PART B
Impact assessment
Proposal infrastructure

INLAND RAIL

CHAPTER B5
Water quality

Narromine to Narrabri
Environmental Impact Statement

ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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B5. Water quality

This chapter provides a summary of the potential water quality impacts of the Narromine to Narrabri project (the proposal). A full copy of the surface water assessment results is provided in Technical Report 5—Surface water quality assessment. The groundwater assessment results are provided in Technical Report 4—Groundwater assessment.

B5.1 Approach

A summary of the approach to the assessments is provided in this section, including the legislation, guidelines and/or policies driving the approach and the methodology used to undertake the assessments. A more detailed description of the approach and methodology is provided in Technical Reports 4 and 5.

B5.1.1 Legislative and policy context to the assessment

Relevant legislation, policies and guidelines

The assessments were undertaken in accordance with the SEARs and with reference to the requirements of relevant legislation, policies and/or assessment guidelines, including:

- The EP&A Act, *Water Act 1912* (NSW), *Water Management Act 2000* (NSW) and Water Management Regulation 2018
- *National Water Quality Management Strategy* (Australian and New Zealand Environment and Conservation Council, 2000a)
- *Australian Guidelines for Water Quality Monitoring and Reporting* (ANZECC/ARMCANZ, 2000b) (the ANZECC guidelines)
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Governments, 2018) (the Water Quality Guidelines)
- *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended in 2013)* (NEPC, 2013)
- *NSW Water Quality and River Flow Objectives* (DECCW, 2006) (the NSW Water Quality Objectives)
- *Managing Urban Stormwater—Soils and Construction:* Volume 1 (Landcom, 2004*)*, Volume 2C *Unsealed Roads* (DECC, 2008a) and Volume 2D *Main Road Construction* (DECC, 2008b) (collectively referred to as the 'Blue Book').

Secretary's Environmental Assessment Requirements

The SEARs relevant to water quality, together with a reference to where they are addressed in the EIS, are provided in Appendix A.

B5.1.2 Methodology

Study area

The study area for the surface water quality assessment included the catchment areas within the proposal site and receiving watercourses, described in section B5.2.

Key tasks

The assessment involved:

- Reviewing existing environmental conditions and publicly available water quality data in the study area to understand the existing physical and chemical water quality characteristics and environmental values
- Undertaking visual site inspections at 25 watercourses within the proposal site, and obtaining water quality samples from five watercourses (see below), in November 2018 and March 2019—watercourses were chosen based on their potential to be sensitive receiving environments
- Undertaking groundwater field investigations, including drilling, monitoring well installation and water quality monitoring at 40 locations within the proposal site, including one location within each borrow pit

- Identifying assessment criteria for the proposal based on:
  - The NSW Water Quality Objectives for catchments affected by the proposal
  - Default trigger values in the ANZECC guidelines, which are the same as those adopted by the new Water Quality Guidelines
- Reviewing the existing and the proposed hydrological conditions (described in chapter B2) to identify risks to water quality that are related to hydrology
- Assessing the potential impacts on water quality during construction and operation
- Recommending mitigation and management measures, including water quality monitoring for identified impacts.

Water quality sampling

Given the drought conditions at the time, and the fact that there had been no rain in the week preceding the site inspections, only five watercourses had sufficient water for water quality sampling to be undertaken. Parameters measured in-situ included temperature, conductivity, salinity and pH. Samples were also subject to laboratory analysis of total and oxidised nitrogen, total phosphorus, benzene, toluene, ethylbenzene, xylenes and naphthalene, total recoverable hydrocarbons and total metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc and mercury).

The groundwater monitoring wells were installed in areas where there is the potential for deeper excavation and a higher potential to intercept groundwater. Four groundwater quality monitoring sampling rounds were undertaken within wells in the proposal site. Two groundwater quality monitoring rounds were undertaken at the wells within each borrow pit. Groundwater levels were recorded during each sampling event. Where sufficient water was available, samples were also subject to laboratory analysis of pH, electrical conductivity, total dissolved solids, hardness, major ions, nutrients, organochlorine pesticide, organophosphorus pesticide, benzene, toluene, ethylbenzene, xylenes and naphthalene, total recoverable hydrocarbons and total metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc and mercury).

Water quality objectives and criteria

The NSW Water Quality Objectives provide the agreed environmental values and long-term goals for NSW's surface waters. The objectives are consistent with the national framework for assessing water quality set out in the Water Quality Guidelines, which supersedes the ANZECC guidelines. The water quality objectives provide environmental values for NSW waters and the Water Quality Guidelines provide the technical guidance to assess the water quality needed to protect those values.

The water quality assessment considered protection of the following values:

- Aquatic ecosystems
- Visual amenity
- Primary and secondary contact recreation
- Livestock water supply
- Irrigation water supply
- Homestead water supply
- Drinking water at the point of supply
- Groundwater
- Aquatic foods (cooked).

While all of these values apply, some of them have less relevance, given the characteristics of the watercourses (the majority are ephemeral). The water quality objective for aquatic ecosystems is to 'maintain or improve the ecological condition of waterbodies and their riparian zones over the long term', which is relevant in all watercourses. The indicators and criteria (trigger values) for this objective are listed in Table B5.1. A detailed list of the indicators and criteria for the other water quality objectives for watercourses within the proposal site is provided in Technical Report 5. The majority of watercourses within the proposal site are considered to be upland watercourses. Watercourses at the southern and northern ends of the proposal site are considered to be lowland watercourses.

TABLE B5.1 TRIGGER VALUES FOR AQUATIC ECOSYSTEMS

Indicator	Lowland River	Upland River
Total phosphorus	50 µg/L	20 µg/L
Total nitrogen	500 µg/L	250 µg/L
Chlorophyll-a	5 µg/L	n/a
Turbidity	6-50 NTU	2–25 NTU
Salinity (Electrical conductivity)	125–2200 µS/cm	30–350 µS/cm
Dissolved oxygen	85–110 % saturation	90–110 % saturation
pH	6.5–8.5	6.5–8
Oils and petroleum hydrocarbons	Insufficient data to give trigger value, although the environmental protection licence is likely to require no visible oils or sheen in discharge water.	Insufficient data to give trigger value, although the environmental protection licence is likely to require no visible oils or sheen in discharge water.

B5.1.3 Risks identified

The environmental risk assessment for the proposal (see Appendix E) included consideration of potential water quality risks. Water quality risks with an assessed level of medium or above, identified by the environmental risk assessment, included:

- Increased sediment loads during rainfall events and from discharge of sediment-laden wastewater
- Increased alkalinity and pH of watercourses due to runoff from concrete batching plant operations
- Increased sediment loads due to changes in surface water flow from the presence of construction infrastructure
- Erosion and sediment transport downstream due to works in watercourses
- Introduction of drainage infrastructure and culverts resulting in water quality impacts
- Impact to surface water quality and receiving environments due to increased runoff from increase in impervious surfaces.

The water quality assessment considered the potential risks identified by the environmental risk assessment, in addition to potential risks and impacts identified by the scoping report (see section A9.1), the SEARs and relevant guidelines and policies (as appropriate).

B5.1.4 How potential impacts have been avoided/minimised

The main potential for impacts would occur during and following rainfall events. Potential water quality impacts would be minimised by managing water quality in accordance with the requirements of the POEO Act and the environment protection licence for the proposal.

Potential impacts that are unable to be avoided would be minimised by designing, constructing and operating the proposal so that potential impacts on water quality are minimised. This would include:

- Designing flow discharge points (culverts and longitudinal drainage) to include erosion controls, such as rock protection, to slow flow velocities and minimise the risk of erosion as surface water enter and exits the structure
- Designing bridges and culverts to have a minimal impact on existing surface flow paths across the proposal site
- Using pre-cast culvert structures to minimise the works within watercourses
- Incorporating protection measures, such as sedimentation basins, water quality ponds and spill basins, as required
- Designing batters and retaining structures using appropriate slope gradients to minimise erosion, or using terracing
- Design of ballast drainage to discharge to suitable outlets and control points
- Selection of fill material for embankments to minimise the risk of erosion
- Minimising the area of disturbance
- Constructing bridge piers in flowing watercourses using driven piles.

Implementation of the design control measures identified above, together with the mitigation measures provided in section B5.5 would enable the proposal to be designed, constructed and operated to avoid or minimise water pollution, and protect human health and the environment.

B5.2 Existing environment

B5.2.1 Catchments and watercourses

The proposal site is located within the major water catchments of the Macquarie-Bogan River, the Castlereagh River and the Namoi River.

A total of 44 intermittent/ephemeral watercourses and three perennial watercourses (Macquarie River, Namoi River and Narrabri Creek) cross the proposal site.

Further information on the existing hydrological environment is provided in section B2.2.

B5.2.2 Sensitive receiving environments

A sensitive receiving environment is one that has a high conservation value or supports human uses of water that are particularly sensitive to degraded water quality. In the context of this proposal, sensitive receiving environments are considered to be:

- Nationally important wetlands
- National parks, nature reserves and State conservations areas
- Threatened ecological communities associated with aquatic ecosystems
- Known and potential habitats for threatened fish
- Key fish habitats
- Recreational swimming areas
- Areas that contribute to aquaculture and commercial fishing.

The majority of the watercourses in the proposal site are ephemeral and do not contain sensitive environments. Watercourses and other surface water features in the vicinity of the proposal site, which are considered to be sensitive receiving environments, are listed in Table B5.2.

The proposal site also extends through the Pilliga East, Merriwindi, Baradine, Cumbil and Euliga State forests.

The design measures considered in section B5.1.4, and the mitigation measures provided in section B5.5, have been developed to protect identified sensitive receiving environments and their associated environmental values, where relevant to the proposal.

TABLE B5.2 SURFACE WATER SENSITIVE RECEIVING ENVIRONMENTS

Name	Stream Order	Potential for threatened species?	DPI (2013) key Fish Habitat type[1]	Watercourse classification
Narrabri Creek	9th	Yes	Type 1	Class 1
Namoi River	9th	Yes	Type 1	Class 2
Bohena Creek	6th	Yes	Type 1	Class 2
Goona Creek	2"—intermittent	Yes	Type 1	Class 2
Mollieroi Creek, Coghill Creek and Rocky Creek	4"—intermittent	Yes	Type 1	Class 2
Stockyard Creek	3rd	No	Type 1	Class 2
Etoo Creek	5"—intermittent	Yes	Type 1	Class 2
Baradine Creek	6th	Yes	Type 1	Class 2
Gulargambone Creek	5th	Yes	Type 1	Class 2
Castlereagh River	7th	Yes	Type 1	Class 1
Kickabil Creek and Emogandy Creek	4"—intermittent	No	Type 1	Class 2

Name	Stream Order	Potential for threatened species?	DPI (2013) key Fish Habitat type[1]	Watercourse classification
Ewenmar Creek	4th—intermittent	No	Type 2	Class 2
Macquarie River	9th	Yes	Type 1	Class 1
Backwater Cowal	N/A—wetland depression on the floodplain	Yes	Type 1	Class 2
Macquarie Marshes	RAMSAR listed wetlands occurs about 100 km downstream of the study area, along the Macquarie River. The site supports permanent populations of threatened fauna including Silver Perch and Murray Cod (DAWE, 2020b).			

Notes:
1. DPI (2013c) identifies: Type 1 'Highly sensitive key fish habitat', Type 2 'Moderately sensitive key fish habitat', and Type 3 'Minimally sensitive key fish habitat.
2. Fairfull and Witheridge (2003) identify four habitat classifications, including: Class 1 'Major fish habitat', Class 2 'Moderate fish habitat', Class 3 'Minimal fish habitat', and Class 4 'Unlikely fish habitat'.

B5.2.3 Existing water quality

Surface water quality

Based on a review of publicly available information, water quality in the Macquarie-Bogan, Castlereagh River and Namoi River catchments is considered to be generally poor, largely due to elevated total phosphorus and nitrogen concentrations exceeding the recommended trigger values. Salinity levels in the Macquarie-Bogan and Castlereagh River catchments are also considered to be poor and exceed the recommended trigger level for protection of aquatic ecosystems.

Based on the visual inspections undertaken, watercourses were noted to be either noticeably impacted by human disturbance (in moderate geomorphic condition) or degraded (in poor geomorphic condition) and exhibited very low to no flow due to the prevailing drought conditions.

The water quality sampling results are compared to the default trigger values in Table B5.3. Existing concentrations that are outside of the range of the default trigger values are shown in bold red font. The results of the monitoring indicated the following:

- Narrabri Creek did not meet the recommended guidelines for protection of aquatic ecosystems, due to exceedances of dissolved oxygen, pH and electrical conductivity as well as oxidised and total nitrogen and phosphorous. Narrabri Creek was flowing at the time of sampling.
- Namoi River and Tallubu Creek (a tributary of Turragulla Creek which flows into the Namoi River) both exceeded the guidelines for protection of aquatic ecosystems for total nitrogen and copper, with Namoi River also exceeding the guidelines for electrical conductivity, pH and total phosphorus. Both of these watercourses were generally dry, with samples collected from small pools. Dissolved oxygen levels were low in both watercourses, likely due to the stagnant conditions.
- The water quality of Macquarie River was better than the other watercourses. This is likely due to the presence of flowing water. Total nitrogen and phosphorous exceeded the recommended guideline values but were reported at lower concentrations than the other watercourses.
- The sample from Backwater Cowal was collected in a turbid pool of water. As such, it had very high turbidity and electrical conductivity concentrations, and total nitrogen and phosphorous concentrations that exceeded the recommended trigger values.

TABLE B5.3 COMPARISON OF BASELINE WATER QUALITY SAMPLING RESULTS AND DEFAULT TRIGGER VALUES

Indicator	Narrabri Creek[1]	Namoi River[2]	Talluba Creek[2]	Macquarie River[3]	Backwater Cowal[1] (Dam)	Trigger values
Dissolved oxygen (% saturation)	110.97	48.1	48.10	105.6	105.6	90–110
Turbidity (NTU)	10.47	n/a	n/a	6.37	461	2–25
Electrical conductivity (µS/cm)	398	1670	109	148.07	546	30–350
pH	8.31	8.41	6.42	7.43	7.36	6.5–8
Oxidised nitrogen (mg/L)	0.23	<0.05	1.25	<0.05	2.5	0.015
Total nitrogen (mg/L)	0.9	5.8	1.7	0.3	5.6	0.25
Total phosphorus (mg/L)	0.14	0.24	0.02	0.055	0.75	0.020
Arsenic (mg/L)	0.001	0.016	<0.0001	0.0015	0.006	0.024
Cadmium (mg/L)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002
Chromium (mg/L)	0.002	<0.001	0.001	0.0008	0.001	0.001
Copper (mg/L)	0.002	0.002	0.003	0.002	0.007	0.0014
Lead (mg/L)	<0.001	<0.001	<0.001	<0.0001	0.009	0.0034
Mercury (mg/L)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00006
Nickel (mg/L)	0.008	0.006	0.003	0.0018	0.0012	0.011
Zinc (mg/L)	0.0007	<0.005	0.011	0.0098	0.007	0.008

Notes:
1. Sampled in 2018
2. Sampled in 2019
3. Sampled in 2018 and 2019

Groundwater quality

Groundwater quality results from the baseline groundwater monitoring rounds were compared to the ecological freshwater criteria from the Water Quality Guidelines and the groundwater investigation levels for fresh waters from the National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended). The following was noted from groundwater samples collected during either one or more of the sampling events:

- Copper, nickel, and zinc concentrations exceeding the Water Quality Guidelines
- Mercury concentrations exceeding the values in the National Environment Protection (Assessment of Site Contamination) Measure 1999
- Nutrient levels were variable, with ammonia reported slightly above the Water Quality Guidelines
- The average pH was 7.6
- Total dissolved solids ranged from 200 to 22,000 milligrams per litre, which is representative of fresh to saline water
- All other concentrations were either below the relevant criteria or below the laboratory limit of reporting.

Detailed results are provided in Appendix C of Technical Report 4—Groundwater assessment.

B5.3 Impact assessment—construction

B5.3.1 Potential water quality impacts

Construction presents a risk to downstream water quality if management measures are not implemented, monitored, and maintained throughout the construction period. If inadequately managed, construction activities can impact water quality if they disturb soil or watercourses, result in the uncontrolled discharges of substances to watercourses, or generate contamination.

Potential sources of water quality impacts include:

- Increased sediment loads from exposed soil transported offsite to downstream watercourses during rainfall events and from discharge of sediment-laden wastewater
- Exposure of actual or potential acid sulfate soils, which may generate acidic runoff
- Increased levels of nutrients, metals and other pollutants, transported in sediments to downstream watercourses or via discharge of wastewater to watercourses
- Increased alkalinity and pH of downstream watercourses due to runoff from concrete batching plant operations (concrete dust, slurry or washout water)
- Chemicals, oils, grease and petroleum hydrocarbon spills from construction machinery directly polluting downstream watercourses
- Litter from construction activities polluting downstream watercourses
- Contamination of watercourses due to runoff from contaminated land
- Construction water sourced from deep groundwater bores impacting the water quality of shallow groundwater and/or surface water due to differences in water quality between the shallow and deeper systems.

The downstream effects of water quality impacts include:

- Smothering aquatic life and/or inhibiting photosynthesis conditions for aquatic and riparian flora
- Impacts on breeding and spawning conditions of aquatic fauna
- Changes to water temperature due to reduced light penetration
- Increased turbidity levels above the design levels of water treatment infrastructure
- Reduced visibility in recreation areas.

Potential impacts as they relate to water quality, including impacts caused by increased sediment loads, are considered below. The potential impacts on aquatic ecology as a result of water quality impacts are considered in chapter B1. The impacts associated with groundwater extraction for construction water are considered in chapter B2. The potential for soil and contamination impacts during construction, including the potential for contamination of surface water and groundwater due to the exposure of acid sulfate soils or saline soils, spills and leaks, and/or the mobilisation of contaminants encountered during demolition of structures are considered in chapter B4. Air quality (dust) impacts are considered in chapter B10. Waste management impacts are considered in chapter D2.

B5.3.2 Earthworks, stockpiling, and general runoff from construction sites

Excavations and the construction of embankments can impact water quality in downstream watercourses as a result of erosion. Runoff from stockpiles has the potential to impact downstream water quality during rainfall if the stockpiles are not managed appropriately. Sediments from the stockpiles could wash into watercourses, increasing levels of turbidity and resulting in transport of contaminants and impacts generally, as described in section B5.3.1.

Stockpiling cleared vegetation creates a risk of tannins leaching into watercourses, resulting in an increased organic load. Discharge of water high in tannins can increase the biological oxygen demand of the receiving environment, which may, in turn, result in a decrease in available dissolved oxygen. Once discharged to the environment, tannins may also reduce visibility, light penetration, and change the pH of receiving waters.

Sediment loads in watercourses can increase in the vicinity of hard surfaces (such as roads) and compacted areas (such as construction compounds and haul roads) due to increased surface runoff.

Although the proposal has the potential to temporarily reduce water quality from pollutants and runoff, it would not be expected to cause significant impacts on the overall condition of surrounding watercourses. Construction is unlikely to result in any long-term water quality impacts in the study area.

Sedimentation basins would be provided at regular intervals along the proposal site, including at key construction infrastructure, as described in section A8.9. The purpose of the sedimentation basins would be to capture any potential runoff during rainfall from the adjacent construction works areas. In addition, the measures provided in section B5.5 would be implemented to minimise the potential for water quality impacts as a result of earthworks, stockpiling and general runoff from construction sites.

In general, with construction of sedimentation basins and implementation of the mitigation measures provided, water quality impacts due to construction runoff would be negligible. This is particularly the case compared to runoff from surrounding agricultural properties following a regional rainfall event.

B5.3.3 Changes to surface water flows

The proposal has the potential to alter surface water flows. This could affect water quality by increasing flow rates and volume, resulting in erosion and turbidity. The potential impacts of changes to surface water flows are considered in chapter B2.

B5.3.4 Works in watercourses

The proposal involves works in watercourses to construct bridges and culverts. These works would disturb bed and bank substrates, potentially leading to localised erosion and sediment transport downstream. As described in section B5.1.4, the proposal includes a number of design features to minimise the extent of disturbance to watercourses. Additionally, only the Macquarie River and Narrabri Creek/Namoi River bridges would require piers to be constructed within flowing water, and these would be constructed from barges using driven piles and silt curtains (or other similar measures) to minimise the potential for sediment transport. All other bridges and culverts would be constructed in watercourses that are ephemeral, with works undertaken only during dry periods. Any impacts on water quality in these watercourse would be managed by implementing standard erosion and sediment controls in accordance with the construction soil and water management plan (see section B5.5).

As noted above, culverts structures would be largely pre-fabricated; however, the concrete bases would need to be poured in situ. For the majority of the proposal site, concrete wash-downs of trucks and other impacted plant and equipment would be undertaken in dedicated wash-down areas within the site compounds; however, some construction areas would be located too far from the dedicated wash-down areas, and temporary wash-down areas would need to be established. With the implementation of the measures provided in B5.5, water quality impacts associated with working in watercourses are expected to be manageable.

B5.3.5 Groundwater quality

Potential risks to groundwater quality include:

- Contamination by hydrocarbons from accidental fuel and chemical spills
- Contaminants contained in turbid runoff from impervious surfaces.

Surface water from site runoff may infiltrate and impact groundwater sources. As the infiltration process is generally effective in filtering polluting particles and sediment, the risk of contamination of groundwater from any pollutants bound in particulate form in surface water runoff, such as heavy metals, is generally low.

Soluble pollutants, such as pH altering solutes, salts and nitrates, as well as soluble hydrocarbons, can infiltrate soils and contaminate the groundwater system. Under certain pH conditions, metals may also become soluble and could infiltrate groundwater.

The mitigation measures provided in section B5.5 would be implemented to minimise the potential for groundwater quality impacts due to contamination from leaks and spills, and runoff.

The presence of salinity within the project site is considered in chapter B4. Given the limited amount of excavation proposed, and the low likelihood of intercepting groundwater due to the depth to groundwater, impacts on groundwater resources and hydrology due to soil salinity are considered unlikely; however, any potential impacts would be mitigated by implementing standard erosion and sediment control measures during construction, including measures to minimise infiltration of increased surface water, and backfilling soil units in the order they were excavated.

As discussed in chapter B2, there is limited potential for groundwater intrusion during construction activities due to the shallow depth of excavation proposed across the majority of the proposal site. Where there is the potential for groundwater intrusion (either during piling or excavation at borrow pits) the likely groundwater inflow volumes would be minimal and would be unlikely to require dewatering. If dewatering is required the groundwater quality would be assessed to determine compliance with the environment protection licence for the proposal, prior to discharge. Pollution laden runoff or discharge to surface water.

Identify and estimate the quality and quantity of all pollutants

As noted above, the proposal has the potential to introduce sediments and gross pollutants (litter) to watercourses via uncontrolled runoff. There is also the potential for runoff to be contaminated during the exposure of surface soils in contaminated land. Potential contaminants of concerns that may be present in the proposal site are described in chapter B4; however, as noted in chapter B4, the potential to encounter gross contamination during construction is considered low. Additionally, the potential for uncontrolled runoff would also be low with the implementation of the mitigation measures provided in section B5.5.2.

The proposal has the potential to introduce the following pollutants to surrounding watercourses:

- Nitrogen and phosphorous—due to use of pesticides and herbicides for weed control near watercourses
- Chemicals, oils, grease and petroleum hydrocarbons—due to leaks and spills during construction or the discharge of water from vehicle wash down areas
- Alkaline wastewater due to the operation of mobile and fixed concrete batching plants
- Sediment-laden wastewater due to discharge of water from sedimentation basins.

By implementing management measures provided in the CEMP, pollutant runoff due to leaks and spills, weed control and the operation of batching plants would be negligible and would be unlikely to cause long-term harm to human health or the environment. Additionally, any mobile and fixed concrete batching plants would be established with appropriate erosion and sediment controls, consistent with current best practice.

In relation to discharge from sedimentation basins, the exact volume of discharge water and discharge points would be identified prior to construction, if required. Discharge points would take into consideration the hydrological attributes of the receiving watercourse, including whether there is sufficient flow volume and velocity to incorporate the discharge volumes. Sedimentation basins would be designed so that any discharge contains concentrations of total suspended sediments of less than 50 milligrams per litre (mg/L), which would also ensure compliance with the Water Quality Guidelines trigger values for turbidity.

Maintaining or achieving the water quality objectives

The NSW Water Quality Objectives and their relevance to the proposal are summarised in Table B5.1 for those pollutants that the proposal may introduce into the water cycle. Further detail is provided in Technical Report 5.

The area occupied by the proposal site constitutes only a small component of the Namoi River, Castlereagh River, and Macquarie-Bogan River basins. Progress towards meeting the water quality objectives depends on activities in the basins as a whole. Water quality impacts would generally be limited to the construction phase and would be short term only.

As described in section B5.2.3, many watercourses where data was available exhibited poor water quality that did not meet the nominated trigger values in Table B5.1. The poor quality is likely to reflect existing soil conditions and agricultural land use practices within the identified catchments.

Construction and operation would be undertaken in accordance with the management measures provided in section B5.5, which would minimise the potential for the proposal to reduce the quality of water in the surrounding watercourses. Additionally, the construction of sedimentation basins, which would be designed in accordance with the Blue Book and to meet the relevant Water Quality Guideline trigger values, would further minimise the potential for a reduction in water quality in surrounding watercourses. Discharge from sedimentation basins, where required, would be undertaken in accordance with the relevant environmental protection licences. This means any discharge water would meet the water quality objectives provided in Table B5.1 and would be of better quality than that within the surrounding watercourses. It is considered unlikely that the proposal would have a material effect on the achievement of the water quality objectives for those catchments within which the proposal is located.

With the implementation of the measures provided in B5.5, and the design control measures in section B5.1.4, pollutant loading to the receiving watercourses would be low and only likely under high-flow conditions. If climatic conditions continue to be as observed over the past few years, the likelihood of high rainfall and subsequent runoff is very low.

B5.4 Impact assessment—operation

During operation, the proposal has the potential to result in water quality impacts, mainly from changes in hydrology (see chapter B2). This could lead to an increase in erosion and sedimentation, and the mobilisation of pollutants from the rail corridor. The proposal would include construction of a rail corridor and new sections of road, which would increase impervious surfaces within the catchments. This could result in increased generation of surface runoff, litter and other pollutants being conveyed to receiving watercourses.

The increase in impervious area is very small relative to the total area of the catchments. The overall impact on surface water quality would be minimal. Runoff from the proposal is expected to be low and not change export of annual pollutant loads to downstream watercourses. As a result, it would be unlikely to decrease water quality during operation.

B5.4.1 Change in pollutants entering watercourses

Contamination of watercourses could occur through increased stormwater runoff containing typical pollutants, such as oils and greases, petrochemicals, and heavy metals, as a result of the operation of rollingstock, track operational wear, and any uncontrolled spills during maintenance activities. Any contamination of watercourses could affect water quality; however, the majority of the watercourses crossed by the proposal are moderately disturbed as a result of existing land use practices. Any contribution of contaminants due to surface runoff from the proposal is anticipated to be minimal.

Maintenance activities would be undertaken in accordance with ARTC's standard operating procedures, which include procedures to handle dangerous goods and hazardous materials and manage spills. This would minimise the potential for water quality impacts due to maintenance activities. As described in section A7.8, freight train services would be provided by a variety of the operators. These operators would be responsible for operating rollingstock such that the potential for impacts on water quality, due to spills from freight loads or leaks from the locomotives themselves, are minimised. An amendment to the POEO Act was passed on 5 July 2019 to include rollingstock operations as a scheduled activity under Schedule 1 of the Act. From August 2020, rollingstock operators on ARTC's network in NSW will require an EPL issued by the EPA. This change means that rollingstock operators' environmental performance outcomes will be regulated by the EPA.

B5.4.2 Erosion and sedimentation

Changes in stormwater flows from any areas that are not adequately stabilised could result in increased erosion and sedimentation impacts. An increase in impervious areas could also result in increased flow volumes and velocities, which have the potential to result in erosion and sedimentation at discharge locations if not adequately mitigated.

During operation, surface water runoff would be controlled through longitudinal (cess) drains and diversion drains. Surface water captured by these drainage structures would be designed to discharge via overland flow. The drainage system would include scour protection at culvert and longitudinal drain outlets to minimise the potential for scouring and erosion. Where appropriate, culvert outlets would be lined to minimise scouring. Appropriate scour protection measures would also be incorporated into the design of bridge piers and abutments, to reduce discharge velocities and minimise the dispersion of sediment laden runoff.

The implementation of appropriate scour protection and the design control measures in section B5.1.4 would not prevent or hinder the development or implementation of any future strategies that may assist in meeting overall water quality objectives for the catchments over the long term.

B5.5 Mitigation and management

B5.5.1 Approach to mitigation and management

Approach to mitigation and management

The assessment identified that if construction is not adequately managed, including managing the potential for erosion and sedimentation, it would have the potential to impact water quality in receiving watercourses.

Constructing the bridges and culverts within watercourses also has the potential to result in localised erosion and sediment transport downstream, particularly where these are constructed in flowing watercourses.

There is limited potential for operation impacts, with the exception of drainage discharges from the rail corridor. The design would include the incorporation of appropriate erosion and scour protection to minimise the potential for impacts on water quality during operation.

Approach to managing the key potential impacts identified

The main risks to water quality are associated with erosion and sedimentation, and works within watercourses. The proposed strategy to avoid and minimise impacts to the water quality of sensitive receiving environments would include preparing a soil and water management plan as part of the CEMP, in accordance with mitigation measure WR6 (see section B2.5). The plan would detail processes, relevant requirements and responsibilities to minimise potential soil and water impacts during construction. The plan would be prepared in accordance with relevant guidelines and standards, including the Blue Book. The development of mitigation measures in the plan would be guided by the Blue Book to determine the magnitude of rainfall events to which the capacity of the construction mitigation measures should be designed. Further information on the CEMP is provided in chapter D5. The requirements for the soil and water management plan are discussed in the CEMP outline provided in Appendix I.

Sedimentation basins would also be constructed throughout the proposal site to capture any sediment-laden runoff. The sedimentation basins would be designed to capture and treat the 80th percentile five-day rainfall event and would be designed in accordance with the relevant requirements of the Blue Book. Sedimentation basins would also be designed so that the discharge is compliant with the Water Quality Guidelines trigger values for protection of aquatic ecosystems, where relevant.

Scour protection measures would be provided at culvert and longitudinal drain outlets to minimise the potential for water quality impacts due to scouring and erosion. Appropriate scour protection measures would also be incorporated into the design of bridge piers and abutments.

Surface water monitoring program

A monitoring program would be developed and implemented to assess water quality prior to discharge of sedimentation basins, at discharge points, and to identify any impacts from construction activities at downstream locations. Given the ephemeral nature of the majority of the watercourses, the discharge points and associated monitoring locations would be determined during detailed design/construction planning. The selection of locations and monitoring of surface water would take into consideration the hydrological attributes of the receiving watercourses.

The monitoring program would include:

- Collection and laboratory analysis of water samples from sedimentation basin discharge points for:
  - Physical properties—pH, total dissolved solids, total suspended solids, turbidity, oil and grease
  - Nutrients—oxidised nitrogen, total nitrogen, ammonia, filterable reactive phosphorus and total phosphorus
  - Contaminants of potential concern—total recoverable hydrocarbons, benzene, toluene, ethylbenzene, xylenes and naphthalene, phenols, polycyclic aromatic hydrocarbons and heavy metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc and mercury).
- Monitoring of water quality parameters at key locations downstream for pH, electrical conductivity, temperature, dissolved oxygen and turbidity
- Visual monitoring of potential points of release of construction water runoff.

Sampling would be undertaken monthly, during a range of wet and dry conditions (where practicable) both prior to, and during, construction.

Surface water monitoring would continue after construction until affected watercourses are certified by a suitably qualified and experienced independent specialist as being rehabilitated to an acceptable condition (or as otherwise required by any conditions of approval).

Approach to managing other impacts

Implementing other relevant measures provided in chapters B2 and B4, including the acid sulfate soils management plan, and the rehabilitation strategy described in section A8.7, would also assist in minimising the potential for water quality impacts during construction.

Expected effectiveness

The implementation of erosion and sediment control measures to manage water quality and hydrology impacts would be in accordance with the requirements of the Blue Book. The measures contained in the Blue Book are based on field experience, tailored to particular project types, and have been extensively used and demonstrated to be effective. In general, the implementation of measures in accordance with the Blue Book will either result in a reduced potential for the impact to be realised or the impact will be avoided (e.g. not undertaking works during wet weather and minimising areas of disturbance); therefore, there is no reason the proposed mitigation measures should not be effective, if implemented in accordance with the Blue Book requirements.

The approach to managing water quality within receiving watercourses has been developed with reference to the water quality management framework defined in the Water Quality Guidelines. These guidelines provide a leading practice framework for managing water quality; therefore, any mitigation measures developed through consideration of this framework would also be expected to be effective.

Monitoring and auditing would be undertaken during construction to ensure that the CEMP relevant sub-plans and the monitoring program are being implemented.

Interaction between measures

Mitigation measures to control impacts on water quality may overlap with mitigation measures proposed for the control of soil and contamination, hydrology and flooding, air quality and waste management impacts. All measures for the proposal would be consolidated and described in the CEMP. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures would be consolidated to ensure consistency and implementation.

B5.5.2 List of mitigation measures

Measures that will be implemented to address potential impacts on water quality are listed in Table B5.4.

TABLE B5.4 WATER QUALITY MITIGATION MEASURES

Stage	Ref	Impact/issue	Mitigation measures
Detailed design/ pre-construction	WQ1	*Water quality*	The design features listed in section B5.1.4 would continue to be refined and implemented to minimise the potential impacts on water quality.
Construction	WQ2	*Discharge to surface water*	Discharge to surface water would be undertaken in accordance with the environment protection licence for construction of the proposal and would consider the hydrological attributes of the receiving waterbody.
	WQ3	*Surface water monitoring*	A surface water monitoring framework would be developed and implemented as part of the soil and water management plan in the CEMP. It would identify: ▸ Monitoring locations at discharge points and selected watercourses where works are being undertaken ▸ Monitoring parameters ▸ Frequency and duration of monitoring. The monitoring framework would include the relevant water quality objectives, parameters and criteria from Technical Report 5. It would be developed in consultation with the Department of Planning, Industry and Environment, and the NSW EPA.
	WQ4	*Dewatering of farm dams that require relocation and/or decommissioning*	A dam dewatering protocol would be developed as part of the soil and water management plan. It would consider: ▸ Options for reuse of water in the dam ▸ Licensing and approval requirements, where relevant ▸ The quality and quantity of the water to be released, where relevant ▸ Strategies to minimise impacts on native, threatened or protected species ▸ Strategies to minimise spread of nuisance flora and fauna species.
Operation	WQ5	*General water quality management*	The proposal would be managed in accordance with the water quality management requirements specified in the environment protection licence.

B5.5.3 Managing residual impacts

Residual impacts are impacts of the proposal that may remain after implementation of:

- Design and construction planning measures to avoid and minimise impacts (see sections A7.2 and A8.1)
- Specific measures to mitigate and manage identified potential impacts (see sections B5.5.1 and B5.5.2).

The key potential water quality issues and impacts originally identified by the environmental risk assessment (see section A9.1) are listed in Table B5.5. The (pre-mitigation) risks associated with these impacts, which were identified by the environmental risk assessment, are provided. Further information on the approach to the environmental risk assessment, including descriptions of criteria and risk ratings, is provided in section A9.1.

The potential issues and impacts identified by the environmental risk assessment were considered as part of the water quality impact assessment, summarised in sections B5.3 and B5.4. The mitigation and management measures (listed in Table B5.4) that would be applied to manage these impacts are also identified. The significance of potential residual impacts (after application of these mitigation measures) is rated using the same approach as the original environmental risk assessment. The approach to managing significant residual impacts (considered to be those rated medium or above) is also described.

TABLE B5.5 RESIDUAL IMPACT ASSESSMENT—WATER QUALITY

Assessment of pre-mitigated risk (see section A9.1 and Appendix E)					Mitigation measure (see Table B5.4)	Residual impact assessment			
Phase	**Potential impacts**	**Likelihood**	**Consequence**	**Risk rating**		**Likelihood**	**Consequence**	**Risk rating**	**How residual impacts will be managed[1]**
Construction	Increased sediment loads during rainfall events and from discharge of sediment-laden wastewater	Possible	Major	High	WR6, WQ2 and WQ3	Rare	Moderate	Low	n/a
	Increased alkalinity and pH of watercourses due to runoff from concrete batching plant operations	Unlikely	Major	Medium	WR6 and WQ3	Rare	Moderate	Low	n/a
	Increased sediment loads due to changes in surface water flow from the presence of construction infrastructure	Possible	Moderate	Medium	WR6 and WQ3	Rare	Moderate	Low	n/a
	Erosion and sediment transport downstream due to works in watercourses	Possible	Major	High	WR6, WQ3 and WQ4	Rare	Moderate	Low	n/a
Operation	Introduction of drainage infrastructure and culverts resulting in water quality impacts	Likely	Moderate	High	WQ1 and WQ5	Rare	Moderate	Low	n/a
	Impact to surface water quality and receiving environments due to increased runoff from increase in impervious surfaces	Likely	Moderate	High	WQ1 and WQ5	Rare	Moderate	Low	n/a

Note:
1. For residual impacts with a risk rating of medium or above.