before they are allowed to carry any concentrated flows. Flows will be limited to those shown in Table 5.2 of Landcom (2004). Foot and vehicular traffic will be prohibited in these areas
Stockpiles and batters, post construction	0.10 (i.e. 60% cover)	Applies after ten working days from completion of formation. Maximum C-factor of 0.10 equals 60% ground cover
All lands, including waterways and stockpiles during construction and operation	0.15 (i.e. 50% cover)	Applies after 20 working days of inactivity, even though works might continue later. Maximum C-factor of 0.15 equals 50% ground cover
All lands post construction	0.05 (i.e. 70% cover)	Applies after 60 working days of completion of works. Maximum C-factor of 0.05 equals 70% ground cover

TABLE 2 LIMITATIONS TO ACCESS DURING CONSTRUCTION

LAND USE	LIMITATION	REMARKS
Construction areas	Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the engineering plans	All site workers should clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope) or similar materials.
Access areas	Limited to a maximum width of 5 metres	The site manager will determine and mark the location of these zones on site. They can vary in position so as to best conserve existing vegetation and protect downstream areas while being considerate of the needs of efficient works activities. All site workers will clearly recognise these boundaries
Remaining lands, including revegetation areas	Entry prohibited except for essential management works	Thinning of growth might be necessary, for example, for fire reduction or weed removal

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GENERAL REQUIREMENTS CONTINUED

SEDIMENT BASINS

- Sediment basin locations and sizing are shown on the following drawings.
- If sediment basin volumes cannot be achieved in the locations shown, some options for alternative management include (but are not limited to):
  - Establish additional multiple small sediment sumps, traps and/or check dams within that catchment to the same capacity;
  - Increased use of erosion controls such as slope breaks or temporary ground covers (e.g. soil binders) when rainfall is likely.
- All disturbed areas that do not drain to a sediment basin will be managed with alternative sediment controls such as sediment fences, linear swale infiltration type basins, pocket basins (i.e. sediment sumps), mulch bunds or similar – refer to the notes on Other Sediment Controls.
- If so desired, dirty water accumulating in boxed out sections can be pumped or carted to a sediment basin providing adequate capacity is available and the basin won't overflow as a result. Note that the 5-day maintenance requirement for basins to be emptied still applies (see below).
- Within 5 calendar days of the conclusion of any rainfall event of 2mm or more (i.e. enough to cause runoff), the sediment basins are to be empty, ready for the next rainfall event. This might include testing water, treating (e.g. flocculating), de-watering and de-silting basins. See notes below regarding dewatering. If rainfall occurs again within 5 days of the previous rain event, the 5-day requirement re-sets.
- Dirty water accumulating in sediment basins can be used onsite for dust suppression or construction purposes. If this occurs it does not need to be treated first. Note that the 5-day maintenance requirement for basins to be emptied still applies.
- The design rainfall event for the sediment basins is 38.6mm. It is assumed that the basins will overflow in an event of more than 38.6mm over any 5-day period.
- The sediment basins are to include outlets (weir overflow/spillway) sized to have a capacity to pass the 100 year peak flow. Outlets are to be onto stable lands or into a waterway.
- Water quality must be checked prior to any controlled release from sediment basins. Refer to the de-watering notes below.
- Additional volume can be provided in sediment basins for storing water if so desired (i.e. they can be made bigger than is required by this ESCP).
- As much as is feasible, gypsum should be included in sediment basin walls and inlets to promote sediment settling.
- A marker peg (or similar) is to be included in every basin showing the top level of the Sediment Storage volume.
- Sediment basins are to be de-silted whenever sediment accumulates to more than 60% of the Sediment Storage Volume. Sediment removed from the basin can be taken to a stockpile area, buried onsite or used as general fill. Ensure sediment removed from basins is not placed where it could wash, blow or fall offsite.
- Sediment basins are to achieve at least 3:1 length:width from their inlet(s) to their spillway. If this is not achieved through the natural shape of the basin, a baffle is to be included.

DE-WATERING

- Any active discharge of water from the project (i.e. where water is moved offsite via direct action such as pumping rather than flowing off the project as a result of heavy rainfall) is to achieve:
  - 50mg/L or less TSS (Total Suspended Sediment); and
  - pH 6.5 to 8.5; and
  - <10mg/L oil and grease and no visible trace.
- Treatment of water in sediment basins can be done with gypsum at a rate of approximately 30 kg gypsum per 100 m3 of dirty water . Alternative flocculating agents can be used if agreed by RMS and allowed under the project EPL. Refer to manufacturer's guidelines for dosage details. Batch dosing of sediment basins should ensure that flocculating agents spread evenly over the entire basin surface.
- Note that water accumulating in any sort of excavation or sump on the project should be managed in accordance with these de-watering requirements.
- If the water is going to be used within the construction site for dust-suppression or construction purposes and will drain back into the sediment capture system it does not require treatment.

OTHER SEDIMENT CONTROLS

- The positioning of other sediment controls such as Check Dams, Mulch Bunds, Sediment Fences or Straw Bale Filters is to be determined on Progressive ESCPs.
- Where sediment fencing is used, install it in accordance with Standard Drawing SD 6-8 (Landcom, 2004).
- Sediment fences are to be firmly trenched into the ground for their entire length.
- Wherever space permits, sediment fences will include small 'returns' at maximum 20m intervals (see Standard Drawing 6-8) to minimise the risk of water flowing along them rather than through them.
- Where mulch filter berms are used, ensure they are placed along the contour, away from areas of concentrated flow and also away from waterways. If required, provide additional bunding to limit the potential for tannin leachate from entering waterways.
- Where straw bale filters are used, install them in accordance with Standard Drawing SD 6-7 (Landcom, 2004).
- Check dams can be formed with sandbags, gravel socks, rock or similar and can be placed in drains to slow flows and assist with sediment capture. Refer to Standard Drawing SD 5-4.
- Silt curtains to be formed in accordance with the manufacturers instructions and as per the recommendations provided on the plans. Also refer to IECA standard drawing FSC-01-03.

SITE INSPECTION, MONITORING AND MAINTENANCE

- Prior to forecast rainfall of 5mm or more over 24 hours, the following will occur:
  - The site environment manager (or their representative) is to inspect (and record the condition of, and any action required) the condition of all erosion and sediment controls;
  - Slope breaks will be pushed up or cut in across large, exposed areas to slow down flows and minimise erosion. The spacing of these slope breaks is to be determined on Progressive ESCPs;
- Prior to forecast rainfall of 10mm or more over 24 hours, the following will occur:
  - Temporary ground covers are to be employed over high risk areas as detailed on the ESCPs.
- Regular site inspections are to be conducted by the site environment manager (or their representative:
  - At least weekly during normal construction hours; and
  - Prior to forecast rainfall (see above); and
  - Daily during rain events (if safe to do so); and
  - Within 24 hours of the cessation of a rain event that causes runoff.
- Additional erosion and sediment controls will be installed as necessary to ensure satisfactory outcomes in keeping with the EPL conditions and best-practice Blue Book guidelines.
- Progressive ESCPs will be updated and/or prepared as required.
- Sediment or rocks tracked from the site will be removed from public roads as soon as possible (e.g. with street sweepers).
- After rainfall, sediment accumulated in trapping devices (e.g. basin, sediment fence) will be removed to a secure location where it can't wash or blow offsite (preferably to an active stockpile).
- Weather conditions will be monitored onsite and daily rainfall will be recorded.
- Safe storage areas for wastes, fuels, excess concrete and other potential contaminants are to be delineated by the site manager. Refer to the SWMP for further details.
- Adequate supplies of erosion control measures (e.g. geofabric rolls, jute matting, hydraulic soil binders) are to be maintained for rapid deployment as required.
- Adequate supplies of flocculant (and flocculating equipment) are to be maintained, based on the number of sediment basins present at that time.
- Dust suppression is to be undertaken as required to minimise the risk of offsite dust impacts. Refer to the Dust Suppression notes for details.
- Batter chutes (see Typical Batter Chute Detail) are to be provided down batters (where necessary) to minimise the risk of scour. The locations for these are to be detailed on Progressive ESCPs.
- Prior to forecast heavy rainfall (e.g. >10mm in 24hrs), forecast high winds or site shutdown (e.g. Christmas/New Year), high erosion hazard areas as shown on the ESCPs will be 'locked down' as much as is feasible and practical using temporary ground covers. Refer to the Stabilisation and Rehabilitation notes.

WORKS AROUND WATERWAYS

- Where access/haul roads cross floodplains, these are to be formed using clean rock with geotextile underlay (or equivalent) to provide a trafficable surface with minimal risk of erosion even when inundated.
- Minimise the extent of disturbance in waterways and on floodplains. When working on floodplains, consider using ground mats instead of clearing vegetation and stripping topsoil.
- Exposed fill batters around waterways and on floodplains are to be stabilised (locked down with soil stabilisers or covered with fabric/matting) as required to minimise the risk of erosion. Refer to the Stabilisation and Rehabilitation notes.
- Permanent stabilisation and rehabilitation of fill batters is to occur progressively as they are completed.
- As fills are raised, they are to be windrowed whenever rain of 5mm in 24hrs (or more) is likely, with regular batter chutes also installed. Refer to the notes on Site Inspection, Monitoring and Maintenance.
- Ideally, construct culverts and clean water diversions as early in the works program as possible.
- To minimise disturbance on floodplains, dirty water can be pooled up in long, near-level drains rather than building dedicated sediment basins (i.e. use "linear basins"). Use large check dams to establish these linear basins if required.
- If sediment basins are established in flood-prone areas, adequate armouring will be required around their bases to minimise the risk of scour in the event of inundation.
- As much as possible, works within watercourses are to be scheduled for late winter or spring months when rainfall is historically lower.
- The duration of works in waterways is to be minimised as much as possible.

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PROJECT TITLE: NOWRA BRIDGE PROJECT

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PHOTO 1 - EXAMPLE OF TEMPORARY PIPED CLEAN WATER DIVERSION INSTALLED PRIOR TO RAINFALL

PHOTO 2 - PROGRESSIVE STABILISATION OF BATTERS AS WORKS PROGRESS

PHOTO 3 - EXAMPLE OF ROCK FILTER DAM AND SUMP

PHOTO 4 - EXAMPLE OF BATTER CHUTE

PHOTO 5 - TEMPORARY STABILISATION OF BATTERS WITH POLYMER

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REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
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PROJECT TITLE

NOWRA BRIDGE PROJECT

DRAWING TITLE

CONCEPT ESCP PHOTO EXAMPLES

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
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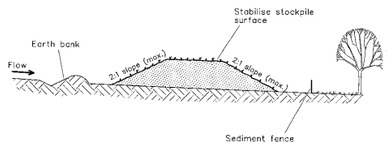
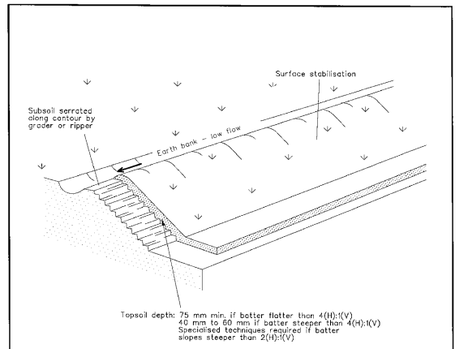


Construction Notes

1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds.
3. Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
4. Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
5. Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

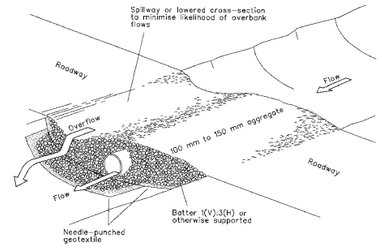
STOCKPILES **SD 4-1**



Construction Notes

1. Scarify the ground surface along the line of the contour to a depth of 50 mm to 100 mm to break up any hardsetting surfaces and to provide a good bond between the respread material and subsoil.
2. Add soil ameliorants as required by the ESCP or SWMP.
3. Rip to a depth of 300 mm if compacted layers occur.
4. Where possible, replace topsoil to a depth of 40 to 60 mm on lands where the slope exceeds 4(H):1(V) and to at least 75 mm on lower gradients.

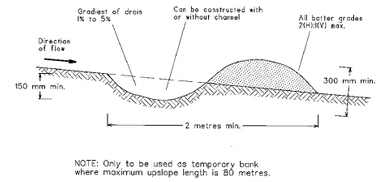
REPLACING TOPSOIL **SD 4-2**



Construction Notes

1. Prohibit all traffic until the access way is constructed.
2. Strip any topsoil and place a needle-punched textile over the base of the crossing.
3. Place clean, rigid, non polluting aggregate or gravel in the 100 mm to 150 mm size class over the fabric to a minimum depth of 200 mm.
4. Provide a 3-metre wide carriageway with sufficient length of culvert pipe to allow less than a 3(H): 1 (V) slope on side batters.
5. Install a lower section to act as an emergency spillway in greater than design storm events.
6. Ensure that culvert outlets extend beyond the toe of fill embankments.

TEMPORARY WATERWAY CROSSING **SD 5-1**

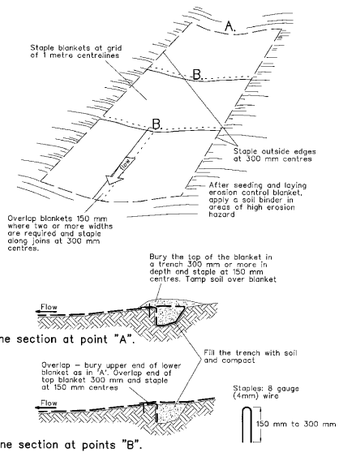


NOTE: Only to be used as temporary bank where maximum upslope length is 80 metres.

Construction Notes

1. Build with gradients between 1 percent and 5 percent.
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V shaped.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction.

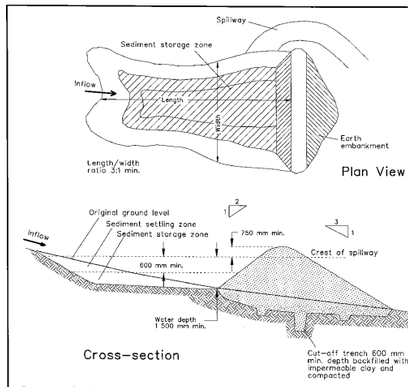
EARTH BANK (LOW FLOW) **SD 5-5**



Construction Notes

1. Remove any rocks, clods, sticks or grass from the surface before laying matting
2. Ensure that topsoil is at least 75 mm deep.
3. Complete fertilising and seeding before laying the matting.
4. Ensure fabric will be continuously in contact with the soil by grading the surface carefully first.
5. Lay the fabric in "shingle-fashion", with the end of each upstream roll overlapping those downstream. Ensure each roll is anchored properly at its upslope end (Standard Drawing 5-7b).
6. Ensure that the full width of flow in the channel is covered by the matting up to the design storm event, usually in the 10-year ARI time of concentration storm event.
7. Divert water from the structure until vegetation is stabilised properly.

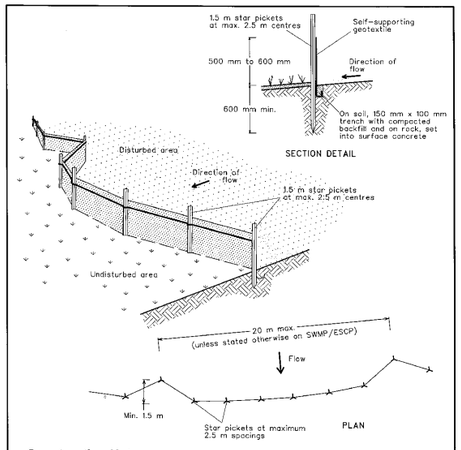
RECP : CONCENTRATED FLOW **SD 5-7**



Construction Notes

1. Remove all vegetation and topsoil from under the dam wall and from within the storage area.
2. Construct a cut-off trench 500 mm deep and 1,200 mm wide along the centreline of the embankment extending to a point on the gully wall level with the riser crest.
3. Maintain the trench free of water and recompact the materials with equipment as specified in the SWMP to 95 per cent Standard Proctor Density.
4. Select fill following the SWMP that is free of roots, wood, rock, large stone or foreign material.
5. Prepare the site under the embankment by ripping to at least 100 mm to help bond compacted fill to the existing substrate.
6. Spread the fill in 100 mm to 150 mm layers and compact it at optimum moisture content following the SWMP.
7. Construct the emergency spillway.
8. Rehabilitate the structure following the SWMP.

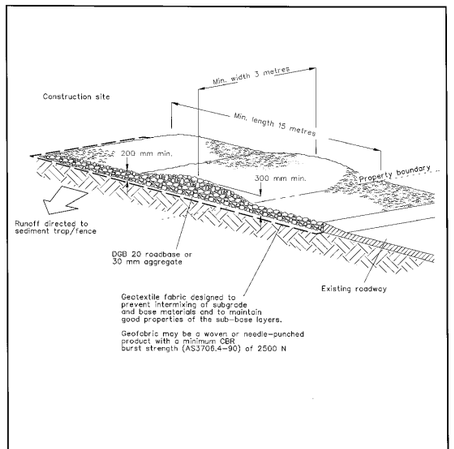
EARTH BASIN - WET **SD 6-4**
(APPLIES TO 'TYPE D' AND 'TYPE F' SOILS ONLY)



Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
5. Join sections of fabric at a support post with a 150-mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

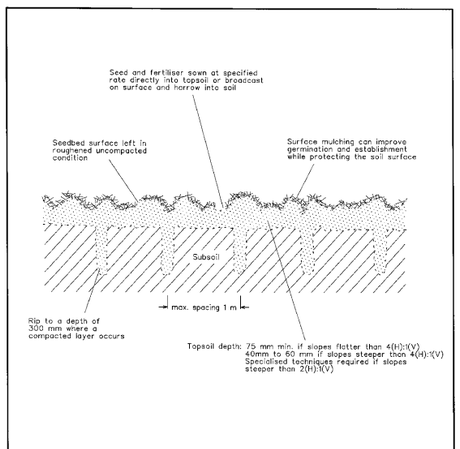
SEDIMENT FENCE **SD 6-8**



Construction Notes

1. Strip the topsoil, level the site and compact the subgrade.
2. Cover the area with needle-punched geotextile.
3. Construct a 200-mm thick pad over the geotextile using road base or 30-mm aggregate.
4. Ensure the structure is at least 15 metres long or to building alignment and at least 3 metres wide.
5. Where a sediment fence joins onto the stabilised access, construct a hump in the stabilised access to divert water to the sediment fence

STABILISED SITE ACCESS **SD 6-14**



Construction Notes

1. Loosen compacted soil before sowing any seed. If necessary, rip the soil to a depth of 300 mm. Avoid rotary hoe cultivation.
2. Work the ground only as much as necessary to achieve the desired tilth and prepare a good seedbed.
3. Avoid cultivation in very wet or very dry conditions.
4. Cultivate on or close to the contour where possible, not up and down the slope.

SEEDBED PREPARATION **SD 7-1**

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	07/02/19	A.J.T.	A.T.	A.M.	FINAL – ISSUE FOR APPROVAL
B	29/01/19	A.J.T.	A.T.	A.M.	FINAL DRAFT – ISSUE FOR REVIEW
A	19/11/18	A.J.T.	L.O.	A.M.	DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	N.A.

FINAL

North

CLIENT: Roads & Maritime

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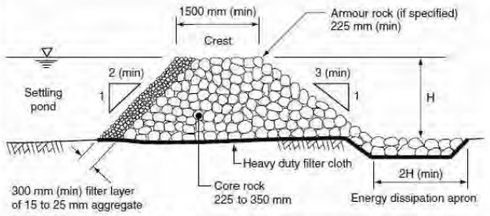
PROJECT TITLE: NOWRA BRIDGE PROJECT

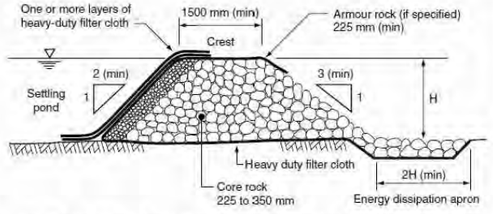
DRAWING TITLE: CONCEPT ESCP BLUE BOOK STANDARD DRAWINGS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP004	00

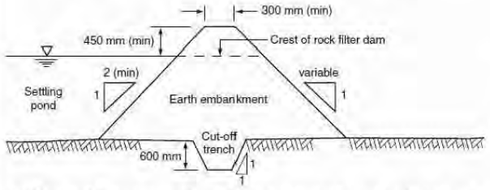
Plot Date: Thursday, February 7, 2019 8:49:52 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP000_REV 00.dwg



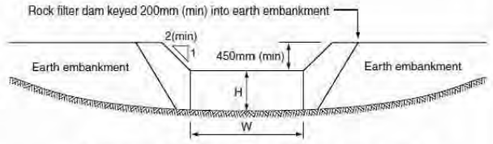
(a) Rock filter dam with aggregate filter



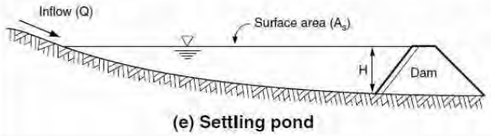
(b) Rock filter dam with geotextile and aggregate filter



(c) Typical cross-section of constructed earth abutment



(d) Typical profile of rock filter dam crest when integrated into an earth embankment



(e) Settling pond

Catchments & Creeks Pty Ltd

Drawn:	Date:		
GMW	Feb-10	Rock Filter Dam	RFD-01

MATERIALS

PRIMARY CORE ROCK: WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, WITH MEAN SIZE AS SPECIFIED IN THE APPROVED PLAN, BUT NOT LESS THAN 225mm, OR GREATER THAN 350mm.

ARMOUR ROCK: WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, WITH MEAN SIZE AS SPECIFIED IN THE APPROVED PLAN, BUT NOT LESS THAN 225mm.

AGGREGATE FILTER: 15 TO 25mm CLEAN AGGREGATE.

GEOTEXTILE FILTER FABRIC: HEAVY-DUTY NON-WOVEN, NEEDLE-PUNCHED FILTER FABRIC, MINIMUM 'BIDIM' A34 OR EQUIVALENT.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE FOUNDATION AREA OF THE ROCK FILTER DAM OF WOODY VEGETATION AND ORGANIC MATTER. DELAY CLEARING THE UP-SLOPE POND AREA UNTIL THE DAM IS FORMED AND IS ABLE TO ACT AS A SUITABLE SEDIMENT TRAP. OTHERWISE AN ALTERNATIVE TEMPORARY DOWNSTREAM SEDIMENT TRAP MAY BE REQUIRED DURING CONSTRUCTION OF THE ROCK FILTER DAM.

3. IF SPECIFIED ON THE PLANS, EXCAVATE A CUT-OFF TRENCH ALONG THE CENTRE-LINE OF THE DAM AND EARTH ABUTMENTS (IF ANY).

4. COVER THE FOUNDATION AREA AND CUT-OFF TRENCH WITH HEAVY-DUTY FILTER FABRIC BEFORE BACKFILLING WITH THE CORE ROCK. OVERLAP ADJOINING FABRIC SHEETS A MINIMUM OF 600mm.

5. CONSTRUCT THE ASSOCIATED EARTH ABUTMENT (IF ANY). ALL CUT AND FILL SLOPES SHOULD BE 2:1(H:V) OR FLATTER. THE DOWNSTREAM FACE OF EARTH ABUTMENTS SHOULD BE 3:1(H:V) OR FLATTER. EARTH ABUTMENTS SHOULD BE CONSTRUCTED OF WELL-COMPACTED, EROSION RESISTANT SOIL THAT IS FREE OF VEGETATION AND ROOTS. OVERFILL EARTH ABUTMENTS 150mm TO ALLOW FOR SETTLEMENT.

6. PLACE THE CORE ROCK FOR THE ROCK FILTER DAM. ENSURE THE UPSTREAM FACE IS 2:1(H:V) OR FLATTER, AND THE DOWNSTREAM FACE IS 3:1(H:V) OR FLATTER.

7. ENSURE THE ROCK IS MACHINE PLACED WITH THE SMALLER ROCKS WORKED INTO THE VOIDS OF THE LARGER ROCKS.

8. IF SPECIFIED, CONSTRUCT THE SPILLWAY SECTION USING THE SPECIFIED ARMOUR ROCK. THE SPILLWAY SHOULD HAVE A MINIMUM PROFILE DEPTH OF 300mm. THE SPILLWAY WEIR CREST MUST BE LEVEL ACROSS ITS FULL WIDTH. THE MAXIMUM LONGITUDINAL SLOPE OF THE ROCK SPILLWAY SHOULD BE 3:1(H:V). THE MINIMUM THICKNESS OF ARMOUR ROCK PROTECTION SHOULD BE 500mm, OR TWICE THE NOMINAL ROCK SIZE, WHICHEVER IS THE GREATER.

9. ENSURE THE SPILLWAY OUTLET SECTION EXTENDS DOWNSTREAM PAST THE TOE OF THE FORMED EMBANKMENT UNTIL STABLE CONDITIONS ARE REACHED, OR A DISTANCE EQUAL TO THE HEIGHT OF THE DAM, WHICHEVER IS THE GREATER. THE EDGES OF THE SPILLWAY SHOULD BE LEFT FLUSH WITH THE SURROUNDING GROUND.

10. INSTALL THE SPECIFIED FILTER (AGGREGATE AND/OR FILTER CLOTH) ON THE UPSTREAM FACE OF THE ROCK FILTER DAM.

11. IF FILTER CLOTH IS USED, THEN:
(i) EXTEND THE FABRIC OVER THE CREST OF THE ROCK FILTER DAM INTO THE SPILLWAY CHUTE.
(ii) CONSIDER THE PLACEMENT OF SEVERAL LAYERS OF OVERLAPPING FABRIC, THUS ALLOWING EACH LAYER TO BE REMOVED INDIVIDUALLY ONCE THE FABRIC BECOMES BLOCKED WITH SEDIMENT.

12. CLEAR THE SETTLING POND AREA OF WOODY VEGETATION AND ORGANIC MATTER TO THE DIMENSIONS SPECIFIED WITHIN THE PLANS.

13. WHERE NECESSARY, EXCAVATE THE UPSTREAM SETTLING POND AND/OR SEDIMENT STORAGE PIT IN ACCORDANCE WITH THE APPROVED PLANS. EXCAVATED PITS TYPICALLY HAVE SIDE SLOPES OF 2:1(H:V) OR FLATTER UNLESS STEEPER SLOPES ARE KNOWN TO BE STABLE.

14. STABILISE ANY ASSOCIATED EARTH EMBANKMENTS IMMEDIATELY AFTER CONSTRUCTION THROUGH APPROPRIATE COMPACTION, VEGETATION AND/OR EROSION CONTROL MATTING.

15. ESTABLISH ALL NECESSARY UP-SLOPE DRAINAGE CONTROL MEASURES TO ENSURE THAT SEDIMENT-LADEN RUNOFF IS APPROPRIATELY DIRECTED INTO THE SEDIMENT TRAP.

16. TAKE ALL NECESSARY MEASURE TO MINIMISE THE SAFETY RISK CAUSED BY THE STRUCTURE.

MAINTENANCE

1. CHECK ALL ROCK FILTER DAMS AFTER EACH RUNOFF EVENT AND MAKE REPAIRS IMMEDIATELY.

2. INSPECT ALL ROCK AND EARTH EMBANKMENTS FOR UNDERCUTTING OR UNDESIRABLE SEEPAGE FLOWS.

3. IDEALLY, ROCK FILTER DAMS SHOULD DISCHARGE (FROM FULL) OVER NO LESS THAN 8 HOURS. IF DRAINAGE IS TOO RAPID, THEN ADDITIONAL FILTER AGGREGATE MAYBE REQUIRED TO ACHIEVE OPTIMUM HYDRAULIC PERFORMANCE.

4. IF FLOW THROUGH THE STRUCTURE IS REDUCED TO AN UNACCEPTABLE LEVEL, THE UPSTREAM FILTER MEDIUM (AGGREGATE OR FILTER CLOTH) SHOULD BE REMOVED AND REPLACED.

5. IF A GREATER DEGREE OF WATER TREATMENT (FILTRATION) IS REQUIRED, EXTRA GEOTEXTILE FILTER FABRIC SHOULD BE PLACED OVER THE UPSTREAM FACE OF THE STRUCTURE.

6. CHECK THE STRUCTURE AND DOWNSTREAM CHANNEL BANKS FOR DAMAGE FROM OVERTOPPING FLOWS. MAKE REPAIRS AS NECESSARY.

7. IMMEDIATELY REPLACE ANY ROCK DISPLACED FROM THE SPILLWAY.

8. REMOVE SEDIMENT AND RESTORE ORIGINAL SEDIMENT STORAGE VOLUME WHEN COLLECTED SEDIMENT EXCEEDS 10% OF THE SPECIFIED STORAGE VOLUME.

9. DISPOSE OF SEDIMENT AND DEBRIS IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

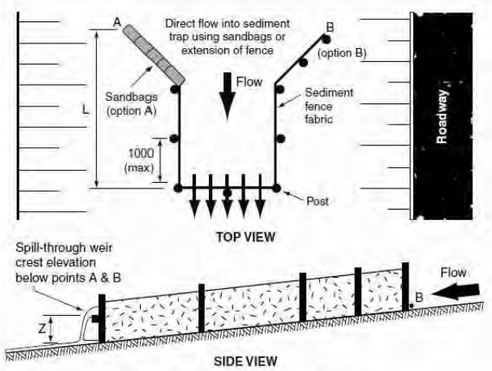
1. WHEN THE UP-SLOPE DRAINAGE AREA HAS BEEN STABILISED, REMOVE ALL MATERIALS INCLUDED DEPOSITED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

2. ALL WATER AND SEDIMENT SHOULD BE REMOVED FROM THE SETTLING POND PRIOR TO THE DAM'S REMOVAL. DISPOSE OF SEDIMENT AND WATER IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

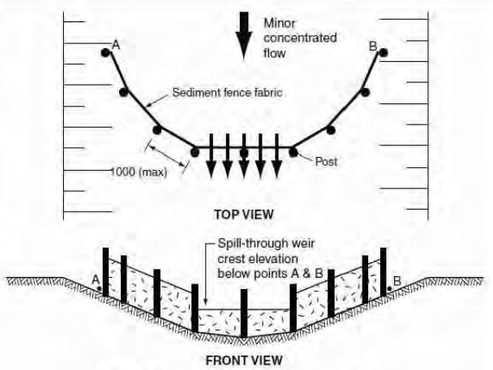
3. BRING THE DISTURBED AREA TO A PROPER GRADE, THEN SMOOTH, COMPACT AND STABILISE AND/OR REVEGETATE AS REQUIRED TO MINIMISE THE EROSION HAZARD.

Catchments & Creeks Pty Ltd

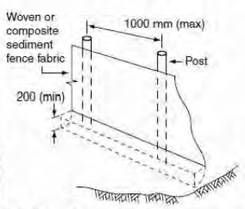
Drawn:	Date:		
GMW	Apr-10	Rock Filter Dam	RFD-02



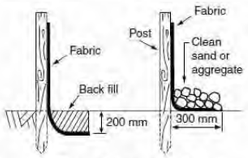
(a) Type AU 'narrow' sediment trap



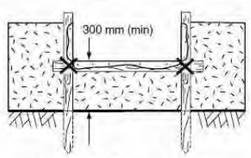
(b) Type BU 'wide' sediment trap



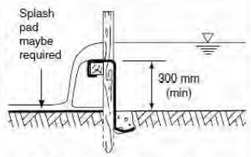
(c) Spacing of support posts



(d) Trenching of fabric



(e) Spill-through weir



(f) Sectional view of weir

Catchments & Creeks Pty Ltd

Drawn:	Date:		
GMW	Apr-10	U-Shaped Sediment Trap	UST-01

MATERIALS

FABRIC: POLYPROPYLENE, POLYAMIDE, NYLON, POLYESTER, OR POLYETHYLENE WOVEN OR NON-WOVEN FABRIC, AT LEAST 700mm IN WIDTH AND A MINIMUM UNIT WEIGHT OF 140g/m². ALL FABRICS TO CONTAIN ULTRAVIOLET INHIBITORS AND STABILISERS TO PROVIDE A MINIMUM OF 6 MONTHS OF USEABLE CONSTRUCTION LIFE (ULTRAVIOLET STABILITY EXCEEDING 70%).

FABRIC REINFORCEMENT: (IF USED) WIRE OR STEEL MESH MINIMUM 14-GAUGE WITH A MAXIMUM MESH SPACING OF 200mm.

SUPPORT POSTS/STAKES: 1500mm² (MIN) HARDWOOD, 2500mm² (MIN) SOFTWOOD, OR 1.5kg/m (MIN) STEEL STAR PICKETS SUITABLE FOR ATTACHING FABRIC.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND REQUIRED TYPE OF FABRIC (IF SPECIFIED). IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, FABRIC TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. INSTALL THE FABRIC IN A U-SHAPE, EXTENDING THE WING WALLS EITHER UP THE SIDE SLOPES AND/OR UP THE CHANNEL INVERT (AS DIRECTED) TO A POINT WHERE THE GROUND LEVEL IS AT LEAST 100mm HIGHER THAN THE CREST OF THE SPILL-THROUGH WEIR.

3. ENSURE THAT THE EXPECTED CHANNEL FLOW WILL ENTER THE SEDIMENT TRAP, EITHER BY EXTENDING THE WING WALLS UP THE BANK SLOPE, OR CONSTRUCTING SANDBAG FLOW DIVERSION BANKS.

4. UNLESS DIRECTED BY THE SITE SUPERVISOR, EXCAVATE A 200mm WIDE BY 200mm DEEP TRENCH ALONG THE ALIGNMENT OF THE SPILL-THROUGH WEIR AND WING WALLS.

5. ALONG THE LOWER SIDE OF THE TRENCH, APPROPRIATELY SECURE THE STAKES INTO THE GROUND SPACED NO GREATER THAN 1m.

6. CONSTRUCT THE SEDIMENT TRAP FROM A CONTINUOUS ROLL OF FABRIC.

7. SECURELY ATTACH THE FABRIC TO THE SUPPORT POSTS/STAKES USING 25mm STAPLES OR TIE WIRE AT MAXIMUM 150mm SPACING WITH THE FABRIC EXTENDED AT LEAST 200mm INTO THE TRENCH.

8. INSTALL A SPILL-THOUGH WEIR AT THE LOWEST POINT IN THE FENCE. THE WEIR MUST BE AT LEAST 300mm ABOVE ADJACENT GROUND LEVEL, AND BELOW THE LOWEST GROUND LEVEL AT THE ENDS OF THE WING WALLS.

9. SECURELY TIE A HORIZONTAL CROSS MEMBER (WEIR) TO THE ADJACENT SUPPORT POSTS. CUT THE FABRIC DOWN THE SIDE OF THE POSTS AND FOLD THE FABRIC OVER THE CROSS MEMBER AND APPROPRIATELY SECURE THE FABRIC.

10. IF DIRECTED, INSTALL A SUITABLE SPLASH PAD IMMEDIATELY DOWN-SLOPE OF THE SPILL-THROUGH WEIR TO CONTROL SOIL EROSION DOWNSTREAM OF THE SEDIMENT TRAP.

11. BACKFILL THE TRENCH AND TAMP THE FILL TO FIRMLY ANCHOR THE BOTTOM OF THE FABRIC AND MESH TO PREVENT WATER FROM FLOWING UNDER THE FENCE.

MAINTENANCE

1. INSPECT THE SEDIMENT TRAP AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR ANY TORN SECTIONS WITH A CONTINUOUS PIECE OF FABRIC FROM POST TO POST.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.
4. IF THE FABRIC IS SAGGING BETWEEN STAKES, INSTALL ADDITIONAL SUPPORT POSTS/STAKES.

5. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 150mm.

6. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

7. REPLACE THE FABRIC IF THE SERVICE LIFE OF THE EXISTING FABRIC EXCEEDS SIX MONTHS.

REMOVAL

1. WHEN DISTURBED AREAS UP-SLOPE OF THE SEDIMENT TRAP ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE SEDIMENT TRAP MUST BE REMOVED.

2. REMOVE MATERIALS AND COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REHABILITATE/REVEGETATE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.

Catchments & Creeks Pty Ltd

Drawn:	Date:		
GMW	Apr-10	U-Shaped Sediment Trap	UST-02

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	07/02/19	A.J.T.	A.T.	A.M.	FINAL – ISSUE FOR APPROVAL
B	29/01/19	A.J.T.	A.T.	A.M.	FINAL DRAFT – ISSUE FOR REVIEW
A	19/11/18	A.J.T.	L.O.	A.M.	DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	N.A.

FINAL

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PROJECT TITLE

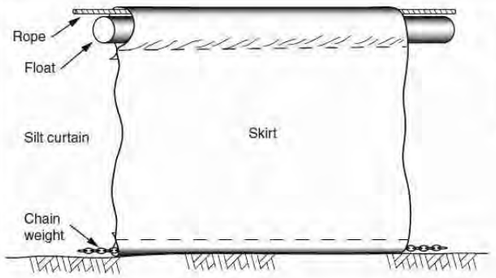
NOWRA BRIDGE PROJECT

DRAWING TITLE

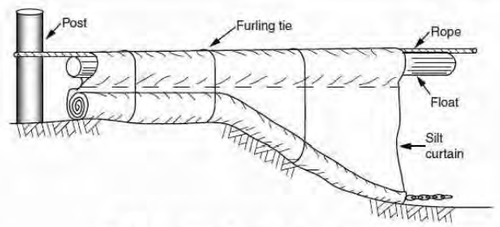
CONCEPT ESCP
IECA STANDARD DRAWINGS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP005	00

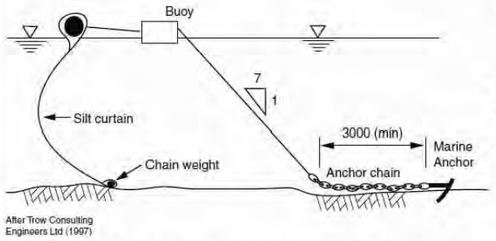
Plot Date: Thursday, February 7, 2019 8:49:56 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP000_REV 00.dwg



(a) Components of a floating silt curtain

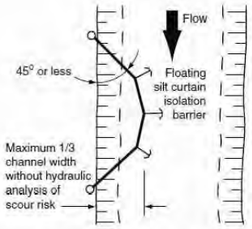


(b) Typical land anchorage system

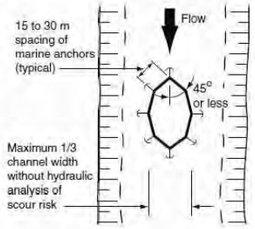


After Trow Consulting Engineers Ltd (1997)

(c) Typical marine anchorage system



(d) Typical installation of floating silt curtain



(e) Typical installation of floating silt curtain

Catchments & Creeks Pty Ltd

Drawn:	Date:		
GMW	Feb-10	Floating Silt Curtain	FSC-01

MATERIALS

SILT CURTAIN FABRIC: MANUFACTURED FROM A WOVEN GEOTEXTILE, CANVAS/TARP MATERIAL, OR A COMMERCIALLY AVAILABLE SILT CURTAIN SUCH AS NYLON REINFORCED POLYVINYL CHLORIDE (PVC) OR EQUIVALENT.

BALLAST CHAIN: 10 TO 13mm GALVANISED CHAIN WITH MINIMUM 1.9 TO 3.3kg/m WEIGHT.

LAND ANCHOR: MINIMUM 100mm DIAMETER TIMBER POST (OR EQUIVALENT).

MARINE ANCHOR: MINIMUM 5kg LIGHTWEIGHT (DANFORTH) TYPE ANCHOR WITH 10 TO 13mm NYLON TIE ROPE AND MINIMUM 3m LENGTH OF 8mm GALVANISED CONNECTING CHAIN.

INSTALLATION

1. PRIOR TO COMMENCING ANY WORKS, OBTAIN ALL NECESSARY APPROVALS AND PERMITS REQUIRED TO CONDUCT THE NECESSARY WORKS INCLUDING PERMITS FOR THE DISTURBANCE OF RIPARIAN AND AQUATIC VEGETATION, AND THE CONSTRUCTION OF ALL PERMANENT OR TEMPORARY INSTREAM BARRIERS AND INSTREAM SEDIMENT CONTROL MEASURES.

2. PRIOR TO THE INSTALLATION, CHECK WEATHER REPORTS FOR A SUITABLE WINDLESS, CALM DAY. DO NOT PROCEED WITH THE INSTALLATION UNLESS SAFE TO DO SO.

3. REFER TO APPROVED PLANS FOR LOCATION AND DIMENSIONAL DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, DIMENSIONS OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

4. CLEAR THE IMMEDIATE LAUNCHING AREA OF ROCK AND DEBRIS. AVOID DISTURBING GROUNDCOVER VEGETATION.

5. LAYOUT A PLASTIC LAUNCHING PAD (SPILLWAY) AT RIGHT ANGLES TO THE WATERCOURSE BANK AND PEG OR ANCHOR IT DOWN. THIS IS TO PROTECT THE CURTAIN AND REDUCE FRICTION WHEN LAUNCHING.

6. UNFOLD THE CURTAIN IN AN OPEN AREA PRIOR TO ITS INSTALLATION. ENSURE THE BARRIER IS FABRICATED WITH SUFFICIENT DIMENSIONS TO BE IN GOOD CONTACT WITH THE BOTTOM OF THE CHANNEL. THE DEPTH OF THE BARRIER SHOULD BE APPROXIMATELY 10% GREATER THAN THE WATER DEPTH TO ENSURE IT RESTS ON THE BED.

7. IDEALLY, THE LENGTH OF THE BARRIER IS 10 TO 20% LONGER THAN THE MEASURED LENGTH OF THE PROPOSED ENCLOSURE.

8. UNFOLD THE FIRST CURTAIN PANEL ON THE SLIPWAY.

9. INSERT THE FLOATS BOTH ENDS FOR EASE OF INSTALLATION.

10. PULL THROUGH THE STEEL CHAIN IN THE BOTTOM SLEEVE USING THE DRAW CORD.

11. PULL THROUGH THE ROPE USING THE DRAW CORD.

12. PRIOR TO DEPLOYING THE BARRIER, GATHER UP THE CURTAIN AND TIE THE CURTAIN WITH LIGHTWEIGHT STRAPS OR ROPE EVERY 1 TO 1.5m. THE AIM OF THIS IS TO ENABLE THE CURTAIN TO BE SET IN PLACE IN THE WATER EASILY WITHOUT THE CURTAIN BEING DRAGGED ALONG THE CHANNEL BED.

13. SET THE UPSTREAM BANK ANCHOR POINT AND TIE OFF ONE END OF THE BARRIER, ENSURING NO WATER WILL BE ABLE TO FLOW INTO THE UPSTREAM END.

14. DEPLOY THE BARRIER FROM THE END OF A BOAT. FASTEN THE FREE END OF THE BARRIER TO THE DOWNSTREAM ANCHOR POINT, THEN ANCHOR THE BARRIER AT INTERMEDIATE POINTS.

15. TAPER THE ENDS OF THE BARRIER TO THE SHAPE OF THE SHORELINE, OTHERWISE TIE THE ENDS OF THE BARRIER WITH FURLING STRAPS SO THE DEPTH OF THE BARRIER CAN BE ADJUSTED TO THE SHAPE OF THE BANK.

16. AFTER THE BARRIER HAS BEEN ANCHORED, CHECK TO SEE THAT THE SKIRT IS NOT TWISTED AROUND THE FLOTATION UNITS. WHEN THE BARRIER IS PROPERLY DEPLOYED, CUT THE TIE ROPES AND LET THE BALLAST WEIGHTS SINK TO THE BED.

17. ENSURE THE SKIRT (AT MAXIMUM WATER LEVEL) IS FREE OF LARGE PLEATS THAT MAY COLLECT SEDIMENT CAUSING THE BARRIER TO BE PULLED UNDER THE WATER SURFACE.

MAINTENANCE

1. INSPECT THE SILT CURTAIN DAILY FOR DAMAGE.

2. ENSURE THE TOP OF THE BARRIER REMAINS ABOVE THE WATER SURFACE, AND THE CURTAIN IS FREE OF TEARS OR GAPS.

3. ENSURE THE BARRIER REMAINS IN THE SPECIFIED LOCATION.

4. CHECK FOR TURBIDITY LEAKS.

5. CHECK ALL ANCHOR POINTS.

6. REPAIR OR REPLACE ANY TORN SEGMENTS.

7. CHECK FOR SEDIMENT BUILD-UP ON THE BOTTOM OF THE SKIRT THAT MAY BEGIN TO PULL THE CURTAIN UNDER THE WATER.

8. DISPOSE OF ANY EXCESSIVE SEDIMENT OR DEBRIS DEPOSITS IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

9. REPAIR ANY PLACES IN THE ISOLATION BARRIER THAT HAVE WEAKENED OR THAT HAVE BEEN SUBJECTED TO DAMAGE FROM INFLOWS OR OVERTOPPING WATER.

REMOVAL

1. THE SILT CURTAIN SHOULD BE REMOVED AS SOON AS POSSIBLE AFTER IT IS NO LONGER NEEDED.

2. IF EXCESSIVE SEDIMENT OR DEBRIS HAS COLLECTED AROUND THE BARRIER, THEN REMOVE SUCH MATERIAL BEFORE THE BARRIER IS REMOVED AND DISPOSE OF SUCH MATERIAL PROPERLY.

3. ENSURE THE CHANNEL WATER CONTAINED WITHIN THE ENCLOSURE HAS ACHIEVED A SUITABLE WATER QUALITY BEFORE REMOVING THE SILT CURTAIN.

4. ENSURE THE RELEASE OF SEDIMENT AND THE DAMAGE TO THE CHANNEL'S BED AND BANKS IS MINIMISED DURING REMOVAL OF THE SILT CURTAIN.

5. IF IT IS NOT FEASIBLE TO WAIT FOR ADEQUATE SETTLEMENT OF SUSPENDED SEDIMENTS, THEN WHERE PRACTICABLE, PUMP THE SEDIMENT-LADEN WATER TO AN OFF-STREAM DE-WATERING SEDIMENT CONTROL SYSTEM FOR TREATMENT. THIS TREATMENT AREA SHOULD IDEALLY BE LOCATED AT LEAST 50m FROM THE CHANNEL.

6. REMOVE ALL CONSTRUCTION MATERIALS, EXCESSIVE SEDIMENT DEPOSITS AND DEBRIS AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

7. RESTORE THE WATERCOURSE CHANNEL TO ITS ORIGINAL CROSS-SECTION, AND SMOOTH AND APPROPRIATELY STABILISE AND/OR REVEGETATE ALL DISTURBED AREAS.

Catchments & Creeks Pty Ltd

Drawn:	Date:		
GMW	Feb-10	Floating Silt Curtain	FSC-02

MATERIALS

SILT CURTAIN FABRIC: MANUFACTURED FROM A WOVEN GEOTEXTILE, CANVAS/TARP MATERIAL, OR A COMMERCIALLY AVAILABLE SILT CURTAIN SUCH AS NYLON REINFORCED POLYVINYL CHLORIDE (PVC) OR EQUIVALENT.

BALLAST CHAIN: 10 TO 13mm GALVANISED CHAIN WITH MINIMUM 1.9 TO 3.3kg/m WEIGHT.

LAND ANCHOR: MINIMUM 100mm DIAMETER TIMBER POST (OR EQUIVALENT).

MARINE ANCHOR: MINIMUM 5kg LIGHTWEIGHT (DANFORTH) TYPE ANCHOR WITH 10 TO 13mm NYLON TIE ROPE AND MINIMUM 3m LENGTH OF 8mm GALVANISED CONNECTING CHAIN.

ALTERNATIVE LAND-BASED INSTALLATION PROCEDURE

1. UNFOLD THE FIRST CURTAIN PANEL ON THE SLIPWAY.

2. INSERT THE FLOATS BOTH ENDS FOR EASE OF INSTALLATION.

3. PULL THROUGH THE STEEL CHAIN IN THE BOTTOM SLEEVE USING THE DRAW CORD.

4. PULL THROUGH THE ROPE USING THE DRAW CORD.

5. PRIOR TO DEPLOYING THE BARRIER, GATHER UP THE CURTAIN AND TIE THE CURTAIN WITH LIGHTWEIGHT STRAPS OR ROPE EVERY 1 TO 1.5m. THE AIM OF THIS IS TO ENABLE THE CURTAIN TO BE SET IN PLACE IN THE WATER EASILY WITHOUT THE WEIGHTS BEING DRAGGED ALONG THE BOTTOM.

6. SET THE UPSTREAM BANK ANCHOR POINT AND TIE OFF ONE END OF THE BARRIER, ENSURING NO WATER WILL BE ABLE TO FLOW INTO THE UPSTREAM END.

7. INSTALL AN EXTRA LENGTH OF ROPE OR CABLE IN THE FINAL CURTAIN POSITION IN THE WATER.

8. TIE THE END OF THE CURTAIN ROPE TO THE EXTRA LENGTH ALREADY IN POSITION AND PULL THE CURTAIN INTO THE WATER STOPPING WHEN THE END OF THE FIRST SECTION OF CURTAIN IS STILL ON THE BANK.

9. UNFOLD THE SECOND SECTION OF CURTAIN ON THE SLIPWAY MAKING SURE THE CURTAIN IS CORRECTLY ORIENTATED WITH THE FIRST SECTION OF CURTAIN

10. INSERT THE FLOATS, CHAIN AND ROPE AS BEFORE.

11. USING THE DRAW CORD FROM THE FIRST SECTION, TIE UP THE ENDS USING THE EYELETS ALREADY IN THE CURTAIN.

12. GATHER UP THE CURTAIN AND TIE TOGETHER WITH TWINE OR THIN ROPE.

13. LAUNCH AS BEFORE.

14. CONTINUE UNTIL THE ENTIRE CURTAIN IS INSTALLED.

15. ANCHOR WELL TO SHORE ANCHORS.

16. USING A SUITABLE BOAT, MOVE ALONG THE CURTAIN AND CUT THE TIES HOLDING THE CHAIN AND CURTAIN AND ALLOW THE WEIGHTED END TO SINK.

17. ENSURE THE SKIRT (AT MAXIMUM WATER LEVEL) IS FREE OF LARGE PLEATS THAT MAY COLLECT SEDIMENT CAUSING THE BARRIER TO BE PULLED UNDER THE WATER SURFACE.

MAINTENANCE

1. INSPECT THE SILT CURTAIN DAILY FOR DAMAGE.

2. ENSURE THE TOP OF THE BARRIER REMAINS ABOVE THE WATER SURFACE, AND THE CURTAIN IS FREE OF TEARS OR GAPS.

3. ENSURE THE BARRIER REMAINS IN THE SPECIFIED LOCATION.

4. CHECK FOR TURBIDITY LEAKS.

5. CHECK ALL ANCHOR POINTS.

6. REPAIR OR REPLACE ANY TORN SEGMENTS.

7. CHECK FOR SEDIMENT BUILD-UP ON THE BOTTOM OF THE SKIRT THAT MAY BEGIN TO PULL THE CURTAIN UNDER THE WATER.

8. DISPOSE OF ANY EXCESSIVE SEDIMENT OR DEBRIS DEPOSITS IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

9. REPAIR ANY PLACES IN THE ISOLATION BARRIER THAT HAVE WEAKENED OR THAT HAVE BEEN SUBJECTED TO DAMAGE FROM INFLOWS OR OVERTOPPING WATER.

REMOVAL

1. THE SILT CURTAIN SHOULD BE REMOVED AS SOON AS POSSIBLE AFTER IT IS NO LONGER NEEDED.

2. IF EXCESSIVE SEDIMENT OR DEBRIS HAS COLLECTED AROUND THE BARRIER, THEN REMOVE SUCH MATERIAL BEFORE THE BARRIER IS REMOVED AND DISPOSE OF SUCH MATERIAL PROPERLY.

3. ENSURE THE CHANNEL WATER CONTAINED WITHIN THE ENCLOSURE HAS ACHIEVED A SUITABLE WATER QUALITY BEFORE REMOVING THE SILT CURTAIN.

4. ENSURE THE RELEASE OF SEDIMENT AND THE DAMAGE TO THE CHANNEL'S BED AND BANKS IS MINIMISED DURING REMOVAL OF THE SILT CURTAIN.

5. IF IT IS NOT FEASIBLE TO WAIT FOR ADEQUATE SETTLEMENT OF SUSPENDED SEDIMENTS, THEN WHERE PRACTICABLE, PUMP THE SEDIMENT-LADEN WATER TO AN OFF-STREAM DE-WATERING SEDIMENT CONTROL SYSTEM FOR TREATMENT. THIS TREATMENT AREA SHOULD IDEALLY BE LOCATED AT LEAST 50m FROM THE CHANNEL.

6. REMOVE ALL CONSTRUCTION MATERIALS, EXCESSIVE SEDIMENT DEPOSITS AND DEBRIS AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

7. RESTORE THE WATERCOURSE CHANNEL TO ITS ORIGINAL CROSS-SECTION, AND SMOOTH AND APPROPRIATELY STABILISE AND/OR REVEGETATE ALL DISTURBED AREAS.

Catchments & Creeks Pty Ltd

Drawn:	Date:		
GMW	Feb-10	Floating Silt Curtain (alt)	FSC-03

MATERIALS

(i) MULCH MUST COMPLY WITH THE REQUIREMENTS OF AS4454.

(ii) MAXIMUM SOLUBLE SALT CONCENTRATION OF 5dS/m.

(iii) MOISTURE CONTENT OF 30 TO 50% PRIOR TO APPLICATION.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND EXTENT. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, MATERIAL TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. WHEN SELECTING THE LOCATION OF A MULCH FILTER BERM, TO THE MAXIMUM DEGREE PRACTICAL, ENSURE THE BERM IS LOCATED:

(i) TOTALLY WITHIN THE PROPERTY BOUNDARIES;

(ii) ALONG A LINE OF CONSTANT ELEVATION (PREFERRED, BUT NOT ALWAYS PRACTICAL);

(iii) AT LEAST 1m, IDEALLY 3m, FROM THE TOE OF A FILL EMBANKMENT;

(iv) AWAY FROM AREAS OF CONCENTRATED FLOW.

3. ENSURE THE BERM IS INSTALLED IN A MANNER THAT AVOIDS THE CONCENTRATION OF FLOW ALONG THE BERM, OR THE UNDESIRABLE DISCHARGE OF WATER AROUND THE END OF THE BERM.

4. ENSURE THE BERM HAS BEEN PLACED SUCH THAT PONDING UP-SLOPE OF THE BERM IS MAXIMISED.

5. ENSURE BOTH ENDS OF THE BERM ARE ADEQUATELY TURNED UP THE SLOPE TO PREVENT FLOW BYPASSING PRIOR TO WATER PASSING OVER THE BERM.

6. ENSURE 100% CONTACT WITH THE SOIL SURFACE.

7. WHERE SPECIFIED, TAKE APPROPRIATE STEPS TO VEGETATE THE BERM.

MAINTENANCE

1. DURING THE CONSTRUCTION PERIOD, INSPECT ALL BERMS AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR OR REPLACE ANY DAMAGED SECTIONS.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.

4. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 100mm OR 1/3 THE HEIGHT OF THE BERM.

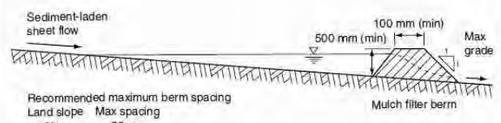
5. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

REMOVAL (IF REQUIRED)

1. WHEN DISTURBED AREAS UP-SLOPE OF THE BERM ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE BERM MAYBE REMOVED.

2. REMOVE ANY COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REHABILITATE/REVEGETATE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.



Recommended maximum berm spacing

Land slope	Max spacing
< 2%	30 m
5%	25 m
10%	15 m
20%	8 m

Figure 1 - Typical placement of mulch filter berm

Catchments & Creeks Pty Ltd

Drawn:	Date:		
GMW	Apr-10	Mulch Filter Berms	MB-01

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	07/02/19	A.J.T.	A.T.	A.M.	FINAL – ISSUE FOR APPROVAL
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FINAL	

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PROJECT TITLE

NOWRA BRIDGE PROJECT

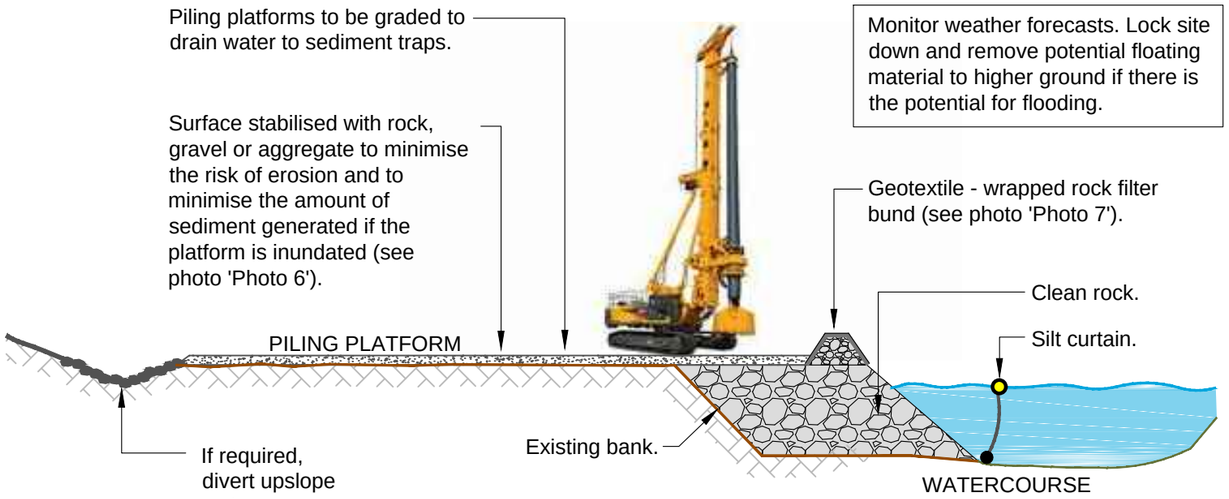
DRAWING TITLE

CONCEPT ESCP
IECA STANDARD DRAWINGS

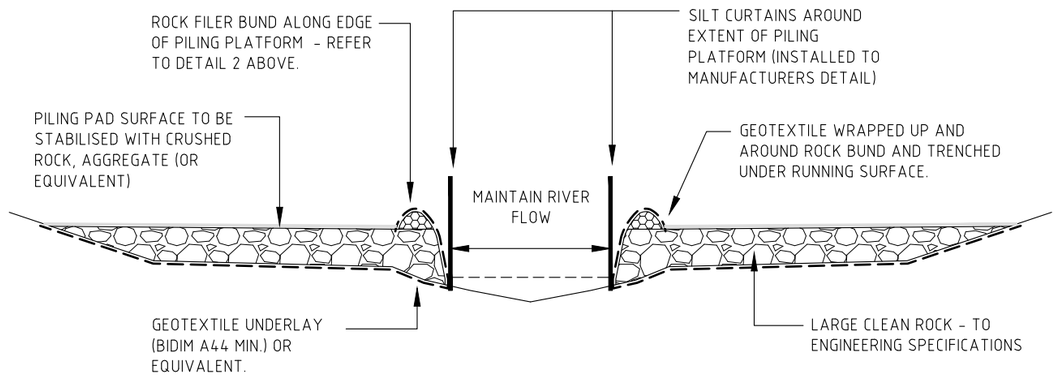
PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP006	00

Plot Date: Thursday, February 7, 2019 8:50:01 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP000_REV 00.dwg

PILING PLATFORM IN/NEAR WATERCOURSE - TYPICAL DETAIL



PILING PAD CONSTRUCTION WORKS TO BE CARRIED OUT IN A FORECAST PERIOD OF NO RAINFALL AND LOW FLOW. ENSURE ALL EXPOSED SOIL SURFACES WITHIN 20m OF THE TOP BANK OF WATERWAY ARE STABILISED/COVERED PRIOR TO RAINFALL AND SITE CLOSURE EACH DAY. USE GEOTEXTILE, ROCK, AGGREGATE OR EQUIVALENT TO ACHIEVE THIS.



PILING PAD CONTROL MEASURES

PHOTO 6 - EXAMPLE OF A PILING PLATFORM STABILISED SURFACE

PHOTO 7 - EXAMPLE OF A PILING PLATFORM WITH ROCK FILTER BUND

NOT FOR

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	07/02/19	A.J.T.	A.T.	A.M.	FINAL – ISSUE FOR APPROVAL
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DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	N.A.

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PROJECT TITLE

NOWRA BRIDGE PROJECT

DRAWING TITLE

CONCEPT ESCP
TYPICAL DETAILS
AND PHOTO EXAMPLES

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP007	00

Plot Date: Thursday, February 7, 2019 8:50:07 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP000_REV 00.dwg

REFER TO THE PRIMARY ESCP (18000363_P01_ESCP000-007) FOR ALL STANDARD REQUIREMENTS, INSTRUCTIONS, PHOTO EXAMPLES, STANDARD DRAWINGS AND DETAILS.

FLOOD PRONE LANDS - ALL EXPOSED SURFACES NORTH OF BOMADERRY CREEK TO BE TEMPORARILY STABILISED PRIOR TO POTENTIAL FLOOD EVENTS WITH A BIODEGRADABLE SOIL POLYMER OR SIMILAR.

THIS AREA IS FLOOD PRONE - BASIN WALLS TO BE BUILT UP SO THE INLET AND OUTLET POINTS ARE ABOVE THE 2YR ARI FLOOD LEVEL. HOWEVER, ENSURE DRAINAGE INTO THE BASIN IS STILL POSSIBLE.
ALSO IF HIGH GROUND WATER OR ACID SULPHATE SOILS ARE PRESENT, THE BASIN MAY NEED TO BE FORMED AS A SHALLOW LINEAR TYPE DEVICE TO MINIMISE EXCAVATION.
IF BASIN CONSTRUCTION CANNOT BE ACHIEVED DUE TO THE ABOVE CONSTRAINTS, ENHANCED EROSION CONTROLS (I.E. TEMPORARY STABILISATION PRIOR TO RAINFALL, INCREASED SLOPE BREAKS, CHECK DAMS AND TIMING OF WORKS TO LOW EROSION HAZARD PERIODS OR ALTERNATIVES AS DETERMINED BY A SOIL CONSERVATIONIST) WILL BE REQUIRED FOR THE DISTURBED BASIN CATCHMENT AND ALTERNATIVE SEDIMENT TRAP TYPE DEVICE/S PROVIDED.

REFER TO ESCP202 FOR ANCILLARY AREA CONTROLS.

LOCATION IS APPROXIMATE. BASIN TO BE LOCATED TO SUIT LEVELS AND CONSTRUCTION CONSTRAINTS.

SB76900E -SIZING
SEDIMENT STORAGE VOLUME = 128m³
SETTLING (WATER) VOLUME = 247m³
TOTAL BASIN VOLUME = 375m³

DURING STAGE 1, OFFSITE CLEAN WATER FLOWS FROM EXISTING PAVEMENTS AND SURROUNDING LANDS TO BE MAINTAINED WITHIN THE EXISTING DRAINAGE SYSTEM AND DIVERTED AROUND THE WORKS.
IF THIS CANNOT BE ACHIEVED, TEMPORARY DIVERSION DRAINS OR PIPES TO BE PROVIDED TO CARRY OFFSITE FLOWS OR SEDIMENT CONTROLS MODIFIED ACCORDINGLY TO TAKE ADDITIONAL FLOWS.

FOR PAVEMENT WORKS ON EXISTING ROAD AREAS:
- UNDERTAKE WORKS PROGRESSIVELY IN SECTIONS AS MUCH AS POSSIBLE AND COMPLETE WORKS AS QUICKLY AS POSSIBLE.
- INSTALL SLOPE BREAKS AT REGULAR INTERVALS ACROSS EXPOSED SURFACES PRIOR TO RAINFALL.
- DIRECT FLOWS TO OFFLINE SEDIMENT CONTROL DEVICES WHERE POSSIBLE OR PROVIDE ADDITIONAL ONLINE SEDIMENT TRAPS/SUMPS.

DURING CONSTRUCTION, EXPOSED BATTERS ARE TO BE TEMPORARILY GROUND-COVERED PRIOR TO FORECAST RAINFALL OF >50% CHANCE OF 10mm OR MORE IN 24 HOURS, HIGH WINDS AND SITE SHUTDOWN WITH A BIODEGRADABLE SOIL BINDER, FABRIC OR SIMILAR AND PROGRESSIVELY STABILISED AS WORKS ARE COMPLETE IN EACH AREA.

THIS AREA IS FLOOD PRONE - BASIN WALLS TO BE BUILT UP SO THE INLET AND OUTLET POINTS ARE ABOVE THE 2YR ARI FLOOD LEVEL. HOWEVER, ENSURE DRAINAGE INTO THE BASIN IS STILL POSSIBLE.
ALSO IF HIGH GROUND WATER OR ACID SULPHATE SOILS ARE PRESENT, THE BASIN MAY NEED TO BE FORMED AS A SHALLOW LINEAR TYPE DEVICE TO MINIMISE EXCAVATION.
IF BASIN CONSTRUCTION CANNOT BE ACHIEVED DUE TO THE ABOVE CONSTRAINTS, ENHANCED EROSION CONTROLS WILL BE REQUIRED FOR THE DISTURBED BASIN CATCHMENT AND ALTERNATIVE SEDIMENT TRAP TYPE DEVICE/S PROVIDED.

REFER TO ESCP201 FOR ANCILLARY AREA CONTROLS.

BASIN LOCATION IS APPROXIMATE. TO BE LOCATED TO MINIMISE VEGETATION DISTURBANCE AND TO SUIT LEVELS AND CONSTRUCTION CONSTRAINTS.

SB76900W -SIZING
SEDIMENT STORAGE VOLUME = 166m³
SETTLING (WATER) VOLUME = 321m³
TOTAL BASIN VOLUME = 487m³

NOT FOR CONSTRUCTION

LEGEND

- OFFSITE (CLEAN) WATER DIVERSION DRAIN/BUND [1]
- ONSITE (DIRTY) WATER DIVERSION DRAIN/BUND [1]
- SEDIMENT FENCE (OR SIMILAR) [1]
- SEDIMENT TRAP (E.G. SUMP, ROCK FILTER DAM, U-TRAP, INFILTRATION SWALE TRAPS OR SIMILAR,) [1]
- SEDIMENT BASIN [1]
- CLEAN FLOW DIRECTION
- DIRTY FLOW DIRECTION
- ENERGY DISSIPATER / SPILLWAY [1] [2]
- TEMPORARY WATER CROSSING (SD 5-1)
- BUND / BERM [1]
- CHECK DAM (SD 5-4)
- STABILISED PILING PLATFORM [1] [3]
- SILT CURTAIN [4]
- STABILISED SITE ACCESS (SD 6-14) OR RUMBLE GRID (LOCATIONS ARE INDICATIVE AND ARE TO BE LOCATED TO SUIT CONSTRUCTION AND SAFETY AND TO MINIMISE VEGETATION DISTURBANCE)
- SLOPE BREAKS (BUNDS) [1]
- ANCILLARY AREA [5]
- CATCHMENTS WHERE ENHANCED EROSION CONTROLS/TEMPORARY STABILISATION APPLY [6]

PIT PROTECTION IS TO BE PROVIDED FOR ALL LIVE PITS WITHIN CONSTRUCTION AREAS WHERE ACTIVE WORKS ARE OCCURRING. ENSURE APPROPRIATE SAFETY PRECAUTIONS ARE IN PLACE FOR LIVE TRAFFIC TO MITIGATE POTENTIAL HAZARDS AND DRAINAGE IMPACTS FROM PIT PROTECTION DEVICES.

[1] DETAILS TO BE CONFIRMED PRIOR TO CONSTRUCTION.
[2] DISSIPATER TO EXTEND TO WATERWAY OR WELL VEGETATED LANDS - LINE WITH GEOFABRIC (BIDIM A34 OR EQUIVALENT) + ROCK Ø200MIN. OR ALTERNATIVELY CONCRETE LINE.
[3] PILING PLATFORM TO BE FORMED WITH LARGE CLEAN ROCK AS PER ENGINEERING REQUIREMENTS. CLEAN ROCK TO BE MAINTAINED ON THE SURFACE OR STABILISED WITH AGGREGATE (OR EQUIVALENT). ALSO REFER TO THE PILING PLATFORM DETAILS AND RECOMMENDATIONS ON ESCP007.
[4] SILT CURTAIN TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS. ALSO REFER TO IECA STANDARD DRAWING FSC -01-03.
[5] ANCILLARY AREA SURFACES TO BE MAINTAINED STABLE. PROVIDE GRAVEL, AGGREGATE, CRUSHED ROCK, DGB OR A HEAVY DUTY TRAFFICABLE SOIL STABILISER WHERE REQUIRED TO ENSURE THIS. STABILISATION IS CRITICAL IN FLOOD PRONE AREAS AND AREAS ADJACENT TO SHOALHAVEN RIVER AND BOMADERRY CREEK.
[6] THESE CATCHMENTS MUST BE SUBJECT TO ENHANCED EROSION CONTROL, MAINLY IN THE FORM OF TEMPORARY GROUND COVER OVER HIGH-RISK AREAS (I.E. STEEP (>20%) BATTERS, FLOOD PRONE LANDS AND CONCENTRATED FLOWPATHS) WHENEVER SIGNIFICANT RAINFALL IS IMMINENT.

SD - BLUE BOOK STANDARD DRAWING (LANDCOM, 2004)
IECA SD - IECA STANDARD DRAWING (IECA, 2008)
(REFER TO SEEC DRAWINGS 18000363_P01_ESCP000-007)

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	07/02/19	A.J.T.	A.T.	A.M.	FINAL - ISSUE FOR APPROVAL
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A	19/11/18	A.J.T.	L.O.	A.M.	DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

North

CLIENT: Roads & Maritime

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PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN SHEET 1 OF 8

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP101	00

Plot Date: Thursday, February 7, 2019 9:07:44 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP100_REV 00.dwg

REFER TO THE PRIMARY ESCP (18000363_P01_ESCP000-008) FOR ALL STANDARD REQUIREMENTS, INSTRUCTIONS, PHOTO EXAMPLES, STANDARD DRAWINGS AND DETAILS.

DURING CONSTRUCTION, EXPOSED BATTERS ARE TO BE TEMPORARILY GROUND-COVERED PRIOR TO FORECAST RAINFALL OF >50% CHANCE OF 10mm OR MORE IN 24 HOURS, HIGH WINDS AND SITE SHUTDOWN WITH A BIODEGRADABLE SOIL BINDER, FABRIC OR SIMILAR AND PROGRESSIVELY STABILISED AS WORKS ARE COMPLETE IN EACH AREA.

FOR PAVEMENT WORKS ON EXISTING ROAD AREAS:
- UNDERTAKE WORKS PROGRESSIVELY IN SECTIONS AS MUCH AS POSSIBLE AND COMPLETE WORKS AS QUICKLY AS POSSIBLE.
- INSTALL SLOPE BREAKS AT REGULAR INTERVALS ACROSS EXPOSED SURFACES PRIOR TO RAINFALL.
- DIRECT FLOWS TO OFFLINE SEDIMENT CONTROL DEVICES WHERE POSSIBLE OR PROVIDE ADDITIONAL ONLINE SEDIMENT TRAPS/SUMPS.

THERE IS TO BE NO DISTURBANCE TO THE CLIFF FACES HERE. ALL WORKS ARE TO REMAIN ON THE UPPER GROUND SURFACE AND MUST NOT ENCROACH INTO THE WATER.

BUNDING TO BE PROVIDED AROUND THE WORK EXTENT TO CONTAIN SITE WATER AND DIRECT IT INTO THE ONLINE SEDIMENT TRAP.

DURING ROCK SAWING OR BLASTING, DUST SUPPRESSION IS TO BE ACTIVELY UNDERTAKEN TO MINIMISE DUST GENERATION AND DUST DRIFT.

SEDIMENT BASINS ARE REQUIRED AT CH 77020 AND CH 77120 (I.E. FOR THE ILLAROO ROAD WORKS). HOWEVER, SPACE, CONSTRUCTION AND TOPOGRAPHICAL CONSTRAINTS WILL NOT ALLOW THIS. THEREFORE, ONLINE SEDIMENT TRAP/S IN CONJUNCTION WITH ENHANCED EROSION CONTROL (I.E. TEMPORARY STABILISATION PRIOR TO RAINFALL, INCREASED SLOPE BREAKS, CHECK DAMS AND TIMING OF WORKS TO LOW EROSION HAZARD PERIODS OR ALTERNATIVES AS DETERMINED BY A SOIL CONSERVATIONIST) WILL BE REQUIRED FOR THESE CATCHMENTS.

OFFSITE CLEAN WATER FLOWS FROM EXISTING PAVEMENTS AND SURROUNDING LANDS TO BE MAINTAINED WITHIN THE EXISTING ROAD DRAINAGE SYSTEM AND DIVERTED AROUND THE WORKS FOR AS LONG AS POSSIBLE.
IF THIS CANNOT BE ACHIEVED, TEMPORARY DIVERSION DRAINS OR PIPES TO BE PROVIDED TO CARRY OFFSITE FLOWS OR SEDIMENT CONTROLS MODIFIED ACCORDINGLY TO TAKE ADDITIONAL FLOWS.

NOT FOR CONSTRUCTION

LEGEND

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(REFER TO SEEC DRAWINGS 18000363_P01_ESCP000-007)

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
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A	19/11/18	A.J.T.	L.O.	A.M.	DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

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CLIENT: Roads & Maritime

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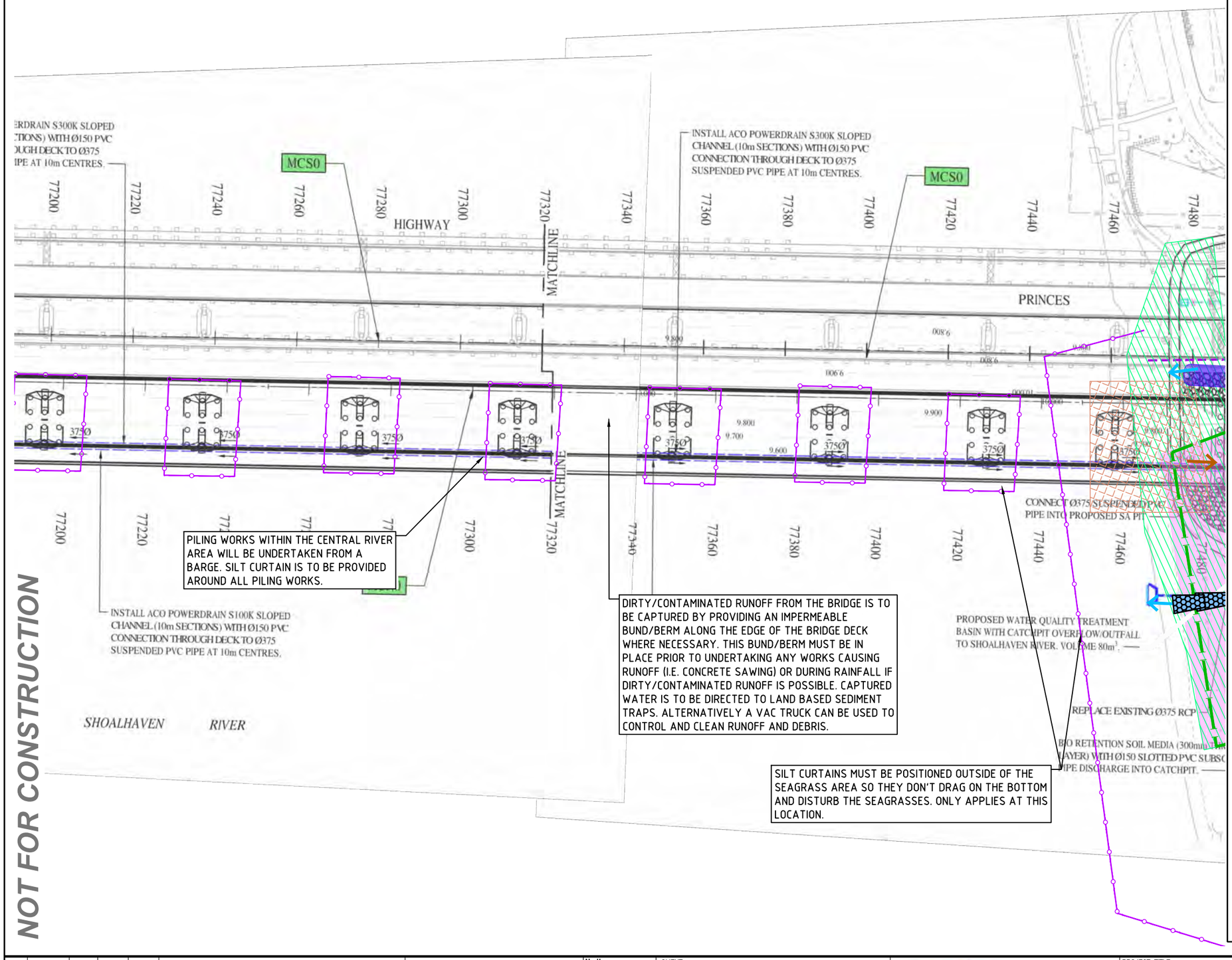
PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN SHEET 2 OF 8

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP102	00

Plot Date: Thursday, February 7, 2019 9:07:47 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP100_REV 00.dwg

REFER TO THE PRIMARY ESCP (18000363_P01_ESCP000-008) FOR ALL STANDARD REQUIREMENTS, INSTRUCTIONS, PHOTO EXAMPLES, STANDARD DRAWINGS AND DETAILS.



NOT FOR CONSTRUCTION

LEGEND

- OFFSITE (CLEAN) WATER DIVERSION DRAIN/BUND [1]
- ONSITE (DIRTY) WATER DIVERSION DRAIN/BUND [1]
- SEDIMENT FENCE (OR SIMILAR) [1]
- SEDIMENT TRAP (E.G. SUMP, ROCK FILTER DAM, U-TRAP, INFILTRATION SWALE TRAPS OR SIMILAR,) [1]
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PIT PROTECTION IS TO BE PROVIDED FOR ALL LIVE PITS WITHIN CONSTRUCTION AREAS WHERE ACTIVE WORKS ARE OCCURRING. ENSURE APPROPRIATE SAFETY PRECAUTIONS ARE IN PLACE FOR LIVE TRAFFIC TO MITIGATE POTENTIAL HAZARDS AND DRAINAGE IMPACTS FROM PIT PROTECTION DEVICES.

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DRAWING STATUS	
DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

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PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN SHEET 3 OF 8

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP103	00

ALL BATTERS AND SURFACES IMMEDIATELY ADJACENT TO THE RIVER THAT DO NOT DRAIN INTO THE SEDIMENT BASIN ARE TO BE MAINTAINED STABLE UNLESS ACTIVE WORKS ARE OCCURRING. USE GEOFABRIC, ROCK OR SIMILAR. ENSURE ALL EXPOSED SURFACES ARE COVERED PRIOR TO RAINFALL OF >50% CHANCE OF 10mm OR MORE IN 24 HOURS, HIGH WINDS OR SITE SHUTDOWN.

FOR PAVEMENT WORKS ON EXISTING ROAD AREAS:
- UNDERTAKE WORKS PROGRESSIVELY IN SECTIONS AS MUCH AS POSSIBLE AND COMPLETE WORKS AS QUICKLY AS POSSIBLE.
- INSTALL SLOPE BREAKS AT REGULAR INTERVALS ACROSS EXPOSED SURFACES PRIOR TO RAINFALL.
- DIRECT FLOWS TO OFFLINE SEDIMENT CONTROL DEVICES WHERE POSSIBLE OR PROVIDE ADDITIONAL ONLINE SEDIMENT TRAPS/SUMPS.

SB77500W -SIZING
SEDIMENT STORAGE VOLUME = 155m³
SETTLING (WATER) VOLUME = 346m³
TOTAL BASIN VOLUME = 501m³

LOCATION IS APPROXIMATE. BASIN TO BE LOCATED TO SUIT LEVELS AND CONSTRUCTION CONSTRAINTS.

REFER TO ESCP203 FOR ANCILLARY AREA CONTROLS.

REFER TO ESCP204 FOR ANCILLARY AREA CONTROLS.

OFFSITE CLEAN WATER FLOWS FROM EXISTING PAVEMENTS AND SURROUNDING LANDS TO BE MAINTAINED WITHIN THE EXISTING ROAD DRAINAGE SYSTEM AND DIVERTED AROUND THE WORKS FOR AS LONG AS POSSIBLE.
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DRAWN BY	L.O.
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PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN SHEET 4 OF 8

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP104	00

Plot Date: Thursday, February 7, 2019 9:07:57 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP100_REV 00.dwg

REFER TO THE PRIMARY ESCP (18000363_P01_ESCP000-008) FOR ALL STANDARD REQUIREMENTS, INSTRUCTIONS, PHOTO EXAMPLES, STANDARD DRAWINGS AND DETAILS.

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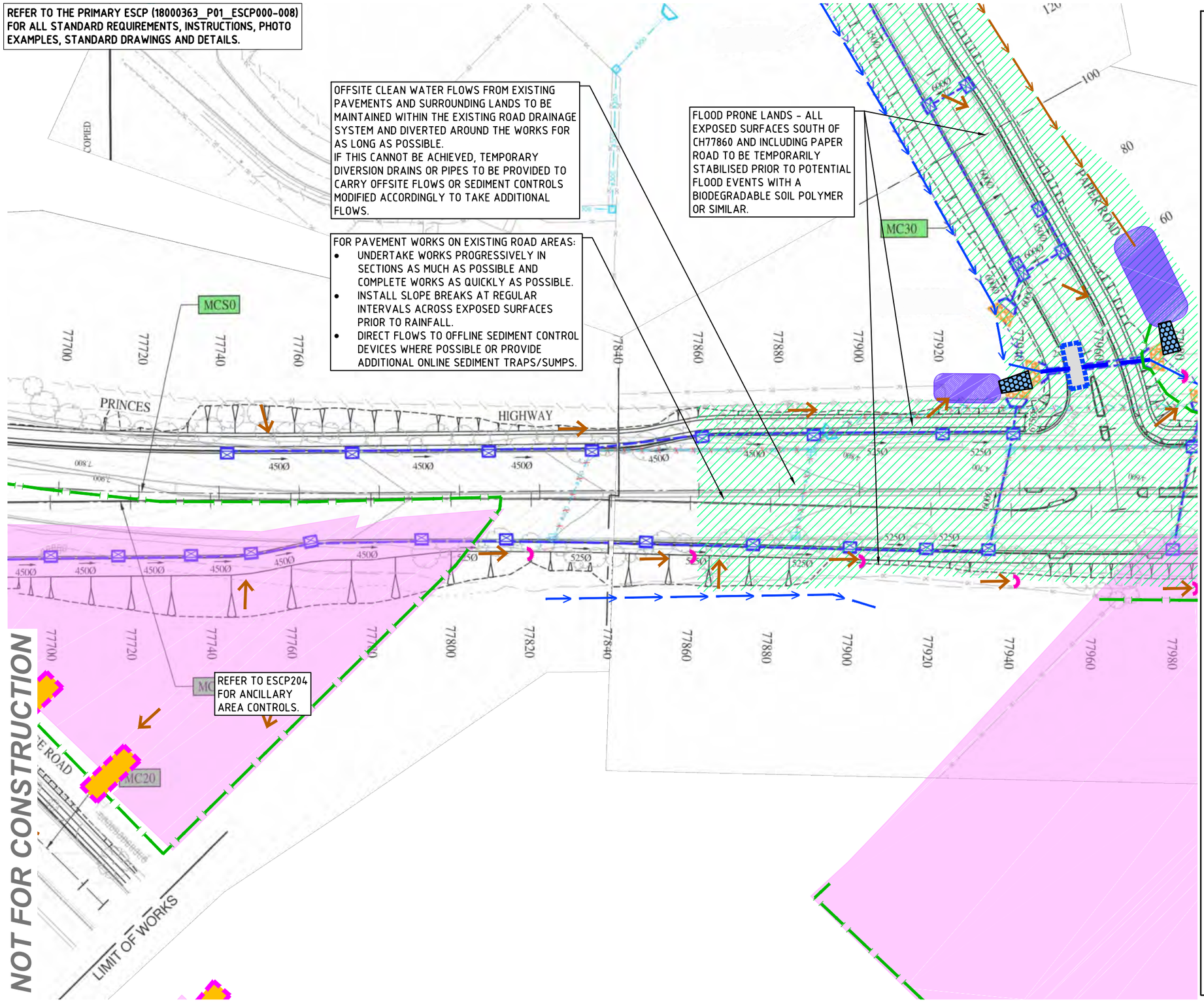
FLOOD PRONE LANDS - ALL EXPOSED SURFACES SOUTH OF CH77860 AND INCLUDING PAPER ROAD TO BE TEMPORARILY STABILISED PRIOR TO POTENTIAL FLOOD EVENTS WITH A BIODEGRADABLE SOIL POLYMER OR SIMILAR.



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[6] THESE CATCHMENTS MUST BE SUBJECT TO ENHANCED EROSION CONTROL, MAINLY IN THE FORM OF TEMPORARY GROUND COVER OVER HIGH-RISK AREAS (I.E. STEEP (>20%) BATTERS, FLOOD PRONE LANDS AND CONCENTRATED FLOWPATHS) WHENEVER SIGNIFICANT RAINFALL IS IMMINENT.

SD - BLUE BOOK STANDARD DRAWING (LANDCOM, 2004)
IECA SD - IECA STANDARD DRAWING (IECA, 2008)
(REFER TO SEEC DRAWINGS 18000363_P01_ESCP000-007)

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	07/02/19	A.J.T.	A.T.	A.M.	FINAL - ISSUE FOR APPROVAL
B	29/01/19	A.J.T.	A.T.	A.M.	FINAL DRAFT - ISSUE FOR REVIEW
A	19/11/18	A.J.T.	L.O.	A.M.	DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

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CLIENT: Roads & Maritime

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PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN SHEET 5 OF 8

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP105	00

Plot Date: Thursday, February 7, 2019 9:08:03 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP100_REV 00.dwg

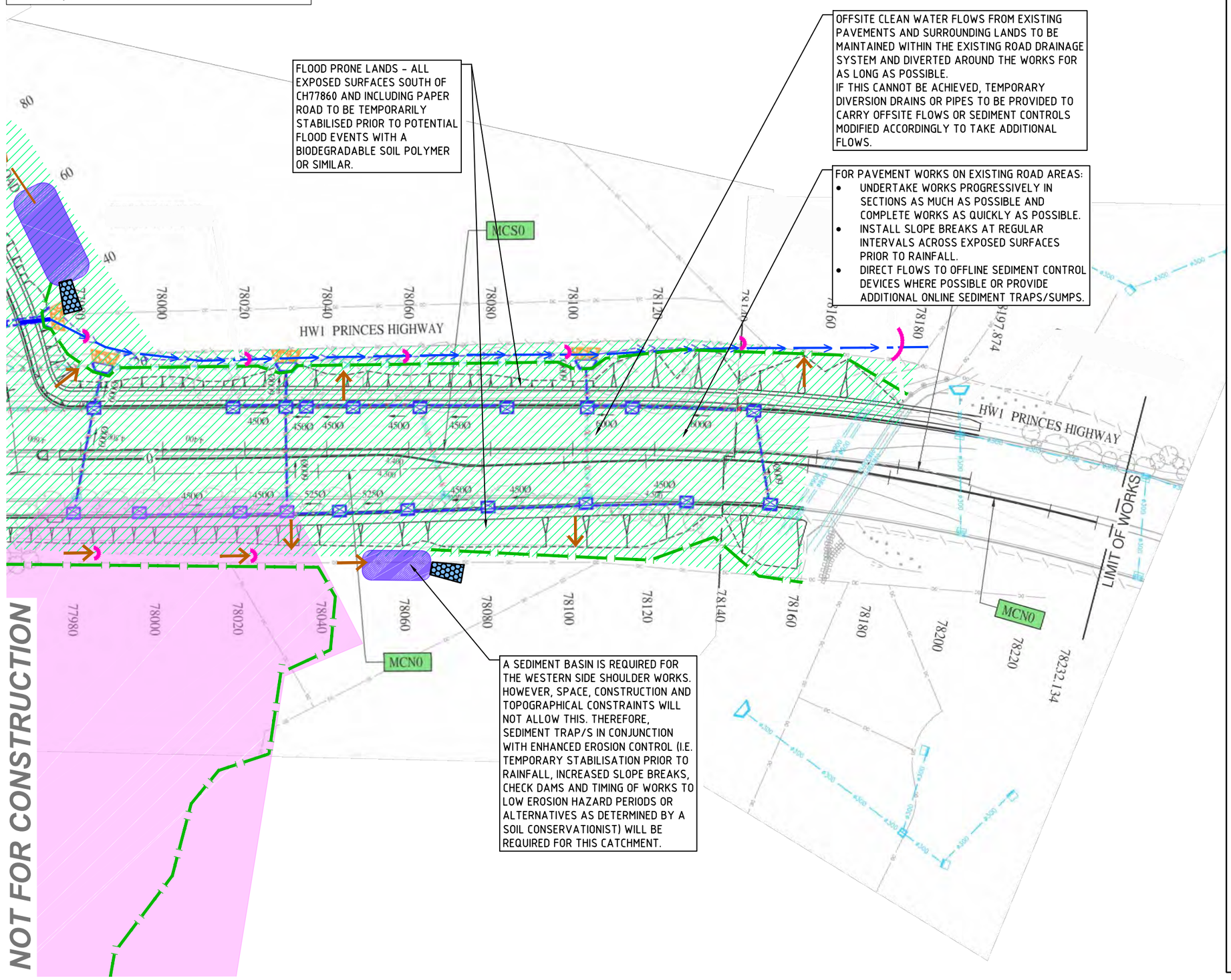
REFER TO THE PRIMARY ESCP (18000363_P01_ESCP000-008) FOR ALL STANDARD REQUIREMENTS, INSTRUCTIONS, PHOTO EXAMPLES, STANDARD DRAWINGS AND DETAILS.

FLOOD PRONE LANDS - ALL EXPOSED SURFACES SOUTH OF CH77860 AND INCLUDING PAPER ROAD TO BE TEMPORARILY STABILISED PRIOR TO POTENTIAL FLOOD EVENTS WITH A BIODEGRADABLE SOIL POLYMER OR SIMILAR.

OFFSITE CLEAN WATER FLOWS FROM EXISTING PAVEMENTS AND SURROUNDING LANDS TO BE MAINTAINED WITHIN THE EXISTING ROAD DRAINAGE SYSTEM AND DIVERTED AROUND THE WORKS FOR AS LONG AS POSSIBLE.
IF THIS CANNOT BE ACHIEVED, TEMPORARY DIVERSION DRAINS OR PIPES TO BE PROVIDED TO CARRY OFFSITE FLOWS OR SEDIMENT CONTROLS MODIFIED ACCORDINGLY TO TAKE ADDITIONAL FLOWS.

FOR PAVEMENT WORKS ON EXISTING ROAD AREAS:
- UNDERTAKE WORKS PROGRESSIVELY IN SECTIONS AS MUCH AS POSSIBLE AND COMPLETE WORKS AS QUICKLY AS POSSIBLE.
- INSTALL SLOPE BREAKS AT REGULAR INTERVALS ACROSS EXPOSED SURFACES PRIOR TO RAINFALL.
- DIRECT FLOWS TO OFFLINE SEDIMENT CONTROL DEVICES WHERE POSSIBLE OR PROVIDE ADDITIONAL ONLINE SEDIMENT TRAPS/SUMPS.

A SEDIMENT BASIN IS REQUIRED FOR THE WESTERN SIDE SHOULDER WORKS. HOWEVER, SPACE, CONSTRUCTION AND TOPOGRAPHICAL CONSTRAINTS WILL NOT ALLOW THIS. THEREFORE, SEDIMENT TRAP/S IN CONJUNCTION WITH ENHANCED EROSION CONTROL (I.E. TEMPORARY STABILISATION PRIOR TO RAINFALL, INCREASED SLOPE BREAKS, CHECK DAMS AND TIMING OF WORKS TO LOW EROSION HAZARD PERIODS OR ALTERNATIVES AS DETERMINED BY A SOIL CONSERVATIONIST) WILL BE REQUIRED FOR THIS CATCHMENT.



LEGEND

- OFFSITE (CLEAN) WATER DIVERSION DRAIN/BUND [1]
- ONSITE (DIRTY) WATER DIVERSION DRAIN/BUND [1]
- SEDIMENT FENCE (OR SIMILAR) [1]
- SEDIMENT TRAP (E.G. SUMP, ROCK FILTER DAM, U-TRAP, INFILTRATION SWALE TRAPS OR SIMILAR,) [1]
- SEDIMENT BASIN [1]
- CLEAN FLOW DIRECTION
- DIRTY FLOW DIRECTION
- ENERGY DISSIPATER / SPILLWAY [1] [2]
- TEMPORARY WATER CROSSING (SD 5-1)
- BUND / BERM [1]
- CHECK DAM (SD 5-4)
- STABILISED PILING PLATFORM [1] [3]
- SILT CURTAIN [4]
- STABILISED SITE ACCESS (SD 6-14) OR RUMBLE GRID (LOCATIONS ARE INDICATIVE AND ARE TO BE LOCATED TO SUIT CONSTRUCTION AND SAFETY AND TO MINIMISE VEGETATION DISTURBANCE)
- SLOPE BREAKS (BUNDS) [1]
- ANCILLARY AREA [5]
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PIT PROTECTION IS TO BE PROVIDED FOR ALL LIVE PITS WITHIN CONSTRUCTION AREAS WHERE ACTIVE WORKS ARE OCCURRING. ENSURE APPROPRIATE SAFETY PRECAUTIONS ARE IN PLACE FOR LIVE TRAFFIC TO MITIGATE POTENTIAL HAZARDS AND DRAINAGE IMPACTS FROM PIT PROTECTION DEVICES.

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(REFER TO SEEC DRAWINGS 18000363_P01_ESCP000-007)

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A	19/11/18	A.J.T.	L.O.	A.M.	DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

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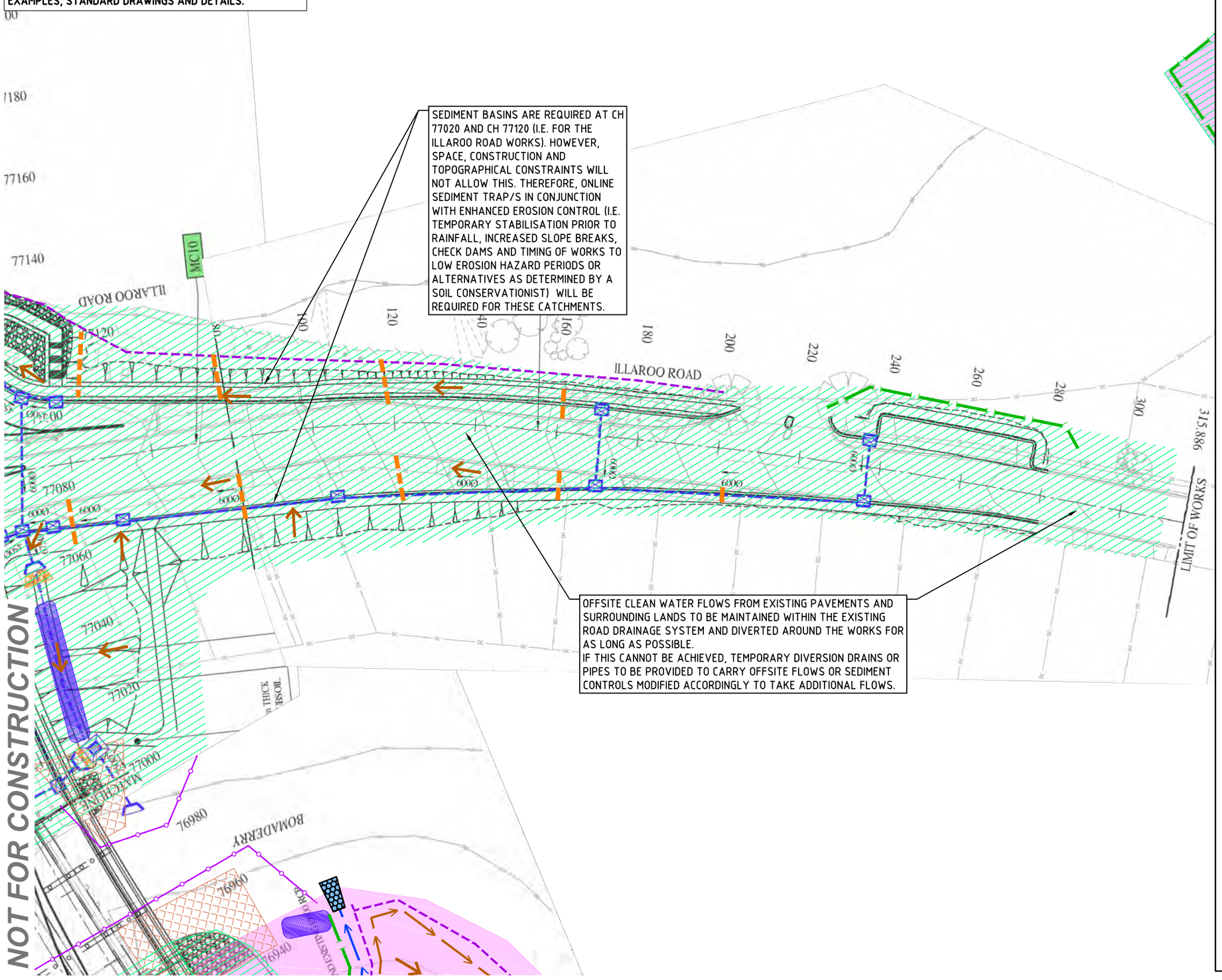
PROJECT TITLE
NOWRA BRIDGE PROJECT

DRAWING TITLE
CONCEPT EROSION AND SEDIMENT CONTROL PLAN SHEET 6 OF 8

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP106	00

Plot Date: Thursday, February 7, 2019 9:08:06 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP100_REV 00.dwg

REFER TO THE PRIMARY ESCP (18000363_P01_ESCP000-008) FOR ALL STANDARD REQUIREMENTS, INSTRUCTIONS, PHOTO EXAMPLES, STANDARD DRAWINGS AND DETAILS.



NOT FOR CONSTRUCTION

LEGEND

- OFFSITE (CLEAN) WATER DIVERSION DRAIN/BUND [1]
- ONSITE (DIRTY) WATER DIVERSION DRAIN/BUND [1]
- SEDIMENT FENCE (OR SIMILAR) [1]
- SEDIMENT TRAP (E.G. SUMP, ROCK FILTER DAM, U-TRAP, INFILTRATION SWALE TRAPS OR SIMILAR,) [1]
- SEDIMENT BASIN [1]
- CLEAN FLOW DIRECTION
- DIRTY FLOW DIRECTION
- ENERGY DISSIPATER / SPILLWAY [1] [2]
- TEMPORARY WATER CROSSING (SD 5-1)
- BUND / BERM [1]
- CHECK DAM (SD 5-4)
- STABILISED PILING PLATFORM [1] [3]
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- STABILISED SITE ACCESS (SD 6-14) OR RUMBLE GRID (LOCATIONS ARE INDICATIVE AND ARE TO BE LOCATED TO SUIT CONSTRUCTION AND SAFETY AND TO MINIMISE VEGETATION DISTURBANCE)
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IECA SD - IECA STANDARD DRAWING (IECA, 2008)
(REFER TO SEEC DRAWINGS 18000363_P01_ESCP000-007)

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00	07/02/19	A.J.T.	A.T.	A.M.	FINAL – ISSUE FOR APPROVAL
B	29/01/19	A.J.T.	A.T.	A.M.	FINAL DRAFT – ISSUE FOR REVIEW
A	19/11/18	A.J.T.	L.O.	A.M.	DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

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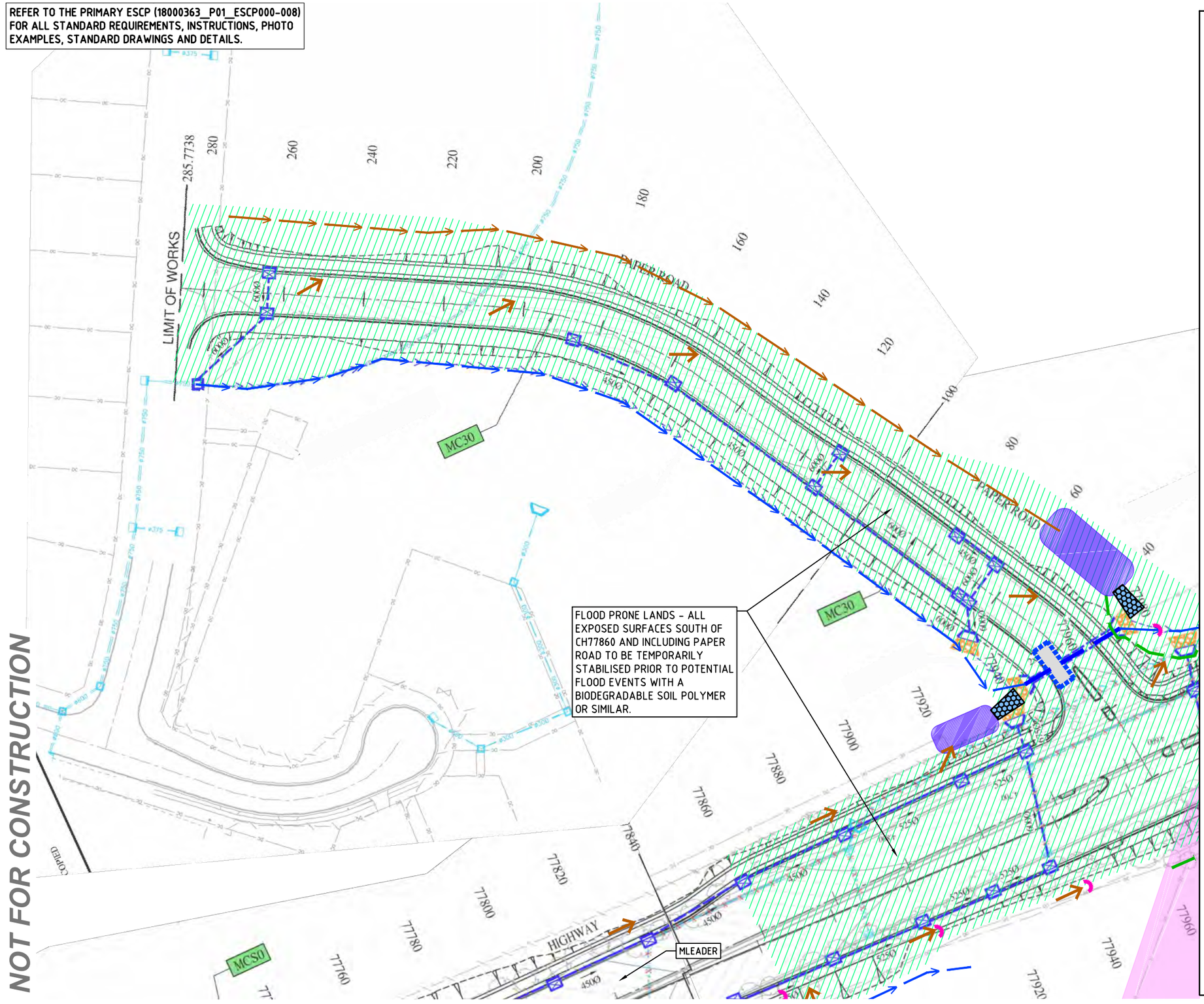
PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN SHEET 7 OF 8

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP107	00

Plot Date: Thursday, February 7, 2019 9:08:12 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP100_REV 00.dwg

REFER TO THE PRIMARY ESCP (18000363_P01_ESCP000-008) FOR ALL STANDARD REQUIREMENTS, INSTRUCTIONS, PHOTO EXAMPLES, STANDARD DRAWINGS AND DETAILS.



LEGEND

- OFFSITE (CLEAN) WATER DIVERSION DRAIN/BUND [1]
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00	07/02/19	A.J.T.	A.T.	A.M.	FINAL - ISSUE FOR APPROVAL
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DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

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PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN SHEET 8 OF 8

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP108	00

Plot Date: Thursday, February 7, 2019 9:08:17 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP100_REV 00.dwg

REFER TO THE PRIMARY ESCP (18000363_P01_ESCP000-008) FOR ALL STANDARD REQUIREMENTS, INSTRUCTIONS, PHOTO EXAMPLES, STANDARD DRAWINGS AND DETAILS.

NOT FOR CONSTRUCTION

LEGEND

- OFFSITE (CLEAN) WATER DIVERSION DRAIN/BUND [1]
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DRAWING STATUS	
DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

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PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN ANCILLARY SITE 1

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP201	00

Plot Date: Thursday, February 7, 2019 9:08:26 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP100_REV 00.dwg

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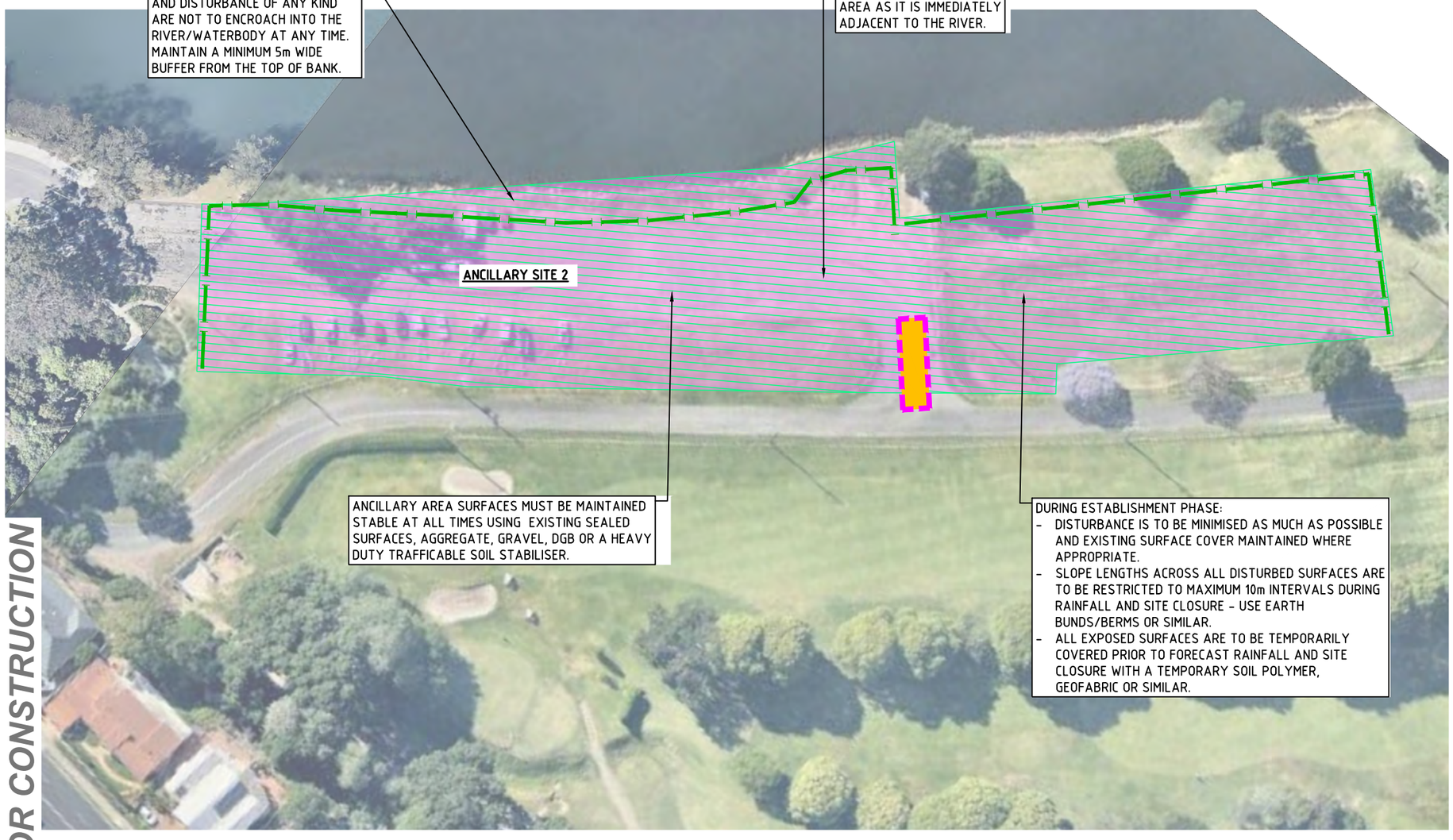

NOT FOR CONSTRUCTION

LEGEND

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SD - BLUE BOOK STANDARD DRAWING (LANDCOM, 2004)
IECA SD - IECA STANDARD DRAWING (IECA, 2008)
(REFER TO SEEC DRAWINGS 18000363_P01_ESCP000-007)

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	07/02/19	A.J.T.	A.T.	A.M.	FINAL – ISSUE FOR APPROVAL
B	29/01/19	A.J.T.	A.T.	A.M.	FINAL DRAFT – ISSUE FOR REVIEW
A	19/11/18	A.J.T.	L.O.	A.M.	DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

North

CLIENT: Roads & Maritime

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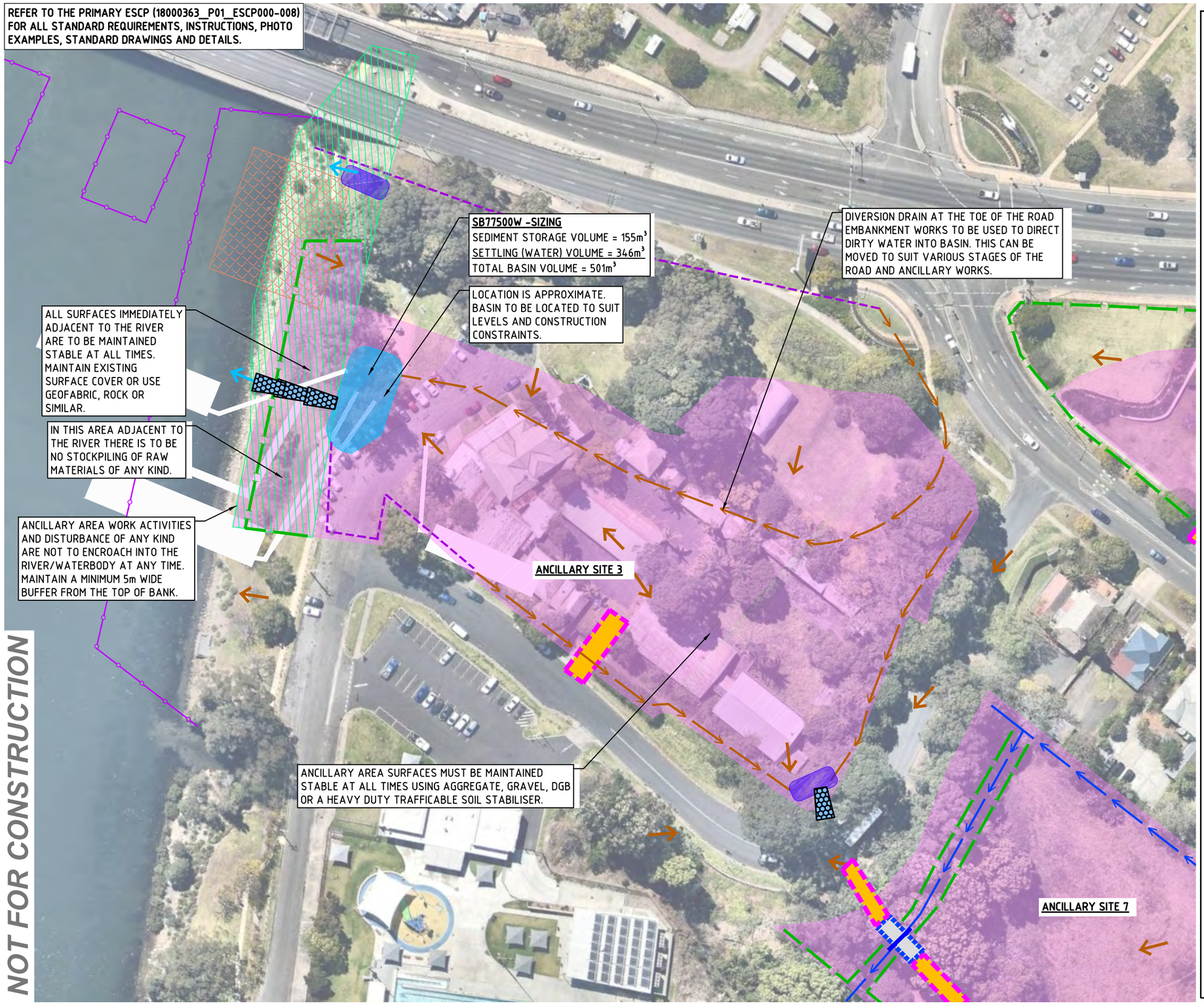
PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN ANCILLARY SITE 2

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP202	00

Plot Date: Thursday, February 7, 2019 9:08:32 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP100_REV 00.dwg

REFER TO THE PRIMARY ESCP (18000363_P01_ESCP000-008) FOR ALL STANDARD REQUIREMENTS, INSTRUCTIONS, PHOTO EXAMPLES, STANDARD DRAWINGS AND DETAILS.



NOT FOR CONSTRUCTION

LEGEND

- OFFSITE (CLEAN) WATER DIVERSION DRAIN/BUND [1]
- ONSITE (DIRTY) WATER DIVERSION DRAIN/BUND [1]
- SEDIMENT FENCE (OR SIMILAR) [1]
- SEDIMENT TRAP (E.G. SUMP, ROCK FILTER DAM, U-TRAP, INFILTRATION SWALE TRAPS OR SIMILAR,) [1]
- SEDIMENT BASIN [1]
- CLEAN FLOW DIRECTION
- DIRTY FLOW DIRECTION
- ENERGY DISSIPATER / SPILLWAY [1] [2]
- TEMPORARY WATER CROSSING (SD 5-1)
- BUND / BERM [1]
- CHECK DAM (SD 5-4)
- STABILISED PILING PLATFORM [1] [3]
- SILT CURTAIN [4]
- STABILISED SITE ACCESS (SD 6-14) OR RUMBLE GRID (LOCATIONS ARE INDICATIVE AND ARE TO BE LOCATED TO SUIT CONSTRUCTION AND SAFETY AND TO MINIMISE VEGETATION DISTURBANCE)
- SLOPE BREAKS (BUNDS) [1]
- ANCILLARY AREA [5]
- CATCHMENTS WHERE ENHANCED EROSION CONTROLS/TEMPORARY STABILISATION APPLY [6]

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SD - BLUE BOOK STANDARD DRAWING (LANDCOM, 2004)
IECA SD - IECA STANDARD DRAWING (IECA, 2008)
(REFER TO SEEC DRAWINGS 18000363_P01_ESCP000-007)

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	07/02/19	A.J.T.	A.T.	A.M.	FINAL – ISSUE FOR APPROVAL
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DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

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CLIENT: Roads & Maritime

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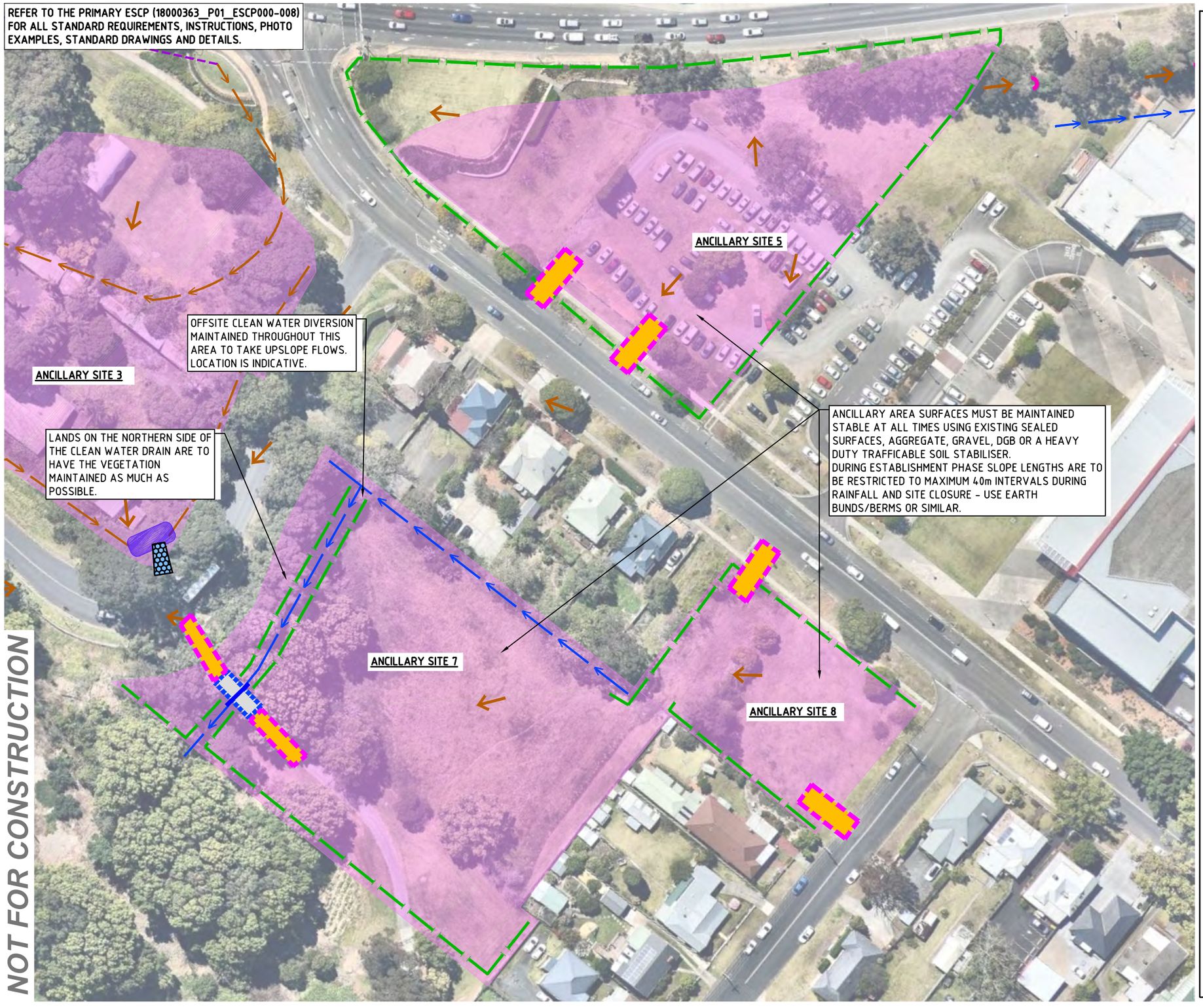
PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN ANCILLLARY SITE 3

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP203	00

Plot Date: Thursday, February 7, 2019 9:08:39 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP100_REV 00.dwg

REFER TO THE PRIMARY ESCP (18000363_P01_ESCP000-008) FOR ALL STANDARD REQUIREMENTS, INSTRUCTIONS, PHOTO EXAMPLES, STANDARD DRAWINGS AND DETAILS.



NOT FOR CONSTRUCTION

LEGEND

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- SEDIMENT BASIN [1]
- CLEAN FLOW DIRECTION
- DIRTY FLOW DIRECTION
- ENERGY DISSIPATER / SPILLWAY [1] [2]
- TEMPORARY WATER CROSSING (SD 5-1)
- BUND / BERM [1]
- CHECK DAM (SD 5-4)
- STABILISED PILING PLATFORM [1] [3]
- SILT CURTAIN [4]
- STABILISED SITE ACCESS (SD 6-14) OR RUMBLE GRID (LOCATIONS ARE INDICATIVE AND ARE TO BE LOCATED TO SUIT CONSTRUCTION AND SAFETY AND TO MINIMISE VEGETATION DISTURBANCE)
- SLOPE BREAKS (BUNDS) [1]
- ANCILLARY AREA [5]
- CATCHMENTS WHERE ENHANCED EROSION CONTROLS/TEMPORARY STABILISATION APPLY [6]

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SD - BLUE BOOK STANDARD DRAWING (LANDCOM, 2004)
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(REFER TO SEEC DRAWINGS 18000363_P01_ESCP000-007)

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00	07/02/19	A.J.T.	A.T.	A.M.	FINAL – ISSUE FOR APPROVAL
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DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

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CLIENT: Roads & Maritime

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PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN ANCILLARY SITES 5, 7 & 8

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP204	00

Plot Date: Thursday, February 7, 2019 9:08:44 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP100_REV 00.dwg

REFER TO THE PRIMARY ESCP (18000363_P01_ESCP000-008) FOR ALL STANDARD REQUIREMENTS, INSTRUCTIONS, PHOTO EXAMPLES, STANDARD DRAWINGS AND DETAILS.

SB76900E -SIZING
SEDIMENT STORAGE VOLUME = 128m³
SETTLING (WATER) VOLUME = 247m³
TOTAL BASIN VOLUME = 375m³

THIS AREA IS FLOOD PRONE - BASIN WALLS TO BE BUILT UP SO THE INLET AND OUTLET POINTS ARE ABOVE THE 2YR ARI FLOOD LEVEL. HOWEVER, ENSURE DRAINAGE INTO THE BASIN IS STILL POSSIBLE.
ALSO IF HIGH GROUND WATER OR ACID SULPHATE SOILS ARE PRESENT, THE BASIN MAY NEED TO BE FORMED AS A SHALLOW LINEAR TYPE DEVICE TO MINIMISE EXCAVATION.
IF FULL VOLUMES CANNOT BE ACHIEVED DUE TO THE ABOVE CONSTRAINTS, ENHANCED EROSION CONTROLS WILL BE REQUIRED FOR THE DISTURBED BASIN CATCHMENT AND ALTERNATIVE SEDIMENT TRAP TYPE DEVICE/S PROVIDED.

OFFSITE CLEAN WATER DIVERSION (DRAIN OR PIPE) PROVIDED TO TAKE STORMWATER RUNOFF FROM BOLONG ROAD.

ANCILLARY SITE 6

STOCKPILING OF RAW MATERIALS OF ANY KIND MUST BE ABOVE THE 2YR ARI FLOOD LEVEL. ROCK BRIDGING OR SIMILAR MAY BE NECESSARY TO ACHIEVE THIS WHERE REQUIRED.

ANCILLARY AREA SURFACES MUST BE MAINTAINED STABLE AT ALL TIMES USING AGGREGATE, GRAVEL, DGB OR A HEAVY DUTY TRAFFICABLE SOIL STABILISER.

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DRAWING STATUS	
DESIGN BY	A.J.T.
DRAWN BY	L.O.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

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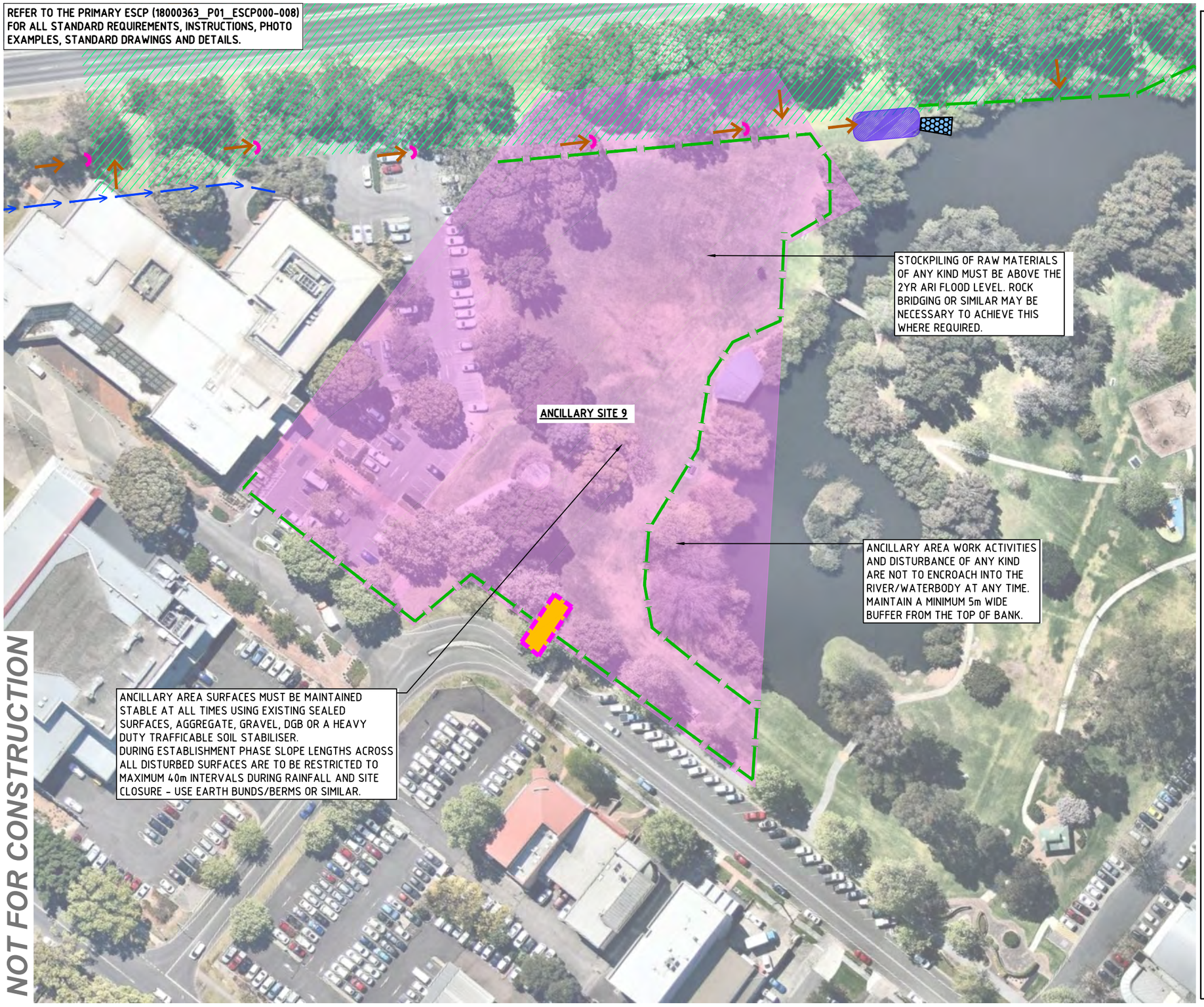
PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN ANCILLARY SITE 6

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP205	00

Plot Date: Thursday, February 7, 2019 9:08:50 AM CAD File Name: U:\18000363 Nowra Bridge Project\Drawings\18000363_P01_ESCP100_REV 00.dwg

REFER TO THE PRIMARY ESCP (18000363_P01_ESCP000-008) FOR ALL STANDARD REQUIREMENTS, INSTRUCTIONS, PHOTO EXAMPLES, STANDARD DRAWINGS AND DETAILS.



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FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

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PROJECT TITLE: NOWRA BRIDGE PROJECT

DRAWING TITLE: CONCEPT EROSION AND SEDIMENT CONTROL PLAN ANCILLARY SITE 9

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000363	P01	ESCP206	00

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Customer feedback
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