Surface Water Monitoring Program

Nambucca Heads to Urunga Pacific Highway Upgrade

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Nambucca Heads to Urunga Pacific Highway Upgrade

Prepared for: Roads and Maritime Services

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Introduction

This document presents the Surface Water Monitoring Program for the northern section of the Warrell Creek to Urunga (WC2U) Pacific Highway Upgrade. The northern section of the highway upgrade covers a distance of approximately 22 kilometres from Nambucca Heads to Urunga (termed 'NH2U' in this report), which runs from design chainage 19,500 m to 41,300 m.

The purpose of this document is to detail a monitoring program for surface water quality for pre-construction, construction and post-construction stages of the NH2U section of the Pacific Highway Upgrade. This document forms part of an overall Water Quality Monitoring Program for the Warrell Creek to Urunga Pacific Highway Upgrade which includes the following accompanying documents:

- Groundwater Monitoring Program - Nambucca Heads to Urunga Pacific Highway Upgrade;
- Groundwater Monitoring Program – Warrell Creek to Nambucca Heads Pacific Highway Upgrade; and
- Surface Water Quality Monitoring Program – Warrell Creek to Nambucca Heads Pacific Highway Upgrade.

1.1 Project Overview

The Warrell Creek to Urunga Pacific Highway Upgrade involves an upgrade of the existing highway to four lane divided highway from the existing Allgomera deviation, south of Warrell Creek, to Waterfall Way at Raleigh north of Urunga. The proposed upgrade extends over approximately 42 kilometres.

The Warrell Creek to Urunga (WC2U) project was identified as a critical infrastructure project by the NSW Government, designed to improve safety, traffic efficiency and increase capacity along the Pacific Highway. It forms part of the overall program for upgrading the Pacific Highway. Planning commenced on the WC2U project in 2003 and project approval was granted on 19 July 2011, under Part 3A of the *Environmental Planning and Assessment Act 1979*.

The 22 kilometre section of the highway upgrade from Nambucca Heads to Urunga has been agreed between the Australian and NSW Governments with major construction likely to commence in 2013. Therefore the Water Quality Monitoring Program for the Warrell Creek to Urunga Pacific Highway Upgrade has been divided into the two highway upgrade sections: Warrell Creek to Nambucca Heads (WC2NH) and Nambucca Heads to Urunga (NH2U).

As part of the Proposal's approval, preparation and implementation of a Water Quality Monitoring Program is required to address the Minister for Planning and Infrastructure's Condition of Approval (CoA) B17, and Sections 2.15.4, and Commitments W3, W6, W7 of the "Warrell Creek to Urunga Submissions and preferred project report" (hereafter referred to as the 'Submissions Report'). Requirements outlined in each of the Conditions and relevant section of the Submissions Report is provided in **Section 1.2**.

1.2 Regulatory Context

1.2.1 Environmental Assessment

The Minister for Planning declared on 5 December 2006 that the Warrell Creek to Urunga upgrade is a project to which Part 3A of the *Environmental Planning and Assessment Act 1979* applies. In accordance with the requirements of the *Environmental Planning and Assessment Act 1979*, an environmental assessment was prepared (SKM, 2010) to assess the potential impacts of the Proposal.

The environmental assessment for the WC2U project outlined a Draft Statement of Commitments that identified a range of environmental outcomes and management measures required to avoid, minimise, manage, mitigate or offset and/or monitor impacts identified in the environmental assessment. After consideration of the issues raised in the public submissions, the draft statement of commitments for the WC2U project were revised as detailed below.

1.2.2 Statements of Commitments

The revised Statement of Commitments relevant to this Surface Water Quality Monitoring Program are reproduced in **Table 1.1** overleaf.

1.2.3 Conditions of Approval

The project approval documents for the WC2U project (RTA, 2011) include conditions of approval from the NSW Minister for Planning. The condition of approval relevant to this Surface Water Quality Monitoring Program is detailed below.

Condition of Approval B17- Water Quality
The Proponent shall prepare and implement a **Water Quality Monitoring Program** to monitor the impacts of the project on SEPP 14 wetlands, surface water quality and groundwater resources during construction and operation. The Program shall be developed in consultation with OEH [now EPA] and DPI and shall include but not necessarily be limited to:

a) identification of surface water and groundwater quality monitoring locations which are representative of the potential extent of impacts from the project;
b) identification of works and activities during construction and operation of the project, including emergencies and spill events, that have the potential to impact on surface water quality and risks to oyster farming in the Nambucca, Bellinger, and Kalang rivers;
c) representative background monitoring of surface water and groundwater quality parameters for a minimum of six (6) months (considering seasonality) prior to the commencement of construction to establish baseline water conditions;
d) development and presentation of indicators or standards against which any changes to surface water quality will be assessed, having regard to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (ANZECC, 2000);
e) contingency and ameliorative measures in the event that adverse impacts to surface water quality are identified;
f) a minimum monitoring period of three years following the completion of construction or until any disturbed waterways/ groundwater resources are certified by an independent expert as being rehabilitated to an acceptable condition. The monitoring shall also confirm the establishment of operational water control measures (such as sedimentation basins and vegetation swales); and
g) reporting of the monitoring results to the Department, OEH and DPI.

The Program shall be submitted to the Director General for approval six (6) months prior to the commencement of construction of the project, or as otherwise agreed by the Director General. A copy of the Program shall be submitted to OEH [now EPA] and DPI prior to its implementation.

Table 1.1 Statements of Commitments

Outcome	*Ref No.*	*Key Action*	*Timing*	*Reference document*
Water quality and hydrology				
	W3	Monitoring of groundwater impacts and surface water quality upstream and downstream of the site during construction will determine the effectiveness of mitigation strategies Implementation of additional feasible and reasonable management measures will occur if necessary.	Pre-construction and construction	Draft *DECC "Managing Urban Stormwater: Soils and Construction, Volume 2, Book 4, Main Road Construction (2006)".* Volume 2A Installation of Services (DECCW 2008). Volume 2C Unsealed Roads (DECCW 2008). Volume 2D Main Roads Construction (DECCW 2008). Managing Urban *Stormwater: soils and construction* (Landcom 2004). The RTA's *Code of Practice for Water Management – Road Development and Management.* RTA *QA Specification G38 Soil and Water Management.*
Minimise groundwater related impacts	W6	Investigation of the potential for changes in the groundwater table will take place before starting any major earthworks. Where a potential for change is identified, the significance of the change and any resultant impacts will be determined and measures to manage the changes will be designed and implemented as necessary.	Pre-construction and construction	Section 16.4 and table 16-4 of the EA. *RTA's Code of Practice for Water Management – Road Development and Management (1999).* RTA *QA Specification G38 Soil and Water Management.* *Water Act 1912*
	W7	Base line monitoring of groundwater levels and chemical levels at cutting sites near springs, creeks or endangered ecological communities prior to construction commenting.	Pre-construction and construction	Section 16.4.1.3 and table 16-4 of the EA. *RTA's Code of Practice for Water Management – Road Development and Management (1999).* RTA *QA Specification G38 Soil and Water Management.* *Water Act 1912*

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Surface Water Environment and Risks

This section provides background information regarding the surface water environment and the general risks to surface waters posed by the highway upgrade. The information in this section is largely based on the environmental assessment by SKM (2010) for the highway upgrade. The purpose of this section is to provide the context to the surface water management monitoring program which is detailed in **Section 4** of this report.

2.1 Catchment Overview

The study area encompasses portions of the following catchments:

- The Bellinger River Catchment (including the Kalang River);
- Deep Creek; and
- The Nambucca River Catchment.

The Bellinger and Kalang Rivers flow within the same river basin and have a common ocean entrance at Urunga. The confluence of these rivers occurs about 750 m before discharge to the ocean. They comprise a total catchment area of approximately 1,110km2, (770km^2 for the Bellinger and 340km^2 for the Kalang). The catchment area of Deep Creek is 93km^2. The Nambucca River catchment has a total area of approximately 1,310km^2. The Nambucca Heads township is located at the entrance (SKM, 2010c:8).

The Stressed Rivers Assessment Report summary for NSW (DLWC, 1998) classified streams in the study area based on an index of hydrological stress (proportion of water extraction to streamflow estimate) and environmental stress (stream health, conservation value and future risk):

- the Bellinger catchment (both Coastal Bellinger and Coastal Kalang subcatchments) were classified as medium priority subcatchments, with a low hydrological stress but high environmental stress;
- the Lower Deep Creek subcatchment was classified as high priority due to high hydrological stress and medium environmental stress; and
- the Coastal Nambucca subcatchment was classified as low priority, with low hydrological and medium environmental stress (SKM, 2010c:15).

2.2 Waterways

The NH2U highway upgrade crosses a number of waterways along its length. These include freshwater and estuarine systems, and tributaries of an intermittently closed and open lakes and lagoon (ICOLL) at Oyster Creek. There are also a number of wetlands including SEPP 14 wetlands located to the east of the highway upgrade. The main waterways and wetlands relevant to the study area are summarised in **Table 2.1**. The waterways / wetlands are shown in **Illustrations 2.1** to **2.4**.

Table 2.1 Watercourses and Wetlands in the Study Area of the NH2U Highway Upgrade

Chainage	*Waterway Name*	*Freshwater / Estuarine*	*Fisheries Classification*[1]
20,800	Boggy Creek	Freshwater / Estuarine	Class 2 – moderate fish habitat
21,700	Cow Creek	Freshwater / Estuarine	Class 2 – moderate fish habitat
23,100	Deep Creek	Estuarine	Class 1 – major fish habitat
26,400	tributary of Oyster Creek	Freshwater	Class 2 – moderate fish habitat

Chainage	Waterway Name	Freshwater / Estuarine	Fisheries Classification[1]
30,100	McGraths Creek	Estuarine	Class 2 – moderate fish habitat
35,900	Kalang River	Estuarine	Class 1 – major fish habitat
36,200	SEPP 14 Wetland No 351	Freshwater	n/a
39,000	SEPP 14 Wetland No 353	Freshwater	n/a

Source: SKM (2010c)

Notes: 1. classification with respect to the *Policy and Guidelines for Bridges, Roads, Causeways and Similar Structures* (NSW Fisheries,1999).

Boggy Creek, Cow Creek, Deep Creek, and the unnamed tributary of Oyster Creek all have poor water quality. Kalang River has moderate water quality. The SEPP 14 wetlands to the east of the highway upgrade had poor water quality conditions in wet weather (SKM, 2010c:51).

2.2.1 Surface Water and Groundwater Interactions

There are two main types of groundwater regimes likely to be found along the area of the highway upgrade based on geological types and groundwater levels observed in standpipe piezometers. These include foothills and alluvial floodplains. The main interactions between surface water and groundwater are:

- in close vicinity to waterways where base flows are provided largely by relatively shallow local and intermediate groundwater flow systems;
- in wetlands; and
- on alluvial floodplains.

Elsewhere in the study area groundwater levels were generally at a significant depth (greater than 10 m depth) which would limit interaction between surface waters and groundwater.

2.2.1.1 Groundwater in Foothills

The phyllite in the hilly areas exhibits low permeability with the main groundwater transport route being defects in the rock, particularly along veins and foliation partings. Groundwater level measurements in these areas indicated that groundwater levels were generally greater than 10 m depth (SKM, 2010a:370).

2.2.1.2 Groundwater in Alluvial Floodplains

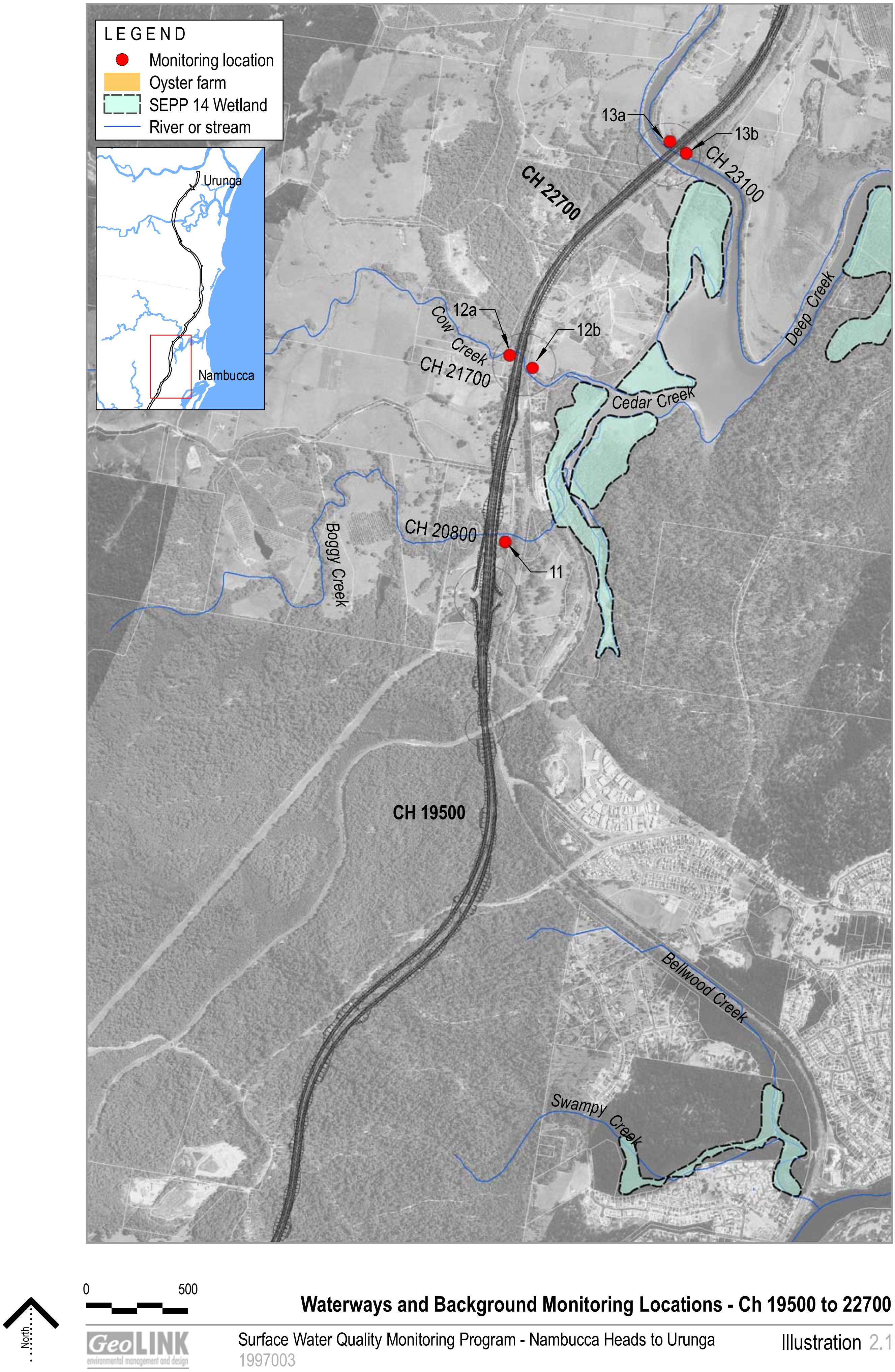
The groundwater found in the alluvial floodplains was high (less than five meters in depth) and typically reflected their proximity to the major water courses. Groundwater levels across the floodplains are likely to fluctuate due to tidal influences by up to 0.5 m (SKM, 2010a:370).

2.2.1.3 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) in the area of the highway upgrade include terrestrial vegetation, base flows in streams, aquifers, or wetlands. Those vegetation communities and habitats with the greatest potential to be affected by changing groundwater levels consist of terrestrial vegetation and wetlands located in the low-lying floodplain areas intersected by the proposed highway upgrade, including:

- Swamp oak floodplain forest;
- Swamp sclerophyll forest;
- Subtropical coastal floodplain forest;
- Lowland rainforest; and
- Freshwater wetlands.

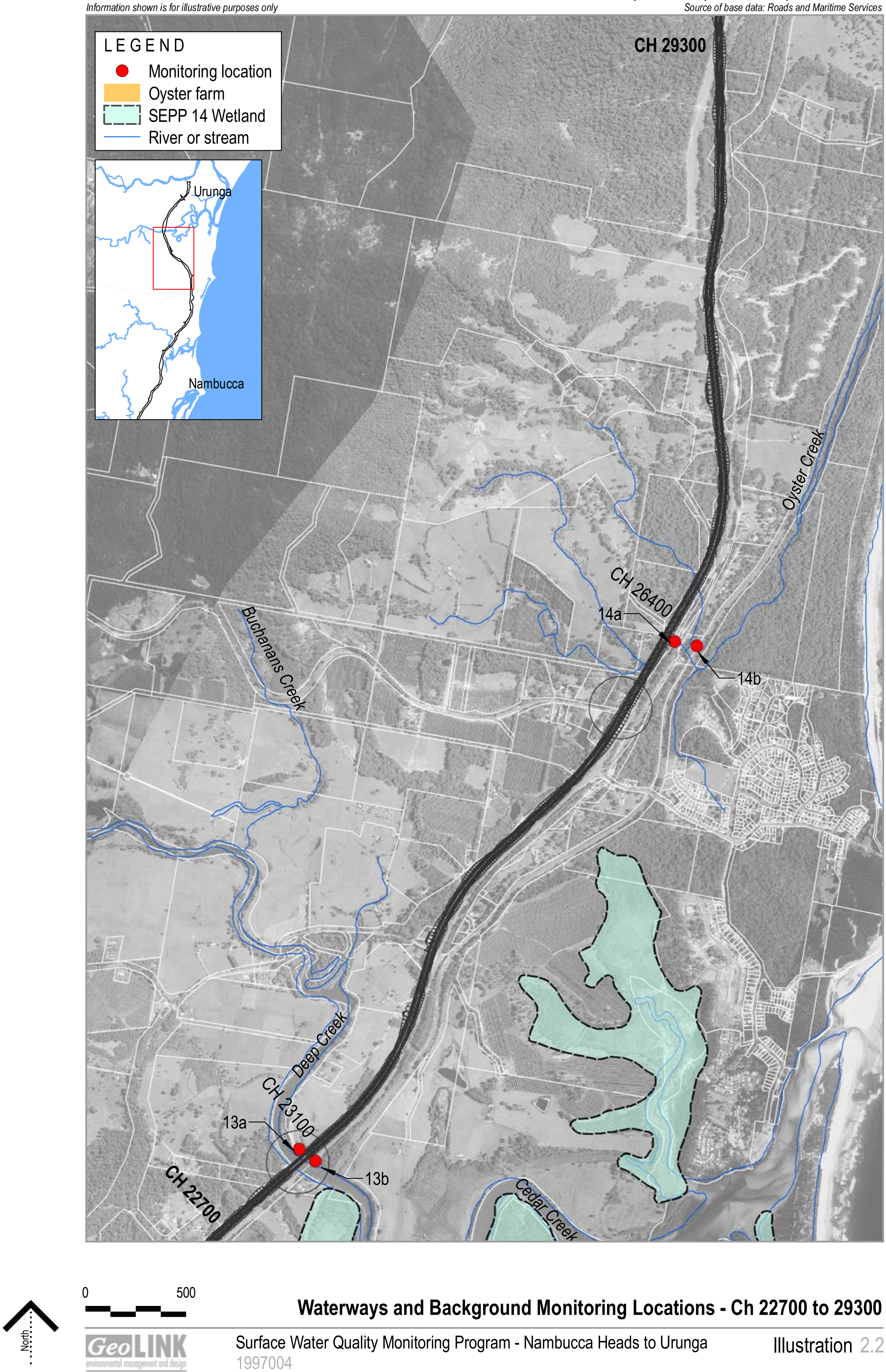
Other vegetation communities within riparian areas may have some level of ground-water dependence, including wet sclerophyll forests in proximity to creek flats (SKM, 2010a:190-191).



Waterways and Background Monitoring Locations - Ch 19500 to 22700

Information shown is for illustrative purposes only

Drawn by: RE Checked by: MVE Reviewed by: TIM Date: June 2012
Source of base data: Roads and Maritime Services

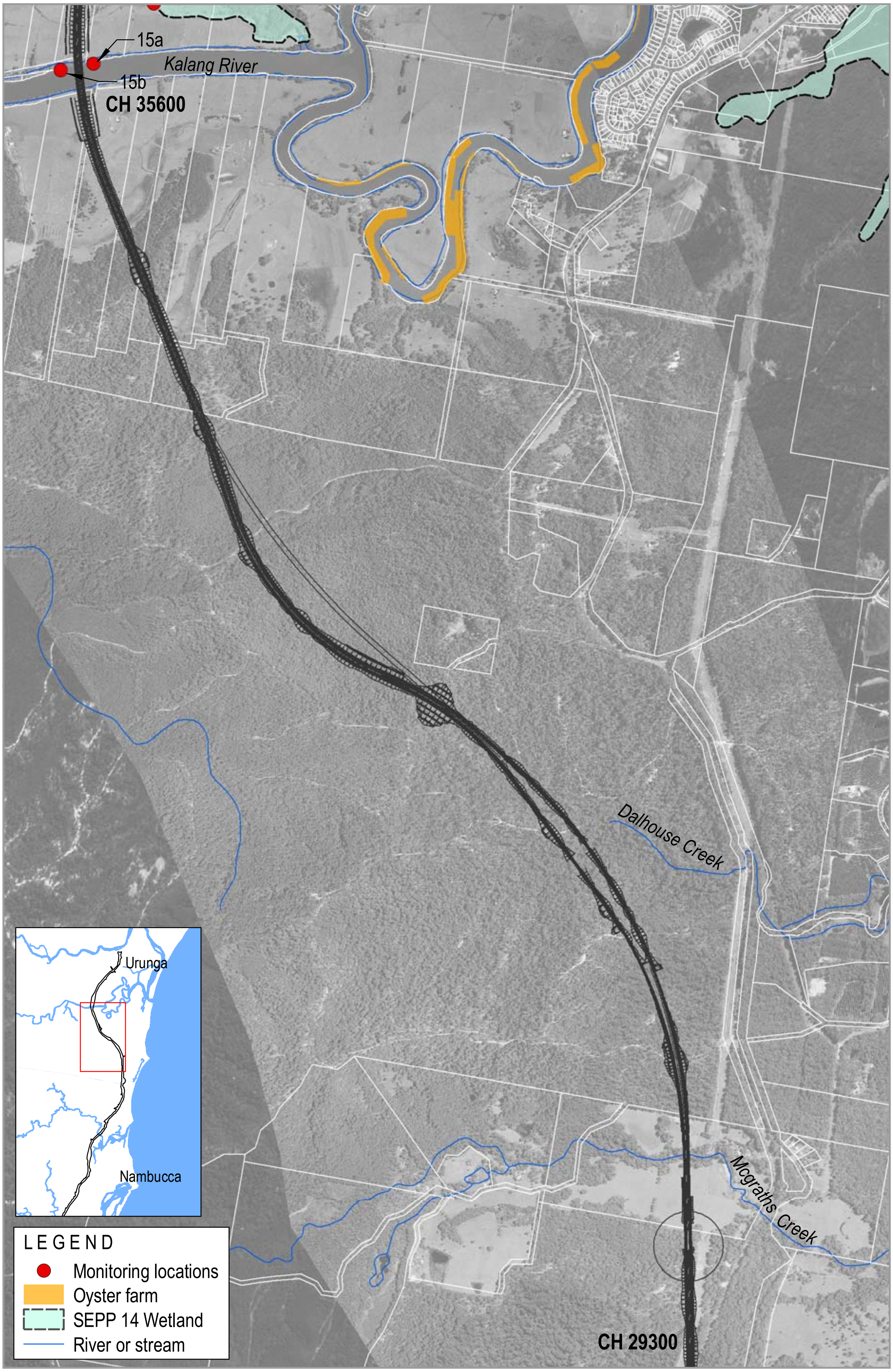


Waterways and Background Monitoring Locations - Ch 22700 to 29300

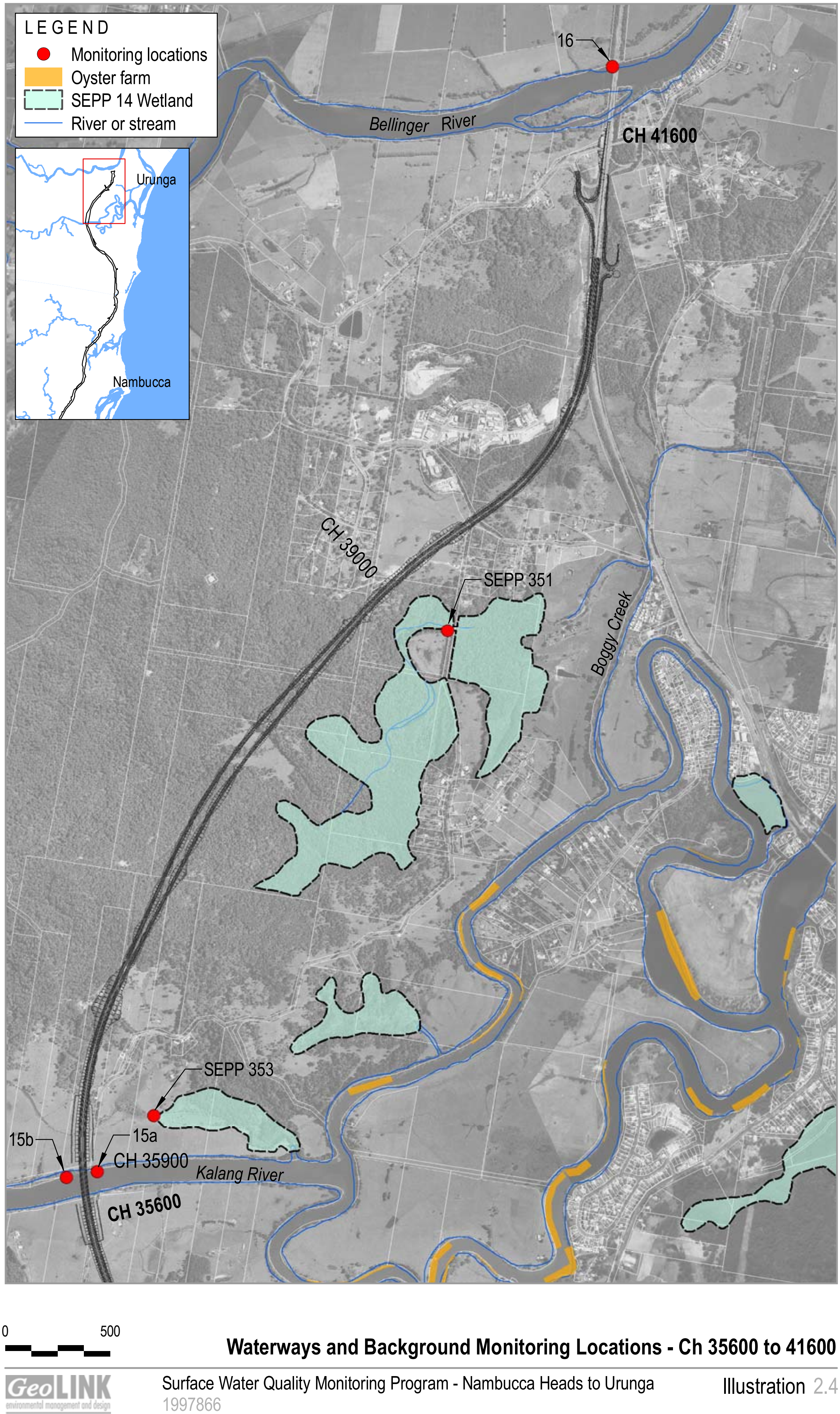
Surface Water Quality Monitoring Program - Nambucca Heads to Urunga
1997004

Illustration 2.2

GeoLINK environmental management and design



Waterways and Background Monitoring Locations - Ch 29300 to 35600



Waterways and Background Monitoring Locations - Ch 35600 to 41600

2.3 Risks to Surface Water

2.3.1 Construction Stage

The main risks to surface water (and consequent risks to oyster farming in the Nambucca, Bellinger, and Kalang rivers) as a result of the construction of the proposal are as follows:

- exposure of soils during earthworks, which creates the potential for off-site transport of eroded sediments and pollutants;
- disturbance of acid sulfate soils, which creates the potential for oxidation of these soils and subsequent generation of acidic run-off. The waterways with the highest probability of acid sulfate soils are Nambucca River, Deep Creek, Kalang River, all SEPP wetlands and other low-lying areas, creeks and wetlands;
- alteration of surface and subsurface flows which could cause disturbances to hydrology and hydraulics;
- off-site discharges of sediment-laden water; and
- accidental spills or leaks of oil, grease or fuel from work machinery and vehicles or from construction sites or compounds, and accidental spills of other chemicals that may be used during the course of construction (SKM, 2010a:374).

The nearest oyster farm leases to the NH2U are located 1,950m downstream on the North Arm and 1,500 m downstream on the South Arm of Kalang River as shown in **Illustrations 2.3 and 2.4**.

The main risks to creeks and rivers crossed by the highway upgrade are associated with an increase in sedimentation and the corresponding reduction in dissolved oxygen. The risk of water quality impacts within the creeks is exacerbated by existing poor water quality and the shallow degraded creek banks (SKM, 2010a:374).

The waterways with the potential to be affected due to a high probability of acid sulfate soils include Nambucca River, Deep Creek, and Kalang River. Exposure of these soils would result in a decrease in pH levels. Well vegetated creeks such as Deep Creek, (an estuarine system), are better protected from potential water quality impacts associated with spillage as well as sedimentation due to the density of the riparian vegetation and also the level of vegetation within the catchment which acts as a filter (SKM, 2010a:374).

The water quality of Bellinger River is not expected to be impacted by the highway upgrade as the northern most point of the proposed works cease just south of this waterway (SKM, 2010a:375).

2.3.2 Operational Stage

The main risk to water quality (and consequent risks to oyster farming) is road runoff from the impervious surfaces and the associated pollutants including suspended sediment; heavy metals attached to particles washed off the paved surface; oil and grease and other hydrocarbon products; nutrients; and anthropogenic litter.

Additional potential risks to water quality that may result from operation of the highway upgrade include:

- accidental spills of fuels or chemicals; and
- impacts associated with the maintenance of the roadway, which may include herbicide use, mowing, road surface cleaning and repair (SKM, 2010a:376-377).

The above risks have the potential to impact on the waterways in a variety of ways such as increase turbidity of the water column, decrease dissolved oxygen levels, increase silting of the waterways, stimulate the growth of algae and some aquatic plants through increased nutrients, toxicity to aquatic biota and fish and other adverse impacts on aquatic and terrestrial ecosystems associated with the waterways.

2.4 Management of Risks to Surface Water

2.4.1 Construction Stage

The key mitigation measures for the construction stage will be construction of sediment basins and additional erosion and sediment controls to intercept run-off and retain the associated sediments and pollutants. These measures will be formulated at the detailed design stage as part of a comprehensive soil and water management plan required to be prepared in accordance conditions B30, B31(d) and C17 of the conditions of approval. The construction water quality management plan is required to be prepared in consultation with the EPA, DPI (Fisheries and NOW) and be approved by the Director General of Department of Planning and Infrastructure prior to construction commencing. The plan will include water quality monitoring at the outlet of the sediment basins (SKM, 2010a:394). Following completion of the construction, a number of the sediment basins would be converted to permanent sediment basins depending on their suitability for operation (SKM, 2010a:389).

Management of acid sulfate soils (ASS) will include:

- avoidance or minimising the disturbance of ASS by minimising excavation or lowering the water table in ASS areas;
- monitoring of water quality downstream of ASS risk areas to allow early identification of ASS leachate to ensure that mitigation measures are implemented in a timely manner; and
- treatment of acid generation where ASS is disturbed (SKM, 2010c:68).

An acid sulfate soils management sub-plan will be developed in accordance with condition B31(d) and implemented prior to the commencement of construction works. The sub-plan will include a contingency plan to deal with the unexpected discovery of actual or potential acid sulfate soils, a water quality monitoring program and measures to manage acid sulfate soil impacts (SKM, 2010a:440).

2.4.2 Operational Stage

The proposed water quality measures that will be incorporated into the drainage design of the highway upgrade include permanent water quality basins, vegetated swales and permanent spill containment basins.

Permanent water quality basins would be used to trap the finer sediments and associated contaminants before stormwater is discharged into the receiving waterways. The basins would treat road pavement and batter runoff collected by the pavement drainage network (SKM, 2010a:396).

Permanent spill containment basins will be used and designed for the retention of a minimum 20,000 litres of oil or chemical polluted run-off for the more sensitive water crossings (SKM, 2010a:395). Permanent operational basins providing spill protection are proposed for the following locations (SKM, 2010c:66) (it is noted that these locations may change during the detailed design phase):

- Boggy Creek – north and south (Ch 20,850);
- Cow Creek – north and south (Ch 21,760);
- Deep Creek – north and south (Ch 23,040);
- Tributary of Oyster Creek – north and south (Ch 26,530);
- McGraths Creek – north and south (Ch 30,070); and
- Kalang River – north and south (Ch 35,790).

A practical water quality monitoring program to assess potential impacts on downstream water quality would also be implemented, until revegetation becomes established. These mitigation and management measures, along with the proposed design features are considered appropriate to manage the potential water quality risks. With the implementation of the proposed impact mitigation and management measures there would be little, if any, residual impacts on water quality. The occurrence of any residual impacts would be identified through the proposed water quality monitoring program, with action taken to address any residual impacts as required (SKM, 2010a:396).

2.5 Previous Monitoring of Surface Water

Monitoring of existing surface water quality has been undertaken at thirty-one monitoring locations for the entire WC2U upgrade as part of the environmental assessment process. The results of this monitoring are summarised below to provide some context to the current condition of the watercourses in the study area.

2.5.1 Previous Sampling Locations and Dates

For most waterways, previous monitoring was generally undertaken immediately upstream or downstream of the proposed alignment crossing. SEPP14 wetland water quality was also monitored including No.s 351 and 353, however results are available for only No. 351 as No. 353 was dry on each sampling occasion (SKM, 2010c:20). Where feasible, sites were chosen approximately 50-100m upstream and downstream of the highway upgrade crossing. Sites upstream of the crossing are labelled 'a' while sites downstream are labelled 'b'. The monitoring locations are shown in **Illustrations 2.1** to **2.4**.

The monitoring dates for each site are shown in **Table 2.2**. Two dry weather sampling events were conducted between 24 and 25 September 2007, and 22 and 24 October 2007 for the NH2U sites. Dry weather is classified as less than 20mm of rainfall in the study area 48hours prior to sampling. Wet weather sampling was undertaken on 30 October and 8-9 November 2007. Wet weather is classified as >20mm of rainfall within the study area 48 hours prior to sampling. An average of approximately 26.6mm, 23.3mm and 12.7mm of rain fell in the Bellinger, Kalang and Nambucca River catchments respectively in the 48hrs prior to 30 October 2007. Most of the rain fell on 29 October 2007 at all three river catchments. An average of approximately 38.9mm, 29.9mm and 50.3mm of rain fell in the Bellinger, Kalang and Nambucca River catchments respectively in the 48hrs prior to 9 November 2007. Most of the rain fell on 8 November 2007 at all three river catchments (SKM, 2010c:20).

Table 2.2 Sampling Dates for Previous Water Quality Monitoring from Environmental Assessment Phase

Site [1]	*24-25 Sep 2007 (Dry)*	*22-24 Oct 2007 (Dry)*	*30 Oct 2007 (Wet)*	*8-9 Nov 2007 (Wet)*
11 - Boggy Creek	✓	✓	✓	✓
12a - Cow Creek	✓	✓	✓	✓
12b - Cow Creek		✓	✓	✓
13a - Deep Creek	✓	✓	✓	✓
13b - Deep Creek	✓	✓	✓	✓
14a - tributary of Oyster Creek	✓	✓	✓	✓
14b - tributary of Oyster Creek	✓	✓	✓	✓
15a - Kalang River	✓	✓	✓	✓
15b - Kalang River	✓	✓	✓	✓
16 – Bellinger River	✓	✓	✓	✓
SEPP 351		✓	✓	✓

Source: Table 3-1 in SKM, 2010c:20

Notes: 1. Numbering system used in Water Quality Working Paper (SKM 2010c). Sites labelled 'a' were located upstream of the proposed crossing, whereas sites labelled 'b' were located downstream of the proposed crossing.

2.5.2 Previous Sampling Parameters

Parameters measured included:

- Turbidity (NTU);
- Conductivity ($mS.cm^{-1}$);
- Salinity (ppt);
- Temperature (°C);
- pH; and
- Dissolved Oxygen (per cent saturation and mg.L-1).

Measurements were generally collected between 15 and 30cm below the surface depending on the depth of water with the sampling depth recorded in the field. For each parameter, three replicate measurements were recorded approximately 10 m apart from the access point to the site. Each parameter was then reported as the average (arithmetic mean) of the three measurements. The individual replicates are also reported to provide an understanding of the variation between individual readings (SKM, 2010c:22).

2.5.3 Monitoring Results from Previous Sampling

The water quality results from the background monitoring are shown in **Table 2.3**. The results are compared with default trigger values for chemical and physical stressors for the protection of aquatic ecosystems for south-east Australia for slightly disturbed estuarine and lowland river ecosystems (ANZECC/ARMCANZ2000). There are no default trigger values recommended for wetlands in south-eastern Australia. Highlighted results in **Table 2.3** indicate exceedences of these default trigger values. The results for each waterway are summarised below.

2.5.3.1 Boggy Creek

Boggy Creek is classified as an intermittently closed and open lakes or lagoon (ICOLL) and known to fluctuate between saline and freshwater conditions. On three sampling occasions conductivities were indicative of a fresh water system and consequently the water quality of Boggy Creek has been compared with the ANZECC/ARMCANZ (2000) guidelines for lowland river ecosystems. On 30 October 2007 conductivities indicated a more estuarine system (mean 2.9mS/cm) and the ANZECC/ARMCANZ (2000) guidelines for protection of estuarine aquatic ecosystems have been applied (SKM, 2010c:43-44).

Overall this site generally had poor water quality. To the east of this monitoring site are high risk ASS. If disturbed, the water quality of Boggy Creek, particularly with respect to pH, could be further exacerbated and become more acidic. The site is generally well vegetated and it is anticipated that this vegetation, together with appropriate mitigation and control measures, would ensure the water quality does not further deteriorate with the construction and operation of the highway upgrade (SKM, 2010c:44).

2.5.3.2 Cow Creek

Similar to Boggy Creek, Cow Creek fluctuates between fresh and estuarine waters at the monitoring site. The water quality of Cow Creek upstream and downstream of the highway upgrade was similar, except that the downstream site failed to comply with relevant guidelines more frequently due to the more stringent guidelines imposed on estuarine ecosystems particularly with respect to turbidity (SKM, 2010c:44).

The most likely impact of the highway upgrade on waterways during construction is increased sedimentation due to the disturbance of soils and potential for rainfall to wash sediments into the creek. These sites are already highly turbid, low in dissolved oxygen and bordered by agricultural land uses that provide little buffer (SKM, 2010c:45).

2.5.3.3 Deep Creek

Deep Creek is classified as estuarine. The site is generally well vegetated although banks become exposed during low tide. Results indicate that despite being located in 'high risk' ASS the pH does not currently appear impacted upon, however should soil become exposed during construction, pH could be reduced significantly and should therefore be monitored and managed carefully.

Dissolved oxygen levels were below ANZECC trigger values following wet weather which is not uncommon as runoff containing organic matter and sediments enter waterways which subsequently decreases dissolved oxygen concentrations (SKM, 2010c:45-46).

2.5.3.4 Tributary of Oyster Creek

This tributary would already be impacted by the existing highway which traverses the creek. This tributary had conductivity indicative of a freshwater system and complied with the default trigger value for protection of lowland river aquatic ecosystems (ANZECC/ARMCANZ, 2000) (SKM, 2010c:46).

This site is heavily impacted by lack of flow and the presence of macrophytes, both of which have the potential to reduce dissolved oxygen concentrations and increase the turbidity of the waterways. Dissolved oxygen results were consistently low and turbidity was also high failing to comply (SKM, 2010c:46).

2.5.3.5 Kalang River

The pH of the Kalang River was consistent with little change following wet weather and complied with the ANZECC/ARMCANZ (2000) guideline. Dissolved oxygen and turbidity levels indicate slightly poorer water quality failing to comply with relevant guidelines during one dry weather and both wet weather sampling events. The greatest risk to water quality of the Kalang River is the potential exposure of high risk ASS during construction of the highway upgrade and increased runoff and sedimentation with the operational stage (SKM, 2010c:49).

2.5.3.6 SEPP 14 No.351

SEPP14 No. 351 generally had poor water quality with low dissolved oxygen and high turbidity. The low dissolved oxygen concentrations during dry weather are most likely due to low flow in the wetland and increased runoff during wet weather. The wetland receives runoff from an adjacent road and from a pipe that discharges into the wetland. These factors would contribute to the high turbidity and overall poor water quality of the wetland (SKM, 2010c:49).

The highway upgrade passes through an area of high risk ASS adjacent to SEPP No 351 which has the potential to cause significant impacts including low pH and dissolved oxygen if exposed and not appropriately managed (SKM, 2010c:49).

Table 2.3 Mean Water Quality Results for Previous Monitoring

Date	*Water Quality Parameter*	*11b (d/s)*	*12a (u/s)*	*12b (d/s)*	*13a (u/s)*	*13b (d/s)*	*14a (u/s)*	*14b (d/s)*	*ANZECC/ARMCANZ (2000) default trigger values for protection of aquatic ecosystems (11b – 14b)*	*15a (u/s)*	*15b (d/s)*	*16*	*SEPP 351*	*ANZECC/ARMCANZ (2000) default trigger values for protection of aquatic ecosystems (15a-16)*
24-25 September 2007 DRY	pH	6.21	6.7	Site inaccessible	7.04	6.66	5.96	6.34	6.5-8 (lowland river) 7.0-8.5 (estuarine)	7.78	7.7167	7.09	No data – not sampled	7.0-8.5
	Conductivity (mS/cm)	0.39	0.21		7.1	8.69	0.26	0.24	0.125-2.2*	28.30	28.70	7.16		N/A
	Turbidity (NTU)	1.33	0.3		7.5	5.57	143	15.5	<50 (lowland river) <10 (estuarine)	3.03	1.8	1.2		<10
	Dissolved Oxygen (% saturation)	31.4	85.2		81.3	87.6	28.7	49.8	85-110 (lowland river) 80-110 (estuarine)	83.1	88.23	82.37		80-110
	Temperature (° C)	16.3	19.4		22.9	22.4	17.5	18.3	N/A	21.4	20.6	19.8		N/A
22-24 October 2007 DRY	pH	7.11	7.22	7.30	7.75	7.76	7.42	6.99	6.5-8 (lowland river) 7.0-8.5 (estuarine)	7.86	7.87	7.69	6.78	7.0-8.5
	Conductivity (mS/cm)	0.49	0.25	14.2	26.8	34.8	0.27	0.26	0.125-2.2*	35.7	35.93	14.8	419.33	N/A
	Salinity (ppt)	0.24	0.1	8.24	66.1	21.6	0.11	0.11	N/A	22.5	22.6	8.19	0.18	N/A
	Turbidity (NTU)	102	17.9	27.6	11.6	13.7	89.5	71.8	<50 (lowland river) <10 (estuarine)	19.77	21.3	19.8	30.1	<10
	Dissolved Oxygen (% saturation)	3.37	51.4	60.7	83.8	80.4	6.77	32.3	85-110 (lowland river) 80-110 (estuarine)	75.5	75.4	77.6	17.8	80-110
	Temperature (° C)	17.5	22.6	25.9	25.1	24.8	19.8	21.3	N/A	24.3	25.26	23.07	19.9	N/A
30 October 2007 WET	pH	7.20	7.34	7.60	7.88	7.96	7.19	7.30	6.5-8 (lowland river) 7.0-8.5 (estuarine)	7.74	7.85	7.91	7.26	7.0-8.5
	Conductivity (mS/cm)	2.9	5.07	42.8	42.7	43.6	0.24	0.23	0.125-2.2*	38.57	38.83	24.4	353.33	N/A

Date	*Water Quality Parameter*	*11b (d/s)*	*12a (u/s)*	*12b (d/s)*	*13a (u/s)*	*13b (d/s)*	*14a (u/s)*	*14b (d/s)*	*ANZECC/ARMCANZ (2000) default trigger values for protection of aquatic ecosystems (11b – 14b)*	*15a (u/s)*	*15b (d/s)*	*16*	*SEPP 351*	*ANZECC/ARMCANZ (2000) default trigger values for protection of aquatic ecosystems (15a-16)*
	Salinity (ppt)	1.60	2.47	27.5	42.7	28.1	0.09	0.09	N/A	7.74	7.85	7.91	0.156	N/A
	Turbidity (NTU)	43.9	30.7	29.9	18.7	16.6	36.6	63.2	<50 (lowland river) <10 (estuarine)	38.57	38.83	24.4	37.7	<10
	Dissolved Oxygen (% saturation)	6.90	46.6	58.3	61.9	64.1	11.5	21.7	85-110 (lowland river) 80-110 (estuarine)	24.51	24.72	14.84	47.23	80-110
	Temperature (°C)	20.3	24.9	29.1	27.5	28.1	20.8	20.6	N/A	21.57	21.73	12.53	22.62	N/A
8-9 November 2007 WET	pH	7.74	8.21	7.50	7.88	7.79	7.32	7.26	6.5-8 (lowland river) 7.0-8.5 (estuarine)	7.993 3	7.87	7.48	7.77	7.0-8.5
	Conductivity (mS/cm)	0.4	0.2	16.3	12.7	11.9	0.22	0.17	0.125-2.2*	33.04	33.36	9.67	547	N/A
	Salinity (ppt)	0.19	0.11	9.58	7.33	6.78	0.11	0.08	N/A	20.74	20.86	5.42	0.25	N/A
	Turbidity (NTU)	30.6	17.2	19.9	18.8	22.1	27.8	27.3	<50 (lowland river) <10 (estuarine)	14.63 3	13.23	27.07	15	<10
	Dissolved Oxygen (% saturation)	33.5	61.7	49.5	73.8	76.3	25.0	48.9	85-110 (lowland river) 80-110 (estuarine)	64.83 3	63.67	63.27	25.8	80-110
	Temperature (°C)	17.0	18.5	19.4	19.9	19.6	18.1	18.1	N/A	21.74	22.00	21.63	16.93	N/A

*Range of default trigger values for conductivity is only relevant for lowland rivers
u/s = upstream; d/s = downstream

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3

Monitoring Objectives

3.1 RMS Water Policy and Objectives

The NSW Roads and Maritime Services' commitment to water management as outlined in the RTA Water Policy states:

> *"The RTA will use the most appropriate water management practices in the planning, design, construction, operation and maintenance of the roads and traffic system in order to:*
>
> - *conserve water*
> - *protect the quality of water resources; and*
> - *preserve ecosystems."*

The general water quality objectives described in the RMS Code of Practice for Water Management (RTA, 1999) essentially aim at minimising potential impacts on the environment as indicated in the following general principles:

- Pre-Construction – designs will incorporate appropriate techniques to contain and treat road run-off to avoid or minimise potential impacts to aquatic and riparian environments (RTA,1999:8);
- Construction – Effective water management practices and procedures will be implemented, in accordance with the CEMP/SWMP, as an integral part of on-site construction management to ensure that water quality and quantity impacts to the environment are minimised (RTA, 1999:10)
- Operational – The RTA will investigate and incorporate appropriate pollution control technologies on existing major roads and bridges to contain and treat road run-off, wherever practical and cost-effective, in order to minimise potential impacts on the environment (RTA, 1999:13)

This Surface Water Quality Monitoring Program links with the above objectives by providing water quality information to assess the impacts of the highway upgrade on the waterways in the study area. This is the general objective of the Statement of Commitment No. W3:- *Monitoring of groundwater impacts and surface water quality upstream and downstream of the site during construction will determine the effectiveness of mitigation strategies. Implementation of additional feasible and reasonable management measures will occur if necessary*.

3.2 Monitoring Objectives

The primary objective of this Surface Water Quality Monitoring Program is to evaluate the impact of the highway upgrade on water quality in the relevant waterways from Nambucca Heads to Urunga.

To achieve the above monitoring objective, this report provides the following information:

- parameters for monitoring during pre-construction, construction and operational stages;
- monitoring locations for surface water quality;
- a monitoring program to establish baseline surface water quality data;
- a monitoring program to identify impacts of the highway upgrade on surface water quality; and
- a monitoring program to help assess and refine surface water management measures.

3.3 Monitoring Approach

The type of monitoring study to be employed is one that measures change (ie. any change in water quality as a result of the highway upgrade). The general category of design for this monitoring program is the before–after, control–impact (BACI) type design as described in ANZECC ARMCANZ (2000b:3-3). This essentially involves monitoring two sites before and after the disturbance occurs (pre-construction and construction/ operation). The two sites comprise one that will be subjected to the disturbance (an 'impact' site) and one that will not (a 'control' site). The same parameters are monitored at both 'control' and 'impact' sites before and after the highway upgrade to determine whether or not the pattern of behaviour over time at the impact site(s) change relative to the control sites.

3.3.1 Defining the Control and Impact Site

The proposed Surface Water Quality Monitoring Program has selected sampling sites on the upstream and downstream side of each waterway crossing with:

- the upstream site representing the 'control' site; and
- the downstream site representing the 'impact' site.

It should be noted there is likely to be some 'natural' variation in water quality between the upstream and downstream sampling sites at the pre-construction stage (pre-disturbance). A measure or sense of this 'natural' variation can be established from the pre-construction monitoring. This 'natural' variation will then need to be incorporated into the analysis of the construction / operational stage monitoring to ensure it is not misinterpreted as an impact of the highway upgrade.

3.4 Statistical Analysis

The proposed technique for comparing sampling results and water quality guidelines or trigger values is with either the use of tabulated results or control charts as described in ANZECC ARMCANZ (2000b:6-17). This is discussed further in **Section 5** of this document.

4

Monitoring Program

4.1 Monitoring Site Locations

The following monitoring locations have been selected for the NH2U section of the highway upgrade:

- Boggy Creek (Site 11 in EA): Chainage 20,800;
- Deep Creek (Site 13 in EA): Chainage 23,100;
- unnamed tributary of Oyster Creek (Site 14 in EA): Chainage 26,100 and 26,200;
- McGraths Creek: Chainage 30,100;
- Dalhousie Creek: Chainage 31,500;
- Kalang River (Site 15 in EA): Chainage 35,900;
- tributary of SEPP 14 No. 353: approximate Chainage 36,000;
- SEPP 14 No. 353: approximate Chainage 36,100;
- tributary of SEPP 14 No. 351: approximate chainage 38,000 and 38,100; and
- SEPP 14 No. 351: approximate chainage 39,000.

The locations are shown in **Illustrations 4.1** to **4.4**. The exact location of the upstream and downstream sampling points at each waterway crossing is preferably just inside the project boundary of the highway upgrade. The exact locations will need to be determined on-site with consideration of safety, access, and the impact of the construction process on access over the duration of the monitoring program. Any proposed changes to sampling points during the construction phase for safety, access or other reasons will need to the discussed at the Environment Review Group meetings.

4.1.1 Reasons for Selection of Monitoring Locations

The monitoring locations were selected with consideration of:

- coverage of the various geographical terrains and waterway types along the project length;
- selection of generally permanent watercourses as opposed to intermittent or low-flow watercourses (Cow Creek);
- representation of waterways in different catchments;
- waterways draining to significant dams used for horticultural irrigation (Dalhousie Creek); and
- monitoring of waterways associated with high value or sensitive ecological communities and estuaries (eg. SEPP 14 wetlands and Oyster Creek estuary).

Monitoring of the two SEPP 14 wetlands (No.s 351 and 353) includes sampling points on the wetland tributaries on the upstream and downstream side of the highway alignment to enable detection of any potential impacts of the highway upgrade – refer to **Plate 4.1** and **4.2**.

Cow Creek was also considered as a surface water monitoring location and for reasons set out in Appendix A – Agency Consultation, monitoring is to occur at construction and operational phases.

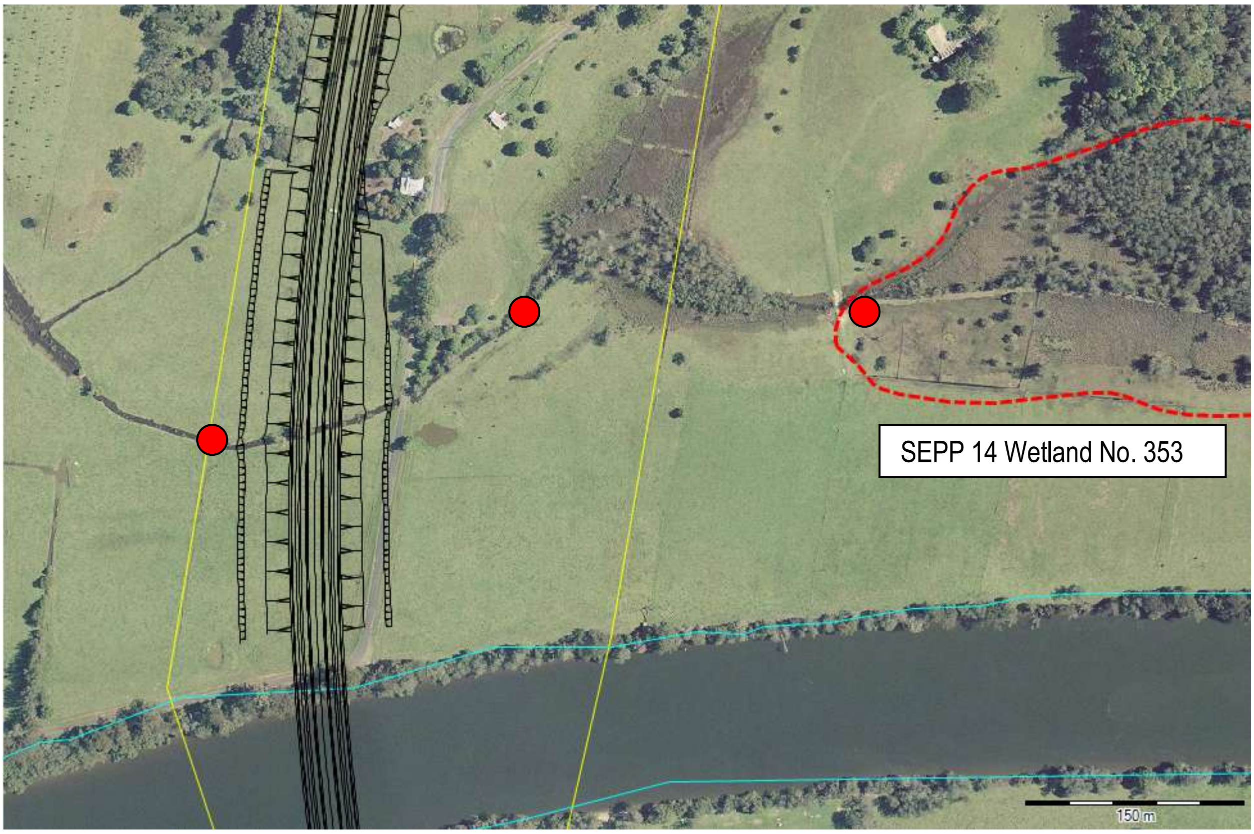


Plate 4.1 Monitoring Sites for SEPP 14 No. 353 – Chainage 36,000 and 36,100

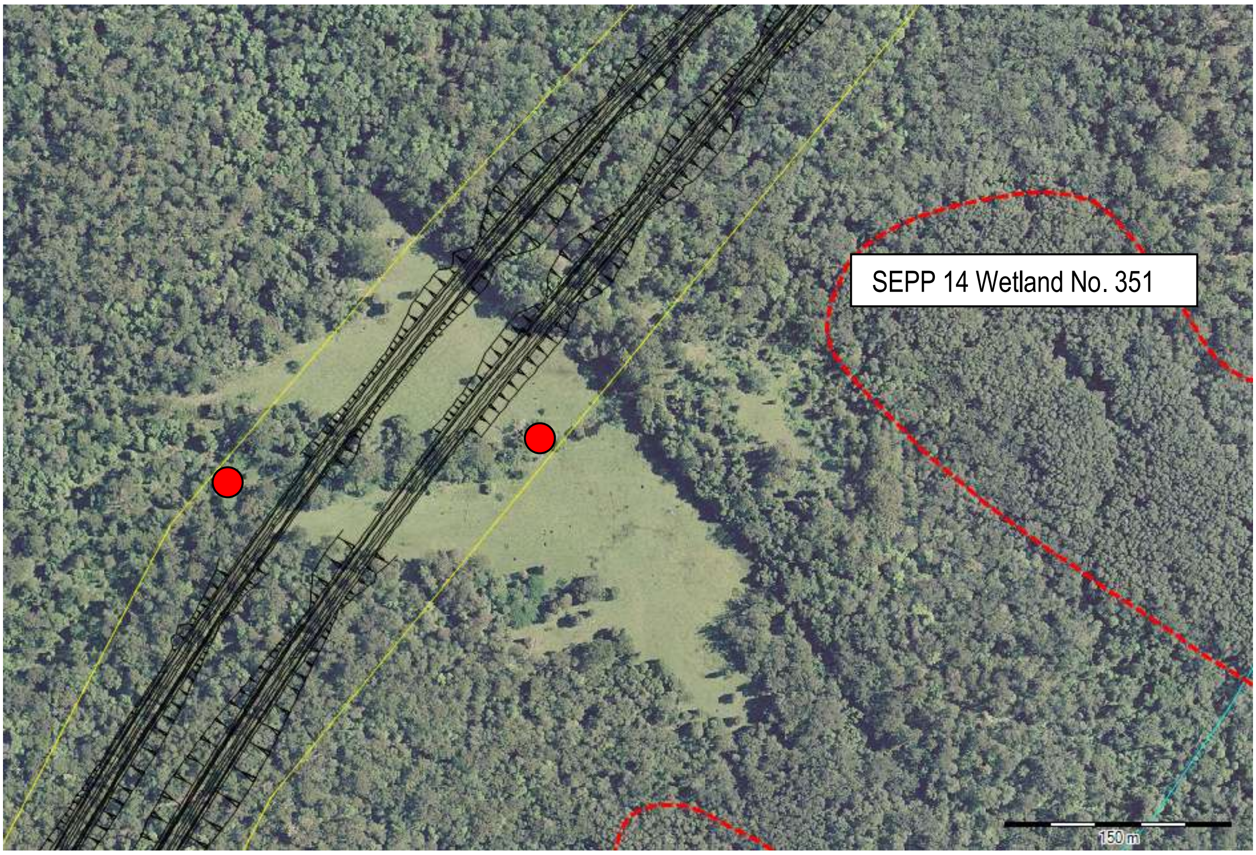


Plate 4.2 Monitoring Sites for SEPP 14 No. 351 – Chainage 38,000

4.2 Monitoring Parameters

Selection of water quality parameters has been based on those previously monitored (refer to **Section 2.5**), RMS *Guideline for Construction Water Quality Monitoring* (RTA, undated) and *Australian guidelines for water quality monitoring and reporting* (ANZECC ARMCANZ, 2000b). The range of parameters to be monitored at each site is listed below. It is noted that some parameters will be monitored more frequently than others – refer to **Section 4.4**.

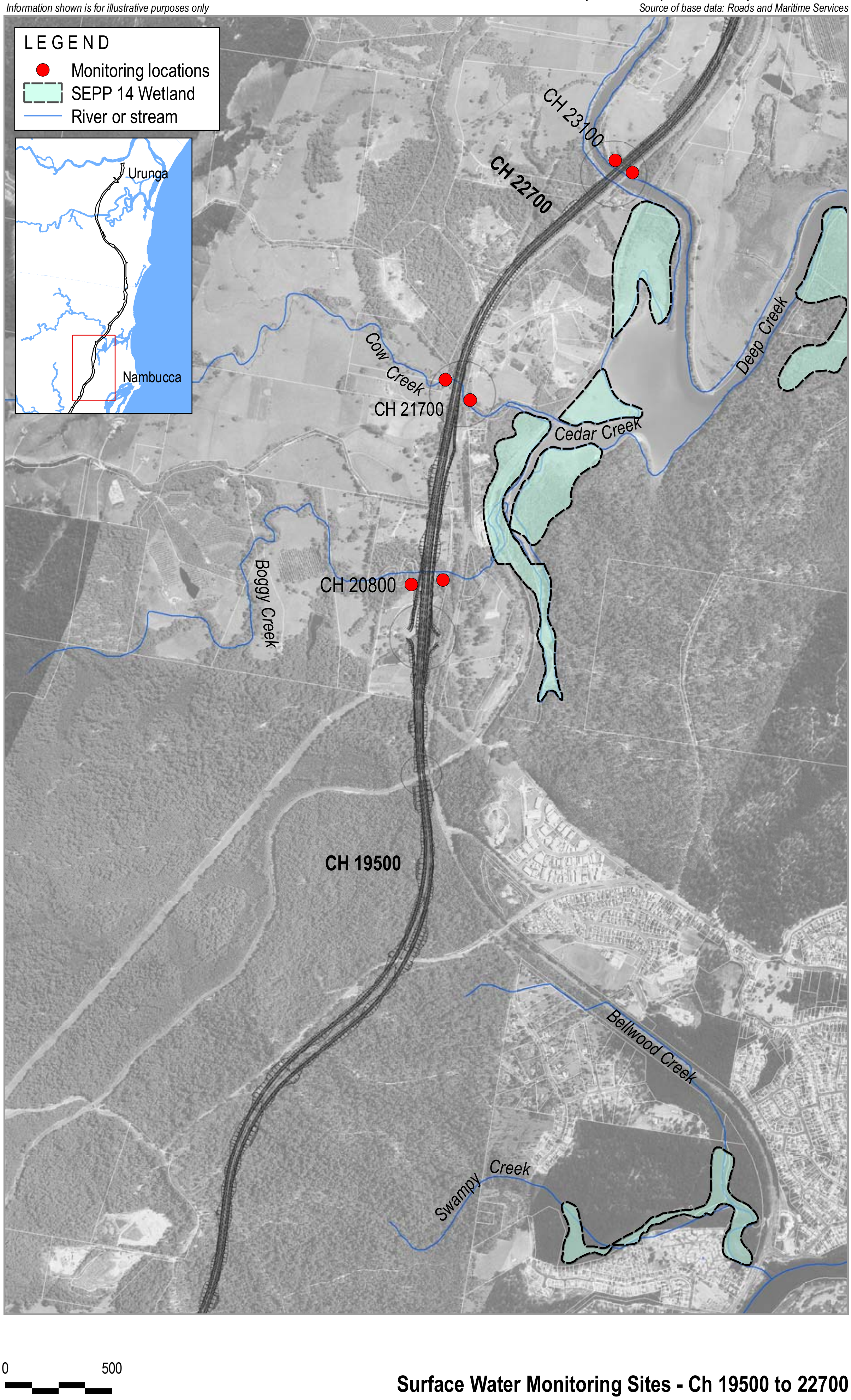
Parameters to be monitored at each site:

- Physical properties: Electrical Conductivity, Turbidity, Total suspended solids (TSS), Temperature;
- Chemical properties: pH, Dissolved Oxygen;
- Hydrocarbons: visual assessments for oils and grease. If oils and greases are visible, a sample is to be taken for TPH analysis;
- Nutrients: Total Nitrogen and Total Phosphorus; and
- Heavy metals.

4.2.1 Other Monitoring Parameters

Daily rainfall figures from the construction site / nearest Bureau of Meteorology sites should also be recorded as part of the monitoring program for practical correlation with surface water monitoring results.

Drawn by: RE   Checked by: MVE   Reviewed by: TIM   Date: June 2012
Source of base data: Roads and Maritime Services
Information shown is for illustrative purposes only



Surface Water Monitoring Sites - Ch 19500 to 22700

GeoLINK environmental management and design

Surface Water Quality Monitoring Program - Nambucca Heads to Urunga
1997031

Illustration 4.1

Information shown is for illustrative purposes only

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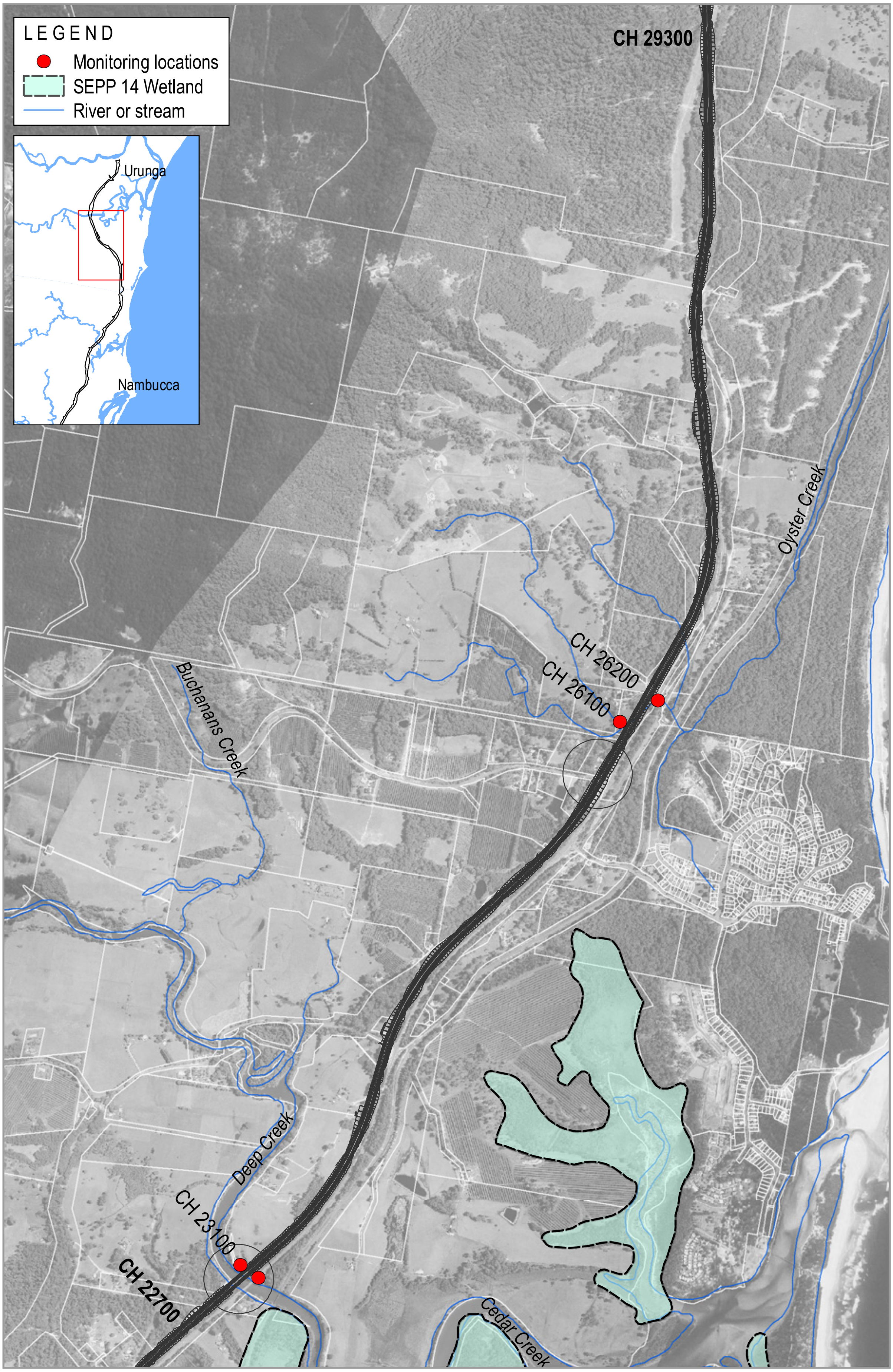
Source of base data: Roads and Maritime Services

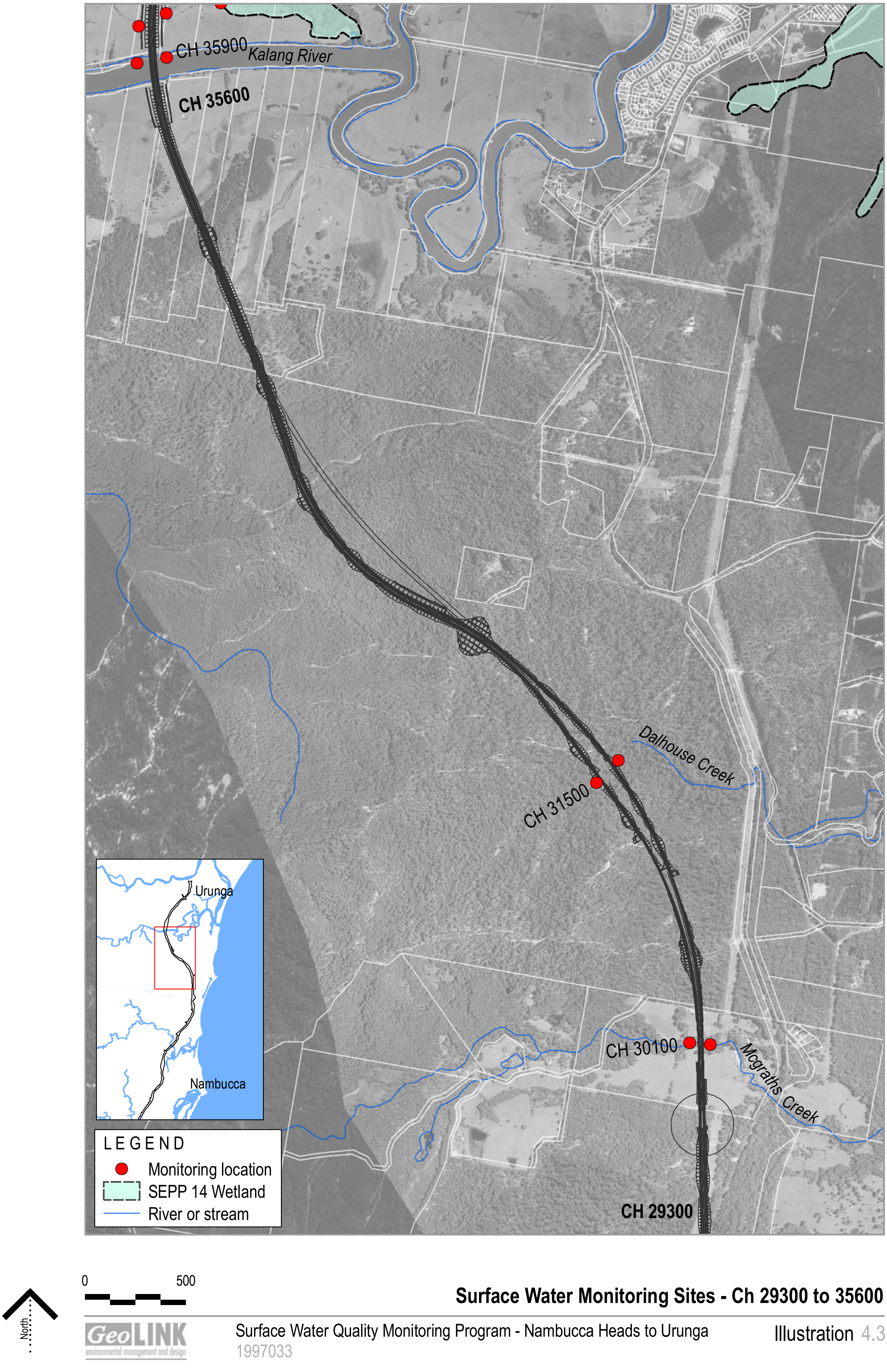


Surface Water Monitoring Sites - Ch 22700 to 29300

GeoLINK environmental management and design

Surface Water Quality Monitoring Program - Nambucca Heads to Urunga
1997032

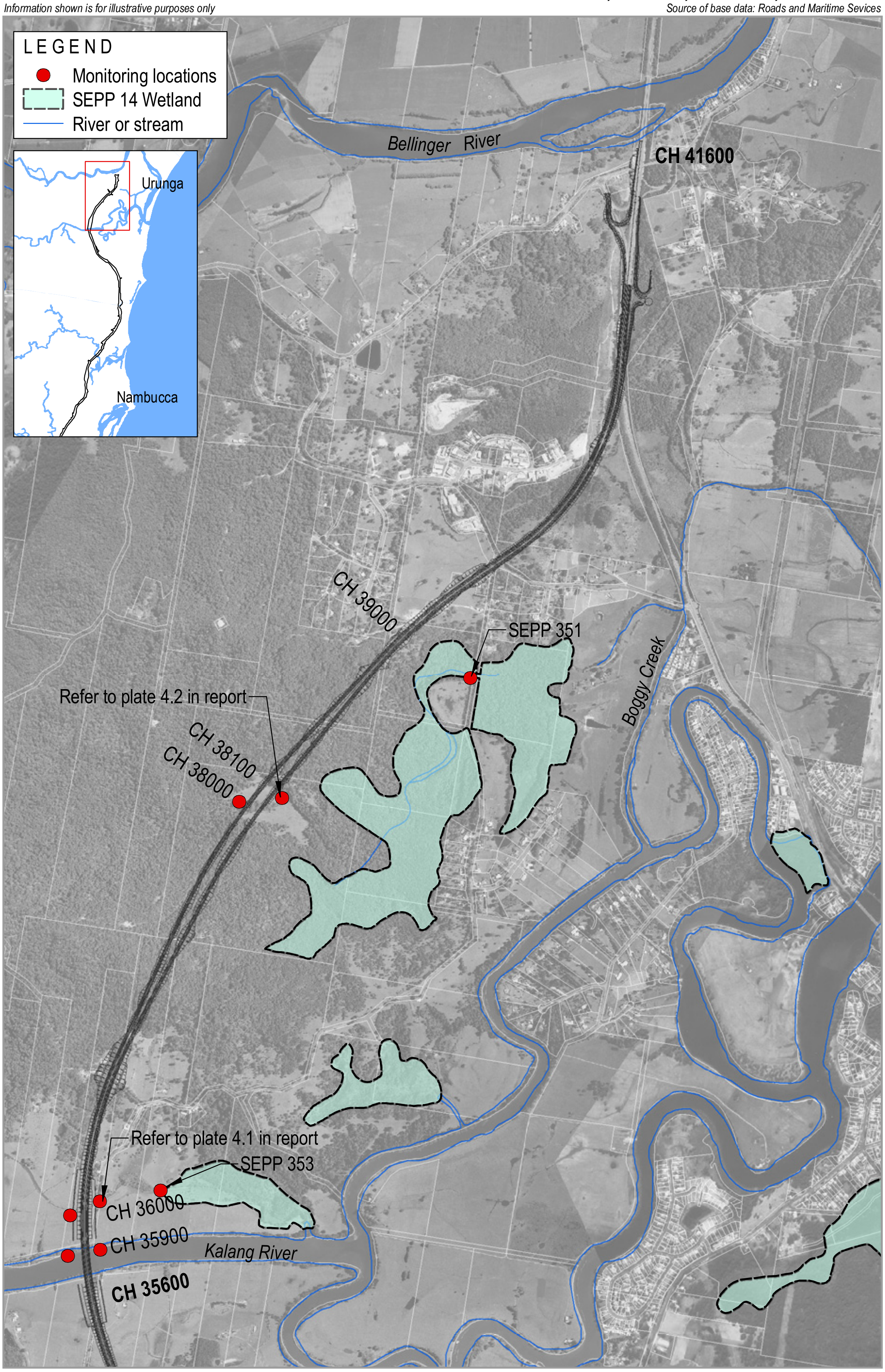
Illustration 4.2



Surface Water Monitoring Sites - Ch 29300 to 35600

Information shown is for illustrative purposes only

Drawn by: RE Checked by: MVE Reviewed by: TIM Date: June 2012
Source of base data: Roads and Maritime Sevices



Surface Water Monitoring Sites - Chainage 35600 to 41600

GeoLINK environmental management and design

Surface Water Quality Monitoring Program - Nambucca Heads to Urunga
1997834

Illustration 4.4

4.3 Monitoring Duration

The durations of the various phases of the monitoring program are:

- Pre-construction phase: a minimum of six months;
- Construction phase: for the duration of the construction period; and
- Operational phase: a minimum of three years following completion or until any disturbed waterways/ groundwater resources are certified by an independent expert as being rehabilitated to an acceptable condition (refer to Condition of Approval B17 in **Section 1.2.3** of this report).

4.4 Sampling Frequency

The proposed sampling frequencies are outlined in the following sub-sections and summarised in **Table 4.1** to **4.5**. Potential water quality impacts from the highway upgrade, particularly the construction activities will most likely result from erosion and sediment loss during rainfall events in the construction stage and from runoff in the operational stage. Therefore, monitoring should include water quality samples during rainfall events (RTA, undated:6).

4.4.1 Pre-Construction Stage

To ensure a comprehensive set of baseline data the following monitoring frequency is required for pre-construction stage:

- for physical properties, chemical properties, and hydrocarbons (monitoring for hydrocarbons involves visual assessments for oils and grease and sampling for TPH if oil and grease is visible):
  - two wet events per month (a wet event is defined as a rainfall event of 10 mm or greater in a 24 hour period); and
  - one dry event per month;
- for nutrients and heavy metals:
  - one wet event per month; and
  - one dry event every second month.

Note: it is proposed that total suspended solids (TSS) is analysed at the same frequency as turbidity in the pre-construction stage to develop a correlation between these two parameters. This will enable a reduction in the frequency of TSS testing in the construction stage by using turbidity as an indicator of TSS levels. This is proposed due to the relative ease and less expense associated with testing turbidity.

4.4.2 Construction Stage

The following monitoring frequency is required for the construction stage (note: the following frequency is consistent with the RMS *Guideline for Construction Water Quality Monitoring* (RTA, undated)):

- for physical properties (excluding TSS), chemical properties, and hydrocarbons (monitoring for hydrocarbons involves visual assessments for oils and grease and sampling for TPH if oil and grease is visible):
  - two wet events per month (a wet event is defined as a rainfall event of 10 mm or greater in a 24 hour period); and
  - one dry event per month;
- for TSS, nutrients and heavy metals:
  - one wet event per month; and
  - one dry event every second month.

4.4.3 Operational Stage

RMS *Guideline for Construction Water Quality Monitoring* recommends monthly monitoring for the operational stage, however if sampling results demonstrate that the site or parts of the site have stabilised, the sampling frequency may be reviewed and reduced or discontinued (RTA, undated:9). Therefore, in general terms monthly monitoring is proposed for the first year of operation after which time it is assumed that revegetation will have generally established and stabilised. Following the first year the frequency will be reduced to once every second month for the second year of operation and then once every six months for the third year of operation.

In detail, the following sampling frequency is proposed for physical properties (excluding TSS), chemical properties, and hydrocarbons (monitoring for hydrocarbons involves visual assessments for oils and grease and sampling for TPH if oil and grease is visible):

- first year of operation:
  - once per month during a wet episode defined as a rainfall event of 10 mm or greater in a 24 hour period; and
  - once every 6 months during a dry episode.
- second year of operation:
  - once every second month during a wet episode; and
  - once every 6 months during a dry episode.
- third year of operation:
  - once every 6 months during a wet episode; and
  - once every 6 months during a dry episode.

For TSS, nutrients and heavy metals, the following sampling frequency is proposed:

- first year of operation:
  - once every second month during a wet episode; and
  - once every 6 months during a dry episode.
- second to third year of operation:
  - once every 6 months during a wet episode; and
  - once every 6 months during a dry episode.

Table 4.1 Surface Water Quality Parameters – Pre-Construction Stage

Frequency	*Analytical Group*	*Analytes*	*Analysis Method*
Monthly (two wet episode sampling events and one dry episode sampling event)[1]	Physical properties	Electrical Conductivity (EC) Turbidity (NTU) Total suspended solids (TSS) Temperature	Field measurement Field measurement Laboratory analysis Field measurement
	Chemical properties	pH Dissolved oxygen (DO)	Field measurement Field measurement
	Hydrocarbons	Visual inspection of oil / grease. Sampling of TPH if oil / grease is visible	Field measurement Laboratory analysis
Monthly to Bi-Monthly (one wet episode sampling event every month one dry episode sampling event every second month)[1]	Hydrocarbons	TPH	Laboratory analysis
	Heavy metals	Copper (Cu) Lead (Pb) Cadmium (Cd) Zinc (Zn) Arsenic (As) Selenium (Se) Iron (Fe) Manganese (Mn) Silver (Ag) Chromium (Cr) Nickel (Ni) Aluminium (Al) Mercury (Hg)	Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis
	Nutrients	Total Nitrogen Nitrate Nitrite Ammonia Total Phosphorus Phosphate	Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis

Notes: 1. A wet episode is defined as a rainfall event of 10mm in a 24hour period. Sampling of a wet episode must occur within 24 hours following a wet episode.

Table 4.2 Surface Water Quality Parameters – Construction Stage

Frequency	*Analytical Group*	*Analytes*	*Analysis Method*
Monthly (one dry episode sampling event and two wet episode sampling events)[1]	Physical properties	Electrical Conductivity (EC) Turbidity (NTU) Temperature	Field measurement Field measurement Field measurement
	Chemical properties	pH Dissolved oxygen (DO)	Field measurement Field measurement
	Hydrocarbons	Visual inspection of oil / grease. Sampling of TPH if oil / grease is visible	Field measurement Laboratory analysis
Monthly to Bi-Monthly (one wet episode sampling event every month one dry episode sampling event every second month)[1]	Hydrocarbons	TPH	Laboratory analysis
	Heavy metals	Copper (Cu) Lead (Pb) Cadmium (Cd) Zinc (Zn) Arsenic (As) Selenium (Se) Iron (Fe) Manganese (Mn) Silver (Ag) Chromium (Cr) Nickel (Ni) Aluminium (Al) Mercury (Hg)	Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis
	Physical properties	Total suspended solids (TSS)	Laboratory analysis
	Nutrients	Total Nitrogen Nitrate Nitrite Ammonia Total Phosphorus Phosphate	Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis

Notes: 1. A wet episode is defined as a rainfall event of 10mm in a 24hour period. Sampling of a wet episode must occur within 24 hours following a wet episode.

Table 4.3 Surface Water Quality Parameters – Operational Stage - First Year of Operation

Frequency	*Analytical Group*	*Analytes*	*Analysis Method*
Monthly (one wet episode sampling event)[1]	Physical properties	Electrical Conductivity (EC) Turbidity (NTU) Temperature	Field measurement Field measurement Field measurement
	Chemical properties	pH Dissolved oxygen (DO)	Field measurement Field measurement
	Hydrocarbons	Visual inspection of oil / grease. Sampling of TPH if oil / grease is visible	Field measurement Laboratory analysis
Bi-Monthly (one wet episode sampling event)[1]	Hydrocarbons	TPH	Laboratory analysis
	Heavy metals	Copper (Cu) Lead (Pb) Cadmium (Cd) Zinc (Zn) Arsenic (As) Selenium (Se) Iron (Fe) Manganese (Mn) Silver (Ag) Chromium (Cr) Nickel (Ni) Aluminium (Al) Mercury (Hg)	Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis
	Physical properties	Total suspended solids	Laboratory analysis
	Nutrients	Total Nitrogen Nitrate Nitrite Ammonia Total Phosphorus Phosphate	Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis
Six-Monthly (one dry episode sampling event)	Physical properties	Same analytes as above	Field measurement
	Chemical properties	Same analytes as above	Field measurement
	Hydrocarbons	TPH	Field measurement / Laboratory analysis
	Heavy metals	Same analytes as above	Laboratory analysis
	Physical properties	Total suspended solids	Laboratory analysis
	Nutrients	Same analytes as above	Laboratory analysis

Notes: 1. A wet episode is defined as a rainfall event of 10mm in a 24hour period. Sampling of a wet episode must occur within 24 hours following a wet episode.

Table 4.4 Surface Water Quality Parameters – Operational Stage - Second Year of Operation

Frequency	*Analytical Group*	*Analytes*	*Analysis Method*
Bi-Monthly (one wet episode sampling event)[1]	Physical properties	Electrical Conductivity (EC) Turbidity (NTU) Temperature	Field measurement Field measurement Field measurement
	Chemical properties	pH Dissolved oxygen (DO)	Field measurement Field measurement
	Hydrocarbons	Visual inspection of oil / grease. Sampling of TPH if oil / grease is visible	Field measurement Laboratory analysis
Six-Monthly (one dry episode sampling event)	Physical properties	Same analytes as above	Field measurement
	Chemical properties	Same analytes as above	Field measurement
	Hydrocarbons	TPH	Field measurement / Laboratory analysis
	Heavy metals	Copper (Cu) Lead (Pb) Cadmium (Cd) Zinc (Zn) Arsenic (As) Selenium (Se) Iron (Fe) Manganese (Mn) Silver (Ag) Chromium (Cr) Nickel (Ni) Aluminium (Al) Mercury (Hg)	Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis
	Physical properties	Total suspended solids	Laboratory analysis
	Nutrients	Total Nitrogen Nitrate Nitrite Ammonia Total Phosphorus Phosphate	Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis
Six-Monthly (one wet episode sampling event)	Hydrocarbons	TPH	Laboratory analysis
	Heavy metals	Same analytes as above	Laboratory analysis
	Physical properties	Total suspended solids	Laboratory analysis
	Nutrients	Same analytes as above	Laboratory analysis

Notes: 1. A wet episode is defined as a rainfall event of 10mm in a 24hour period. Sampling of a wet episode must occur within 24 hours following a wet episode.

Table 4.5 Surface Water Quality Parameters – Operational Stage - Third Year of Operation

Frequency	*Analytical Group*	*Analytes*	*Analysis Method*
Six-Monthly (one dry episode sampling event and one wet episode sampling event) [1]	Physical properties	Electrical Conductivity (EC) Turbidity (NTU) Temperature	Field measurement Field measurement Field measurement
	Chemical properties	pH Dissolved oxygen (DO)	Field measurement Field measurement
	Hydrocarbons	Visual inspection of oil/grease. Sampling of TPH if oil/grease is visible	Field measurement Laboratory analysis
	Heavy metals	Copper (Cu) Lead (Pb) Cadmium (Cd) Zinc (Zn) Arsenic (As) Selenium (Se) Iron (Fe) Manganese (Mn) Silver (Ag) Chromium (Cr) Nickel (Ni) Aluminium (Al) Mercury (Hg)	Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis
	Physical properties	Total suspended solids	Laboratory analysis
	Nutrients	Total Nitrogen Nitrate Nitrite Ammonia Total Phosphorus Phosphate	Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis Laboratory analysis

Notes: 1. A wet episode is defined as a rainfall event of 10mm in a 24hour period. Sampling of a wet episode must occur within 24 hours following a wet episode.

4.5 Timing of Sampling

Due to the tidal nature of a number of the waterways, water quality and flow direction may vary according to the tidal cycle. Therefore, to provide comparable data between sampling events it is preferable that sampling is:

- consistently taken during the same tidal phase for each sampling event (or as close as practical) at the sites listed below; and
- conducted on an ebb (falling) tide and as close to low tide (at the monitoring location) as possible to ensure the flow direction is from the 'control' point (upstream monitoring location) to the 'impact ' site (downstream monitoring location)

The monitoring sites that are potentially influenced by tidal flows are:

- Boggy Creek: Chainage 20,800;
- Deep Creek: Chainage 23,100; and
- Kalang River: Chainage 35,900.

It is noted the above timing preferences will not always be practical due to shifting tidal cycles not always aligning with normal work hours. It is recommended the above timing preferences are adhered to wherever practical or reasonable.

4.6 Field Measurements and Observations

4.6.1 Field Measurements

Some parameters (e.g. temperature) can only be measured in the field. For other parameters (e.g. dissolved oxygen), field measurements are highly desirable because the value of the parameter might change in the sample after collection ANZECC ARMCANZ (2000b:4-1). The following parameters are to be measured in the field:

- Electrical Conductivity (EC);
- Turbidity (NTU);
- Temperature;
- pH; and
- Dissolved oxygen (DO).

Field measurements are to be made on separate sub-samples of water to avoid contamination.

4.6.2 Field Observations

At each visit, the following information is to be recorded on a field-record sheet (based on information in ANZECC ARMCANZ, 2000b):

- the exact locations of sampling sites (if sites need to be refined during the construction phase due to safety, access or other reasons, these proposed changes will be discussed at the Environment Review Group meetings);
- accurate description of where samples were collected;
- weather conditions and general observations on the condition of the waterbody because these factors may influence the variables being measured;
- the date and time when samples are taken (standard or daylight-saving time);
- tidal cycle (ebb or flood tide and time of nearest low tide at the sampling site) for the monitoring sites at: Boggy Creek: Chainage 20,800; Deep Creek: Chainage 23,100; and Kalang River: Chainage 35,900;
- visual observations of oil/grease on the water surface and gross pollutants such as litter in the waterway, on the banks or within the adjacent water quality measures (eg. sediment basins);
- any other observations or information on the conditions at the time of sampling that may assist in interpretation of the data; and
- photographic records are also highly desirable for future reference.

4.7 Field Sampling

Due to the relatively shallow depth of the waterways, bottle sampling is considered an appropriate sampling technique. For this purpose, immersion of a sample bottle by hand to just below the surface (typically 0.25–0.5 m depth) is satisfactory, provided any contribution from surface films is avoided, the sampler is downstream of where the sample is to be collected and other standard sampling techniques are adopted to avoid contamination of the sample (ANZECC ARMCANZ, 2000b:4-5 – 4-6).

4.8 Replicate Samples

It is recommended that one blind replicate water sample is collected for each monitoring event. This is based on the general requirement of one blind sample for every 20 samples.

4.9 Sampling Protocol

Sampling protocol to follow standard procedures as outlined in documents such as Australian Standard AS/NZS 5667 and *Australian guidelines for water quality monitoring and reporting* (ANZECC ARMCANZ, 2000b).

4.9.1 Sample Collection

Protocols to include the following basic precautions for avoiding contamination during sample collection:

- field measurements to be made on separate sub-samples of water;
- new or reused sample containers must be appropriately cleaned (use of containers supplied by the analytical laboratory is recommended);
- all field equipment is pre-cleaned to the same standard as the containers;
- sample bottles suitable for each parameter to be used;
- containers are uncapped or removed from their transport bags for minimum amounts of time;
- containers that were filled with water as part of the preparation protocol are emptied well away from and downstream of the sampling location before being rinsed with sample and refilled; and
- sampling staff should use standard techniques to avoid contamination when handling sample containers (eg. avoid touching the sample and the insides of caps or containers) (ANZECC ARMCANZ, 2000b:4-11,4-14).

4.9.2 Tracking Samples and Field Data

During sampling or field measurements, it is important to fill in a field data sheet or similar record that describes the samples taken, their labels and other relevant details (see **Section 4.4.2** - Field Observations). All field data and instrument calibration data are recorded on this sheet. All field records must be completed before leaving a sampling station. Any observations or information on the conditions at the time of sampling that may assist in interpretation of the data should be noted on a field-record sheet. Chain of custody documentation to be recorded as part of the sampling program is listed in **Table 4.6**.

Table 4.6 Chain of custody documentation

Process Step	*Quality Assurance Procedure*
Field sampling	Field register of sample number, site, type/technique, time, date, technician, field data sheet
Sample storage and transport	Field register of transport container number and sample numbers, time, date
Laboratory receipt of samples	Laboratory register of transport container number and sample numbers, time, date
Laboratory storage of samples	Laboratory register of storage location, type, temperature, time, date
Sample preparation	Analysis register of sample (laboratory) number, pre-treatment, date, technician
Sample analysis	Analysis register of instrument, calibration, technician, standard method, date, result

Source: Table 4.6 in ANZECC ARMCANZ (2000b:4-14)

4.9.3 Sample Identification

Sample containers should be marked in a clear and durable manner in order to permit clear identification of all samples in the laboratory. Blind replicate samples should be submitted to the laboratory as individual samples without any indication to the laboratory that they are replicates.

4.9.4 Sample Preservation

Water samples are susceptible to change as a result of physical, chemical or biological reactions which may take place between the time of sampling and the analysis. These changes are often sufficiently rapid to modify the sample considerably in the space of several hours.

All samples are to be stored in a refrigerated state immediately following sampling (eg. stored on ice in an esky or in a vehicle refrigerator).

The preservation of samples to be analysed for heavy metals may require acidification in the field (which would necessitate the use of separate sample containers for the heavy metals sample) or acidification in the laboratory within 6 hours of sampling. Liaison with the analytical laboratory should be undertaken to confirm the most appropriate method of preservation of the heavy metals samples.

4.9.5 Sample Transport

Samples will be transported according to the relevant parts of Australian Standard AS/NZS 5667.1:1998. The time between sampling and analysis is to be reported.

4.10 Sample Analysis

Standard laboratory analytical procedures are employed throughout and all analyses are undertaken by laboratories with NATA-accredited methods.

Parameters that require laboratory analysis are:

- physical properties: total suspended solids (TSS);
- hydrocarbons;
- nutrients; and
- heavy metals.

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5

Data Analysis and Interpretation

5.1 Data Analysis

5.1.1 Pre-Construction Monitoring Data

Data analysis of the pre-construction monitoring results will aim to establish baseline data and an indication of the degree of variation for each water quality parameter for existing conditions.

Analysis of the pre-construction data will also need to assess the existing variation in water quality between the upstream and downstream sampling sites at each monitoring location. This existing variation will then need to be incorporated into the analysis of the construction / operational stage monitoring to ensure it is not misinterpreted as an impact of the highway upgrade.

The pre-construction data will also be used to establish a correlation between total suspended solids and turbidity to assist in using turbidity as an indicator of total suspended solids during the construction and operational phases.

5.1.2 Trigger Values

It is difficult to specify meaningful trigger values due to the significant variation in some water quality parameters between monitoring events in each of the waterways as shown in **Table 2.3** in this report. The pre-construction data will provide an indication of baseline conditions and the degree of variation for each water quality parameter for existing conditions which can be used for comparison with construction and operational sampling results.

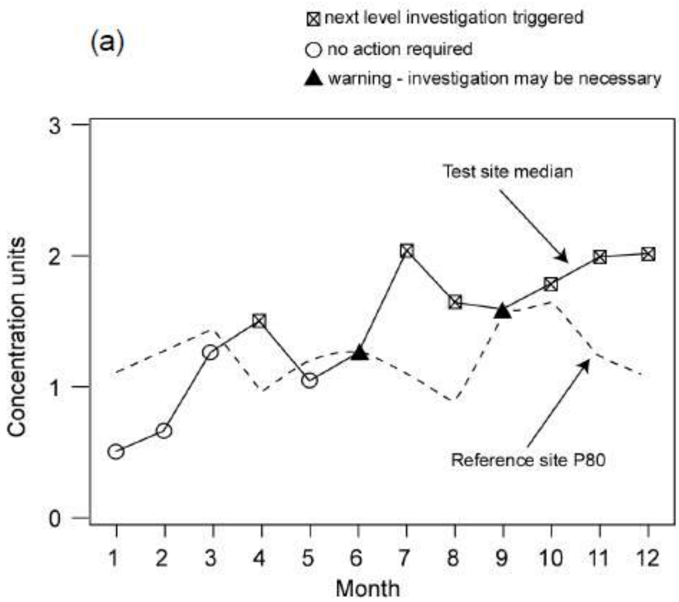
To assist the comparison of construction/operational sampling results with the pre-construction data, a comparison of median data versus 80th percentile data can be employed. This involves comparing the median values of the downstream data with the 80th percentile of values of the upstream data at each monitoring location. This comparison is aimed at ensuring the downstream median quality values for each parameter are lower than the upstream 80th percentile of values (or greater than the upstream 20th percentile for parameters such as dissolved oxygen where low values are the problem). Thus the 80th and 20th percentiles can be used as a trigger guide (ANZECC ARMCANZ, 2000b:6-17).

It is noted that the use of the downstream median value comparison with the upstream 80th / 20th percentiles will need to include consideration of the pre-construction variation (or 'natural' difference) in water quality between the upstream and downstream sampling sites at each monitoring location as discussed in **Section 5.1.1**.

5.1.3 Comparison of Sampling Data and Baseline Data

The proposed technique for comparing sampling results and baseline data or trigger values is with the use of either tabulated results or control charts (or a combination of both).

An example of the use of control charts for the comparison of downstream median value with the upstream 80th/20th percentiles is shown in Plate 5.1. Here, the monthly results for a test parameter for a monitoring location are graphed in a control chart whereby the test site results (at the downstream or 'impact' site) are compared to the trigger value using the 80th/20th percentile from the adjusted reference site data (upstream monitoring location).



Source: Figure 6.7 in ANZECC ARMCANZ, 2000b:6-19

Plate 5.1 Example Control Chart

5.2 Data Interpretation

After the data analysis, the results are to be collated into a concise statistical summary and assessed in the context of the monitoring objectives below.

5.2.1 Pre-Construction Stage

Data interpretation for the pre-construction stage monitoring will address:

- consideration of the difference in the pre-construction monitoring results between the upstream and downstream sites at each waterway crossing (refer to **Section 5.1.1**); and
- establishment of baseline surface water quality data for the project including the degree of variation for each water quality parameter for existing conditions.

5.2.2 Construction Stage

Data interpretation for the construction stage monitoring will address:

- identification of impacts of the highway upgrade construction on surface water quality; and
- refinement of construction surface water management measures.

5.2.3 Operational Stage

Data interpretation for the operational stage monitoring will address:

- identification of impacts of the highway upgrade operation on surface water quality;
- adjustment of operational surface water management strategies and stabilisation works.

5.3 Reporting

5.3.1 Pre-Construction Stage

At the completion of the pre-construction stage monitoring a report is to be produced containing full and complete details of all aspects of the monitoring. The report will include:

- introduction and background: description of the program and objectives and delineating the study boundary;

- experimental detail, describing the study location and study design, including detail of the sampling locations so they can be unambiguously identified, e.g. GPS directions and descriptions of methods of sampling and analysis;
- presentation, interpretation and discussion of the results including addressing the items outlined in **Section 5.2.1** and compliance with the Statement of Commitments;
- review and recommendations for the monitoring program for the construction and operational stages; and
- appendices, providing laboratory reports, data tables or other relevant information.

5.3.2 Construction Stage

Reporting during the construction stage will include interim reports, annual reports and a final report at the completion of the construction stage.

Interim reports will be produced on a monthly basis to provide the results of the monitoring during the past month. This may comprise a simple but clear tabulation of the monitoring results to be tabled at the monthly Environmental Review Group meetings. The report may include any relevant discussion of the results to inform the ongoing management of the surface water management measures or this discussion may simply be verbalised and minuted at the monthly Environmental Review Group meetings.

Annual reports will be of a similar format to that outlined in **Section 5.3.1**.

Similarly, the final report at the completion of the construction stage will be of a similar format to that outlined in **Section 5.3.1** and will include recommendations for the operational monitoring program.

5.3.3 Operational Stage

Reporting during the operation stage will also include interim reports, annual reports and a final report at the completion of the first three years of operation.

Interim reports will be produced on a six-monthly basis to provide the results of the monitoring during the past six months and any relevant discussion of the results to inform the ongoing management of the permanent surface water management strategies and stabilisations works.

Annual reports will be of a similar format to that outlined in **Section 5.3.1** for the pre-construction stage but excluding recommendations for the operational monitoring program.

Similarly, the final report at the completion of the first three years of operation will be of a similar format to that outlined in **Section 5.3.1** but including recommendations for a continued operational monitoring program if deemed appropriate.

6

Management Actions

The Surface Water Quality Monitoring Program will form part of the Construction Environmental Management Plan (CEMP) and the Operational Environment Management System and as such will be reviewed annually as part of the CEMP review.

6.1 Management Actions

During the construction stage the monthly interim reports will be discussed at monthly Environmental Review Group meetings to provide input to the potential refinement of surface water management measures or other relevant measures / procedures in the CEMP.

Similarly, during the operational stage the interim and annual reports outlined in the previous section will be assessed to provide input to the potential refinement of surface water management measures or other relevant measures / procedures in the Operational Environment Management System.

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7

Consultation

7.1 Regulatory Agencies

The NSW Environment Protection Authority (EPA), Department of Primary Industries (DPI), and NSW Office of Water (NoW) have been consulted during preparation of this monitoring program (refer to **Appendix A**).

EPA, DPI and NoW are to be consulted during the implementation of the Surface Water Quality Monitoring Program. As a minimum, this consultation is to include forwarding of all reports (interim, annual and stage completion reports) outlined in **Section 5.3** to NSW EPA.

7.2 Landholders

Landholders relevant to the proposed monitoring sites are to be consulted as required throughout implementation of the Surface Water Quality Monitoring Program in regard to establishment of monitoring sites and ensuring ongoing access to monitoring sites and related matters.

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Project Team

The project team members included:

Tim Ruge
Environmental Engineer

Duncan Thomson
Environmental Engineer

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References

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ANZECC ARMCANZ (2000b). *Australian guidelines for water quality monitoring and reporting*. Australian and New Zealand Environment and Conservation Council (ANZECC), Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

AS/NZS 5667.1:1998. Australian / New Zealand Standard™. *Water Quality – Sampling. Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*.

AS/NZS 5667.12:1999. Australian / New Zealand Standard™. *Water Quality – Sampling. Part 12: Guidance on sampling of bottom sediments*.

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NSW Fisheries 1999, *Policy and Guidelines: Aquatic Habitat Management and Fish Conservation*: (1999 update). Smith, A. and Pollard, D.A. (eds) NSW Fisheries, Port Stephens Research Centre.

RMS (2012). *Pacific Highway upgrade – Warrell Creek to Urunga. Brief – Preparation of Water Quality Monitoring Program.* March 2012. Contract No. 12.2544.0085

RTA (1999). *Code of Practice for Water Management. Road Development and Management.* [Online]. Available: http://www.rta.nsw.gov.au/environment/downloads/enviro_wcop_dl1.html [Accessed 14th March 2012].

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SKM (2010b). *Warrell Creek to Urunga, Upgrading the Pacific Highway. Environmental Assessment.* Volume 2 – Working Paper No.1 – Flora and Fauna. January 2010.

SKM (2010c). *Warrell Creek to Urunga, Upgrading the Pacific Highway. Environmental Assessment.* Volume 2 – Working Paper No.5 – Water Quality Impact Assessment. January 2010.

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Copyright and Usage

Appendix A

Agency Consultation

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NSW Environment Protection Authority

ENVIRONMENT PROTECTION AUTHORITY - COMMENT SHEET

Project:	Pacific Hwy Upgrade – Warrell Creek to Urunga		
Document title:	Surface and Ground Water Monitoring Plan		
Revision No.:			
Reviewer name:	S.Garwood	Review date:	July 2012
Responses by:		Response due:	

Thank you for the opportunity to comment on the Project's surface and ground water monitoring plan. Due to resourcing matters, the EPA has not reviewed the surface and ground water monitoring plan and therefore has provided comments specifically referenced to the document.

However in consideration of lessons learnt, best practices, industry standards and monitoring plans developed for previous Pacific Hwy Upgrade projects, the EPA highlights a number of key factors and key principles that should be addressed if not already done so.

Report Reference	EPA Comments	Consequent Response / Amendments to Monitoring Program
Consultation	EPA recommends the surface and ground water management plans also be prepared in consultation with key stakeholders such as Council, and relevant uses of the waterways, and aqua-culture industries.	Consultation has been undertaken with NoW, DPI and EPA. Councils have been consulted via review of the environmental management plans for the highway upgrade. Implementation of the monitoring programs will also include consultation with EPA, DPI, and NoW – as a minimum, this consultation is to include forwarding of all reports (interim, annual and stage completion reports)

Report Reference	EPA Comments	Consequent Response / Amendments to Monitoring Program
Guidelines/Standards	EPA recommends the plan be developed in accordance with the ANZECC Guidelines for Water Quality Monitoring and Reporting	The plans have been developed with consideration of ANZECC Guidelines for Water Quality Monitoring and Reporting
Objectives	Imperative the plan addresses surface and ground water objectives in consideration with state, catchment and local water quality objectives and management strategies. This may include addressing existing CMA / Council data, projects, programs. Objectives should be measurable	The primary objectives of the plans are: ▪ Surface Water: to evaluate the impact of the highway upgrade on water quality in the relevant waterways from Nambucca Heads to Urunga ▪ Groundwater: to evaluate the impact of the highway upgrade on groundwater levels and quality in the study area from Nambucca Heads to Urunga The objectives have been developed in consideration of the NSW State Groundwater Policy Framework and RMS Water Policy The objectives are considered measureable
Identifying waterways	The plan should identify and demonstrate the location of all waterways, drainage lines, creeks, wetlands, dams etc in which the project traverses and or falls adjacent to.	All major waterways / wetlands have been identified in the illustrations in the report as well as EEC's / GDE's
Identifying waterways	Each waterway should be characterised and its priorities ranked following a risk assessment. The risk assessment should address values as per ANZECC guidelines and address ecological values. This includes not just the values at the site but also downstream receiving environment. It is expected this would also identify sensitive areas; such swamp sclerophyll EECs, wetlands etc.	The waterways / wetlands characteristics and priorities have been based on information in the environmental assessment by SKM (2010) for the highway upgrade: *Warrell Creek to Urunga, Upgrading the Pacific Highway. Environmental Assessment*. Volume 1 Environmental Assessment. January 2010. (and supporting documents)

Report Reference	EPA Comments	Consequent Response / Amendments to Monitoring Program
Sources of risk - Construction	It is recommended risks associated with: ▪ increased volumes and concentration of tannin leachate ▪ curing compounds ▪ rock from working platforms etc ▪ sludge from basin de-silting ▪ sludge from under boring ; boring using bentonite ▪ sedimentation of waterways – not just increased turbidity or sediment laden runoff. ▪ potential exposure/leachate of soil contamination ▪ concrete slurry – boring, bridge works **Imperative the plan addresses primary and secondary impacts from increased sediment loads of sediments.** **It is also important to address how and to what level do these risks pose on local environmental values.**	The risks have been based on the environmental assessment for the highway upgrade by SKM (2010) as noted above. The risks assessed generally cover those listed in the adjoining "EPA comments" column however each specific risk listed is not individually addressed. It is considered that the general risks addressed and the consequent monitoring programs adequately cover the significant risks.
Sources of risk - Operation	It is recommended the plan addresses gross pollutants.	It is proposed that field observation recorded each monitoring period will include notes / photographs regarding gross pollutants such as litter.
Overview of the catchments	The plan should provide an overview of activities within each of the catchments and identify other likely contributing factors and variables.	The reports include an overview of the catchments and the general condition of the relevant waterways / wetlands
Baseline monitoring	It is recommended baseline studies are undertaken at each sensitive receiver and those waterways of medium to high ecological and community values.	The plans include 6 months of baseline monitoring prior to commencement of construction

Report Reference	EPA Comments	Consequent Response / Amendments to Monitoring Program
Baseline monitoring	This would also include surveys of existing sediment / soil profile and establish a series of monitoring stations to **monitor accumulative sediment deposition** into areas sensitive areas adjacent to and downstream of construction. This would include the assessment of ecosystem health, structure etc prior to construction.	Surveys of existing sediment/soil profile are not included in the baseline monitoring nor is establishment of a series of monitoring stations to monitor accumulative sediment deposition. It is considered the effectiveness of the proposed water quality measures (eg sediment basins) will be more easily / effectively monitored by targeting TSS in the water column during both wet and dry conditions. In respect to assessment of ecosystem health, structure etc prior to construction, this is not covered by the water quality monitoring plans. It is assumed this is addressed by the ecological monitoring required under *Condition of Approval B10 - Ecological Monitoring*
	In summary, EPA would expect the monitoring plan adequately address the key principles below. 1. **Environmental values and human uses** determined by the community for their waterways 2. **Water Quality Objectives** these represent the community's environmental values for waterways expressed for each catchment in the state 3. **Protection levels** set for each waterway according to its condition: high conservation value; slightly to moderately disturbed; or highly disturbed 4. **Waterway issues and level of risk** What are the issues or problems which might threaten the achievement of local environmental values? What level of risk do these issues pose for local environmental values?	1. **Environmental values and human uses:** the characteristics and general condition of the relevant waterways / wetlands is included in the plan – based on information in the environmental assessment by SKM (2010) for the highway upgrade 2. **Water Quality Objectives:** objectives have been developed in consideration of the NSW State Groundwater Policy Framework and RMS Water Policy. General water quality objectives are to ensure that water quality and quantity impacts to the environment are minimised 3. **Protection levels**: specific protection levels have not been specified. Sampling data will be compared with the baseline data at monthly Environmental Review Group meetings during construction to assess appropriate response measures

Report Reference	EPA Comments	Consequent Response / Amendments to Monitoring Program
	5. **Indicators** Choose the right indicators for the issues or problems for local environmental values 6. **Trigger values** Trigger values for each indicator used to assess the risk to an environmental value	**4. Waterway issues and level of risk** **water quality risks are identified in Section 2 of the plans** 5. **Indicators** Indicators have been selected based on the identified risks/issues and in consideration of relevant water quality monitoring guidelines 6. **Trigger values** It is difficult to specify meaningful trigger values due to the significant variation in some water quality parameters between monitoring events in each of the waterways. The pre-construction data will provide an indication of baseline conditions and the degree of variation for each water quality parameter for existing conditions which can be used for comparison with construction and operational sampling results. Sampling data will be compared with the baseline data at monthly Environmental Review Group meetings during construction to assess appropriate response measures

Please note that whilst the Environment Protection Authority encourages the use of procedures, EPA maintains its independence in the process in order to effectively discharge our regulatory responsibilities. Therefore, we are prepared to provide comments to assist the proponent in refining the document; however we will not evaluate detailed provisions or endorse any aspect of the documents. In addition, the above comments in no way negate any statutory requirements of conditions of approval.

Department of Primary Industries (DPI)

Consultation

Email from Kristy Harvey (RMS) to James Sakker (DPI) sent Tuesday, 19 June 2012 2:00 PM

Subject: Nambucca Heads to Urunga Water Quality Monitoring Plans

Hi James,

Plans attached to fulfill B17 of attached Conditions of Approval for the NH2U stage 1 of the Warrell Creek to Urunga Project.

Please provide any comments and let me know if you have any questions.

Kind Regards,

Kristy Harvey
Environmental Officer Federal Prgm
Major Projects Northern | Northern Region
Roads and Maritime Services
76 Victoria Street Grafton NSW 2460

File(s) will be available for download until 26 June 2012:

File: Conditions of Approval.pdf, 1,948.41 KB [Fingerprint: 9aeceb79086e1425670140bce6945f0a]

File: 1997303 Surface Water Quality Monitoring Program - Nambucca Heads to Urunga chainage 19500-41300_Final Draft.pdf, 3,271.88 KB [Fingerprint: 7795416e7397087ddf8a1cb22f363191]

File: 1997335 Groundwater Quality Monitoring Program - Nambucca Heads to Urunga chainage 19500-41300_Final Draft.pdf, 7,426.06 KB [Fingerprint: 4394ddd7eb0bf500eb9f1c1a889a1c3a]

File: for client 1997303 Surface Water Quality Monitoring Program - Nambucca Heads to Urunga chainage 19500-41300_Final Draft.docx, 3,435.72 KB [Fingerprint: 15e5520bf599537aa8c3a1a726adae31]

File: for client 1997335 Groundwater Quality Monitoring Program - Nambucca Heads to Urunga chainage 19500-41300_Final Draft.docx, 517.20 KB [Fingerprint: 017c52305e4d15366ae06513a08b135f]

Comments from DPI

Email from James Sakker (Conservation Manager - Pacific Highway Upgrade, NSW DPI) to Kristy Harvey (RMS) sent Monday, 30 July 2012 9:33 AM

Hi Kristy

Thank you for referring the surface water quality monitoring plan and groundwater monitoring plan to NSW DPI for review.

NSW DPI endorses the comments made by the EPA in relation to the plan and seeks clarification on the monitoring sites in figures 2.1 and 2.2 as only downstream locations are shown at chainage 20800 and 26400 respectively whereas in figures 4.1 and 4.2 both upstream and downstream monitoring locations are shown. It is important that the sites proposed in figures 4.1 and 4.2 are used to show any effects of construction on water quality.

NSW DPI has no further comments to make on the groundwater monitoring program
regards James

James Sakker Conservation Manager (Pacific Highway Upgrade) Department of Primary Industries NSW (NSW DPI) 1243 Bruxner Highway Wollongbar NSW 2477

Consequent Response / Amendments to Monitoring Program

The monitoring sites in Illustrations 2.1 and 2.2 are the sampling locations used during the environmental assessment (EA) phase and are not the proposed monitoring locations for the monitoring program. The title of Illustrations 2.1 to 2.4 amended to avoid confusion between proposed monitoring sites and monitoring sites implemented in the EA phase.

Comments from DPI (3 October 2012)

NSW DPI recommends that Cow Creek be included in the surface water monitoring program as it is near a high risk cut as identified in the groundwater monitoring program and it is a tributary just upstream of the Class 1 waterway Deep Creek which could potentially be affected during and post construction.

Consequent Response / Amendments to Monitoring Program

Cow Creek was considered as part of the assessment for pre-construction monitoring locations, however the refinement process resulted in Boggy Creek being selected over Cow Creek as a representative tributary of Deep Creek (in addition to selection of Deep Creek itself). Boggy Creek is considered the preferred location because:

- it contains an GDE / EEC (sub-tropical coastal floodplain forest) over the monitoring locations (see illustration below); and
- it is less influenced by tidal flows compared to Cow Creek which means it will be more accurate to identify any potential impacts associated with the construction and operation phases of the highway upgrade.

Notwithstanding the above, it is considered prudent to monitor Cow Creek during the construction and operational phases of the highway upgrade to ensure the proposed water quality control mitigation measures are effective.

NSW Office of Water (NoW)

Consultation

Email from Kristy Harvey (RMS) to Patrick Pahlow (NoW) sent 20/07/2012 10:02 am

Hi Patrick,

Warrell Creek to Urunga Plans for comment.

Kind Regards,
Kristy

File(s) will be available for download until 27 July 2012:

File: 1997303 Surface Water Quality Monitoring Program - Nambucca Heads to Urunga chainage 19500-41300_Final Draft.pdf, 3,271.88 KB [Fingerprint: 7795416e7397087ddf8a1cb22f363191]

File: 1997335 Groundwater Quality Monitoring Program - Nambucca Heads to Urunga chainage 19500-41300_Final Draft.pdf, 7,426.06 KB [Fingerprint: 4394ddd7eb0bf500eb9f1c1a889a1c3a]

Comments from NoW

Email from Patrick Pahlow (NoW) to Kristy Harvey (RMS) sent Friday, 20 July 2012 11:44 AM

Hi Kristy,

I have briefly reviewed the information contained in the Water Quality Monitoring Plan for NH2U and am satisfied that the monitoring program as describe is satisfactory for the management of surface water quality for the abovementioned project.

Patrick Pahlow | Senior Licensing Officer |
NSW Department of Primary Industries | Office of Water |
135 Murwillumbah Street | Murwillumbah NSW 2484
PO Box 796 | Murwillumbah NSW 2484
W: www.dpi.nsw.gov.au | www.water.nsw.gov.au

Consequent Response / Amendments to Monitoring Program

No amendments to document resulting from NoW comments