

**Guidelines for  
Implementing Total Management Planning**

**Asset Management**

**MAINTENANCE MANAGEMENT  
Implementation Guide**



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## **LIST OF ACRONYMS**

KPI	key performance indicator
SWOT	strengths, weaknesses, opportunities, threats
TMP	Total Management Plan
WSP	Water Service Provider

# 1 PURPOSE

This guide is intended to provide guidance for water service provider (WSP) practitioners and their consultants on the processes involved in establishing and implementing effective maintenance management strategies and procedures and developing associated documentation.

# 2 INTRODUCTION

## Outcomes

Effective maintenance management will ensure that:

- life cycle costs are minimised;
- there is efficient use of resources;
- environmental compliance is not compromised through asset failure; and
- service levels are maintained or improved.

## Outputs

Outputs from the maintenance management process include:

- Maintenance Management Plan (TMP sub-plan);
- maintenance plans; and
- maintenance management system.

# 3 THE MAINTENANCE MANAGEMENT PROCESS

The maintenance management process involves two interrelated phases:

- strategic phase; and
- operational phase.

## 3.1 The strategic phase

The strategic phase of maintenance management is illustrated in Figure 1.

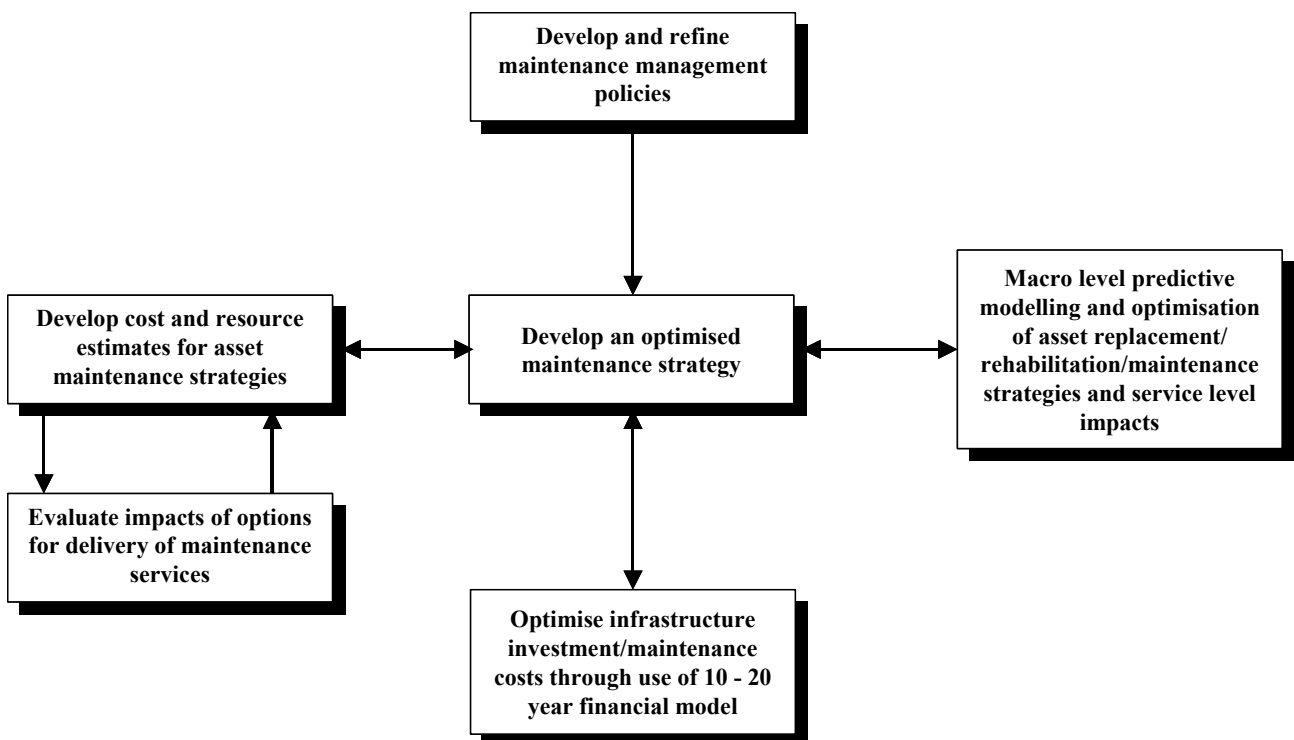


FIGURE 1: The strategic phase of maintenance management

The purpose of the strategic phase is to:

- set a policy framework for the WSP's maintenance management;
- identify the impacts of various maintenance strategies on:
  - service levels;
  - cost of maintenance (planned and unplanned); and
  - infrastructure investment costs (particularly asset replacement or rehabilitation);
- develop a strategy for the delivery of maintenance services; and
- develop a strategy for the management of the maintenance process.

## **Policy**

Policies that may be developed by WSPs would include:

- policy on the delivery of maintenance services (e.g. level of outsourcing; contractual arrangements); and
- overall policy clarifying the WSP board of management's philosophy and direction in relation to the maintenance of assets.

## **The process**

The strategic phase involves evaluating, as far as possible, the impacts of various maintenance strategies on the WSP as a whole. This could possibly include evaluating the impacts of various maintenance delivery strategies. This may also be addressed during the procurement phase for certain facilities. Based on the balance of costs and service levels, an optimised maintenance strategy will be developed. This will include projected maintenance costs for the next 5–10 years.

The approach to this optimisation will vary from WSP to WSP, depending on the availability of information and size of the WSP. For many organisations the initial approach may be very simple, using basic spreadsheet models which would rely on coarse data and projections. Initially the model outcomes will require a critical review by management. However, over time the model can be refined on the basis of real verifiable data. Over the next few years, as formalised asset management and supporting processes become well established within a competitive environment, it is likely that optimisation of asset maintenance and renewal costs against service standards will become a critical asset management activity.

The strategic phase will also address the issue of support systems for managing maintenance activities such as:

- maintenance planning;
- directing and controlling maintenance;
- management of shutdowns;
- recording and reporting maintenance; and
- analysing and optimising maintenance.

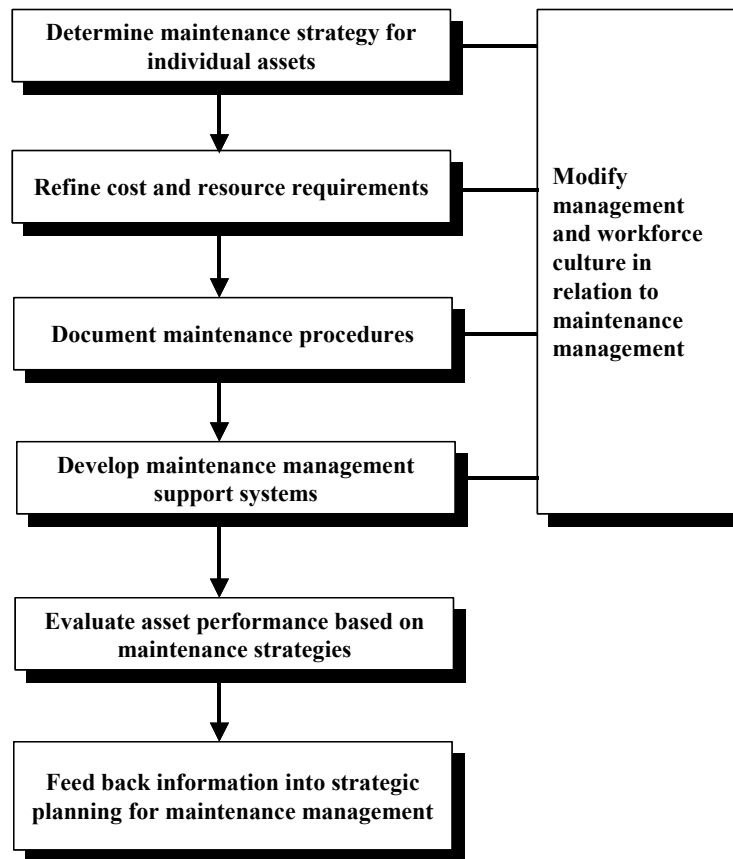
This will involve developing a strategy and action plans for implementing a formalised maintenance management system. Options include one or more of the following:

- basic wall charts;
- card-based system;
- basic spreadsheet, database, or GIS-based system;
- specialist computerised maintenance management system; or
- integrated asset management system.

All these systems have advantages and limitations, with the simpler systems being more appropriate for the smaller WSPs. These systems are discussed in other asset management texts (see 'References and further reading'). Information management is discussed in the separate Implementation Guide on Performance Management.

## **3.2 The operational phase**

The operational phase involves the more detailed implementation of the strategies developed in the strategic phase. The operational phase is illustrated in Figure 2.



**FIGURE 2: The operational phase of maintenance management**

The maintenance strategy adopted for each asset will depend on:

- direction set in the strategic phase;
- level of importance of the asset (directly related to consequence of failure);
- probability of failure of the asset;
- availability of asset for maintenance (e.g. shutdown of irrigation channels);
- recommended maintenance requirements; and
- optimal water industry practices.

Strategies available include:

- planned maintenance;
- scheduled maintenance;
- condition based/predictive maintenance; and
- unplanned maintenance.

The initial development of strategies will be an iterative process, requiring the balancing of resources and available budgets as determined in the strategic phase.

A number of tools exist to assist WSPs in developing appropriate maintenance strategies for assets. One of these tools is reliability-centred maintenance, a subject dealt with by a number of specialist texts. Essentially the process evaluates:

- the functions of an asset;
- ways in which it could fail to provide the function;
- the causes of each functional failure;
- the effects and consequences of each failure;
- options to predict or prevent failure; and
- options for managing a failure.

Many WSPs, as part of their quality management system, document their planned and unplanned maintenance procedures. The process can have a heavy consumption of time and resources, so the following steps will be necessary:

- Identify activities to be documented.
- Prioritise activities to be documented, according to issues such as:
  - importance level of the asset;
  - frequency of the activity; and
  - development of documentation.
- Carry out peer review of the documentation to:
  - ensure clarity and succinctness of information;
  - ensure compliance with regulatory requirements; and
  - identify opportunities for more efficient procedures.

The documentation should have a consistent, user-friendly style that is suitable for incorporation into a quality management system. Flow charts should be used where appropriate. The documentation should include a section on risk management to ensure that all risks are minimised. Risk will be addressed under the following categories:

- political/social (e.g. Should there be any notification of consultation with customers?);
- public health (e.g. Are any special procedures required to protect public health?);
- safety (e.g. Are there specific workplace health and safety issues that need to be highlighted?); and
- environmental (e.g. Are procedures adequate to minimise environmental harm?).

Procedures should also include a data collection sheet where appropriate.

The documentation can be compiled into a system or facility maintenance plan that outlines maintenance procedures and their frequency. In many instances the documentation process may occur in parallel with the input of maintenance procedure information into a computerised maintenance management system.

A critical maintenance management activity will be the analysis of asset performance data. This analysis will be used to:

- evaluate the cost-effectiveness of the adopted maintenance strategies and their impact on service standards; and
- provide information to enhance and/or calibrate predictive models for optimisation of asset replacement, rehabilitation and maintenance, and of service level impacts.

## **4 RISK ISSUES**

Potential risks associated with maintenance management include:

- failure of critical assets;
- non-compliance with service standards;
- non-compliance with regulatory requirements;
- workplace health and safety risks;
- inadequate customer communication or consultation;
- environmental impacts of maintenance practices;
- public health risks;
- political or social risks;
- customer complaints;
- inadequate emergency response;
- culture change from reactive or informal practices to more planned, formal practices;
- sub-optimal maintenance practices;
- inaccuracy or unreliability of maintenance data and information;
- inadequate feedback to planners, designers and management;
- selection of an inappropriate maintenance management system;
- competition for service;

- industrial action;
- poor contractor performance;
- sabotage; and
- vandalism.

## **5 TMP REQUIREMENTS**

Each WSP's Total Management Plan (TMP) should include an outline of key issues and identified strategies addressing these issues for the WSP's services in respect of maintenance management. Appendix A provides indicative content and appropriate TMP development level for this sub-plan.

A hierarchy has been established to define the level to which a WSP should develop its plan under total management planning. This is discussed in more detail in the TMP Development Guide. The development level depends on the size of the WSP (in terms of the replacement cost of its assets).

## **REFERENCES AND FURTHER READING**

*International Infrastructure Management Manual*, National Asset Management Steering Group, Association of Local Government Engineers New Zealand, Wellington, 2000.

*Total Management Planning – Urban Water-related Services: Management Issues*, Department of Primary Industries (Water Resources), Brisbane, 1994.

## APPENDIX A: Content and development level of sub-plan

**TABLE A1: Indicative sub-plan content**

Sub-plan features	Maintenance Management Plan content
Issues covered in sub-plan	<ul style="list-style-type: none"> <li>▪ Maintenance strategies.</li> <li>▪ Maintenance procedures.</li> <li>▪ Maintenance management support systems</li> </ul>
Purpose of plan	<p>To provide an overview of:</p> <ul style="list-style-type: none"> <li>▪ existing maintenance strategies and practices;</li> <li>▪ status of existing maintenance support (management) systems; and</li> <li>▪ future initiatives in infrastructure maintenance.</li> </ul>
Policies that may be required	<ul style="list-style-type: none"> <li>▪ Delivery of maintenance services.</li> <li>▪ Philosophy and direction in relation to asset maintenance.</li> </ul>
Other Total Management Plan Elements that are intimately linked to this sub-plan	<ul style="list-style-type: none"> <li>▪ Operations Management Plan: interaction of operation and maintenance.</li> <li>▪ Asset Evaluation and Renewal Plan: asset register, condition assessment.</li> <li>▪ Financial Management Plan: higher investment in maintenance can reduce depreciation charges.</li> <li>▪ Risk Management Plan: maintenance strategies are likely to become more risk-based.</li> </ul>
External issues contributing to the current operating environment that need to be considered	<ul style="list-style-type: none"> <li>▪ There is an increasing recognition by WSPs and the community that the level of maintenance has an impact on service delivery.</li> <li>▪ The accounting profession, through AAS27, recognises the importance of maintenance on asset depreciation.</li> <li>▪ Commercialisation and outsourcing of maintenance will require more formal reporting on maintenance activities.</li> </ul>
Issues that need to be considered in summarising the status of current operations	<ul style="list-style-type: none"> <li>▪ Overview of maintenance strategies for different asset groups.</li> <li>▪ Status of existing maintenance documentation.</li> <li>▪ Status of existing maintenance support systems.</li> <li>▪ Overview of delivery of maintenance services (e.g. in-house or outsourcing).</li> <li>▪ Broad SWOT analysis of relevant operations.</li> </ul>
Strategic basis of the plan	<p>The strategic elements forming the basis of the plan should include:</p> <ul style="list-style-type: none"> <li>▪ goal for asset management;</li> <li>▪ objective(s) for maintenance management;</li> <li>▪ adopted KPIs; and</li> <li>▪ management strategies and performance targets.</li> </ul> <p>The management strategies developed will be based on the identified key strategic issues and SWOT findings, including risk assessment, in respect of maintenance management, and on the required TMP development level.</p> <p>Many WSPs are likely to require strategies for developing maintenance documentation, optimising maintenance practices and strategies, and implementing a maintenance management support system.</p> <p>The strategies should be supported by detailed action plans covering a period of up to 3 years.</p>

Sub-plan features	Maintenance Management Plan content
Suggested performance measures	<p>Outcome:</p> <ul style="list-style-type: none"> <li>▪ Number of unplanned interruptions/100 km main</li> <li>▪ Number of planned interruptions/100 km main</li> <li>▪ Percentage of unplanned interruptions restored within 5 hours</li> <li>▪ Percentage of planned interruptions restored within 5 hours</li> <li>▪ Average duration of unplanned interruptions</li> <li>▪ Average duration of planned interruptions</li> </ul> <p>Output:</p> <ul style="list-style-type: none"> <li>▪ Number of main breaks/100 km main</li> <li>▪ Number of sewer blockages/100 km main</li> <li>▪ Number of service repairs</li> <li>▪ Percentage of connections experiencing multiple interruptions</li> <li>▪ Ratio of planned to total maintenance jobs (by asset type)</li> <li>▪ Operations, Maintenance &amp; Administration (OMA) cost/100 km main</li> <li>▪ OMA cost/1000 customers</li> <li>▪ OMA cost/ML</li> </ul>
Supporting documentation	<p>This will depend on the WSP, but typically would include:</p> <ul style="list-style-type: none"> <li>▪ operation and maintenance manuals; and</li> <li>▪ documented maintenance procedures.</li> </ul>

**TABLE A2: Required sub-plan development level**

Development level <sup>1</sup>	Target management mechanisms of Maintenance Management Plan
3	<ul style="list-style-type: none"> <li>▪ Operation and maintenance manuals available for all key facilities.</li> <li>▪ Maintenance documentation forms part of Quality Management System.</li> <li>▪ Maintenance strategies optimised using modelling.</li> <li>▪ Infrastructure investment and maintenance costs optimised through use of 10–20 year financial model.</li> <li>▪ Options for delivery of maintenance systems evaluated.</li> <li>▪ Maintenance management systems linked to financial system.</li> </ul>
2	<ul style="list-style-type: none"> <li>▪ Operation and maintenance manuals available for all key facilities;</li> <li>▪ Maintenance documentation forms part of Quality Management System;</li> <li>▪ Infrastructure investment and maintenance costs optimised through use of 10–20 year financial model;</li> <li>▪ Maintenance management systems linked to financial system.</li> </ul>
1	<ul style="list-style-type: none"> <li>▪ Operation and maintenance manuals available for all key facilities;</li> <li>▪ Maintenance documentation forms part of Quality Management System.</li> </ul>

<sup>1</sup> Defined in Section 4.2 of TMP Development Guide.