

# **-WATER QUALITY MONITORING STRATEGY-**

**Subdivision Part Lot 4 DP771597 & Portion 4,  
off Leo Drive, Narrawallee**

Ref: D301-1

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Prepared for

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## Project Identification

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Part Lot 4 DP771597 & Portion 4, off Leo Drive  
Narrawallee

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## 1. Introduction

Australian Wetlands has been commissioned by J. Wyndham Prince Pty Ltd (JWP) on behalf of Hazcorp Pty Ltd to prepare a water quality monitoring strategy for the proposed subdivision of Part Lot 4 DP771597 and Portion 4 off Leo Drive, Narrawallee.

Shoalhaven City Council's Subdivision Code (SCC, 2001) specifies the stormwater quality management objective '*To ensure that existing downstream systems are not adversely affected and ensure no net increase in pollution levels discharging from the development*'.

Additionally, the subject site lies within the Coastal Zone and as such is subject to State Environmental Planning Policy No. 71 - Coastal Protection (SEPP 71). To satisfy the requirements of SEPP 71, the Department of Infrastructure, Planning and Natural Resources (DIPNR) has requested the establishment of a water quality monitoring program. The program is to be prepared prior to the commencement of works on Stage 1 and is to be conducted by the developer for the length of the project and until at least 80% of dwellings are completed on all stages.

This strategy has been prepared in response to these conditions to assist in achieving water quality objectives in the long-term.

### 1.1 Background

A Stormwater Management Strategy (JWP, 2003) has been developed for the site which includes a combination of gross pollutant traps, constructed wetlands, grass swales, bio-retention swales and potential stormwater re-use (JWP, 2003). The results of a water quality analysis conducted using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) are included in the Strategy with the aim of predicting potential nutrient reduction performance. The results indicate that the proposed water quality management system will comply with Environment Protection Authority (EPA) reduction targets and will compare favourably with target values nominated in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000) (see Section 3.2).

The purpose of this Water Quality Monitoring Strategy is to monitor the effectiveness of these proposed water quality devices to confirm they are performing as intended to achieve the target pollutant reductions. Water quality monitoring is a means by which the results of the water quality modelling can be verified. It involves regularly testing for physical and chemical indicators and comparing the results with the water quality of surrounding waterways and water quality targets.

### 1.2 Water Quality Monitoring Objectives

Water quality monitoring involves testing a number of physical and chemical parameters for the protection of downstream environments. There are many different types of physical and chemical stressors that impact an ecosystem and biota in different ways. Water quality parameters commonly chosen as key indicators of general water quality and will be monitored in the current strategy include: Total Suspended Solids (TSS), Total Nitrogen (TN) and Total Phosphorus (TP).



TSS is a measure of suspended particulates in the water. Water can contain fine clay colloids that are difficult to remove from the water column, which in turn reduces light penetration into the water. Nitrogen is essential for plant growth, however increased levels of nitrogen can contribute to excessive algal growth and weeds. Phosphorus is an essential plant and animal nutrient, however increased levels of phosphorus can contribute to excessive algal growth and weeds.

Water quality targets have been guided by criteria from the EPA (NSW) and from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000) and are discussed further in Section 3.1.

The primary goal of the water quality monitoring is to determine if water discharging from the site complies with the nominated water quality targets (see Section 3.1 for target values). As such, the objectives of water quality monitoring are as follows:

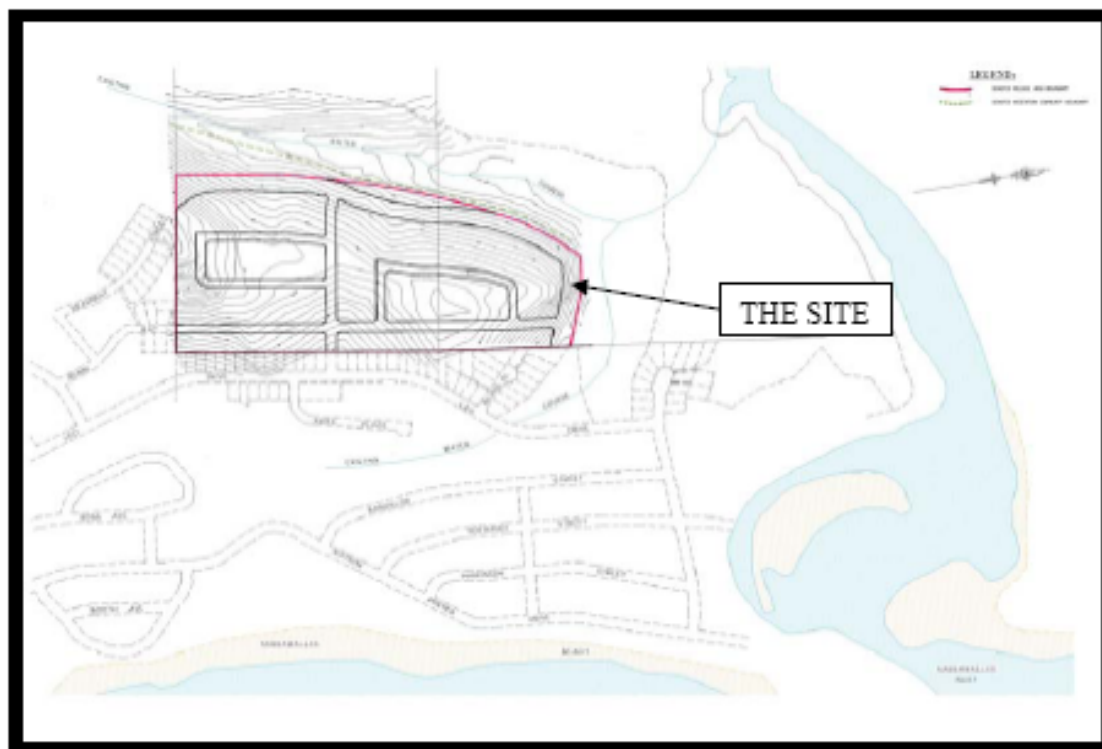
- Determine whether quality of water discharging from the site meets water quality targets,
- Assess the performance of stormwater controls proposed for the subdivision,
- Assist in understanding sources of pollutants and 'hot spots', and
- Provide guidance for the identification of management issues that may have implications for water quality.



## 2 Site Details

### 2.1 Site Location and Description

The subject site is located within the Shoalhaven Local Government Area and is bounded by properties fronting Leo Drive and Blake Place to the east, dense bushland to the north and west and properties fronting Seaspray Street and Gemini Way to the south (Figure 2.1).



**Figure 2.1 Site Location**

Source: JWP, 2003.

The subject site has an area of approximately 21.39 Ha. The proposed subdivision of the land is to create a residential development consisting of 212 residential lots and associated road network and road drainage.

There are a number of discharge points on the perimeter of the site including:

- **Western Catchment:** This catchment drains in a westerly direction into an existing swamp forest and unnamed watercourse located to the west of the site. This watercourse drains into Narrawallee Inlet (JWP, 2003), with a catchment area to the western boundary of 12 Ha.
- **Northern Catchment:** This catchment is located in the north eastern corner of the site and drains northwards to the eastern tributary of the unnamed watercourse. It has an area of 2.7 Ha (JWP, 2003).
- **Leo Drive Catchment:** This catchment drains in an easterly direction into the street drainage system which services Leo Drive. It has an area of 7.9 Ha (JWP, 2003).



Sub catchment areas are detailed within the JWP (2003) report, Figure 2 with Plan reference number: 7109P2.

## 2.2 Stormwater Management Strategy

The proposed Stormwater Management Strategy designed by JWP (2003) incorporates a 'treatment train' approach where various types of pollutants are removed by a number of devices acting in series to maintain stormwater quality. The water quality treatment train proposed for the part of the site draining directly to the Swamp Forest is to include:

- 'Enviropod' (or equivalent) pit inserts in every inlet pit to remove trash, litter, vegetative matter, visible oils and greases and sediment from stormwater prior to discharge to a bio-retention swale.
- A bio-retention swale will be constructed at the interface of the Swamp Forest to control nutrients and fine sediments, evenly distribute flows, promote infiltration to groundwater and provide buffer storage to imitate existing inundation patterns.
- A detention storage component will be incorporated into the bio-retention swale to reduce post development discharges to the Swamp Forest for all storms up to and including the 5 year ARI design event to pre-development levels.

The eastern sub-catchments will discharge to existing infrastructure along the eastern boundary of the proposed sub-division. 'Enviropod' (or equivalent) pit inserts will be provided in every inlet pit within the eastern catchments to remove trash, litter, vegetative matter, visible oils and greases and sediment from stormwater prior to discharge to the downstream drainage system.

Details of the Stormwater Management Strategy can be found within the report prepared by JWP (2003) with reference number 7109rpt1. The components of the 'treatment train' have been designed, and their performance quantified via computer modelling, to provide standards of water quality consistent with the target values identified by EPA (NSW) and ANZECC/ARMCANZ.





## 3 Literature Review

### 3.1 Water Quality Targets

This literature review seeks to contextualise the proposed water quality strategy against relevant policy and water quality typical of the Narrawallee region. Water quality targets have been guided by criteria from the EPA (NSW) and from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000).

#### 3.1.1 Environment Protection Authority (NSW) Stormwater Quality Guidelines

The EPA has set guidelines for stormwater quality from urban developments and has developed stormwater management objectives for the reduction of various pollutants occurring post construction (EPA, 1997). The retention criteria are detailed in Table 3.1.

**Table 3.1 Average annual pollutant retention loads required by EPA (NSW)**

Pollutant	Retention of Average Annual Load
Total Suspended Solids	80%
Total Nitrogen	45%
Total Phosphorus	45%

This is the primary performance criteria being imposed upon the site.

#### 3.1.2 ANZECC/ARMCANZ Water Quality Guidelines

The ANZECC/ARMCANZ Guidelines (2000) provide a range of default trigger values for pollutants as part of a decision framework for managing water bodies. The values were derived from unmodified to slightly modified ecosystems and as such may be too stringent for certain highly disturbed environments. The Guidelines suggest that for certain highly disturbed environments, a lower level of protection be sought through reference site data, predictive modelling or professional judgement.

The Guidelines state that where toxicants occur naturally at levels exceeding trigger values, the background level should become the site-specific guideline trigger. Consequently, a review of local water quality data has been conducted and compared with performance rates derived from modelling using MUSIC. This enables anticipated stormwater quality post-treatment to be compared to water quality typical of the local area. This comparison is made in section 3.2.

With respect to the ANZECC/ARMCANZ guidelines the trigger values for lowland, east flowing coastal rivers in New South Wales for slightly disturbed ecosystems, are the most applicable to the Narrawallee site (Table 3.2).



**Table 3.2 ANZECC/ARMCANZ trigger values for total nitrogen and total phosphorus for lowland, east flowing coastal rivers in NSW for slightly disturbed ecosystems**

Pollutant	Trigger Value (mg/L)
Total Nitrogen	0.35
Total Phosphorus	0.025

### 3.2 MUSIC Modelling

A water quality analysis for the site was undertaken by J. Wyndham Prince Pty Ltd using the computer model MUSIC (Model for Urban Stormwater Improvement Conceptualisation). MUSIC predicts the performance of the water quality treatment system, allowing it to be evaluated with regard to water stated quality objectives.

The MUSIC modelling predicted that the proposed water quality management system will comply with Environment Protection Authority (EPA, 1997) reduction targets and will compare favourably with target values nominated in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000) (Table 3.3). In the absence of site specific data, streamflow and pollutant loading rates were adopted based on the default values of the MUSIC model (JWP, 2003).

**Table 3.3 Comparison of pollutant concentrations to target levels**

Pollutant	MUSIC Mean Pollutant Loading Rate-Urban Storm Conditions (mg/L)	MUSIC Median Discharge Concentration (mg/L)	ANZECC/ARMCANZ Trigger Value (mg/L)	MUSIC Reduction of Pollutant Loads (%)	EPA Target Reductions (%)
TSS	158	2.69	6 00	87.7	80
TN	2.63	0.432	0.35	56.7	45
TP	0.355	0.041	0.025	61.0	45

MUSIC modelling suggests that the proposed water quality treatment system will satisfy the requirements of the EPA (NSW) for all three parameters and achieve nutrient reductions close to the values nominated by the ANZECC/ARMCANZ guidelines.

### 3.3 Local Water Quality Data

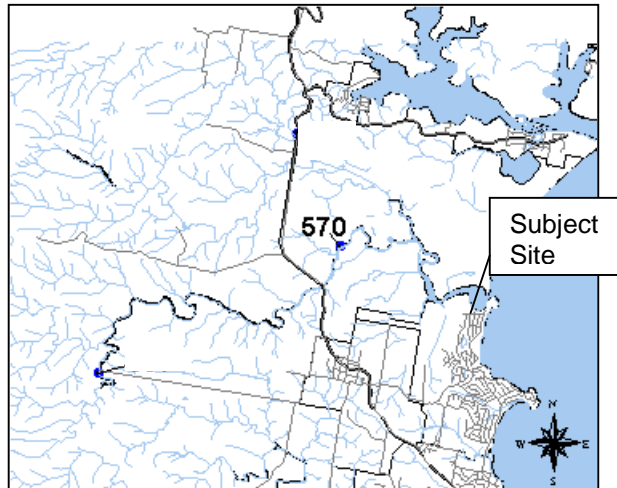
Activities within the catchment as well as catchment characteristics such as soil and geology can affect the water quality of waterways, and should be considered when creating site specific water quality targets. In order to allow site data to be assessed in a broader context and to have confidence in the results, a search for existing local water quality data was conducted.

Local water quality data for the Narrawallee Creek Catchment was sourced from the Shoalhaven City Council (State of the Environment Report, 2003/2004). The water quality of Croobyar Creek was monitored periodically for four years from 2000 - 2004 (Sampling point 570, Figure 3.1). During this period, nutrient levels (both Nitrogen and Phosphorus) frequently exceeded the Australian guidelines (Figures 3.2 and 3.3).

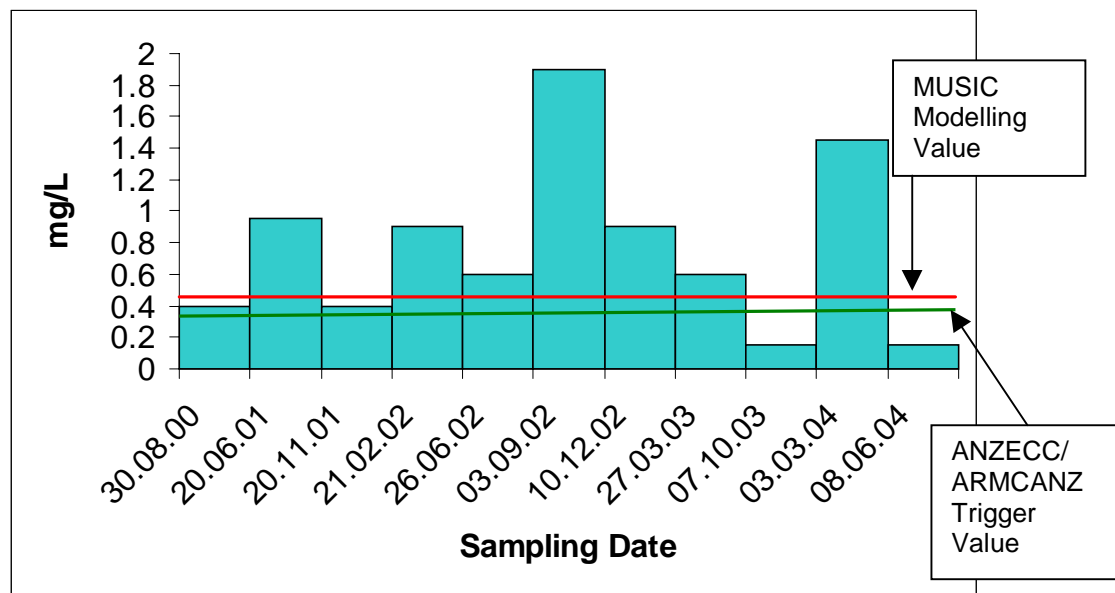


This information will be compared with water quality data from the site throughout the duration of water quality monitoring in order to contextualise site data with that of the nearby Croobyar Creek.

At the preliminary level, the review of local water quality data suggests that the performance predicted via MUSIC modelling will constitute a significant improvement in water quality typical of the local area.

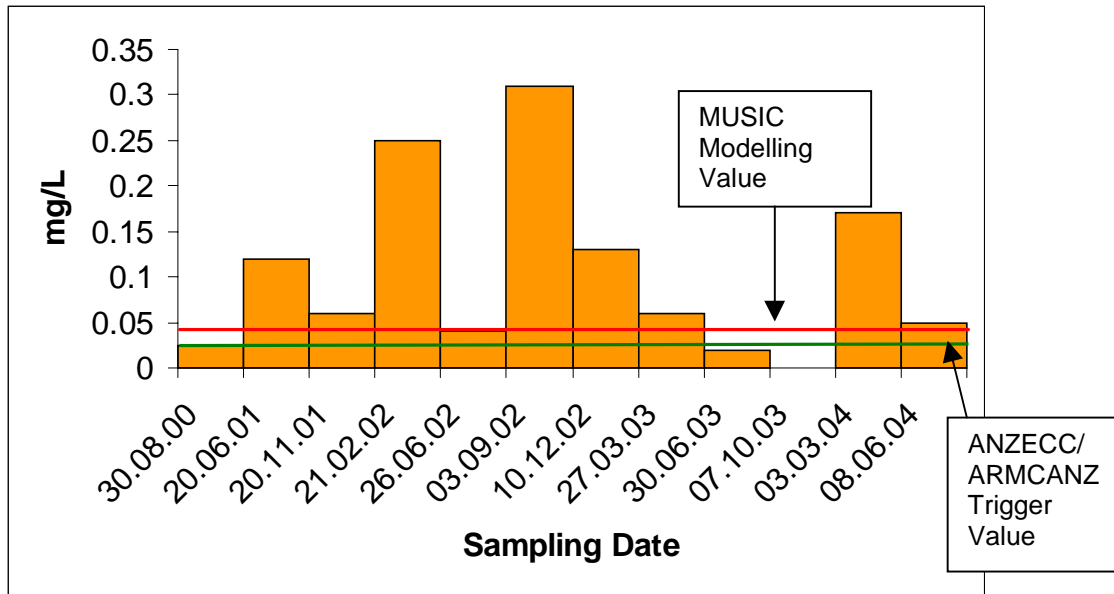


**Figure 3.1 Location of Shoalhaven City Council water quality monitoring site 570 in Croobyar Creek, Narrawallee**



**Figure 3.2 Total nitrogen levels for Croobyar Creek, Narrawallee between 2000 and 2004**





**Figure 3.3 Total phosphorus levels for Crooybar Creek, Narrawallee between 2000 and 2004**



## 4 Water Quality Monitoring

Water quality monitoring is the systematic and careful collection and analysis of samples, observations and in situ measurements with the aim of providing information and knowledge about a water body (ARMCANZ and ANZECC, 2000b). To be effective it is important that monitoring programs be carefully designed and planned to ensure its objectives are achieved (EPA, 1997). It is also important for the design to be iterative to allow refinement of the program as necessary.

### 4.1 Monitoring Strategy

The Strategy is based on the National Water Quality Monitoring Strategy (NWQMS) which is a nationally agreed set of policies, processes and guidelines developed by ANZECC and ARMCANZ (2000b) and endorsed by the Council of Australian Governments. The accepted framework for a well-designed water quality monitoring strategy will be adopted for this strategy and has been summarised within Figure 4.1. The relevant section of this report for each of the monitoring strategy steps is also provided.

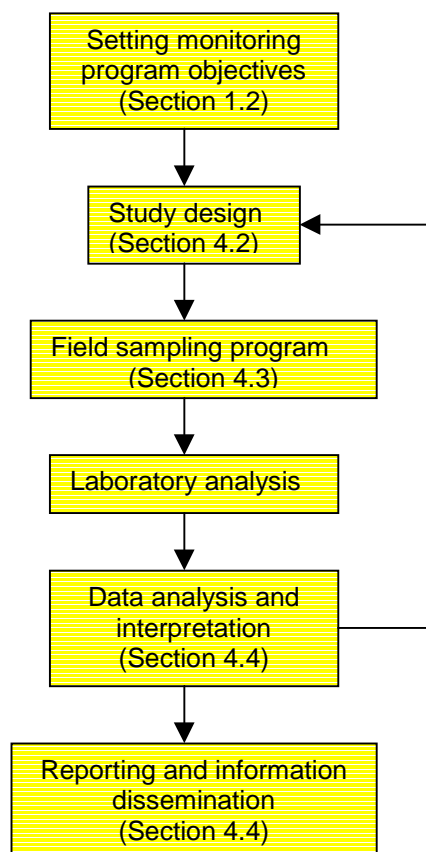


Figure 4.1 Framework for the water quality monitoring program.



## 4.2 Sampling Design

Following the preliminary site visit and given the sampling duration, the final location of sampling sites will be best determined at the completion of construction of the stormwater control measures and may be changed throughout the monitoring period. When selecting sites, prescriptions found within the Council Handbook for Managing Urban Stormwater (EPA, 1998), specifically section G2.1 will be considered.

For the purposes of this project the client requires monthly sampling to be undertaken. It is proposed that two samples be collected from inlets and outlets for each parameter. Composite sampling will enable a greater number of locations to be sampled. On this basis it is proposed that each of the two inlet and outlet samples will be comprised of 3-4 sub-samples from locations within the site, making a total of 12-16 samples being collected for analysis. The number of sub-samples will likely vary between months due to the erratic nature of storm events and the number of sub-catchments within the site. The strategy is summarised in Table 4.1 below.

**Table 4.1 Summary of sampling strategy**

<b>Frequency</b>	Monthly
<b>Parameters</b>	TSS, TN, TP
<b>Number of Samples to be Analysed</b>	TSS: 2 composite samples for inlets and outlets
	TN: 2 composite samples for inlets and outlets
	TP: 2 composite samples for inlets and outlets

Collected data should be compiled into a database that allows interpretation of results and comparison with local water quality records and trigger values. A suggested format for maintaining data is detailed within section 4.4.

The results of the analysis will enable the pollutant reduction performance of the stormwater treatment system to be measured.

## 4.3 Sampling Method

The sampling method should be planned, documented and consistent to ensure collection of field data that can be analysed objectively under control conditions. Good sampling principles are integral to the Water Quality Strategy and will require:

- Forward planning, including organisation of means of sample delivery and coordination with the laboratory for timing of analysis of samples,
- Consistency of sampling method, and
- Use of appropriate materials.

The following outlines on how to collect, preserve and prepare water samples for analysis should be undertaken and adhered to for each sampling event:

1. All bottles should be labelled and dated,



2. All bottles should be rinsed with the sample water three times to avoid contamination from previous samples. Do this downstream of the sampling site to avoid contaminating the site with disturbed sediment,
3. When collecting water samples from inflow and outflow sites, allow water to flow into the bottle and replace cap when full,
4. Samples should be collected as far away from the bank as possible, preferably in at least 20cm of water to avoid disturbing and collecting sediments,
5. For a composite sample equal proportions from the different locations must be collected and combined, and
6. Place all sample bottles in an esky filled with ice and send the samples to a NATA accredited laboratory for analysis the same day as sample collection.

#### **4.3.1 Sampling Materials**

The following materials will be required:

1. An appropriate number of plastic bottles that can store the appropriate volume required for analysis. For nutrient sampling, polyethylene (low or high density) sample bottles are the most favoured type, glass has the potential to adsorb ions such as phosphate (ANZECC/ARMCANZ, 2000),
2. Labels for the bottles,
3. Extender for collection of water without disturbance of sediments,
4. Ice and esky for transportation to laboratory, and
5. Sampling log book to record the following field observations during each sampling event:
  - Date
  - Time
  - Collector's name
  - Location
  - Weather conditions
  - Presence of nuisance organisms (eg algal mats)
  - Presence of odour or frothing
  - Other observations

#### **4.4 Data Compilation and Interpretation**

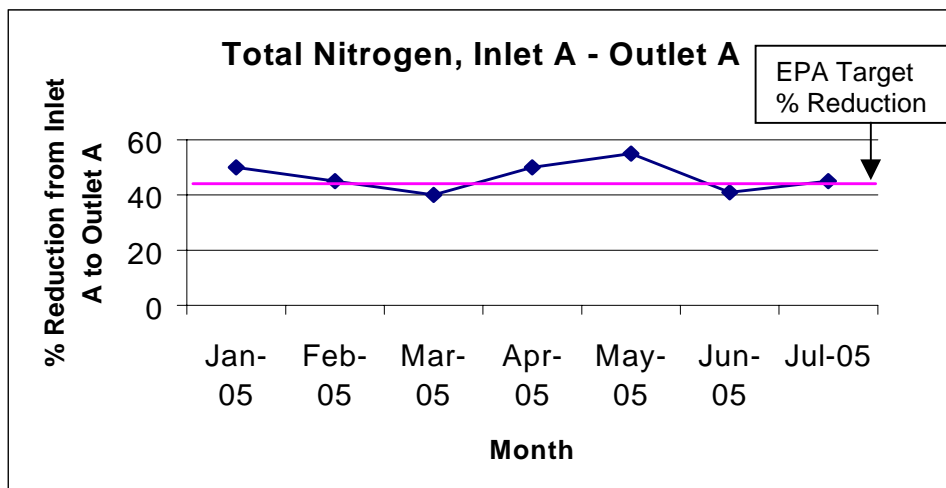
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After each monthly sampling event the results will be compiled and a short report prepared. Water quality data will be entered into a pro-forma similar to Table 4.2 which allows an ongoing assessment of compliance with reduction targets. Six of these pro-formas will be needed; one for each water quality parameter for each sampling site. A visual representation of the results will be presented in graphs similar to Figure 4.2.



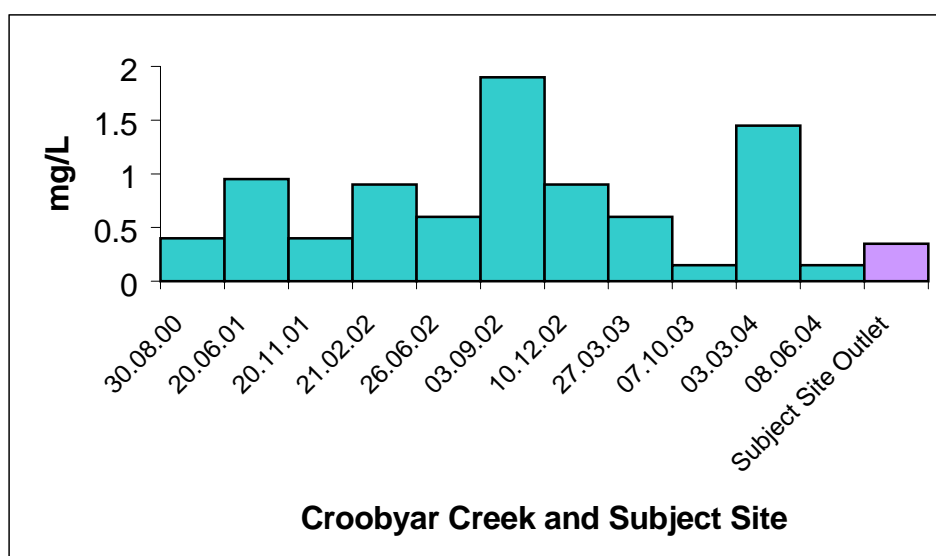
**Table 4.2 Example pro-forma for assessment of compliance with reduction target.**

Site	Inflow A		Parameter	Total Nitrogen	
Date	Inlet (mg/L)	Outlet (mg/L)	% Reduction	Target % Reduction	Compliance (Y/N)
				45%	
				45%	
				45%	
				45%	
<b>ANZECC Trigger Value: 0.35</b>			<b>%Samples complying with target</b>		



**Figure 4.2 Example graph of actual % reduction of TN against the target % reduction**

In addition, the outflow results will be compared to typical levels for the local area so that rather than only considering reduction targets, the water quality leaving the site can be contextualised with the surrounding region. This will assist in the identification of management issues. Graphs similar to Figure 4.3 will be included in the monthly reports.



**Figure 4.3 Example graph comparing the subject site outlet TN with TN for local river site.**





In the event that program objectives are not satisfied, the report will include suggestions for modifications to the sampling method, sampling locations or any other aspect of the study design as necessary.



## References

- Australian and New Zealand Environment and Conservation Council & Agriculture and Resources Management Council of Australia and New Zealand 2000(a), *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, ANZECC & ARMCANZ.
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