10 Water quality

This chapter describes the potential impact of the proposed upgrade on water quality of the area. It summarises the approach described in *Working Paper 2 – Water Quality Assessment*.

Environmental assessment requirement	Where addressed
Consideration of water quality impacts to the catchments of Emigrant Creek and Wilsons River, in consultation with Rous Water	Section 10.8 and 10.9
Consideration of water quality impacts from both accidents and runoff (i.e. acute and chronic impacts) taking into account and considering relevant public health and environmental water quality criteria specified in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000*	Section 10.8 and 10.9

10.1 Assessment approach

The assessment of water quality impacts and the development of mitigation measures for the proposed upgrade involved:

> Review of existing conditions in Emigrant Creek and Wilsons River catchment areas.
> Consultation with Rous Water and local community members.
> Hydrological analysis to determine run-off flows from the proposed upgrade.
> Literature review of potential impacts on water quality associated with highway drainage.
> Defining the proposed treatment approach to be used for the separate catchment areas.
> Development of construction water quality treatment measures based on guidelines in Managing Urban Stormwater – Soils and Construction 4th Edition (Landcom 2004).
> Development of operational water quality treatment measures based on guidelines in AP-R232 – Guidelines for treatment of stormwater runoff from the road infrastructure published by Austroads (2003b), RTA document – Procedure for selecting treatment strategies to control road runoff (2003), and more generally from best-practice measures.
> Development of a MUSIC water quality model to assess the performance of proposed operational treatment measures.
> Review and discuss potential chronic and acute pollution impacts and performance of treatment measures proposed for Pacific Highway upgrade.

10.2 Existing water system

As discussed in **Chapter 9 - Hydrology,** there are four named creeks that would be either crossed by or be in the immediate vicinity of the proposed upgrade. These are

> Emigrant Creek.
> Skinners Creek.
> Byron Creek.
> Tinderbox Creek.

Between Martins Lane at Knockrow and Broken Head Road at Newrybar the proposed upgrade would pass through the drinking water catchment area for the Emigrant Creek dam for a distance of 5.2 km. Thereafter the proposed upgrade would be in the drinking water catchment area for the proposed Lismore source water extraction facility on the Wilsons River until the alignment enters the tunnel under St Helena hill, a distance of 7.2 km. The existing Pacific Highway passes through both of the drinking water catchments detailed above for distances of 4.8 km and 8.4 km respectively. The proposed upgrade and drinking water catchment areas are shown in **Figure 10.1**.

South of the Emigrant Creek dam catchment the proposed upgrade would be within the catchment of the section of Emigrant Creek immediately downstream of the dam. North of St Helena hill, runoff from the proposed upgrade would enter Simpsons Creek and ultimately the Brunswick River to the north.

10.3 Drinking water supply overview

Rous Water is a single purpose County Council with a primary responsibility to supply water in bulk to the local government areas of Lismore, Byron, Ballina and Richmond Valley.

Water presently comes from two main sources Rocky Creek dam and Emigrant Creek dam. Other minor sources include plateau bores and Woodburn bores.

Rocky Creek dam was constructed in 1953 and has a capacity of 14,000 ML and a safe yield of about 11,600 ML per annum. Emigrant Creek dam was originally constructed in 1967-68 to provide a water supply to Lennox Head and Ballina. In the late 1990s Rous Water decommissioned the supply from Emigrant Creek dam due to concerns about the raw water quality. A new water treatment plant at the dam wall was opened in January 2006 and the dam is now used to supplement the drinking water supply from Rocky Creek dam. Its capacity is 820 ML with a safe yield of about 2,600 ML/annum although this will fall to 1,600 ML/annum in the future due to modified environmental flow requirements downstream of the Emigrant Creek dam.

The Rous Water *Regional Water Management Strategy* which was adopted in 1995 (and was amended in 2004) presented a range of options to meet water requirements. Rous Water adopted four actions from the strategy:

> Investigate and develop alternative water sources such as reuse, where appropriate.
> Implement demand management measures.
> Develop the Lismore Source.
> Develop Dunoon dam.

Rous Water plays an active role in catchment management to assist in producing good, clean drinking water. Particular emphasis in the Emigrant Creek dam catchment has been focused on the provision of healthy riparian buffer zones.

Rous Water has also been undertaking demand management to reduce the demand for water, however, with the growth in population in the area, the existing supplies are considered not adequate to meet Rous Water's future needs. They are therefore proceeding with the augmentation of the supply by the development of a new water source near Lismore.

The proposed new water source is referred to as the Lismore source and will consist of a pump station extracting up to 30 ML/day of water from the upper reaches of a tidal pool in the Wilsons River about 5 km upstream of Lismore (Howards Grass). The proposed Lismore source is currently under construction. The extracted water will be pumped as required to the Nightcap water treatment plant, where it will enter the Rous Water distribution network.

10.4 Emigrant Creek dam catchment

10.4.1 Catchment description

Emigrant Creek dam

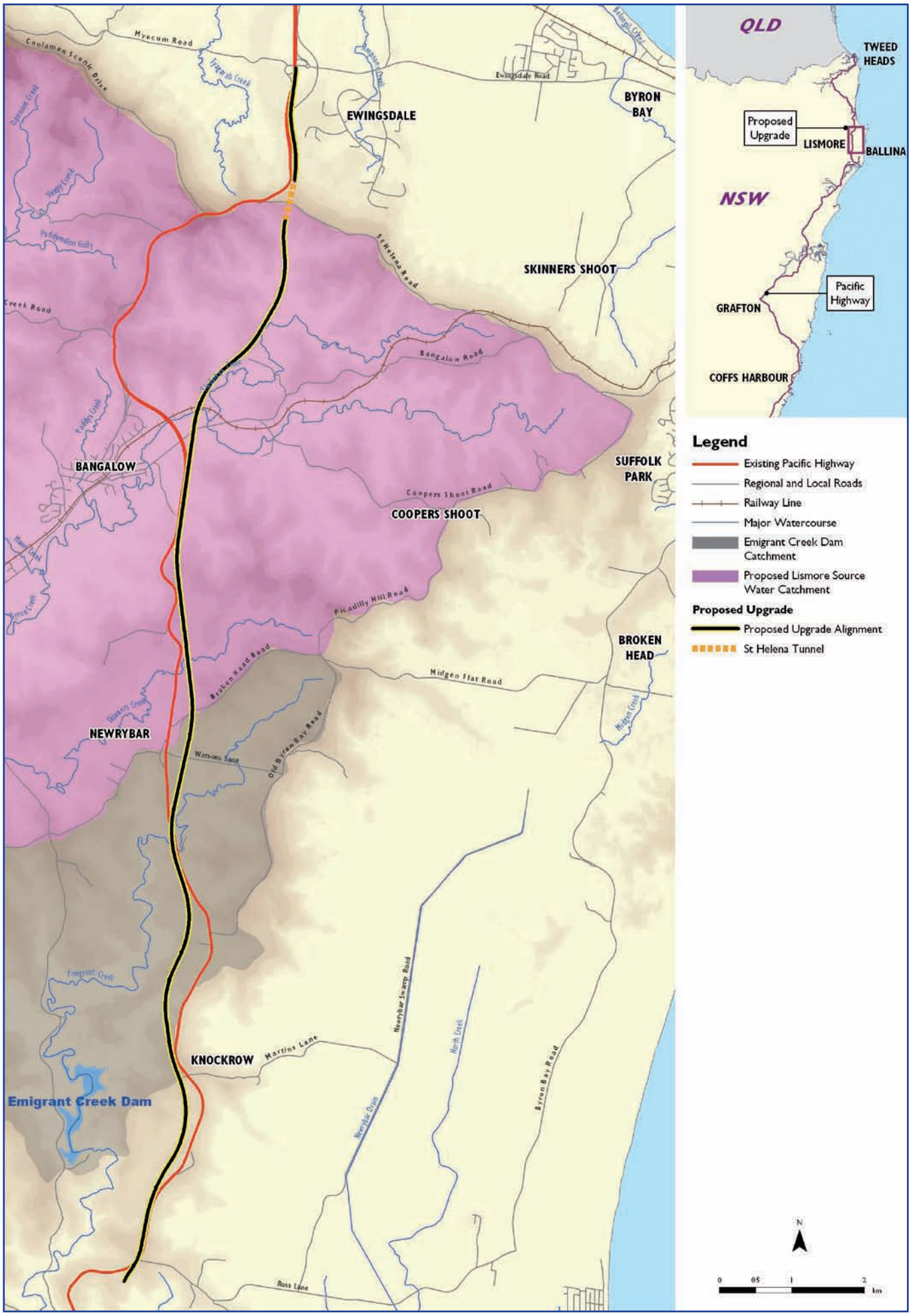
Emigrant Creek drains a catchment of 1,960 ha, consisting of a variety of land uses including grazing and horticulture (mainly macadamia plantations), which together comprise over 77 percent of the total area. Other landuses include residential, nurseries and other horticulture including orchards and plantations of banana, coffee and stone fruit. Only a small percentage (7.7 percent) of the catchment is bushland, most of which surrounds the bottom half of Emigrant Creek dam (Rous Water 2004 in SKM 2005).

10.4.2 Existing water quality in the Emigrant Creek dam catchment

Egis Consulting conducted a Drinking Water Quality Risk Management Review (2001) which identified the following major risks associated with various land uses in the Emigrant Creek dam catchment:

> Septic tank/infiltration systems – water quality results do not indicate excessive export of coliforms however this remains a risk.
> Macadamia Castle tourist development (due to its small zoo, high level of use and proximity to a small watercourse that drains into Emigrant Creek).
> Creek systems used for cattle watering.
> Pathogens from dairy farms.
> Pesticide spills from farms.
> Contamination from dip sites.

Figure 10.1 - Drinking water catchment areas



Rous Water commissioned SKM Consulting to undertake a review of existing water quality data in Emigrant Creek (SKM 2005). This report suggested that Emigrant Creek suffers from poor water quality, particularly during and following wet weather. The main water quality indicators of concern were nutrients and E.coli.

As part of the assessments for the proposed upgrade, further water quality sampling was undertaken by The Ecology Lab Pty (documented in *Working Paper 5 – Aquatic ecology assessment*). Though based on less robust data, The Ecology Lab formed similar conclusions to SKM in respect of the prevailing water quality.

10.5 Proposed Lismore source catchment

10.5.1 Catchment description

Minor creekline in the upper Wilsons River catchment indicating typical catchment land use.

The proposed upgrade is at the far upstream end of the catchment for the proposed Lismore source. Runoff from the proposed upgrade would enter the Wilsons River via Tinderbox, Byron and Skinners creeks. Tinderbox Creek joins Byron Creek east of Bangalow. Skinners Creek joins Byron Creek west of Bangalow. Byron Creek has its confluence with the Wilsons River near Nashua (about 7.5 km to the south-west of Bangalow). The off-take point for the proposed Lismore source is approximately 61 km downstream of the proposed upgrade.

The catchment area for the Wilsons River at Lismore is approximately 1,400 km^2. The catchment includes the steep and dissected plateau of the Nightcap and Koonyum Ranges, near the coast, running west to the Lofts Pinnacles. The component of the catchment in the vicinity of the proposed upgrade is similar in character to that of the Emigrant Creek dam catchment, being predominantly rural.

10.5.2 Existing water quality in the proposed Lismore source catchment

As stated above The Ecology Lab undertook some water quality sampling on Byron and Skinners creeks which form part of the Wilsons River Catchment. Though the sampling was limited, it indicated water quality in these creeks reflects the rural nature of the catchment and is similar to water quality on the Emigrant Creek dam catchment.

The Environmental Impact Statement for The Lismore Source (Parsons Brinkerhoff 2006) indicates that a water quality monitoring program was undertaken by Rous Water in the vicinity of the off-take point, from 2002 to 2005. The water quality at the proposed Lismore Source was considered to be acceptable as a raw source of drinking water.

Rous Water engaged the NSW Department of Commerce to carry out an assessment of the water quality risks in supplying their customers with drinking water pumped from the proposed Lismore Source and treated at Nightcap water treatment plant.

Their report *Wilsons River Risk Assessment – Risk Assessment and Mitigation Measures Report* (Department of Commerce 2005) identified that the highest risk events that could affect water quality were:

> Runoff from storms washing potentially harmful micro-organisms from sewerage systems into the river.
> Storms washing soils and phosphorus from farmland into the river.
> Pollutants moving upstream with the tide to the extraction point.
> Low river flow and high nutrient concentrations leading to high algal concentrations, and consequently toxicity, taste and odour problems.

Other events that were considered to have high consequences, but were assessed as having a low overall risk included:

> Terrorist attack.
> Chemical spills from traffic accidents.

These low risk events were considered to be best managed through an Emergency Response Plan rather than as part of normal operational procedures.

10.6 Consultation

10.6.1 Stakeholder workshops

Throughout the duration of the project the RTA and Arup have conducted a number of workshop sessions in order to ensure that the interests of all the project stakeholders are correctly defined and addressed appropriately.

As a key stakeholder to the project Rous Water were invited to attend all of these workshop sessions. Representatives of Rous Water did not attend the first planning focus meeting however representatives attended all of the four subsequent workshop sessions.

During the assessment of potential route options and identification of the preferred route for the upgrade, the RTA met with representatives of Rous Water prior to the value management workshop sessions in order to review their key issues and concerns.

10.6.2 Rous Water workshops and meetings

Further to the stakeholder workshops there has been significant additional consultation with Rous Water representatives in respect of the potential water quality impacts arising from the proposed upgrade.

As a result of concerns raised by Rous Water following the value management workshop further meetings and workshops were arranged so that key issues regarding the potential impacts on the drinking water catchment areas are adequately addressed in the development of the project proposals.

The meetings and workshops were supplemented by regular exchange of correspondence with Rous Water. Throughout this process the primary emphasis of Rous Water concerns has been on the potential impacts of the proposed upgrade on the Emigrant Creek dam and its catchment area.

The consultation with Rous Water influenced the scope of the water quality impact assessment, for example detailed risk analyses (both in relation to chronic and acute risks) were carried out as a result of the consultation, to accurately assess likely impacts on the Emigrant Creek dam water supply as well as to help identify the most appropriate water treatment method.

The key meetings and workshops arising from this consultation process are detailed below:

> **Meeting with Rous Water**
May 2006, Lismore.
Meeting to present Storm Consulting to Rous Water and outline proposed water quality modelling work to be undertaken prior to finalisation of preferred route.

> **Meeting with Rous Water**
June 2006, Lismore.
Presentation given by Arup and Storm Consulting detailing the examination of chronic water quality risks associated with proposed upgrade and potential management strategies. Agreement to undertake a water quality impacts risk assessment to include acute risks.

> **Meeting with Rous Water**
October 2006, Lismore.
Meeting to discuss findings of water quality impacts assessment. Agreement to hold risk workshop in December 2006.

> **Visit to Emigrant Creek Dam Water Treatment Plant**
November 2006, Emigrant Creek Dam.
Visit by Arup and Storm Consulting to WTP to assist in understanding and defining the water supply operation and the potential risks of the proposed highway upgrade.

> **Risk Workshop**
December 2006, Ballina.
Risk workshop, independently facilitated by Urbis JHD, to develop a joint risk register for water quality impact risks arising from the proposed highway upgrade. Workshop attended by representatives from Rous Water, RTA, Arup, Storm Consulting and Sydney Catchment Authority.

> **Meeting with Rous Water**
July 2007, Ballina.
Workshop / meeting to present and discuss results of further assessment works of water quality impacts from the proposed upgrade at Emigrant Creek. Review of 21 Management Strategies recommended by Rous Water in their submission of 20 April 2007.

> **Meeting with Rous Water**
November 2007, Lismore.
Meeting with Rous Water to provide update on key issues detailed in Rous Water submissions of 20 April 2007 and 24 October 2007. Review of status of chronic and acute water quality impact assessment work undertaken by Arup and Storm Consulting.

> **Meeting with Rous Water**
March 2008, Lismore.
Meeting with Rous Water to provide update on status of environmental assessment of proposed upgrade and program for lodging project proposal with NSW Department of Planning. Review of work undertaken and proposed mitigation for proposed upgrade in Emigrant Creek dam and Wilsons River catchments.

10.6.3 Community representations

A number of representations have been made by members of the community during the environmental assessment and concept design phase of the project in relation to the potential impact of the proposed upgrade on water quality.

The submissions have focused on the route selection process and the consideration given to the potential impact of the route options on Emigrant Creek dam and its surrounding catchment area.

10.7 Water quality guidelines

There are several water quality criteria routinely applied in NSW and more broadly in Australia and overseas. In order to assess the potential water quality impacts associated with the proposed Tintenbar to Ewingsdale Pacific Highway upgrade the following water quality performance targets have been reviewed:

> ANZECC Guidelines for Fresh and Marine Water Quality (2000).
> Australian Drinking Water Guidelines (NHMRC 2004).
> NSW Department of Environment and Climate Change (DECC) stormwater quality guidelines – current and proposed.
> Richmond River Water Quality Objectives in conjunction with "Using the ANZECC Guidelines and Water Quality Objectives in NSW" (DEC, undated).
> UK Highways Agency, Design Manual for Roads and Bridges, Volume 11, Section 3 Environmental Assessment Techniques, HA 216/06 Road Drainage and the Water Environment.

The ANZECC guidelines provide a framework tool for catchment managers to assess and manage ambient water quality in a particular resource. The guidelines contain default trigger values for assessing aquatic ecosystem health however these values are not meant to be applied directly to stormwater quality unless the stormwater system is regarded as having conservation value.

In terms of drinking water quality, the ANZECC guidelines refer directly to the Australian Drinking Water Guidelines. These provide general guidance on managing drinking water supplies. They also include guideline values for various drinking water characteristics which are aimed at the quality of water that is drunk by humans. No guidelines values are provided in terms of quality of water entering a water supply catchment or system.

Numerical guidelines included in ANZECC (2000) and the Australian Drinking Water Guidelines are therefore not considered appropriate to assess the water quality impacts of a major road project in isolation. The principles associated with these guidelines were however considered in the route selection process and the development of the concept design for the proposed upgrade.

DECC has water quality criteria which are applicable to any new development in NSW. The specific pollutant retention targets as shown in **Table 10.1** below.

Table 10.1 - DECC current and proposed stormwater pollutant retention criteria

Pollutant	Current guideline Minimum retention (%) of the average annual load	Draft guideline Minimum retention (%) of the average annual load
Total Suspended Solids	80%	85%
Total Nitrogen	45%	45%
Total Phosphorus	45%	65%
Oil and Grease	None visible	None visible

The current guidelines were introduced in the document *Managing Urban Stormwater: Council Handbook - Draft* (EPA 1997) and provide guidance for local government agencies to adopt into their stormwater management plans.

The draft guidelines were issued for consultation in 2007. The changes in minimum retention values represent improvements in best management practices for the treatment of stormwater runoff and the values have subsequently been adopted by a number of NSW council areas in respect of their water quality management guidelines.

The targets are measured by comparing a proposed development without any water quality treatment against a proposed development with treatment.

The DECC criteria have been developed to ensure that receiving waters are afforded suitable levels of protection without imposing a severe burden on developers. These criteria have been widely tested by the DECC and reflect the need to manage the critical water quality parameters of concern in NSW i.e. sediments and nutrients. These criteria however have wider effects because in the context of a stormwater treatment train, retention of soluble nutrients may also result in the retention of other pollutants typically found in stormwater.

The guidelines provided by the DECC requiring specific pollutant retention targets were identified as being appropriate criteria to apply to potential water quality impacts from the proposed upgrade in the Emigrant Creek catchment via the modelling of potential treatment options.

For the remaining sections of the proposed upgrade, including the section in the Wilsons River catchment area, it is proposed that water quality impacts would be managed in accordance with recommended minimum design standards for erosion and sediment control during the construction and operation of main roads. Proposed measures would also provide appropriate spill containment in order to minimise acute water quality impact risks.

In addition to the DECC guideline values discussed above, the guiding principles listed in the Australian Drinking Water Guidelines were considered. **Table 10.2** identifies the project response to each of these guiding principles.

Table 10.2 - Project response to the guiding principles of the Australian Drinking Water Guidelines

Guideline Principle	Project Response
The greatest risks to consumers of drinking water are pathogenic microorganisms. Protection of water sources and treatment are of paramount importance and must never be compromised.	The proposed upgrade would be a potential source of pathogens. The sediment removed as part of the proposed treatment train would play a major role in reducing the concentration of pathogens entering receiving waters.
The drinking water system must have, and continuously maintain, robust multiple barriers appropriate to the level of potential contamination facing the raw water supply.	The Rous Water treatment system contains multiple barriers. Additional barriers would be added as part of the treatment train for the proposed upgrade.
Any sudden or extreme change in water quality, flow or environmental conditions (e.g. extreme rainfall or flooding) should arouse suspicion that drinking water might become contaminated.	Sediment basins are proposed, that would retain runoff from most storm events. Ongoing communication between Rous Water and the RTA would assist in identifying any contamination after extreme events.
System operators must be able to respond quickly and effectively to adverse monitoring signals.	The RTA would work closely with other stakeholders to prepare an emergency response plan for incidents occurring on the road network within the catchment area
System operators must maintain a personal sense of responsibility and dedication to providing consumers with safe water, and should never ignore a consumer complaint about water quality.	The RTA acknowledges Rous Water's commitment to providing safe drinking water.
Ensuring drinking water safety and quality requires the application of a considered risk management approach.	The risks to drinking water quality (both acute and chronic) have been carefully considered in both the route selection and environmental assessment process.

10.8 Construction phase water quality impacts

The construction phase of the proposed upgrade has the potential to generate pollutants which could affect water quality.

The primary potential impact on water quality during construction would be due to increased sediment loads from exposed soil entering receiving waters during wet weather. Increased sedimentation of watercourses can smother aquatic habitats and organisms, and can increase levels of nutrients, metals and other potential toxicants that attach to sediment particles. Other pollutants that may potentially affect water quality during the construction period include:

> Hydrocarbons and chemicals as a result of spills and leakages from construction vehicles or fuel / chemical stores on construction sites.
> Litter and gross pollutants from construction material and activities.

The risks are best managed by the application of *Managing Urban Stormwater – Soils and Construction Volume 2D – Main Road Construction* guidelines together with comprehensive construction management measures.

During the development of the detail design a specialist soil conservation consultant would be engaged by the RTA to assist in the development of the erosion and sediment control measures and strategies.

Water quality impacts are discussed over in terms of chronic (or day to day) impacts and acute impacts (which result from a one-off severe event). Based on the operation and maintenance of the proposed water treatment methods described in **Section 5.10.**

10.8.1 Chronic water quality impacts during construction

Water quality during construction is proposed to be managed primarily through a series of sediment basins. An initial concept for the sediment basin location and size has been developed. This is shown in **Figures 9.2a-e in Chapter 9.**

Outside the Emigrant Creek dam catchment (including in the catchment for the proposed Lismore source) the basins are to be designed to capture and treat the 80th percentile 5 day rainfall event. This design capacity level meets the requirements specified *Managing Urban Stormwater – Soils and Construction Volume 2D – Main Road Construction* (Landcom 2004).

The Emigrant Creek dam catchment is considered more sensitive to water quality impacts due to the proximity of the proposed upgrade to the dam and the water treatment plant off take. The basins in this catchment are therefore proposed to have a higher capacity than those discussed above. These sediment basins are proposed to capture all runoff from the 85th percentile, 5 day rainfall event.

Where space permits basins are proposed to accommodate an additional 5 percent. This method provides a conservative basin volume.

Construction impacts to water quality up to the respective design storm events both within and outside the Emigrant Creek dam catchment would be expected to be minimal.

It should be noted however that a larger storm event could result in overtopping of basins and the potential deposition of sediment and associated pollutants into receiving waters.

Additional measures designed to further minimise impacts are described in **Section 10.10.**

10.8.2 Acute water quality impacts during construction

Risks of acute water quality impacts during construction are primarily in relation to spills or leaks of fuels / oils and other machinery liquids such as radiator coolants which could arise from negligence, accident or deliberate sabotage.

Sediment basins in all catchments would be of a size that would capture a very large spill of this nature. The likelihood of a spill entering waterways is therefore minimal. In

addition secondary treatment measures such as sediment fencing, erosion controls within sub-catchments, temporary vegetation and diversion banks would provide some level of protection to nearby waterways.

Additional measures that would further minimise the risk and consequences of an acute event during construction are described in **Section 10.10.**

10.9 Operational phase water quality impacts

The assessment of water quality impacts has identified that the section of upgraded highway that passes through the Emigrant Creek dam catchment has the potential to have a greater consequence on drinking water quality as a result of any pollutants contained in the surface water runoff. A greater level of detail has therefore been undertaken in assessment of water quality impacts for the Emigrant Creek dam catchment.

Water quality impacts are assessed in terms of potential chronic and acute impacts.

Refer to **Section 5.10** for a description of the water treatment train and maintenance requirements of water treatment measures.

10.9.1 Chronic water quality impacts during operation

Water quality outside the Emigrant Creek dam catchment (including in the catchment for the proposed Lismore source) would primarily be managed during operation through conversion of construction sediment basins to operational wet basins in accordance with normal RTA practice. Additional water quality management would occur through the filtering effect of landscape treatments, which would cover the majority of the road reserve beyond the carriageways. The risk to water quality within Byron, Skinners and Tinderbox creeks, as well as Emigrant Creek downstream of the dam, would be reduced as a result of the transfer of the majority of traffic to the proposed upgrade which would have a higher level of treatment than the existing highway.

Impacts to water quality at the proposed Lismore source as a result of the upgrade would be expected to be minimal given the above treatment methods and large distance downstream of the extraction point from the proposed upgrade.

Due to the proximity of Emigrant Creek dam to the proposed upgrade it was identified that a more sophisticated treatment option for stormwater runoff from the proposed upgrade should be provided within the catchment area for the dam. Additionally the stormwater runoff from the section of existing Pacific Highway which is realigned at Emigrant Creek would be passed through the proposed treatment option prior to discharge.

The proposed water quality management option for the Emigrant Creek catchment was to convert the construction sediment basins, sized to capture all runoff from the 85th percentile 5 day rainfall event, to a permanent bioretention basin using sand as a filter medium. In addition a gross pollutant trap would be provided upstream of the sand filter to prevent large debris clogging the filters and adversely affected their performance.

Detailed assessment of the performance of the proposed treatment was carried out in relation to operational water quality impacts within its catchment. Water quality modelling was carried out, using the MUSIC water quality model, for key pollutants to predict the

performance of the proposed sediment basins. Two separate models were developed, so that the quality of runoff from the existing highway (pre-upgrade) could be compared with the post-upgrade situation where runoff would occur both from the existing highway (with reduced vehicle use) and the proposed upgrade.

Based on the performance of similar sediment basins, the key pollutants modelled are considered as appropriate indicators of the ability of the basins to remove other pollutants such as heavy metals (refer to *Working Paper 2 – Water Quality Assessment* for more details on the likely relationship between removal of modelled pollutants and other pollutants).

The comparison between pre-development and post-development pollutant loads in the Emigrant Creek dam catchment are shown in **Table 10.3.**

Table 10.3 - Comparison of pre-upgrade and post-upgrade annual pollutant loads for Emigrant Creek catchment

	Pre-upgrade	Post-upgrade	% change
Total Suspended Solids (tonnes/yr)	51.6	24.9	52% reduction
Total Phosphorus (kg/yr)	121	61	50% reduction
Total Nitrogen (kg/yr)	685	590	14% reduction

The modeling results indicate that the proposed upgrade would result in a reduced pollutant load entering the Emigrant Creek dam catchment compared to the current situation. This reduction would be mainly due to the transfer of the majority of traffic from the existing highway onto the proposed upgrade, where there would be high level water quality controls.

The compliance of the proposed water quality treatment with the DECC criteria discussed in **Section 10.7** above is shown in **Table 10.4.** These results are also based on the water quality modelling undertaken and compare the quality of runoff before treatment to the quality of runoff after treatment.

Table 10.4 - Comparison of predicted annual pollutant retention with DECC criteria for Emigrant Creek catchment

	Before treatment	After treatment	Percent retention	Current DECC criteria	Draft DECC criteria
Total Suspended Solids (tonnes/yr)	99	13.9	86%	80	85
Total Phosphorus (kg/yr)	180.6	42	77%	45	65
Total Nitrogen (kg/yr)	846	467	45%	45	45

The results of **Table 10.4** indicate that the proposed upgrade would meet both current and proposed DECC criteria.

In developing the detailed design for the proposal further modelling and design refinement may occur to optimise performance and function of the water quality treatment measures. Through this process other design solutions that also provide compliance with the load reduction and pollution criteria may be considered.

10.9.2 Acute water quality impacts during operation

A chemical spill resulting from a road traffic accident on the proposed upgrade may present a risk to the quality of Emigrant Creek water supply. To identify the magnitude of this risk, a detailed acute risk assessment was undertaken in relation to the Emigrant Creek dam catchment. This assessment included the identification of the likelihood and consequences of a major spill from a vehicle carrying dangerous goods (which are categorised as explosives, flammable gases, flammable liquid, flammable solids, oxidising agents, organic peroxides, toxic and infectious substances, radioactive substances, or corrosives).

The estimated probability of an accident involving a dangerous good vehicle and a spill of greater than 150 kg is shown in **Table 10.5** below. A comparison is made between scenarios with and without the proposed upgrade.

Table 10.5 - Dangerous goods vehicle accident and spill probabilities

Scenario	Probability of dangerous goods vehicle accident	Probability of dangerous goods vehicle accident involving a spill greater than 150 kg
Highway not upgraded	1 in 2.7 years	1 in 63 years
Highway upgraded	1 in 12.8 years	1 in 298 years

The reduction in likelihood of accidents and spills shown in **Table 10.5** can be attributed to the improved design standards of the proposed upgrade compared to the existing highway.

The risk assessment suggests that under dry conditions a large spill (up to 20,000 litres) would be fully contained within the proposed basins. Wet weather would result in an increased risk of pollutants entering the creek system and the main body of the dam however it is estimated that even under wet conditions, less than 1 percent of any given spill is likely to enter the water treatment plant intake. The likelihood of pollutants entering the water supply system if they reach the water treatment plant is further reduced due to:

> The plant process itself, which includes a range of measures for reducing the concentrations of various pollutants that may result from a spill.

> Rous Water's existing procedures that include a spill notification procedure from emergency services and the ability to shut down the Emigrant Creek supply temporarily with no supply interruption to customers.

The acute risk to the proposed Lismore source could be expected to be substantially lower than the risk to Emigrant Creek dam due to the large distance between the proposed upgrade and the extraction point.

10.10 Management of impacts

10.10.1 Management of impacts during construction

Water quality would be primarily managed through the design measures described in **Section 5.10.** A number of other activities would be undertaken during construction however to minimise impacts on the downstream creek system. These include:

> Top soil would be stockpiled and reused during vegetation. Stockpile heights would be minimised to limit wind erosion.

> Disturbed areas would be limited to only those areas which need to be worked on at that point in time and areas will be rehabilitated and sealed as soon as possible following construction.

> Batter slopes would be minimised to ensure that minimum possible area is disturbed.

> Clean run on water would be diverted around all works using diversion drains.

> Construction of sediment basins as early as practical in the construction process.

> Establishment of effective procedures for the recovery of spilt materials.

> The sediment basins would be operated to ensure that sediment is removed when the sediment storage zone has reached 80 percent of capacity.

> Sediment basins would be flocculated with appropriate, approved flocculants to enhance the settling of dispersible and small sediment particles.

> Best practice soil and water management would also put in place. This would include the use of sediment fences, check dams, level spreaders and other devices to mitigate the export of soil from the site.

> Trees would be mulched on site and the mulch used in the revegetation and stabilisation of the site.

> Top soil dressing and revegetation would take place as soon as possible.

> Revegetation would only use native endemic species.

> Temporary sterile grass covers would be used to seal areas whenever practical.

> The use of floating booms shall be made where major crossings and permanent pools are put at risk from construction activities.

> All storages of fuel and chemicals would be bunded and stored in approved storage containers.

> Steep batter slopes would be sealed using jute matt or mesh as appropriate or equivalent erosion control blankets would be employed. These would be biodegradable.

> During the development of the detail design a soil conservation consultant would be engaged by the RTA to assist the design and implementation of best practice measures to ensure that water quality objectives for the project are achieved.

10.10.2 Management of impacts during operation

Management of water quality impacts during operation would focus on the appropriate maintenance of sediment basins and the landscape treatments within the road reserve. Adaptive management measures would be developed to ensure that the performance of

the water quality treatment measures remain satisfactory in the event that future rainfall events increase in either frequency or intensity.

Regular maintenance inspections would be conducted, with appropriate recording to identify and rectify general problems, including:

> Areas of erosion, sediment deposition and/or poor vegetative cover.
> Blocked drains and gross pollutant traps.
> Slumped batters.
> Sediment basins or other stormwater treatment measures requiring maintenance or repair.

In addition a detailed emergency response plan would be developed, in consultation with key stakeholders, including NSW Fire Brigade, NSW Police, Rous Water and the RTA, to ensure that the appropriate response is provided to any major incident on the highway which may impact on water quality. Operational measures would include appropriate signage within the catchment areas to ensure that road users alert the appropriate authorities in the event of an incident occurring.