Guideline for Construction Water Quality Monitoring

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1.1 INTRODUCTION

Water quality monitoring (monitoring) is often recommended for road works to provide assurance of compliance with regulatory requirements and to ensure that environmental degradation does not occur as a result of the works. RTA encourages the implementation of monitoring where there is potential for adverse environmental impacts from the works and Project Management can effectively use the results of monitoring. This guideline provides direction on the decision process for whether monitoring is required and the technical aspects of a monitoring program.

This guideline has been developed to provide direction for the preparation and implementation of monitoring for RTA road works. This guideline encourages the preparation of monitoring programs that effectively identify potential water pollution problems from roadworks, the cause of the problems, and provide mechanisms to manage any identified issues.

A range of monitoring techniques are discussed in this guideline. A combination of field tests with probes and laboratory analysis is provided. The use of probes for water quality analysis is a good means to undertake water quality monitoring at reasonable cost.

1.2 OBJECTIVES

This guideline has been developed for RTA staff and contractors on the preparation and implementation of monitoring programs. It is to be used for road works where road works could significantly impact on receiving waters. Additional features can be added to each monitoring program to address site-specific requirements for each project.

The principal objective of this guideline is to provide direction on water quality monitoring issues for the phases of project development, construction and implementation. Key objectives of this guideline are to:

- provide direction on the decision process of whether a monitoring program is required for the project;
- develop monitoring programs that are effective in identifying potential pollution issues;
- provide a framework for the technical methodology for any monitoring program, and;
- develop monitoring programs that provide direction for project staff on the appropriate actions to be taken following interpretation of the monitoring results.

1.3 WHO SHOULD USE THIS GUIDELINE?

This guideline is a reference for all RTA and contractor staff, and specifically for those responsible for:

- environmental impact assessment;

- project management;
- environmental management;
- contract development and management, and;
- sample collection, data interpretation and reporting for monitoring programs.

This guideline should be used in the planning phase of project development to assess the need for monitoring programs. Any monitoring undertaken during the environmental impact assessment (EIA) stage of project development should be undertaken in accordance with this guideline, adapted for each project with project size and potential environmental impacts taken into account.

1.4 NOTE

Water quality monitoring is only one type of environmental or other monitoring that may be undertaken for road upgrade projects. For the purposes of this guideline water quality monitoring is referred to as ‘monitoring’, and ‘monitoring’ refers only to water quality monitoring.

2 POLICY

2.1 POLICY STATEMENT

The RTA's water policy is:

"The Roads and Traffic Authority (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."

3 GUIDELINES FOR WATER QUALITY MONITORING

3.1 WHEN IS WATER QUALITY MONITORING REQUIRED?

As shown in Figure 1, the decision on whether water quality monitoring is required will be derived from information collected during the environmental impact assessment (EIA) phase of project planning (see Appendices A and L of the *RTA Environmental Impact Assessment Policy Guidelines Procedures*). The key factors to be assessed at this stage are:

- the assessment of the receiving environment’s sensitivity;
- the potential for adverse impacts on the receiving environment from the proposed works;
- the outcomes of consultation with regulatory authorities, particularly the NSW EPA.

If a monitoring program is recommended in the EIA documents in the decision process, then it must be demonstrated that the results of the monitoring program can be effectively used by Project Management to identify any potential pollution issues and to manage those identified issues.

Water quality monitoring is an expensive operation. Therefore, it is important that cost and practicality issues are borne in mind when developing water quality monitoring programs.

3.2 LINKS TO OTHER CONTRACT DOCUMENTS

The monitoring program should be developed in conjunction with the project's Soil and Water Management Plan (SWMP). The SWMP will be prepared in accordance with RTA Specification G38 – Soil and Water Management Plan or Specification G39 – Soil and Water Management Plan (Erosion and Sediment Control Plan).

The requirements for the monitoring program must be specified in the project contract documents prepared during the detailed design and implementation phase of a project. The monitoring program will form part of the Contractor's Environmental Management Plan (CEMP).

3.3 MODEL PROGRAM CONTENT

The monitoring program should be easy to understand and should clearly inform all involved parties including RTA, contractors, subcontractors and regulatory agencies of the:

- rationale for the monitoring program.
- objectives of the monitoring.
- legal and other monitoring requirements.
- parameters to be monitored.
- sampling sites and frequency.
- accountabilities, responsibilities and training required to meet the objectives of the monitoring program.
- the method of comparison of results between sampling locations (eg: upstream and downstream) and any water quality criteria and/or targets for the project.
- reporting and recording of monitoring outcomes.
- responsibility for programming, implementing, checking and reviewing each element of the monitoring program.

3.4 MONITORING PROTOCOLS

3.4.1 Pre-construction Phase Monitoring

Objectives

The objectives of pre-construction monitoring are to:

- identify parameters for monitoring during construction.
- determine the indicative existing water quality.

Where possible, pre-construction monitoring should be undertaken during the EIA phase of the project. It is the preferred process to follow rather than further pre-construction monitoring after project approval. Any data collection for an Environmental Impact Statement (EIS) or Review of Environmental Factors (REF) should follow these Guidelines so that it can be used as part, or all of the pre-construction monitoring data for the project.

Sampling Sites

The monitoring should be undertaken as close as possible to the proposed discharge points of the proposed project to the receiving waters. The sampling locations should be representative of where the site discharge mixes with the receiving waters.

Sampling Regime

The purpose of pre-construction monitoring is to determine the parameters for monitoring during the construction works, with particular emphasis on the assessment of analytes that are not in the base set of parameters for construction phase monitoring, being:

- pH
- Total suspended solids (TSS).
- Oils and grease

Pre-construction monitoring is therefore focussed on all parameters identified from literature review on previous water monitoring, initial results, visual assessment, recommendations from the Department of Infrastructure, Planning and Natural Resources (DIPNR), EPA, Council or other sources.

A minimum of 2 pre-construction samples should be taken from each identified sampling site to ensure a representative sample is taken.

Potential impacts from construction activities will most likely result from erosion and sediment loss during rainfall events. Pre-construction monitoring should, as far as possible, include water quality samples during rainfall and storm events.

Parameters

The pre-construction monitoring samples should be analysed for the following parameters:

- pH, electrical conductivity (EC), turbidity, dissolved oxygen (DO), and temperature (where possible these parameters should be tested using a portable probe to reduce costs);
- Total suspended solids (TSS);
- Oils and grease (visual assessment). If oils and grease are visually evident, a sample will be forwarded to the laboratory for analysis, and;

- Other parameters as identified from literature review on previous water monitoring, initial results, visual assessment, and recommendations from the Department of Infrastructure, Planning and Natural Resources (DIPNR), EPA, Council or other sources.

The program needs to be flexible to meet individual project needs and local environmental factors. Additional factors that must be taken into consideration when programming the sampling program include the sensitivity of the receiving waters and the information provided by agencies.

Interpretation of results

Other water studies that have been carried out in the catchment should be reviewed and referenced. In the case where there is substantial existing data on the receiving waters, a review of these studies may be used to reduce the number of sampling events, and parameters analysed, that are required to meet the objectives of the pre-construction monitoring phase.

Where the proposed project intersects more than one receiving waterway, the sampling results should be assessed to provide an explanation of differences in the pre-construction water quality that may be useful when interpreting the construction and post-construction monitoring water quality.

3.4.2 Construction Phase Monitoring

Objectives

The objectives of construction monitoring are to:
- identify if water quality problems are occurring as the result of construction activities.
- demonstrate compliance with legal and other monitoring requirements including the water quality criteria and/or targets for the project.

Sampling sites

- During construction, monitoring is generally undertaken upstream and downstream of the works (read *3.5.1 Sampling Site Selection* for further guidance).

Water sampling must be complemented by visual inspection of the site conditions. If a water quality problem is indicated from the monitoring results the results should be used to assist in identification of the problem and management of the problem.

Sampling frequency

As the construction works mainly have an impact on the receiving waters during times of site discharge, upstream and downstream samples should be taken as soon as practical following rainfall events. Rainfall events refer to times when runoff from the site is entering the receiving waters through on-site sedimentation controls such as silt

fencing or windrows or when sedimentation basins require maintenance discharge to restore their design capacity.

Samples should be collected at the rate of:

- two samples per month during periods when rainfall results in any discharge from the site or when discharging from a point source such as controlled sedimentation basin discharges.
- one sample per month during times when there is no rainfall.

Instream real-time monitoring

It has been suggested that instream real-time monitoring may be useful for the management of some construction sites. It is recommended that instream real-time monitoring only be considered where there is an identified environmental need and that the results may be practically used in the management of the site. It must also be demonstrated that instream real-time monitoring provides technical and cost efficiencies compared to traditional monitoring techniques. Factors to be considered include cost effectiveness, practicality and security of equipment. An example of where instream real-time monitoring may be of use is where there is a continuous discharge into the receiving waters.

Parameters

Construction monitoring samples will be analysed for:

- pH
- Total suspended solids (TSS)
- turbidity (where a correlation with TSS is sought and a portable probe is available)
- Oils and grease (visual assessment). If oils and grease are visually evident, a sample will be forwarded to the laboratory for analysis.
- Possibly other parameters as identified following pre-construction monitoring.

(Note: pH, turbidity and other suitable analytes if specified, should be recorded in-situ with a portable probe. Turbidity measurements may be substituted for TSS analysis provided a correlation has been established between the two parameters on asite specific basis within the project)

Turbidity Measurements as a Trigger for Site Management

Turbidity measurements should be taken at all sampling sites during construction using either a portable probe or turbidity tube. A portable probe is preferred to a turbidity tube as the results obtained from using a turbidity tube may be limited by the variability of the eyesight of users and may not be highly accurate.

Turbidity measurements have the advantage of providing site management with immediate data, while TSS may take one week or more to be analysed and reported. Where routine turbidity measurements show that there may be impact on the receiving waters, additional measurements can be taken with the probe to further define the source of elevated measurements.

Where changes in turbidity levels indicate that construction may be impacting on the receiving waters, water samples should be collected for TSS analysis to quantify the potential impacts.

Interpretation of results

The monitoring program must incorporate a feedback loop to provide for rapid dissemination of the results (either visual, in-situ or laboratory) to project management to ensure problems are rectified as soon as possible.

If the results exceed the site criteria for any sample, refer to 3.6.1 Reporting and responding to exceedances.

If repeated results demonstrate that the site or parts of the site have stabilised, upstream and downstream sampling parameters, frequencies and locations should be reviewed in order to reduce or discontinue monitoring.

3.4.3 Post-construction Phase Monitoring

Objectives

The objective of post-construction monitoring is to:

- assess and manage impacts on the receiving waters as the site stabilises;
- assist in deciding when the site has stabilised.

Sampling sites

Post-construction monitoring sites should be representative of the impact site runoff will have on receiving waters. The number of sampling sites would likely be less than in the construction phase, dependent on changes in site hydrological conditions following the installation of the operational stormwater system.

Sampling frequency

Recommended default sampling frequency for post-construction monitoring is once per month. If a number of results demonstrate that the site or parts of the site have stabilised, the sampling frequency and sampling locations may be reviewed and reduced or discontinued.

Parameters

Post-construction monitoring parameters will be the same as those used during the construction of the project. Individual parameters may be withdrawn from the program as the site stabilises or the parameter is demonstrated to be no longer of concern. For example, where erosion has been controlled through re-vegetation and all operational stormwater controls have been installed.

Interpretation of results

If the results exceed the site criteria for any sample, refer to Section 3.6.1 – "Reporting and Responding to Exceedances".

If individual parameters or sampling sites are to be withdrawn from the program, it should be demonstrated that there is no longer an impact over a minimum period of 2 months.

3.5 MONITORING METHODOLOGIES

3.5.1 Sampling site selection

Sampling sites should be selected to comply with the requirements of *Australian Standard AS/NZS 5667.1 1998 – Water quality – Sampling - Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples* (available on the Standards Australia internet site – www.standards.com.au).

The availability of practical sampling sites will vary greatly between projects. The selection of sampling sites must take into account the objectives of the monitoring program and the safety of sample collection staff. All selected sampling sites should have permanent water.

Sampling sites will be selected to best identify any impacts of the construction works on the receiving waters. Upstream and downstream sampling locations will be selected to allow the assessment of site discharge against receiving water quality at the time of discharge. Any upstream sampling must be undertaken as close to, but outside the area of influence of the project. Downstream monitoring samples must be undertaken within influence of the discharge of the project where there is sufficient mixing to show the representative impact of any site discharge on the receiving waters, unless this is not possible due to safety issues or if suitable sampling sites are not available.

For some projects there may be external discharges, between the upstream and downstream sampling locations, that may impact on the receiving water quality. These may include other tributaries or stormwater discharges from agriculture or industry. In these cases, the simple comparison of upstream and downstream sample results may not indicate the actual impact of the works. Therefore, sampling locations must be selected to obtain results that are indicative of the project's impact relative to the other sources of impacts.

Other variables between the sampling locations to be considered include the depth of water, the flow velocity, resuspension of sediments and stream configuration. These variables may have impact on the results obtained and should be taken into account when interpreting the monitoring data.

- Occupational Health and Safety (OH&S) issues must be taken into consideration when developing the program, in particular the sampling site selection and safe access after rainfall.

3.5.2 Sampling collection

Sample collection is to comply with the NSW EPA's *Approved Methods for the Sampling and Interpretation of Results of Water Pollutants in NSW* (available on the EPA's internet site – www.epa.nsw.gov.au or 'Pollution Line' (131 555).

3.5.3 Laboratory analysis

Any laboratory used must be National Association of Testing Authorities (NATA) registered for each analysis required. This assurance of reliability is essential because the results may be used to make management decisions on improving the environmental performance of the works or for demonstrating compliance with the project conditions of approval or licence.

3.5.4 Training and equipment use

All staff that undertake monitoring sample collection and/or in-situ testing must be appropriately trained in the technical and administrative aspects of sample collection, equipment calibration and use, field reporting requirements and all OH&S aspects of the work. The monitoring program that is prepared for the works will specify the training requirements. The nominated people to interpret the results and to report to the Project Manager will also be included in the program.

All analytical equipment shall be calibrated according to the manufacturer's recommendations. Records of calibration of equipment are to be kept as part of the monitoring plan file.

3.6 REPORTING REQUIREMENTS

The Project Manager should receive regular routine water quality monitoring reports relevant to the frequency of sampling and analysis. Reports should be brief and should include:

- names of the people who collected the reported data, and the name of the client for the report.
- data tables (with water quality criteria shown and any high results highlighted).
- discussion of any high results or any results that indicate potential pollution from the site, and the potential source of the problem.

In the case of high results or identified potential pollution the report should include a brief interpretation of the potential source of the pollution and the contributory causes. The discussion of contributory causes should include brief interpretation of the following factors:

Physical Observations

Colour, clarity and odour of the water

Climatic Conditions

It is essential that the monitoring results be reported in reference to the climatic conditions at the time of sample collection. Items to be reported include rainfall over the previous week and the timing of the monitoring sampling in relation to the rainfall event.

Site Differences

Differences between sampling locations that may have an impact on the assessment of the data must be reported and interpreted in each report to the Project Manager.

3.6.1 Reporting and responding to exceedances

The Program shall include a process for reporting and responding to exceedances of water quality criteria and/or targets for the project that should include but not be limited to:

- validation of result(s) showing exceedance.
- repeated or further monitoring.
- investigation to determine cause and source of the exceedance (to include the contributory causes listed in 3.1.5)
- review of pollution controls and/or construction activities or procedures
- reporting to the Project Manager.
- statutory reporting to relevant government agencies.
- documentation of all of the above.

Figure 1: Flowchart for Construction Water Quality Monitoring