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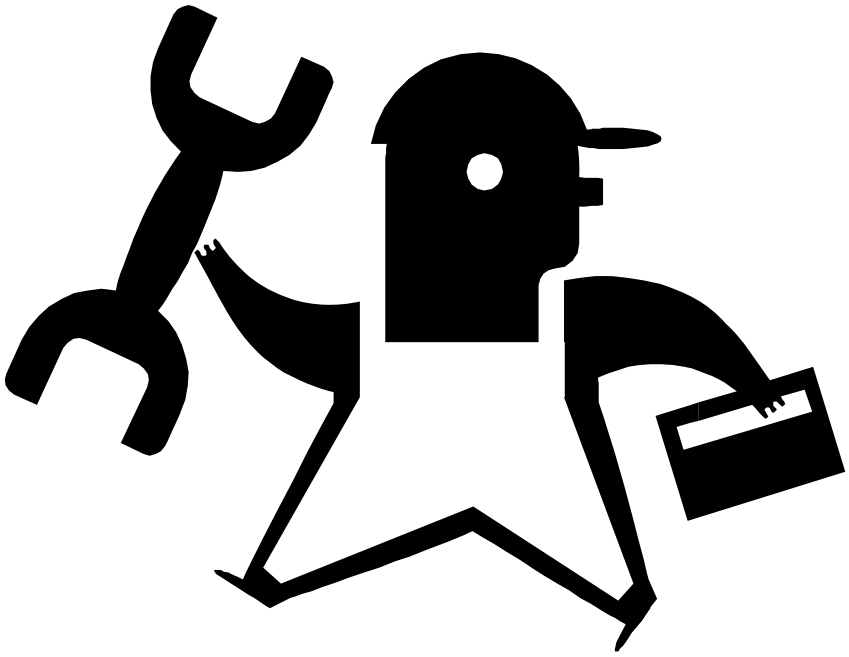

ASSET MANAGEMENT GUIDELINE FOR DRAINAGE/SEWERAGE SYSTEM

Hanoi, April 2009

Ministry of Construction – Hanoi

in cooperation with

Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH

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ABBREVIATIONS AND GLOSSARY

AMG	Asset Management Guideline
BOD	Biological Oxygen Demand
BOOT	Build-Own-Operate-Transfer
BOT	Build-Operate-Transfer
BTO	Build-Transfer-Operate
CCTV	Closed-Circuit Television is the use of video cameras to transmit a signal to a specific place, on a limited set of monitors
COD	Chemical oxygen Demand
CSOs	Combined Sewer Overflows
D&C	Design and Construct
DeD	German Development Services
DoC	Department of Construction
DoNRE	Department of Natural Resource and Environment
EUR	Euros
EPC	Engineering Procurement Contacting - contract is characterized by Functional Requirements, with clearly defined responsibilities for all the systems part of a subsea production system
FC	Financial Cooperation
GTZ	German Technical Cooperation
ISO	International Organization of Standardization
GIS	Geographical Information System
GPS	Global Positioning System
KfW	German Development Bank
KPM	Key Performance Measures
MIS	Management Information System
MoC	Ministry of Construction
ODA	Official Development Assistance
O&M	Operation and Maintenance
PPC	Provincial People' Committee
PPP	Public Private Partnership
PS	Pumping Station
PSP	Private Sector Participation
SP	Service Provider
SOP	Standard Operation Procedure
TA	Technical Assistance
TC	Technical Cooperation
WSC	Water Supply Company
WWC	A wastewater company
WWM	Wastewater and Solid Waste Management in provincial centers
WWTP	Wastewater Treatment Plant

CHAPTER 1: INTRODUCTION

1.1 Financial and Technical Cooperation of the Federal Republic of Germany in Vietnamese Wastewater Sector

The German Development Bank (KfW) has allocated about EUR 70 Million for financial cooperation (FC) with the Government of Vietnam to support the augmentation of wastewater collection and treatment facilities in six provincial cities in Vietnam, namely Bac Ninh, Hai Duong, Vinh, Can Tho, Soc Trang and Tra Vinh.
The overall goal of the programme is the enhancement of environmental conditions through the provision of improved wastewater facilities, comprehensive and efficient wastewater management, improving customer services, and gradual changes of community awareness and behaviour patterns.

Complementary to the FC module, the German Government has committed a technical cooperation (TC) module through German Development Cooperation (GTZ), called Wastewater and Solid Waste Management (WWM) Program to strengthen institutional capacities and improve the service delivery quality of the participating public works companies and state owned enterprises. These activities are implemented through active participation of the German Development Service (DED).

The Wastewater and Solid Waste Management Program consists of three components:

- Component 1 - Policy supporting to Ministry of Construction;
- Component 2 – Strengthening capacity for Wastewater Management companies;
- Component 3 – Strengthening capacity for Solid Waste Management companies.

In order to meet its objectives, the technical cooperation – component 2 focuses its operations in three activities areas, namely (a) Development of Institutional Framework Conditions at local government level; (b) Capacity Building in Wastewater Companies; (c) Capacity Building in Departments of Natural Resources and Environment. Within the Capacity Building in Wastewater Companies, the Component is focussing in five corporate subjects: (i) institutional and organizational improvement for wastewater management companies; (ii) improvement of financial management of wastewater management companies; (iii) community participation and management; (iv) wastewater asset management; and (v) improvement of human resource management.

1.2 Scope of Technical Cooperation with regard to Wastewater Asset Management

Under the objective of ‘asset management’, Technical Cooperation, Component 2 of the WWM Program is supporting participating wastewater companies in improving their managerial and operational performance in the field of asset management. Specifically, appropriate operation & maintenance (O&M) of existing and future assets needs to be assured. Thus, Wastewater Management Advisory services focuses on the following aspects:

- Preparation of institutional assessment and detailed identification of existing O&M practices, in close cooperation with the participating provincial wastewater operators.
- Participative preparation of the wastewater operators’ corporate development plans (CDP), with regard to asset management and to O&M activities.
- Set-up of the organizational structure for asset management and O&M planning, implementation, documentation/reporting and monitoring.
- Graphical and numeric documentation of existing and future drainage and wastewater assets, in close cooperation with the FC consultants and contractors.
- Preparation of an **asset management guideline** and conducting related asset management implementation trainings.
- Preparation of individual O&M manuals for each wastewater operator, comprising wastewater collection, pumping, and treatment works.

- Preparation of Job Specifications for all principle staff involved in O&M activities.
- Agreement with the wastewater operators on the assignment of suitable O&M staff.
- Implementation of O&M related staff training in the fields of wastewater collection, pumping, and treatment, including procedures relating to O&M planning, budgeting, implementation, documentation and reporting.
- Preparation of specific standard operation procedures (SOP) for O&M planning, implementation, documentation/reporting and monitoring, including the preparation of adequate O&M schedules, in close cooperation with the FC consultants and contractors.
- Support the commissioning of new FC financed wastewater facilities in close cooperation with the wastewater operators and the FC consultants involved.
- Assessment on post training O&M practices of each wastewater operator, identification of additional training needs and on-the-job exercising activities.

1.3 Purpose of the asset management Guideline

The main purpose of this guideline is to encourage and assist drainage/sewerage system owners and drainage/sewerage system operators to develop necessary tools and management systems to achieve:

- Evaluation of existing assets and development of renewal strategies;
- Management of assets operation and maintenance;
- Management of assets performance;
- Procedures for drainage/sewerage system expansion (assets expansion);
- Risk management for operation and maintenance of drainage/sewerage systems.

1.4 Assets of a Drainage/Sewerage System

Function of a drainage/sewerage system is to collect wastewater and storm water from the related catchment areas and to transport it via combined sewer overflow (CSOs), pumping station, regulating lakes, retention basins etc. to wastewater treatment plants or to storm water outlets, to treat the wastewater and to discharge treated wastewater and storm water into the receiving water bodies. Treatment and disposal of residues from wastewater treatment (sands, grits, greases, fats, and sludge) is also a part of drainage/sewerage system and its management.

Operation and management of a drainage/sewerage system need fixed assets and mobile assets.

As fixed assets the network of drainage and sewers, interceptors, pressure mains, pumping station, combined sewer overflow chambers (CSO's), regulation lakes and ponds, canals and ditches, wastewater treatment plants and outlet structures are defined. This includes all auxiliary building and structures for the purpose of wastewater and storm water collection, transport, storage, treatment and discharge into the receiving water bodies.

As mobile assets are all auxiliary machinery, specialized vehicles, tools and other equipment necessary for proper operation and maintenance defined.

According to Decree 88/CP-2007 the fixed assets including tertiary network and inspection chambers for the connection of discharging households are property of the system owner, while mobile assets are property of the operating agency. The house connection pipes between building and the inspection chambers are within the responsibility of the connecting households and stay in their private property.

The house connection pipes between the inspection chambers and the public sewers including the manholes are parts of the assets of the system owner.

The main characteristics of a drainage/sewerage system are:

- Construction and installation of drainage sewerage system need high investment and long realization periods for design, tendering construction and commissioning. Most system is realized in phases, over many years.
- The drainage/sewerage network and the mayor parts of the structures of a drainage/sewerage system are constructed underground and are generally the lowest laying technical infrastructure component. Proper documentation by measures of a GIS system should be technical standard.
- Drainage/sewerage systems must cope with a wide range of permanently changing hydraulic load. In combined systems which carry, during the dry season, only the dry weather flow, during heavy rainfall the hydraulic load of storm water and wastewater could be more than 100 times dry weather flow. Combined sewer overflow chambers (CSOs), storage basins or regulating lakes must be provided to cope with these changing flow quantities.
- Wastewater can contain a high load of solids which could settle and result in reduced hydraulic capacity or even blockage of the system. Sufficient flow velocity to meet the required carrying capacity for the sediments must be achieved, even during the dry season.
- All parts of drainage/sewerage systems which are exposed to wastewater or from wastewater generated emissions are subject to corrosion. Corrosion prevention by means of good ventilation of the system and selection of material with high corrosion resistance is required.
- Considering there above mentioned assets characteristics sound asset management is required. Good function of the system components and high quality standards of the invested materials can achieve long useful life and sustainable solutions for successful operation and management of drainage/sewerage systems.

1.5 Objectives of Drainage/Sewerage Asset management

Main objectives of Asset Management include:

- Deep understanding of existing drainage/sewerage systems, since they are the existing assets. This includes for all assets:
  - Location;
  - Technical and physical conditions;
  - Hydraulic or treatment capacity;
  - Performance during dry season and during heavy rainfall;
  - Deficiencies of the existing system:
    - technical deficiencies;
    - operational deficiencies;
    - managerial deficiencies;
    - financial deficiencies
  - Definition of resources needed for operation and maintenance;
  - Preparation of asset repair, rehabilitation and renewal strategies and plans.
- Optimization of the life cycle value of the fixed and mobile assets by investigations about repair, rehabilitation or replacement of existing assets and by providing a prioritization list for necessary repair, rehabilitation or replacement measures.
- Provision of basic information for preparation of financial proposals and preparation of investment plans for financing the investment of necessary assets, which are already identified in the prioritization list.
- Preparation of a risk management plan, which shows possible existing and future risks for systems, analyses the identified risks concerning their importance to endanger

proper operation and management of the drainage/sewerage system and develop investigation or avoidance strategies to be implemented in order to solve problems.

1.6 Asset Management Activities

1.6.1 Evaluation of existing assets and development of renewal strategies

An effective assets evaluation and renewal will allow asset owners and assets operators to have an intimate knowledge of:

- Assets, which are under control;
- the location of these assets;
- the value of these assets;
- the condition and performance of these assets;
- the approximate residual life of these assets; and
- prioritized projections of asset repair, rehabilitation or replacement costs.

This is a time consumed process, it needs a high commitments from assets owners and assets operators, even with a new modern Geographical Information System (GIS) and Global Positioning System (GPS).

1.6.2 Asset Operation and Maintenance Management

This includes the provision of material and manpower inputs required to fulfill duties and obligations resulting from operation and maintenance activities. This shall be achieved by implementation of annual sufficient budgets for operation and maintenance activities and by permanently executing operation and maintenance activities in order to achieve the proposed sustainability of the system.

Operation and Maintenance Management also means to provide the institutional set up for implementation of the O&M plans.

1.6.3 Assets Performance Management

This includes:

- Definition of performance standards and performance indicators;
- Introduction of an asset performance monitoring system;
- Monitoring by assessing and evaluating operation and maintenance performance;
- Documentation of monitoring results an identification of performance improvement measures;
- Implementation of the performance improvement measures.

1.6.4 Asset Planning Management

All asset planning is based on an inventory (asset register) of current assets and assessment of their current performance.

Further the demand for system's or system components repair and rehabilitation, the system elements replacement or systems expansion must be identified and prioritized. Asset planning management also includes financing of the identified demand and the realization of repair, rehabilitation, replacement and expansion measures (i) to keep the system running, (ii) to provide best possible service to the inhabitants, and (iii) to achieve optimum environmental protection in an appropriate manner, which is socially and economically acceptable.

1.6.5 Risk Management

Risk management is a permanent asset management duty because all operational and management activities can achieve positive but also negative results, which are per definition risks. It is therefore necessary to:

- Identify risks;
- To analyze risks and their importance;
- To develop measures for risk minimization, mitigation or avoidance.

CHAPTER 2: EVALUATION OF CURRENT ASSETS AND DEVELOPMENT OF RENEWAL STRATEGY

Expected outcomes of current assets evaluation and renewal: Effective assets evaluation and renewal will allow asset owners and assets operators to have an intimate knowledge of:

- assets it has under its control;
- the location of these assets;
- the value of these assets;
- the condition and performance of these assets;
- the approximate residual life of these assets; and
- prioritized projections of asset repair, rehabilitation or replacement costs.

Outputs from the asset evaluation and renewal process include:

- an Asset Evaluation and Renewal Plan;
- asset registers which can be presented in text or graphical outputs as asset inventory;
- asset condition/performance reports;
- asset valuation reports;
- specific asset management studies; and
- a prioritized asset replacement/rehabilitation program.

The asset evaluation and renewal process: The asset evaluation process is illustrated in picture 1 and Figure 1 below:

Picture 1: Assets documentation and its usage purposes

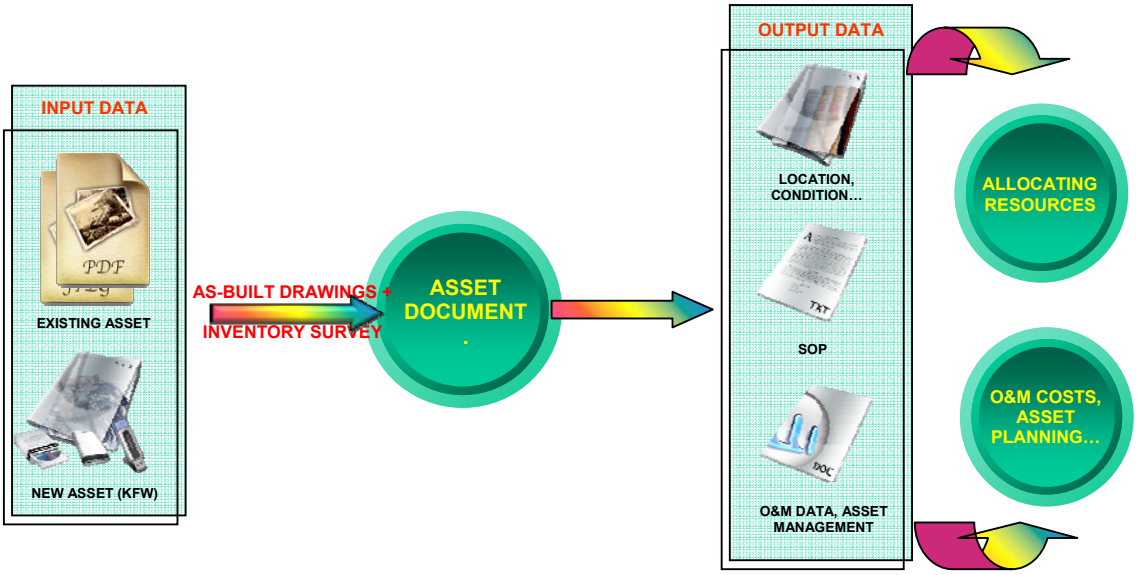
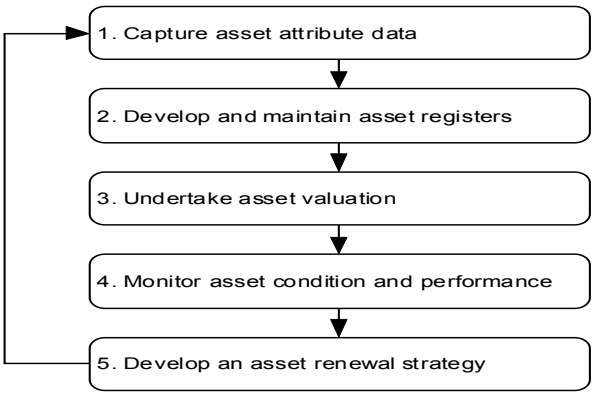


Figure 1: The asset evaluation and renewal process



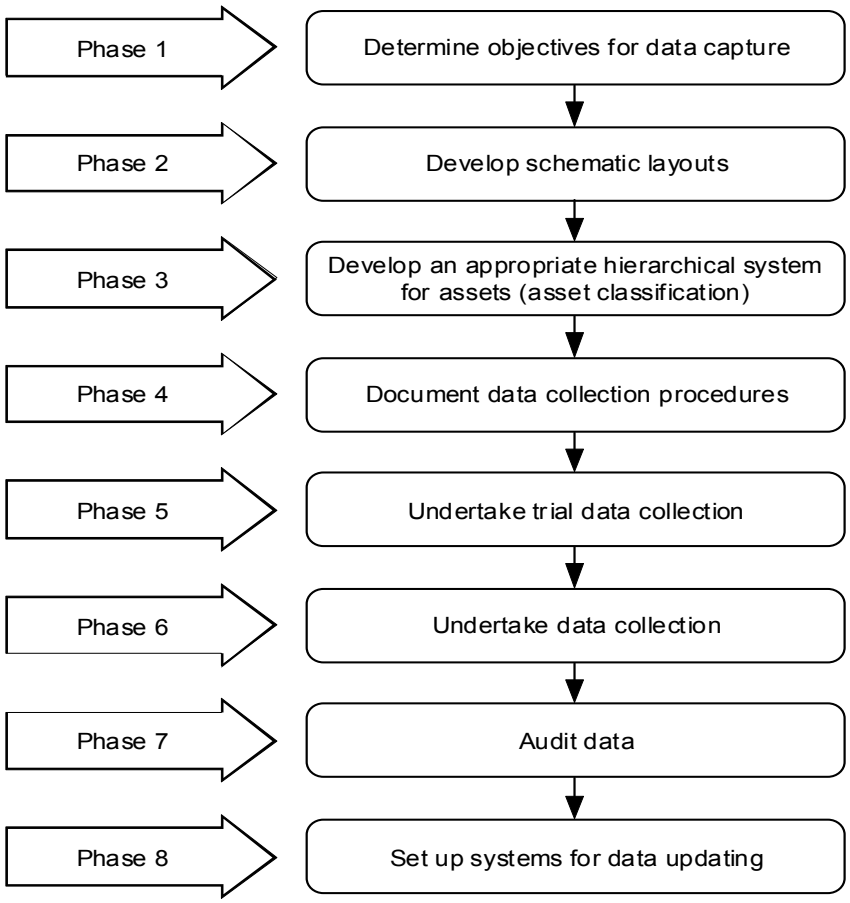
2.1 Capturing Asset Attribute Data

The initial data collection requires significant resources (human and financial). Data can be collected from a range of sources including:

- drawings and contract documents;
- operation & maintenance manuals;
- inspection and measurement of assets;
- geographical positioning systems, for asset location;
- photogrammetric mapping; and
- digitizing of existing drawings.

The data capture process can be extremely expensive, so it is essential that the process is well planned. The steps are illustrated in Figure 2.

Figure 2: The asset data capture process



Processes must be established to capture new and/or modified asset data. Permanent updating is a must, otherwise the asset database will gradually deteriorate and become unreliable and useless.

Phase 1: This sets the level of detail, accuracy, completeness of required data.
Examples:

- meeting accounting requirements
- setting up a maintenance management system
- predictive modeling of asset failure.

Phase 2: This is a highly effective means of understanding the system, how it should and actually works, and the role of each component in delivering the service. This facilitates the development of an appropriate hierarchical system for the assets.

Phase 3: Asset should be classified within a hierarchical structure that:

- is logical and easily understood
- consistent with proposed asset register software requirements
- facilitates data collection and recording.

Phase 4: Quality management procedures should be developed for:

- data collection for different asset groups including detail and accuracy of data
- auditing/verification of data
- presentation of information
- storage of information
- audit trails

Phase 5: This will allow the asset operators an opportunity to review and refine:
- project resources/budgets
- level of detail of data to be collected
- data collection methodology
- quality procedures for data capture.

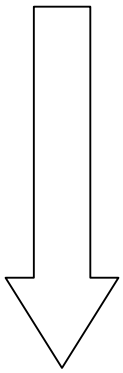
Phase 6: This may take a significant amount of time, particularly for larger wastewater systems. Management support and commitment and staff enthusiasm are essential to ensure quality outputs.

Phase 7: Undertaken to ensure:
- compliance with agreed quality procedures
- accuracy and completeness of data.

Phase 8: It is critical that processes are permanently updated to capture information on new or modified assets otherwise the register will rapidly become out of date. The update shall be achieved quarterly.

2.2 Developing and Maintaining Asset Register System (Documentation)

Table 1: Asset registers application by different users

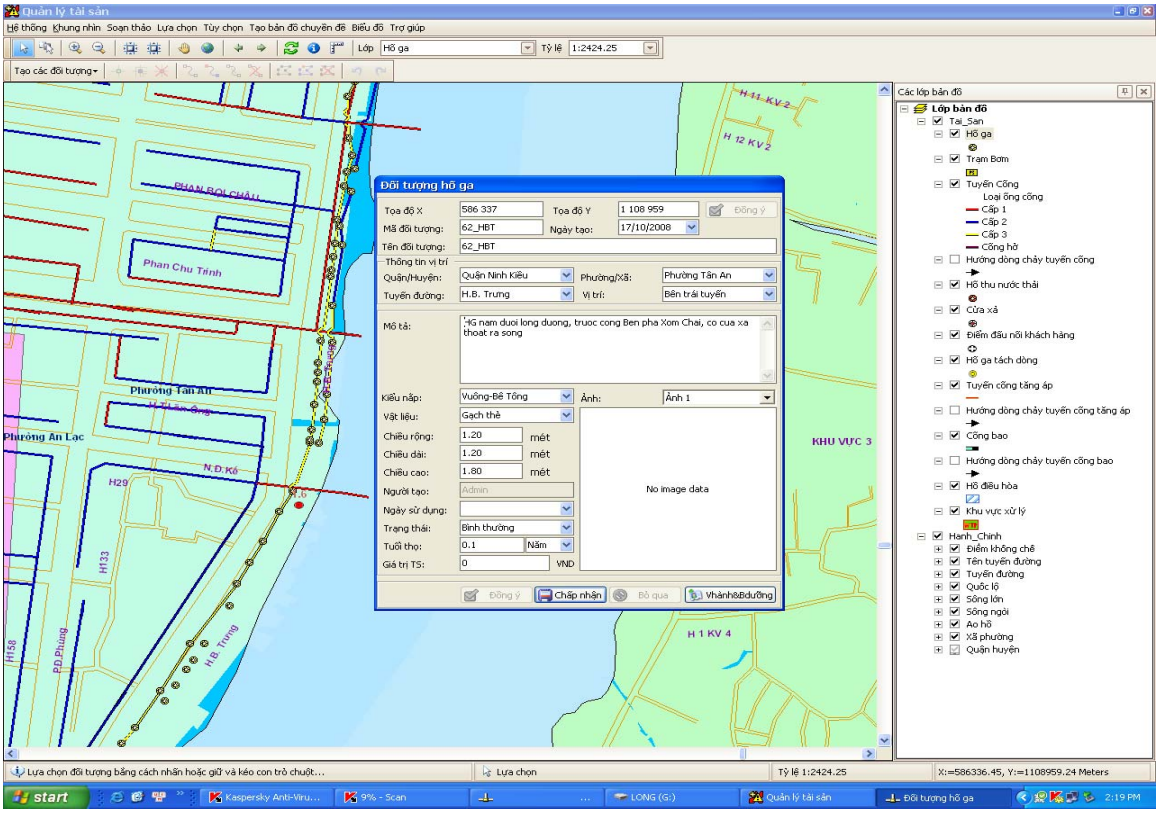
Level of detail	User group	Type of information
	Financial Management	• Extent of asset • Asset valuation • Depreciation • Asset useful life • Asset residual life
	Technical Management	• Asset capacity/size • Asset condition • Other technical parameters • Risk of asset failure or break down
	Maintenance management	• Detailed asset information • Spare parts • Supplier details • Associated drawings and catalogues

An asset register includes information on asset description, location, condition, residual life and current asset values, depreciation and value.

An asset register will include:
- a unique asset identification number;
- asset location/description;
- basic dimensions;
- material;
- year constructed;
- importance level for asset;
- useful life;
- condition rating;
- residual life;
- current cost;
- accumulated depreciation;

- written-down current cost; and
- annual depreciation.

Picture 2: Development of Schematic layout of the assets



Screening: It is important that a sound screening process be applied before data are entered in the asset register, to ensure that financial reporting provides a true picture of the Asset. The screening process would involve confirming the asset and applying the deprival test, as described below.

- Confirming the asset:
  - Does the asset operator control the asset?
  - Does the asset have a service potential?
  - Can its value be reliably measured?
  - Is its value likely to be material?
- Applying the deprival test:
  - Would the asset's service potential be restored following rehabilitation to the deprival value?

Asset numbering systems: Asset numbering in asset inventory and asset register shall be consistent in accordance to an agreed data structure. A hierarchical system is recommended.

Asset's level of importance: Within a wastewater disposal scheme, some assets are more important or more critical than others, on the basis of whether their function is related to level of service and the cost of correcting a preventable breakdown. Assigning an importance factor (IF) to each asset provides an indication of its relative importance and the consequence of its failure. This rating will assist in objectively determining and prioritizing maintenance or replacement strategies for that asset. A suggested rating system for the asset register is a scale of 0 to 5 (where 5 indicates the most critical importance).

Table 2: Criteria for asset importance

Importance factor	Effect of failure of asset
High (3 - 5)	• immediate and unacceptable impact on the levels of service; or • large number of customers affected; • results in considerable cost to the assets operators; • affects the safety of operator staff or the community. • likely to cause long-term problems which are costly to rectify; or • potentially unsafe conditions may result for SP staff or the community
Low (1 - 2)	• probably will not adversely affect the levels of service; or • small number of consumers affected; or • cause minor cost to the assets operators; or • unlikely to affect the safety of operator staff or the community.
Within each rating level, the following factors may influence the importance of an asset: • building damage • effect on business and essential service; • damage to other utilities; • traffic disruption; and • environmental pollution.	

Useful life: The useful life of an asset should achieve the proposed functions for:

- the period where the asset will provide the designated level of service at an economic cost; or
- the period by which time the asset will be technologically obsolescent; or
- the period by which time the assets service potential is no longer required.

Table 3: Indicative useful lives

Asset	Indicative useful life (years)
Wastewater collection and transport	
Sewers – concrete	30
Sewers – concrete lined	50
Sewers – other materials of higher quality	80
Manholes concrete	30
Manholes concrete lined	50
Pressure mains and siphons	50
Open ditches	10
House connection	30
CSO civil structure	50
Mechanical equipment in sewers (valves, flap gate etc)	15
Pumping stations	
Structures, buildings	40
Wastewater pumps	12
Stormwater pumps	20
Mechanical equipment	15
Electrical equipment	12
Stormwater inlets in roads	30
Percolation systems for stormwater if applicable	5
Special vehicles for: - septic tanks emptying - high pressure sewer cleaning - separate cleaning (oil, grease and fat)	10
TV – Inspection vehicles	10
Wastewater treatment plants	
Wastewater treatment	
Buildings and concrete structures	40
Structures with lined earth dams	20
Smaller compact prefab plants	20
Mechanical equipment	15
Trickling filter material	30
Electrical equipment	12
M-S equipment	12

Asset	Indicative useful life (years)
Sludge treatment	
Concrete structures	40
Sludge drying beds	30
Digestion tanks:	
- concrete	40
- steel	40
- open tanks	25
Mechanical equipment	15
Electrical equipment	12
Operation Buildings	40
Electrical buildings	40
Workshops, Laboratory	40
Central control room electrical	12
Sand Filtration	10

Asset condition scale

Based on the results of the asset condition evaluation, a condition rating of the evaluated asset should be established. Examples for condition rating are given in table 4 and 5.

Table 4: Example of an asset condition scale

Condition rating	Asset condition (taking into account asset
1	Excellent
2	Good
3	Average
4	Fair
5	Poor
6	Unserviceable

Table 5: An alternative condition scale

Condition rating	Asset condition	Description	Alternative description (e.g. for a pipeline)
1	Perfect/excellent	Only normal maintenance required.	Expected residual life >50 % of useful life
2	Minor defects only	Minor maintenance required (5%)	Expected residual life 40 - 50 % of useful life
3	Backlog maintenance required	Significant maintenance required.	Expected residual life 20 -40 % of useful life
4	Requires major renewal	Significant renewal/ upgrade required.	Expected residual life 10 -20% of useful life
5	Imminent failure	Over 50% of the asset requires replacement.	Expected residual life <1 year
6	Asset failed	Total replacement	Zero residual life

2.3 Asset valuation

Publicly owned asset operators are required, through relevant account standards, to value their assets at current value.

Effective asset valuations are critical to the management of a operator for the following reasons:

- to ensure compliance with regulatory requirements;
- to reflect the value of assets to stakeholders;
- to measure the financial performance of the asset operator; and
- to enable consistent benchmarking of the financial performance of the asset operator with similar agencies.

The valuation process can be separated into three major parts:

- preliminary work;
- determining asset values; and
- presentation of results.

Personnel involved should:

- have a working knowledge of the technical and financial aspects and audit requirements;
- understand and support the need for the asset valuation; and
- be properly briefed, in writing.

The valuation report should clearly specify the outputs required, for example:

- valuation report;
- spreadsheet summaries;
- detailed calculations to be retained/controlled.

Determination of Asset Values

The collection of information about current level of costs is essential for successful valuation of a drainage/sewerage system. The information sources could be:

- recent contracts in the service provision area (or adjacent area) with indexing of contract prices less than 5 years old;
- day labour costs (provided they reflect the true cost of service);

- unit rates from consultants (these should have been calibrated against local costs and accompanied by a valuation report that explains how the unit rates were derived); or
- full valuation by an external consultant (with supporting information).

Appropriate overhead costs (e.g. construction contingencies, financial contingencies, design, supervision, administration) should also be included.

Generic cost graphs and rates should only be used as a check that the calculated current cost is in the right ball park. Old contract sums (say last 20 years) can also be indexed to check the order of costs.

The value may need to take a range of approaches to valuation depending on availability of raw data, cost information, etc.

Determine asset values: To obtain the asset value (written down current cost) it will be necessary to subtract depreciation over the asset life to date from the current cost. Usually straight line depreciation is applied with the residual value of Asset being zero. A critical component of the valuation process is therefore useful life. Generic useful life information should be reviewed and refined to suit local conditions and experience by service provision officers. Reasons for deviations from generic useful lives (table 3) should be documented.

A valuation report about the valuation will be daily working tool for O&M management. It also provides necessary information for auditing and is a basic documentation for the following valuation, which should be normally be performed after a 5 years period.

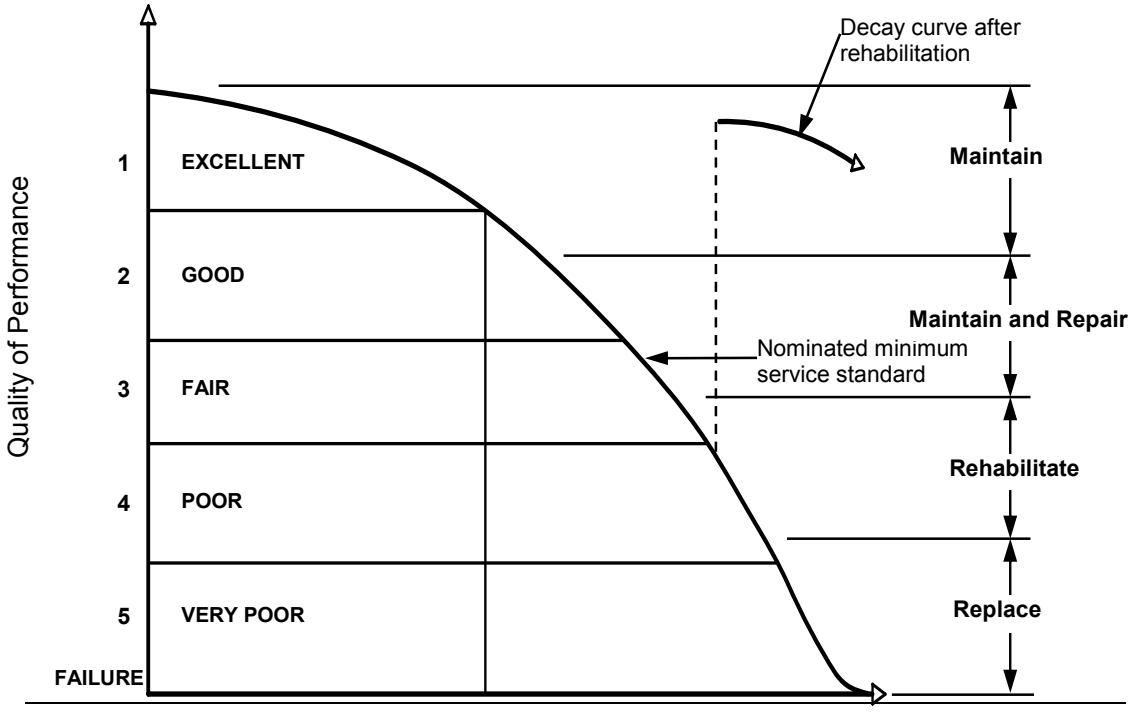
2.4 Evaluating Asset Condition and Performance

The purpose of asset condition and performance evaluation is to:

- trigger asset maintenance (condition-based or predictive maintenance);
- identify assets requiring rehabilitation and replacement in the short and medium term; and
- provide raw data for developing and/or calibrating asset deterioration/failure models.

Figure 4 illustrates a typical condition decay curve for assets. In many instances condition assessment may only identify assets that are well into their useful life and in need of replacement or rehabilitation.

Figure 4: Typical condition decay curve for assets



Any condition/performance evaluation process should possess the following characteristics:

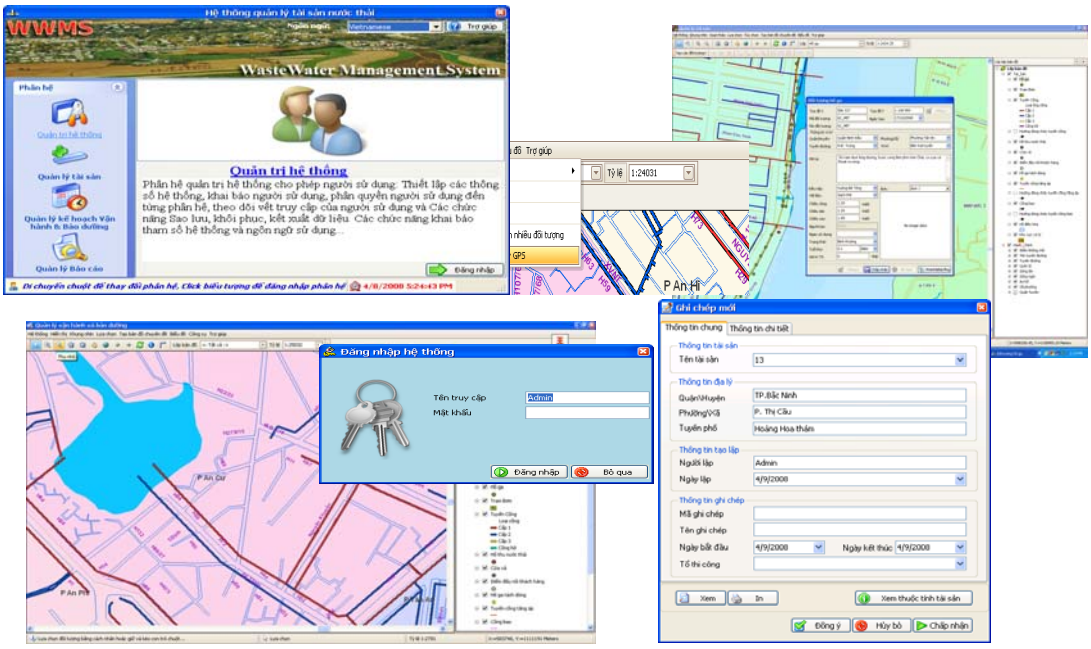
- **repeatability**: the same condition rating will be determined if a different person performs the rating;
- **objectivity**: the rating can be measured on the basis of some physical characteristics such as cracking;
- **simplicity**: simple systems are easier to use and generally lead to more consistent results.

An asset operator will use a number of condition and performance monitoring techniques. Many of these activities will be incorporated into a asset operator's planned maintenance program or operational data analysis, monitoring and reporting. Asset operators will define criteria for establishing a consistent condition rating for each asset group. In some instances, for example a closed-circuit television (CCTV) evaluation of sewers, standard approaches and specialist software are available to determine condition of assets.

Due to the extensive nature of assets and the resources required to monitor their condition and performance, a risk-based approach may need to be developed to prioritize their assessment, particularly where the assessment is relatively expensive (e.g. CCTV inspections of sewers).

The preliminary condition rating may be based on such factors as age of the asset, material type or asset performance history (formally and informally recorded).

Picture 3: Example of Asset Documentation Software:



2.5 Developing an Asset Renewal Strategy

In many instances, the identification of future asset renewal costs and addressing the prioritization and funding of these liabilities are among the greatest challenges facing asset operators, particularly where a large part of the Asset is nearing the end of its useful life. Questions that arise include the following:

- Are residual life estimates correct?
- Are the replacement costs reasonable?
- How will we fund this expenditure?
- What will be the impacts on customers and environment if we defer asset replacement/rehabilitation?

- What would happen if we spent more on planned/predictive maintenance practices?
- What will be legal consequences if postponement of investment for replacement, creating environmental damage?

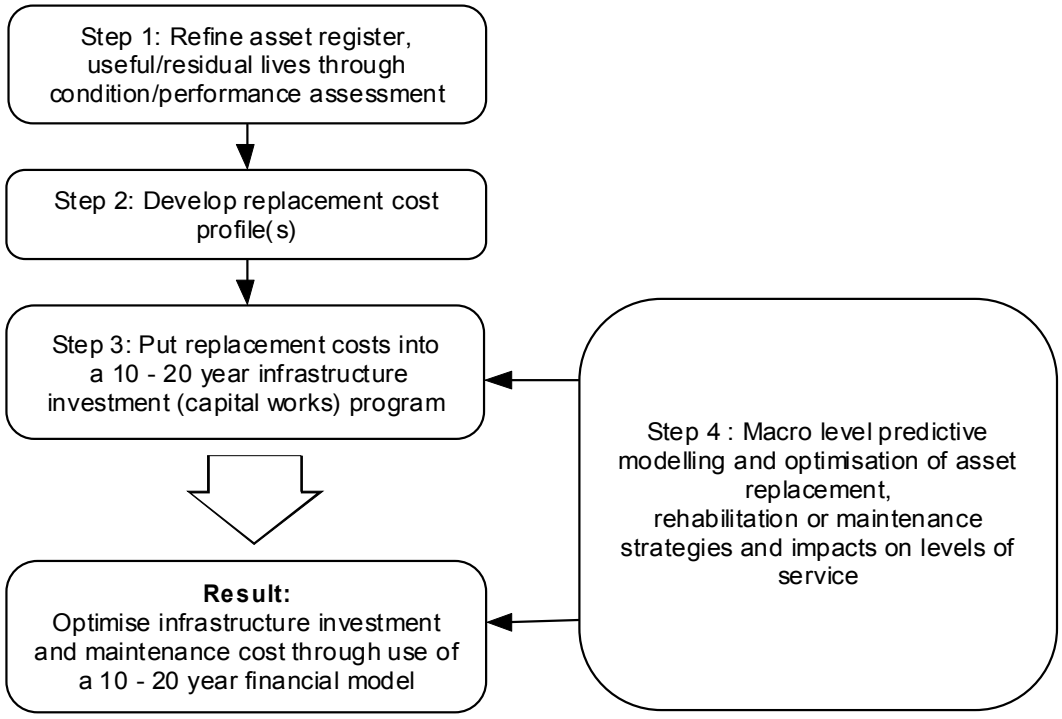
It is therefore essential that each asset operator has an asset renewal strategy to:

- optimize expenditure on asset rehabilitation and maintenance;
- plan ahead, particularly for funding asset replacement or rehabilitation; and
- review the existing stock of asset to determine whether existing asset as it approaches the end of its useful life should be:
  - replaced with a similar asset;
  - replaced with larger capacity asset as part of an augmentation program;
  - replaced with smaller capacity asset as customer demands have reduced; or
  - disposed off.

Strategic level: A macro level (strategic) approach to developing an asset renewal strategy is illustrated in Figure 5 and explained below. The purpose of this stage is to develop:

- short-, medium- and long-term cost estimates; and
- funding strategies for asset replacement/rehabilitation.

Figure 5: Development of a macro level asset renewal strategy



Step 1: At the strategic level, cost estimates are derived for asset replacement/rehabilitation over the next 10-20 years. Over time useful/residual life estimates used for asset registers will be refined through condition and performance assessment.

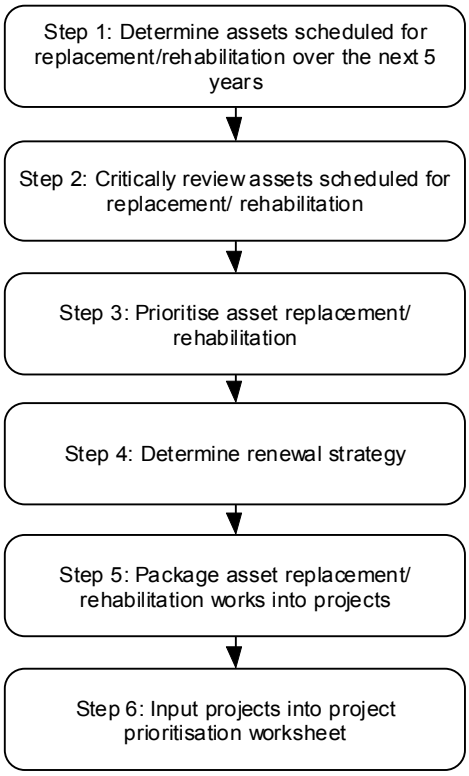
Step 2: It may also be desirable to develop a range of profiles based on various asset life scenarios.

Step 3: Rolling 5-10 year average replacement costs derived from the replacement cost profile may be input into a 10-20 year Asset investment program linked into the 10-20 year financial model. Financial modeling will allow the asset Operator to determine financial impacts of the proposed asset renewal costs and allow the asset Operator to either:

- determine financial strategies to fund the renewal; or
- based on financial constraints set upper limit targets for asset renewal budgets.

Step 4: Spreadsheet based models based on calibrated asset degradation curves can be a useful tool to allow an asset Operator to estimate anticipated Asset failure based on a range of maintenance and rehabilitation scenarios/budgets. The models can then be used to develop an optimum maintenance/asset rehabilitation budget for an asset group (e.g. main sewers). These budgets can form an input into the 10-20 year financial model.

Figure 6: Development of a micro level asset renewal strategy



Detailed level: The micro level (detailed) approach to developing an asset renewal strategy is illustrated in Figure 6. The purpose of this stage is to clearly identify and prioritize asset renewal projects.

Step 1: If the asset register is well maintained with asset residual lives that reflect asset condition and performance evaluation results, then assets requiring replacement or rehabilitation over the next 5-10 years can be readily determined.

Step 2: It will be necessary to critically review the assets listed for replacement/rehabilitation, particularly in the early stages of formalized asset management. Operational staff who have intimate but informal knowledge of asset performance should be consulted during this stage.

Step 3: A sample process for a sewer main renewal prioritization is illustrated in Table 6. Different prioritization matrices should be developed for different asset groups (eg electrical/mechanical assets). This simple process can be refined as asset Operators develop asset management processes. The prioritized list of assets should be reviewed by operational staff to confirm/refine the results.

Step 4: Options including:
- replacement with an asset of similar capacity;
- replace with a larger capacity asset as part of an augmentation program;
- replace with a smaller capacity asset because customer demands have reduced and are unlikely to increase substantially in the future;
- rehabilitate the existing asset (e.g. lining of an existing sewer);
- increase level of maintenance; or
- dispose off the asset.

Asset disposal may be an option where:
- the asset is surplus to requirements;
- the service could be more cost-effectively delivered by other means; or
- there are potential risks associated with the asset (e.g. vandalism, financial, environmental, legal).

Step 5: These project modules would need to be prioritized against other infrastructure projects. Alternatively an asset Operator may have already determined an appropriate asset renewal budget. In this case the prioritized project modules whose aggregate total comes within the budget will be funded.

Table 6: Sample asset renewal prioritization matrix

Preliminary condition rating	Asset Importance Level		
	A	B	C
5 (poor)	Replace/rehabilitate within 1 year	Replace/rehabilitate within 1 year	Replace/rehabilitate within 5 years
4	Replace/rehabilitate within 3 years	Replace/rehabilitate within 5 years	Replace/rehabilitate within 10 years
3			
2			
1 (excellent)			

2.6 Risk Issues

Potential risks associated with asset evaluation and renewal include:
- inappropriate level of data capture (too coarse/too detailed);
- inaccurate data;
- registers becoming outdated due to lack of maintenance;
- inappropriate useful life estimates (over- or underestimate);
- over- or underestimation of asset values;
- inappropriate or sub-optimal asset renewal/rehabilitation investment;
- non-compliance with financial audit requirements;
- unreliable outputs; and
- selection of inappropriate software for information management.

CHAPTER 3: ASSETS OPERATION AND MAINTENANCE MANAGEMENT

3.1 Desired outputs and outcomes of assets Operation and Maintenance Management

Outcomes: Effective assets operation and maintenance management will ensure:

- achievement of operational (including environmental) objectives in accordance with economical and environmental objectives at least costs;
- provision of cost-effective services, which are regularly reviewed to achieve appropriate best practice;
- shared knowledge within the assets operators of its operating philosophy and procedures; and
- compliance with statutory requirements;
- life cycle costs are minimized;
- life cycle time is optimized;
- there is efficient use of resources;
- environmental compliance is not compromised through asset failure;
- service levels are maintained or improved.

Outputs: Outputs from the operations and maintenance management process include:

- Operation and Maintenance Management Plan, including management system;
- Operation and maintenance philosophy and procedures are documented; and
- Operation and Maintenance plans;

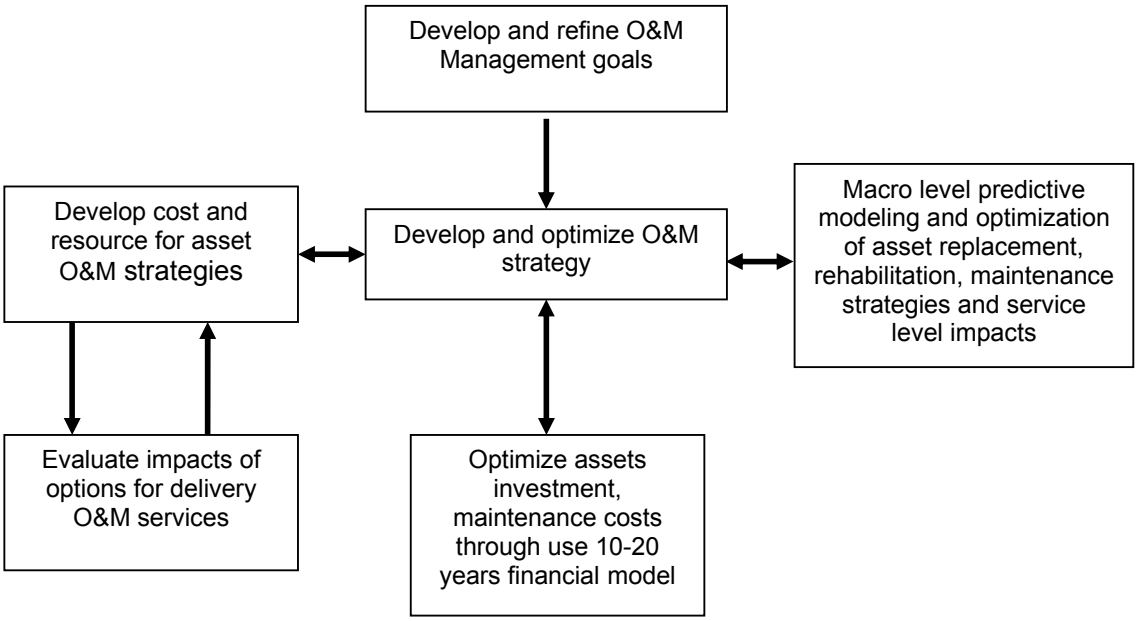
The operation and maintenance management process: The operation and maintenance management process involves two interrelated phases:

- Strategic phase; and
- Implementation phase.

3.2 The strategic phase operation and maintenance management process

The strategic phase of operation and maintenance management is illustrated in Figure 7.

Figure 7: The strategic phase of operation and maintenance management



The purpose of the strategic phase is to:

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

Developing and refining operation and maintenance management policies: The process analysis phase will highlight key policies required for development. Some of these would include:

- workplace health and safety;
- delivery of operation and maintenance services (e.g. level of outsourcing, contractual arrangements); and
- benchmarking and continuous improvement.

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

- operation and maintenance planning;
- directing and controlling operation and maintenance;
- management of shutdown for operation and maintenance or repair;
- recording and reporting operation and maintenance; and
- analyzing and optimizing operation and maintenance.

This will involve developing a strategy and action plans for implementing a formalized operation and 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 computerized operation and maintenance management system; or
- integrated asset management system.

The operation and 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 operation and maintenance (e.g. shutdown of sewers or pumping stations required);
- recommended maintenance requirements; and
- asset operation practices.

Strategies available include:

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

A number of tools exist to assist assets operators in developing appropriate operation and maintenance strategies for assets. One of these tools is reliability centered operation and maintenance. 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

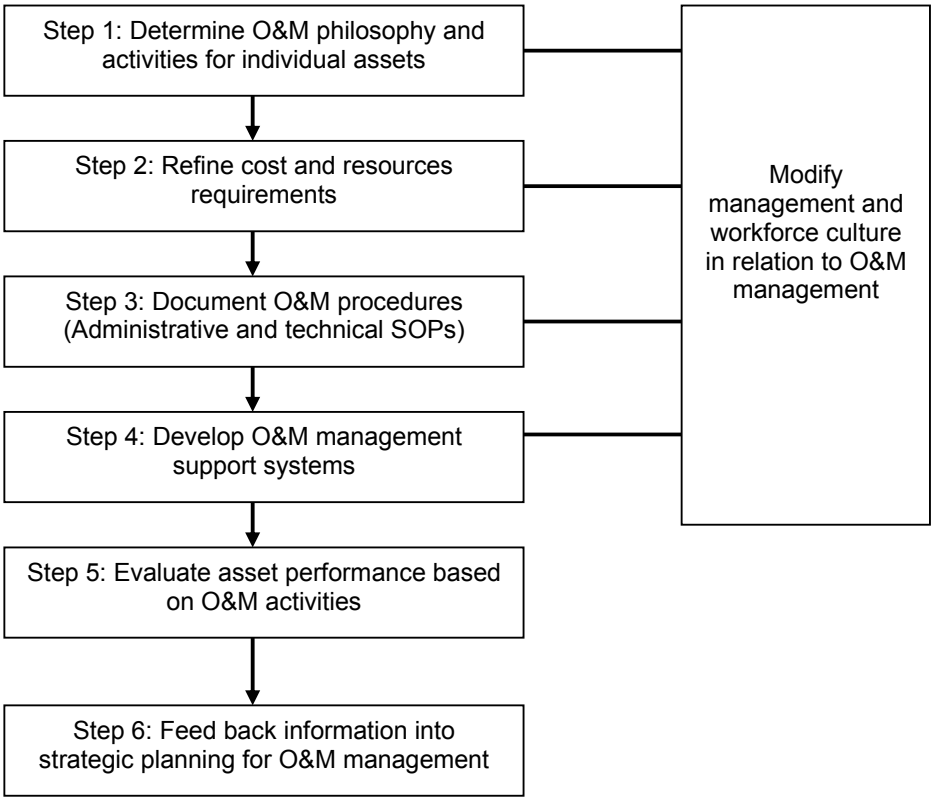
- options for managing a failure.
- evaluate the cost-effectiveness of the adopted operation and maintenance strategies and their impact on service standards; and
- provide information to enhance and/or calibrate predictive models for optimization of asset replacement, rehabilitation and maintenance.

For larger assets operators the process may involve splitting the system into sub-systems, e.g. house connections to wastewater treatment plant.

3.3 The implementation phase of operation and maintenance management process

The operational phase involves the more detailed implementation of the strategies developed in the strategic phase.

Figure 8: The implementation phase of operation and maintenance management



Step 1: **Developing, documenting and refining the operating and maintenance philosophy:** There are a number of benefits in documenting the operating and maintaining philosophy, including the following:

- Managers, planning and operational staff develop a consensus as to how the system operates and maintain.
- Through documenting the operating and maintaining philosophy, opportunities for efficiency improvements can be identified.
- Planning assumptions/intentions will reflect operation and maintenance reality.

Operating and maintaining philosophy needs clear understanding of the management about the drainage/sewerage system, its components, its capacity, the customers as wastewater dischargers, about external impacts on the system and about the receiving water bodies.

For a wastewater disposal system, this might include:

- Definition of the catchment area for main sewers, the pumping stations, combined sewer overflows, outlets into receiving water bodies, wastewater treatment plants;
- Locations of major structures;

- Capacity of major structures;
- Water levels in receiving water bodies;
- Tidal influence, if applicable;
- Location of important industrial wastewater discharges;
- Risk management for system component's failure – actions in case of failure of major structures;
- Key personnel for decision making and their responsibilities.

Sewerage and drainage components and main O&M activities
Table 7: Describes the sewerage/drainage components and the operation and maintenance activities:

Table 7: sewerage/drainage components and the operation and maintenance activities:

Sewerage/Drainage components	O&M activities	Implementation of O&M activities	
		Current status	in the future
Septic tank	Emptying	Yes	Yes
House connection	Installation	No	Yes
	Service	Yes	Yes
Sewer, Manhole, Street Inlet, Back flow flap	Cleaning	Yes	Yes
	Inspection	Yes	Yes
	Repair	Yes	Yes
	Rat control	No	Yes
Box Culvert	Inspection	Yes	Yes
	Cleaning	No	Yes
	Repair	No	Yes
Open Channel	Inspection	Yes	Yes
	Cleaning	Yes	Yes
	Dredging	No	Yes
	Repair	Yes	Yes
Storm Water PS	Operation and Control	Yes	Yes
	Maintenance	Yes	Yes
	Repair	Yes	Yes
Waste Water PS	Operation and Control	No	Yes
	Maintenance	No	Yes
	Repair	No	Yes
Waste Water PS	Operation and Control	No	Yes
	Maintenance	No	Yes
	Repair	No	Yes

Step 2: **Refine cost and resource requirements**

The costs for operation and maintenance will be built up from:

- Labor costs for system components operators;
- Costs of consumable items, such as power consumption, fuels/petrol, lubricants, chemicals, construction materials, safety measures, etc…;
- Depreciation costs of operators' mobile equipment, tools, etc…;
- Depreciation costs of fixed assets, including mechanical and electrical equipment and civil works structures.

The resources to cover the operation and maintenance costs, currently are allocated budgets of the provincial or town People' Committees. However, there are uncertainties about these resources, as provincial or town authorities have many priorities to spend their limited budgets.

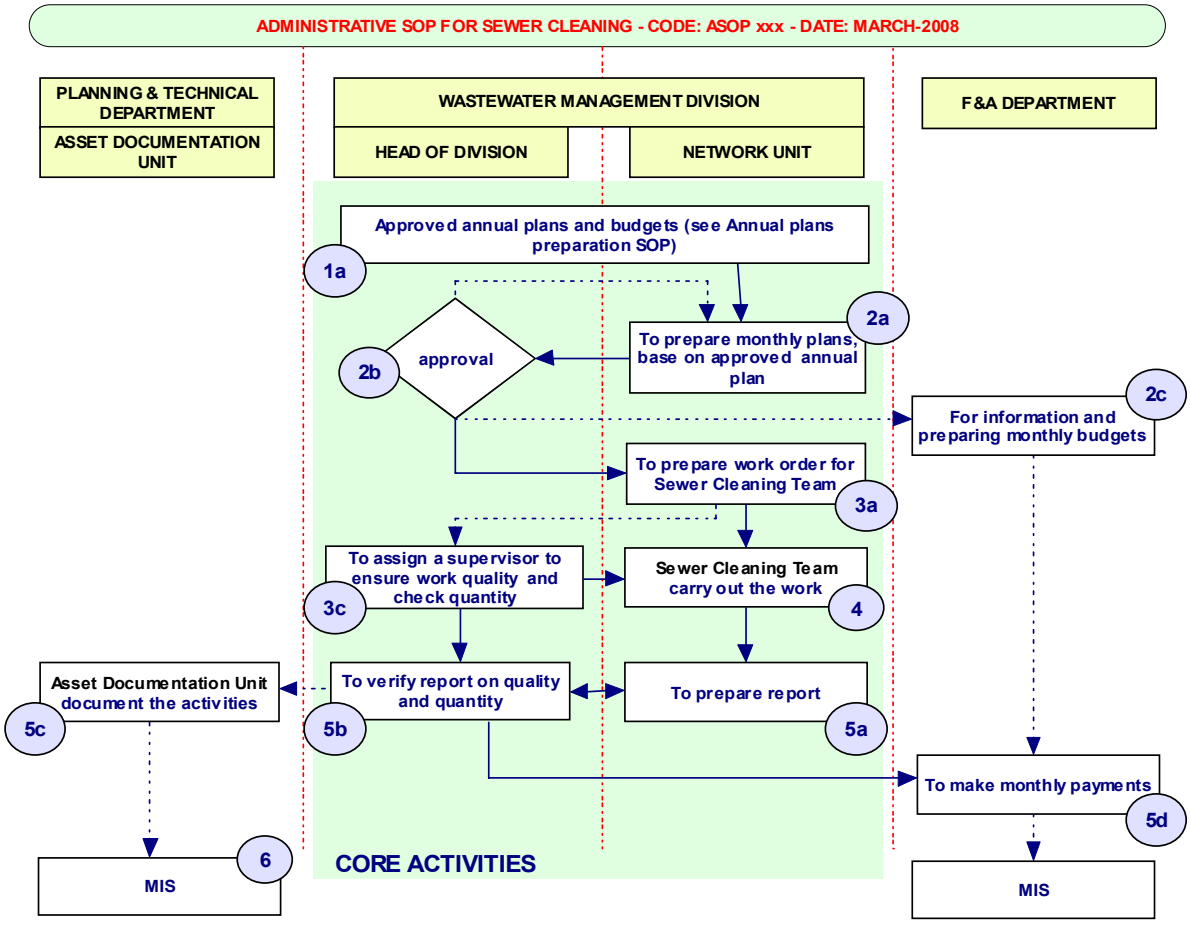
More reliable resource to cover the operation and maintenance costs would be revenue stream from service users. However, the concept of wastewater tariff does not exist at the moment, only wastewater surcharge of 10% on top of water supply bills. The problems are (i) revenue from wastewater surcharge does not cover the full operation and maintenance costs, and (ii) more seriously that the revenue does not transferred to the service provider' accounts. This needs to be changed in very near future to ensure adequate financial resources for proper operation and maintenance of drainage/sewerage systems.

Step 3: **Development of O&M procedures**

Development of O&M procedures will involve:

- development of initial documentation; and
- peer review of documentation to:
  - ensure clarity and succinctness of information;
  - ensure compliance with current standards; and
  - identify opportunities for more efficient procedures.

Picture 4: ***a template of an administrative standard procedure for sewer cleaning***



A template of Standard Operations Procedure: Mechanical Cleaning Sewer Network

Location: Sewer Network

Work time: depending on amount and type of sludge in sewers
Frequency: as scheduled or emergency cases
Task Performed By: Network Management Unit
Personal Protective Equipment: Hard hat, gloves, brogue or rubber boots.

Description of work flow

1. Organizing the work-sites, placing the traffic warning signals;
2. Opening of the manholes and checking the concentration of dangerous gases;
3. Positioning two winches at the manholes;
4. Pulling sling through the sewer, between manholes
5. The cleaning ball is fixed from two sides and connect to each of the winches;
6. While pulling one winch, the other winch will be loosen (and vice versa)
7. The cleaning ball runs along the sewer, pulling sludge, solid waste towards the manholes;
8. Continue pulling the cleaning ball until the required result is achieved
9. Loading sludge, solid waste onto a transportation vehicle;
10. Dismantling the winches, cleaning ball and other equipment, cleaning them by fresh water and properly closing the manholes;
11. Checking and cleaning the work-sites;
12. Documentation the work results into work order/report form.

Personnel qualification:

- The Team leader must have sufficient knowledge to the use of the winches;
- The members of the team have been instructed in the use of the winches.

Health & safety details:

- Before entering, the manhole must be aerated adequately and the air must be checked for dangerous gases;
- Operators have to strictly follow the personal safety measures, wearing safety, protected equipment.

Mechanical cleaning sewer network

Positioning winch next to the manhole

One of two slings is pulled through the Sewer, between manholes

The cleaning ball is fixed from two sides

Positioning of direction-changing devices

Remove sludge from sewer

Step 4: **Develop O&M management support system**

The O&M management support includes (i) asset documentation system with GIS technologies and global positioning equipment; and (ii) management Information system (MIS). With the MIS all the operation and maintenance activities are updated daily and the information of drainage/sewerage assets can be obtained at any time as required.

Step 5: **Evaluate asset performance based on O&M activities**

Monitoring and optimizing system performance: A assets operator will rely on a number of information systems to monitor and optimize operational performance and compare these to operational targets. These information systems include:

- complaints on system failure;
- financial information (e.g. O&M cost/ML);
- system network models. These will allow actual system performance to be compared to theoretical performance and allow anomalies to be investigated.

Monitoring and control systems are critical to improving system operation and maintenance. An effective monitoring and control system can provide:

- summary reports required for planning, operations, maintenance, system performance monitoring management and regulatory reporting;
- information for infiltration/inflow management;
- calibration of network models;
- energy management;
- security of facilities against vandalism and sabotage;
- linkage with GIS and network models;
- flooding events;
- information to confirm/refine existing design flows and peaking factors;
- premature warning of potential problems;
- opportunities for efficiency gains through increased automation;
- risk management;
- internal performance indicators (A range of operation and maintenance indicators are available; a sample is included in Table 8. Many of these would be site-specific.); and
- performance comparison information. This information is becoming more readily available. In some instances it may be a useful tool to identify potential areas of inefficiency.

Undertaking process analysis: This involves mapping key operational and support processes. The benefit of this approach is that it allows assets operators to:

- identify critical operation, maintenance and support activities;
- identify areas requiring policies and procedures (i.e. a basis for a quality management system);
- assist in activity-based cost budgeting and control.

The identification of operational efficiency gains will involve:

- a detailed assessment of existing procedures;
- consultation with staff on opportunities for cost savings;
- benchmarking (where appropriate), including:
  - metric benchmarking, establishing current performance levels and defining appropriate target performance levels; and
  - process benchmarking, how to improve performance.

The benchmarking process, if done properly, is a highly structured, resource-intensive team activity. Nevertheless, if it focuses on critical, high-expenditure, operational activities, it can produce significant dividends.

Table 8: Example of internal O&M performance indicators

General	• Employees/1000 m sewers/1000 inhabitants • Real O&M cost index • Positive internal survey returns (% per survey)
Sewerage	• O&M and A cost/1000 connections • O&M and A cost/10 km main • O&M and A cost/m^3 - collection system – individual treatment plant • Number of new sewerage connections installed • Length of mains inspected by CCTV/year • Length of defective collectors, main sewers or interceptors identified and repaired • Length of defective collectors, main sewer or interceptors identified but not repaired • Number and % of defective manholes identified and repaired • Number and % of confirmed illegal connections remedied • Number and % of connection defects remedied • Number and % of defects not remedied in each of the above categories • kWh/m^3 (for each major pump station and treatment plant) • Energy cost/ML (for each major pump station and treatment plant) • Length of sewer mains • Flooding affecting customer properties/1000properties • No. of blockages/100 km sewer • pump station overflows • Quantity of treated effluent discharged per day, per month, per year.

3.4 Risk issues for operation and maintenance management

Potential risks associated with operations management include:

- non-compliance with service standards;
- non-compliance with regulatory requirements;
- workplace health and safety risks;
- lack of professional education and professional training of the staff.
- inadequate customer communication/ consultation;
- environmental impacts of operational and maintenance practices;
- customer complaints;
- inadequate emergency response;
- lack of corporate knowledge of system operation;
- accuracy or reliability of operational data and information;
- inadequate feedback to planners, designers and managers;
- competition for service (third party access);
- poor contractor performance;
- sabotage; and
- vandalism;
- waste of energy, man-powers or materials leading to waste of money
- failure of critical assets;
- public health risks;
- culture change from reactive or informal practices to more planned, formal practices;
- sub-optimal maintenance practices;
- inaccuracy or unreliability of maintenance data and information;
- selection of an inappropriate maintenance management system;
- lack of equipment for operation and maintenance
- lack of funds for preventive maintenance and for consumables.

CHAPTER 4: ASSETS PERFORMANCE MANAGEMENT

4.1 Introduction on Performance Management

Performance management is the key component of any business management system. A Performance Management Plan provides a formal, regular, rigorous process for data collection, analysis and usage. Thus changes in effectiveness and efficiency can be measured, enabling comparison of performance over time and against that of other similar entities.

These guides provide for a range of performance management approaches to suit different sizes of assets operator organizations. Each assets operator, regardless of size, should review its performance management requirements and develop their own asset and business performance improvement measures as appropriate.

Outcomes: Performance management:

- provides a comprehensive picture of how the assets operator is progressing towards achieving its performance goals;
- provides a mechanism for responding to emerging issues/cost pressures that may require remedial action;
- identifies potential to improve the cost effectiveness of services (through comparison with other organizations); and
- Secures service standards as required legally and contractually.

Outputs: Outputs from a performance management process include:

- performance monitoring and benchmarking reports
- strategic/detailed planning reports; and
- an asset investment program, revised, prioritized and updated annually.

4.1.1 The Importance of Performance Management:

Service standards are generally seen as central to an assets operator's activities and one of the main drivers of its corporate or business plan. A Performance Management Plan provides the means of identifying opportunities to improve service and asset management performance, and/or demonstrate that service standards are being met.

4.1.2 Improving Service Delivery and Asset Management.

A Performance Management Plan shall show the following key objectives:

- **effectiveness**: the extent to which the asset management program is achieving its intended purpose;
- **efficiency**: how well the organization manages information, and human and financial resources, to plan, acquire, operate and maintain asset; and
- **compliance**: to ensure asset management and service delivery strategies comply with relevant policies and legislation.

Improving service delivery and asset management (i.e. performance management) is integral to daily asset management activities. To ensure any Performance Management Plan remains useful and relevant, the following processes need to be established:

- a process for formal adoption of the Performance Management Plan;
- ongoing annual reviews of service levels and customers satisfaction with these levels;
- incorporation of the results of annual service level reviews into annual operation plans and the Performance Management Plan itself;
- on-going participation in .benchmarking surveys with compatible business functions (externally as well as internally) to ascertain performance against "best national practice".

4.1.3 Implementing a Performance Management Framework

Overview: A performance management framework will make it possible for assets operators to address:

- desired outcomes and objectives;
- the performance indicators;
- setting performance targets;
- monitoring performance;
- performance assessment and evaluation;
- statutory performance reporting requirements; and
- performance improvement.

This Guide provides a quality framework for performance management capable of consistent implementation by all service providers. At this stage it defines only the minimum number of generic performance measures for performance assessment and reporting.

Assets operators should review their performance management requirements and use this Guide to develop their own asset management measures as appropriate.

Performance measures: Performance measures are tools to measure work performed and results achieved against a given objective. Performance measures should focus on the performance of assets and asset programs (i.e. for investment, operations, maintenance and disposal).

The performance measures should:

- identify the success or otherwise of the asset or asset program performance;
- align with the key objectives of effectiveness, efficiency and compliance;
- be used to assess whether objectives are achieved;
- be able to be monitored ;
- provide the necessary information on asset performance and whole-of-business reporting; and
- be reviewed as part of the planning process to ensure relevance and practicality of asset management.

Developing performance measures: To develop performance measures, the underlying logic of asset programs should be analyzed. The suggested approach (detailed below) is to identify the key areas and issues within an asset management program, particularly in relation to outputs.

Involving management involves asset management staff and other stakeholders in decisions on the outputs to be measured and the performance information to be collected.

This is particularly important if asset management staff are concerned that the links between asset program inputs and outputs are not sufficiently within their control. It also promotes acceptance of responsibility for outputs of the program.

Understanding the objectives: The key objectives of the assets operator's corporate (or business) plan need to be understood, and the outputs of the asset management program should be aligned to them.

Understanding the asset management process: It is important to understand the links between inputs, the process and outputs in any asset program. This analysis is best undertaken in consultation with the major stakeholders so that a shared understanding of the program is developed.

The asset and the asset program outputs should be assessed for effectiveness, efficiency and compliance.

When deciding on the appropriate method for measuring performance information, asset managers should consider:

- the level of detail that should be measured;
- the length of time it takes for the program outputs to be achieved;
- the degree to which external factors may influence the achievement of the outputs;
- the possibility of unanticipated program outputs; and
- the extent to which program managers should be held responsible for achievement of results.

When assessing assets, the following characteristics are to be addressed:

- physical performance;
- functional performance; and
- financial performance.

Determining the performance measures: The following questions will help asset managers to determine the appropriate performance measures and assess their relevance and validity:

- Will the measures assess performance of the asset and/or program?
- Will the measures provide ongoing monitoring and evaluation information?
- What happens if the information is inappropriate?
- Can the performance measures identify performance trends?
- Can the performance measures be used for comparison with similar organizations?

4.1.4 Characteristic of Good Performance Measures

The characteristics of good performance measures include the following:

- They are qualitative or quantitative as appropriate.
- They achieve appropriate balance.
- Data are valid, reliable and accurate.
- They include an appropriate number of measurable items.
- Cost is balanced against benefit.
- They are repeatable for consistent use.

These characteristics are further discussed in the following sections.

Table 8: provides some samples of key performance measures for sewerage and treatment systems

Qualitative and quantitative performance measures: Performance measures may be quantitative (numerical value) or qualitative (descriptive). Often it is only through qualitative performance measures that the objectives and strategies can be directly linked and cause/effect (impact) relationships demonstrated.

Achieving appropriate balance: All performance measures should be considered together to assess the overall performance of the program. If only one aspect of an asset management program's performance is measured, it is likely that this is what asset managers will focus on. As a result, overall program performance could deteriorate.

Performance measures should be balanced to facilitate:

- management and accountability; and
- analysis and improvement of all factors that influence outputs.

Each performance measure should provide a different perspective on program performance. It is important that the elements of a set of performance measures are selected because they measure something that is significant and useful, not just because they are easy to measure.

Validity, reliability and accuracy of data: Any performance measure used should be of a high quality. Therefore, it should be:

- valid, in that it actually measures the characteristic performance data;
- reliable (i.e. given set conditions, the information collected will not vary significantly); and
- accurate and timely.

Numbers of measurable: There is no ideal number of performance measures. The emphasis should be on balance, quality, usefulness and timeliness. A small set of key performance measures is likely to be more manageable and consequently more useful.

It is important not to collect large volumes of performance data that are not strategic or timely, or are simply too hard to interpret and manage.

Balancing cost against benefit: The cost/benefit of collecting key data items or improving existing data collections is an important consideration. The benefits of collecting additional or more accurate measures need to outweigh the costs of collecting, storing and using the information. It is useful to consider:

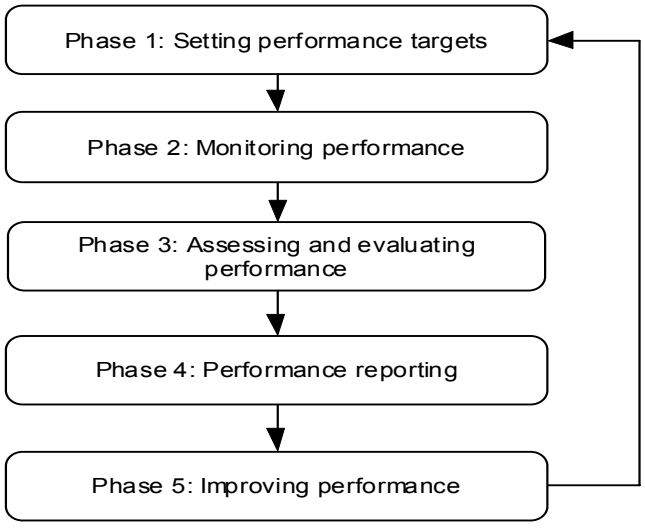
- the risk that the investment in information collection may not produce long-term benefits;
- the possibility that policy or program changes may result in performance information becoming inadequate or irrelevant;
- the risk that poor data collection processes may render the resulting performance information unreliable and unusable; and
- the relative collection costs for individual items of performance information.

Consistency of use: An important aspect of performance measures is that they be used consistently to determine what trends exist (e.g. whether performance is improving over time).

4.2 The performance Management Process

4.2.1 Phase 1: Setting Performance Targets

Figure 9: The performance management process



Managers should set achievable targets that focus on overall asset performance and program performance rather than on the achievement of individual targets. Targets should:

- relate to overall program performance, or the components of that performance;
- encourage improved performance;

- be required for each measure, with at least one target;
- be able to be monitored and measured;
- make it possible to identify and resolve problems readily;
- be achievable;
- provide benchmarks for continuous improvement; and
- be reviewed as part of the planning process to ensure relevance and practicality.

Performance targets should have the following characteristics:

- They should focus on outcomes achieved rather than action taken. Measuring whether programs are succeeding is more important than knowing how much activity is taking place.
- They should focus on outcomes that can be influenced by performance management.
- They need to be used consistently, so that results can be analyzed and compared over time and across programs.
- Simplicity should be as highly valued as reliability.
- Qualitative as well as quantitative information should be considered. Rarely do numbers tell the whole story. Qualitative information on performance may be equally important.

4.2.2 Phase 2: Monitoring Performance

Monitoring performance is integral to the performance management processes and typically involves:

- setting up procedures and assigning resources to measure performance over time;
- monitoring performance;
- verifying that targets and supporting standards can be measured and are relevant; and
- reviewing the cost-effectiveness of the monitoring process.

Business management information systems should support the performance monitoring process. These systems should have a comprehensive structure, and be linked to the financial management system and the asset register. This will allow service providers to:

- monitor performance of assets by type, scheme or facility;
- analyze and evaluate the effectiveness and cost efficiency of programs;
- report and advise on program performance;
- evaluate performance and implement strategies to improve performance.

Typical information in the business management information systems should include:

- performance against planned targets; and/or
- performance against benchmarks and standards; and/or
- checklists, customer surveys, and other means of gathering information; and
- planned targets and actual performance.

4.2.3 Phase 3: Assessing and Evaluating Performance

Asset managers should continuously assess and evaluate the performance both of the assets and of the whole service, to verify that:

- the asset programs make the organization’s service delivery program achievable;
- improvement strategies will address differences between the planned and actual performance;
- the planning processes applied in the asset programs are valid and effective, and provide value for money;
- the stated targets are achieved and used as the basis for the current planning period;

- the asset programs achieve their budget objectives; and
- the asset programs comply with relevant policies and customer service agreements.

The assessment and evaluation should enable asset managers to:

- identify any deviation from the performance management plan;
- understand the cause of the deviation;
- identify minimum acceptable performance levels;
- identify and establish benchmarks for acceptable performance levels; and
- develop strategies to solve the problem.

Performance assessment:

Performance assessment is an important step in understanding the extent of performance achievement. It is based on comparisons using a range of targets, benchmarks, standards and milestones.

Targets: Targets express quantifiable performance levels, or changes of level, to be attained in future, rather than a minimum level of performance.

Benchmarking: Benchmarking involves:

- searching for best practice;
- comparing best practice with existing practice; and
- introducing best practice.

Benchmarking can concentrate on comparing:

- the same activity between different parts of the same organization;
- the same activity in other organizations that deliver a similar service; or
- similar processes with other organizations which may have different services or processes.

Performance information is used to compare and evaluate practices within and between organizations.

Standards: Standards are predefined levels of excellence or performance specifications. They can be set for any aspect of an organization or program. Standards are set to define the expected level of performance. Progress in delivering the service can be measured against the standard.

Table 9: Example of Performance Benchmarking Indicators.

No	Diễn giải / *Description*	Unit Đ. Vị	Min/ Max
1	**QUẢN LÝ TÀI CHÍNH** ***FINANCIAL MANAGEMENT***		
1.1	Giá thành đơn vị/ m3 nước đã xử lý *Unit Cost per m3 of metered wastewater treated*		
a.	Bao gồm chi phí Vận hành & Bảo dưỡng *O&M*	VND/m3	
b.	Bao gồm chi phí Vận hành & Bảo dưỡng + Khấu hao cho các thiết bị cơ điện (yêu cầu của KfW) *O&M & depreciation for M + E equipment (KfW requirement)*	VND/m3	
c.	Bao gồm chi phí Vận hành & Bảo dưỡng + Khấu hao toàn bộ + Lãi vay *O&M & full depreciation & interest*	VND/m3	
1.2	Tỷ lệ chi phí nhân công trên chi phí Vận hành & Bảo dưỡng *Labor cost to O&M ratio*	%	

No	Diễn giải / *Description*	Unit Đ. Vị	Min/ Max
1.3	Tỷ lệ chi phí năng lượng trên chi phí Vận hành & Bảo dưỡng *Energy cost to O&M ratio*	#	
1.4	Giá bình quân (được phê duyệt và áp dụng) *Average Approved and Applied customer tariff*	VND/m3	
1.5	Tỷ lệ bù đắp chi phí *Cost recovery ratio*		
a.	Cho Vận hành & Bảo dưỡng *O&M*	#	> 1.0
b.	Cho Vận hành & Bảo dưỡng + Khấu hao cho các thiết bị cơ điện (yêu cầu của KfW) *O&M & depreciation for M + E equipment (KfW requirement)*	#	> 1.0
c.	Cho Vận hành & Bảo dưỡng + Khấu hao toàn bộ + lãi vay vốn *O&M & full depreciation & interest*	#	> 1.0
1.6	Số ngày cần thiết để thu những hóa đơn chưa thu được tiền (vào thời điểm cuối năm) *Account receiveable (at the end of year)*	days	< 60
1.7	Tỷ lệ thanh toán nợ (tất cả hoạt động của công ty) *Debt service ratio (Overall Company Operations)*	#	> 1.2
1.8	Tỷ lệ thanh toán nợ ngắn hạn (tất cả các hoạt động của công ty) *Current ratio (Overall Company Operations)*	#	> 1.5
1.9	Tỷ lệ nợ trên vốn (hay là tỷ số nợ) (tất cả các hoạt động của cty) *Debt-equity ratio (Overall Company Operations)*	#	< 3.0
2	**QUẢN LÝ DỊCH VỤ KHÁCH HÀNG** ***CUSTOMER SERVICE MANAGEMENT***		
2.1	Tỉ lệ phần trăm các khiếu nại đã được giải quyết hiệu quả *Customer complaint handling efficiency (percent of solved complaints)*	%	> 95
3	**VẬN HÀNH KỸ THUẬT** ***TECHNICAL OPERATION***		
3.1	Tỷ lệ bao phủ dịch vụ *Service coverage ratio*		
a.	Trên tổng dân số đô thị (dân số đươc phục vụ/ dân số đô rhị) *Total municipal population (population served/municipal population)*	%	> 60
b.	Trên tổng dân số trong khu vực dịch vụ (dân số được phục vụ/ dân số trong khu vực dịch vụ) *Total population in the SA (population served/population in SA)*	%	> 90
c.	Tổng số đấu nối trong khu vực dịch vụ (số đấu nối/ số hộ gia đình + cơ quan + xí nghiệp trong khu vực dịch vụ) *Total connections in the SA (connections/number premises/buildings in the SA)*	%	> 90
3.2	Mức độ tin cậy (tỷ lệ phần trăm của thời gian) *WW Scheme reliability (percent of time)*		
a.	Của Hệ thống thu gom *Collector system*	%	100
b.	Của Trạm bơm *Pumping stations*	%	>90
c.	Của Trạm xử lý nước thải *Treatment plant*	%	>90
3.3	Tỉ lệ sử dụng công suất trạm xử lý (tỷ lệ phần trăm công suất thiết kế) *Plant capacity utilization (percent of design capacity)*	%	> 80
3.4	Tỉ lệ số ngày đạt tiêu chuẩn xả (tỷ lệ phần trăm về thời gian) *Discharge standards compliance (percent of time)*	%	> 90

No	Diễn giải / *Description*	Unit Đ. Vị	Min/ Max
4	**QUẢN LÝ NGUỒN NHÂN LỰC** ***HUMAN RESOURCE MANAGEMENT***		
4.1	Tỷ lệ nhân viên (số nhân viên trên 1000 đầu nối) *Employee Ratio (number of employees per 1.000 connections)*	#	< 8.0
4.2	Ngân sách đào tạo *Training Budget*		
a.	trên Chi phí nhân công per cent of *Labour cost*	%	
b.	trên Chi phí Vận hành & Bảo dưỡng per cent of *O&M cost*	%	
4.3	Bình quân năm về tiền lương, phụ cấp và tiền thưởng *Average Compensation (per year - incl. all benefits and bonuses)*		
a.	Công nhân vận hành *Operational staff*	VND*tr./ng VND*mil/ staff	
b.	Cán bộ quản lý *Management*	VND*tr./ng VND*mil/ staff	

Performance evaluation

Evaluation is the systematic, objective assessment of the effectiveness, efficiency and compliance of a service or part of a service. Performance evaluation should be part of the asset management performance program, to ensure that the asset investment, operations and maintenance and renewal/replacement programs are evaluated.

The continued evaluation of the asset programs will lead to an improved understanding of the program's performance and its link with:

- the organization's service delivery requirements;
- asset life cycle planning; and
- management service strategies with the investment providers, such as energy performance contracting and greenhouse gas reduction.

Service performance evaluations can lead to improved service delivery outcomes, assist decision-making, and help account for service performance. However, evaluations need good performance information so that they can focus on key issues.

4.2.4 Phase 4: Performance Reporting

Reporting on asset management performance should be in accordance with asset owner and service provider policy requirements.

Performance reporting is an essential step in the management of asset and service performance, because it provides information:

- on the performance of the assets and the approved asset programs;
- on the physical, functional and financial performance of the asset;
- on the achievement of the planned program objectives, targets and budgets;
- that allows asset level performance information to be evaluated at the asset and service delivery level;

Performance reporting should:

- be comprehensive and structured to the asset management information system; and

- allow the asset manager to take timely action to improve the asset's performance, avoid potential difficulties and resolve problems.

4.2.5 Phase 5: Improving Performance

Performance improvement is a fundamental component of a service provider's asset management system.

Performance improvement involves:

- identifying strengths and weaknesses in the asset programs and management systems;
- developing strategies to improve the system so that it delivers more effective and efficient asset management.

Improvement strategies will impact on all resources that are inputs to the asset management process. These include human resources, business information systems and financial resources. The gains from continuous improvement are essential to maximize value for service.

Developing improvement strategies: Developing strategies to improve performance may include revising performance measures, and involve:

- generating potential solutions;
- evaluating possibilities;
- identifying barriers;
- developing implementation strategies;
- developing improvement milestones;
- approving performance solutions; and
- implementing solutions.

Reviewing the performance management system: Setting up a performance management system will allow regular monitoring and review of the improvement strategies and targeted performance milestones.

Outcomes:

- measured impact of performance improvement solutions; and
- analysis of deviations from the performance management plan.

Standardization:

- Define and document the new standardized process/procedure.
- Develop compliance standards.
- Monitor results of the new process.

CHAPTER 5: DRAINAGE/SEWERAGE ASSETS EXPANSION MANAGEMENT

This chapter is intended to provide guidance for assets owners, assets operators, practitioners and their consultants on the processes involved in establishing and implementing effective asset expansion planning strategies and procedures and developing associated documentation.

Outcomes: Outcomes from effective asset planning include:

- identification of necessary asset expansion measures
- a cost-effective asset investment program;
- minimization of life cycle costs;
- integration into regional asset planning studies;
- continued achievement of service standards;
- protection of the natural environment;
- the minimization of risk, and
- sustainability of the system.

Outputs: Outputs from an asset planning process include:

- an asset Plan ;
- a suite of strategic/detailed planning reports;
- an asset investment program, revised, prioritized and updated on annual basis.

5.1 The Asset Planning Process

For most assets operators, particularly those servicing growing markets, asset planning is a continuous interlinked process. For assets operators with static or declining markets and with limited impacts of regulatory requirements on asset investment (e.g. stricter effluent standards), the process may involve only a regular review of:

- performance;
- current and future system demands; and
- system performance in relation to service standards and regulatory requirements.

Asset planning is a dynamic process consisting of a number of interrelated steps/activities:

Step 1: Developing, Adopting and Refining Asset Planning Policies

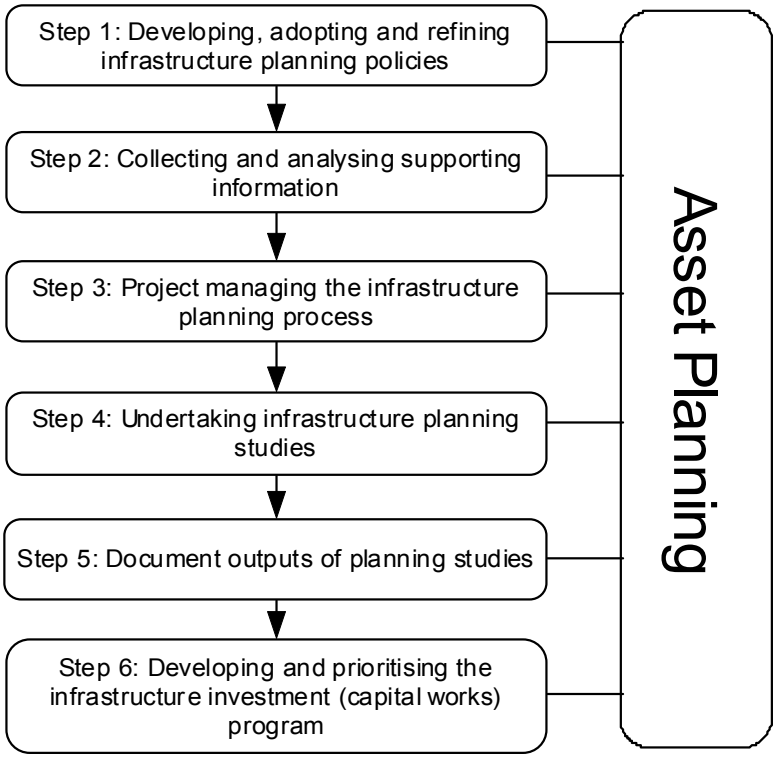
Asset planning policies could relate to such matter as:

- Asset planning principles such as:
  - the necessity to consider non-asset solutions, full life cycle costs, risks and existing alternatives before deciding to construct new or replacement assets;
  - application of strategic thinking to the planning process;
  - application of risk management to the asset planning process; and
  - optimizing asset investment;
- community consultation in the asset planning process;
- responsibility for asset planning (owner and operator1);
- planning/design standards, guidelines, best practice, State planning policies;
- compatibility with land-use planning, regional planning, existing drainage/sewerage system master planning;
- planning documentation internal/external review, approval, monitoring and updating; and

[1] Decree 88/CP dated May 28, 2007

- responsibilities and processes for asset investment prioritization.

Figure 10 The Asset planning process



Step 2: Collecting and Analyzing Supporting Information

Effective information collection is a critical foundation for Asset Planning.

Required information can be grouped into:

- macro level information; and
- micro level information.

Macro information will set the context for the planning study and will include such matters as:

- wastewater treatment standards development trend;
- wastewater quantity development trends;
- economic trends impacting on wastewater production;
- current and future land-use zonings;
- outputs from regional infrastructure studies;
- the strategic direction for the assets operator;
- business development opportunities for the assets operator.

Micro-level information are the technical information required to develop optimal asset planning outputs, and will include:

- determination of a suitable Asset system for all wastewater disposal system components;
- Concerning:
  - System's capacity demand;
  - Location of system's components;

- Dimensioning of system's components;
- Operation process of the wastewater disposal system;
- Required effluent standards and other required technical standards;
- Obligation of customers to connect to the system;
- Operation and maintenance requirements and costs;
- Cost of the system:
  - o capital costs: (i) interest rates; (ii) depreciation
  - o operation and maintenance costs;
  - o management cost;
  - o monitoring cost;
- System's basic information data:
  - o topographical + cadastral survey;
  - o geological survey;
  - o meteorological date;
  - o tidal data;
  - o population growth data;
  - o economical development data.

Table 10 Planning report types

Planning report type	Level of information
Strategy / master planning report	General information and complete service area of the assets operator
Pre-investment report	Project outlines
Investment report	Conceptual planning
Investment project	Detailed planning
Technical / Final design	Tender level
Shop drawings	Execution drawing of contractor
As built drawings	Detailed existing inventory drawings as input for asset register

Step 3: Project Managing the Asset Planning Process

Project management of asset planning involves a number of activities including the following:

- **Programming and budgeting for asset planning studies.** This will include programming Asset planning (at a preliminary, strategic or detailed level) in response to:
  - timeframe since previous studies;
  - outputs from other studies;
  - environmental or operational problems; and
  - changes in regulations (e.g. environmental issues).
- Determining the degree of asset planning required. The appropriateness of different levels of planning is summarized in Table 10.
- **Briefing and monitoring** (quality, timeliness and value for money) of asset planning work undertaken internally or by consultants.
- **Coordinating the handover of asset planning documentation** including:
  - registering, storing and distributing planning reports; and

- registering and storing supporting information such as CAD/GIS files, network models.

- **Ensuring updating** of**:**
  - Asset investment (capital works) program;
  - Asset charges plan;
  - planning report schematic “map”; and
  - planning report summaries.
- **Coordinating** internal review and documentation approval by the assets operator.

The output of Asset **planning activities would address the issues at an appropriate level of detail.**

The level of detail and the objectives to be achieved on each planning level are defined in the relevant Vietnamese regulations concerning planning activities for wastewater disposal systems.

For ODA projects differing planning stages may exist, considering the planning requirements of the financing agencies; hence close coordination and harmonization of the procedures are advisable.

Table 11 Asset planning levels

Asset planning level	Output	Objectives
Strategic /master planning	Strategic / master planning report	Determination catchment area of the system Legal requirements and responsibilities Links to urban and regional planning Determination of main component locations of a suitable technical system for short-medium and long term wastewater disposal strategies
Project outlines	Pre-investment report	Project development for financing and budgeting purposes
Investment report	Conceptual planning	Feasibility of the project with investigation on project alternatives Dynamic cost evaluation over medium term period (20 years)
Investment project	Basic design	Design of all components of the project including cost evaluation based on a BOQ
Technical design	Final design	Final design of the project as far as necessary for tendering and contracting Actualization of cost estimates for budgeting
Shop drawings	Contractor design	Execution drawings of the contractor
As built drawings		Drawings showing all details of the executed works

Step 4: Undertaking Assets Investment Planning Studies

A preliminary/concept study would address the issues at an appropriate level of detail. A strategic or detailed assets investment planning study would consider the following issues:

- the objectives and desired outcomes for the study;

- related studies;
- the assets operator's strategic direction;
- regulatory requirements;
- characteristics of the study area;
- the existing system, including:
  - assets location, capacity and performance;
  - the current operating context/philosophy;
  - current performance including service standards, operational problems; and
  - current operating efficiency;
- current historical customer requirements; and future requirement scenarios, covering annual, monthly and daily average and peak wastewater quantity and system's capacity;
- gap analysis (includes identifying the gaps between current performance and required current and future performance);
- for future asset investment demand;
- identification and evaluation of options. This process would involve the application of strategic thinking whereby assumptions are challenged, alternative ideas are generated and appropriate and/or innovative solutions developed.

The process may involve community consultation, depending on the nature of the study or assets operator's policy.

The assets investment planning process would critically evaluate non-asset solutions such as:

- improvements to operational efficiency and effectiveness;
- more efficient use of existing assets;
- infiltration/inflow reduction.

The evaluation of options would include:

- economic evaluation using net present value (NPV) and internal rate of return (IRR) of revenues and costs;
- assessment of changes in service levels (should each of the options proceed) to be evaluated in terms of service improvements in:
  - reliability;
  - quality;
  - quantity;
  - environmental; and
  - operational efficiency;
- assessment of the risks associated with each option, which could include the following risk categories:
  - reliability;
  - social and political;
  - public health;
  - safety;
  - structural or serviceability failure of assets;
  - financial;
  - environmental; and
  - legislative/legal;
- benefits of each option to various stakeholders (customers, owners, operator, regulator, and the general community);
- selection of the most appropriate option;
- commercial implications of the project in relation to such matters as:
  - whether the project is financially viable;
  - what contributions from the owner (e.g. State or local government) or payments for community service obligations are required to make the project financially viable;
  - options for project delivery;

- o opportunities for tax minimization; and
- o whether there are other potential markets that would enhance the financial viability of the project.

Assets investment planning overview document: This document addresses:

- current assets investment planning processes within assets operator;
- the external environment in relation to assets investment planning;
- future strategies/initiatives in assets investment planning;
- action plans supporting the strategies; and
- a listing of key supporting documents, should the reader require more detailed information.

The evaluation process may be facilitated through a value management study. Value management is a structured, analytical process for developing innovative, holistic solutions, and is a useful tool in both the infrastructure planning and design phases. While many of the principles should already be an integral part of the assets investment planning process, value management builds on the synergy of a team approach. Additional information on value management is included in Appendix 3B.

Step 5: Document Outputs of Planning Studies

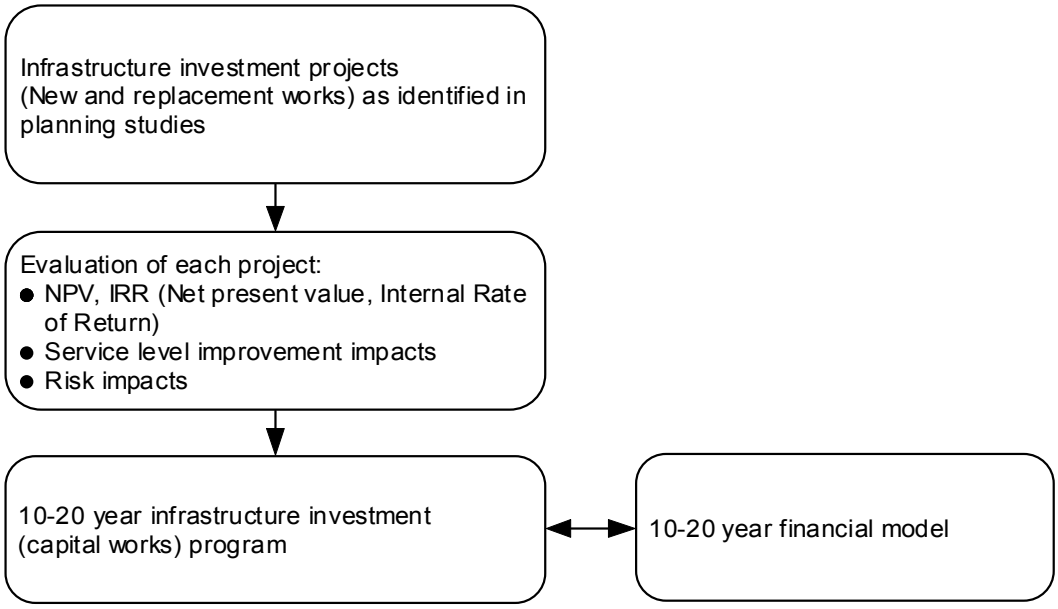
The assets investment planning process will provide the following outputs:

Planning reports: A planning report should be user friendly and clearly communicates its findings, analysis and recommendations to relevant stakeholders. The use of diagrams and schematic layouts will assist the communication of ideas.

Planning report' summary: The summary will provide an overview of key points arising from a planning study. A sample layout is shown in Appendix 3C. This may be useful for larger assets operators, or ones that undertake a significant number of planning and other studies. For smaller assets operators a listing of planning studies may be adequate.

Step 6 Developing and Prioritizing the Asset Investment (Capital Works) Program

Figure 11 The project prioritization process



Planning studies will identify a range of projects to be incorporated in the asset investment (capital works) program. Good business practice dictates that an assets operator will prioritize projects, to maximize financial and non-financial returns. These projects may involve non-asset solutions (e.g. demand management), as well as new or replacement asset. The prioritization process, illustrated in Figure 11, is similar to that for evaluating options in individual planning studies. Further information is provided. It is likely that only projects programmed for the short term (e.g. 1 - 3 years) can be confidently prioritized. For smaller assets operators with limited capital works projects, the prioritization process should be relatively simple and could be based on an informal benefit/risk assessment. The process can also be used to prioritize non-asset initiatives (e.g. demand or energy management), if required.

The result of the process will be a 10 - 20 year asset investment (capital works) program although the confidence in the planning and prioritization will be less the further into the future.

Risk Issues on Planning Level

Potential risks associated with asset planning include:

- inadequate financial resources allocated to the asset planning process;
- insufficient lead time to allow adequate planning;
- planning based on inaccurate data, resulting in inappropriate asset investment decisions;
- over-conservative projections, resulting in premature or non-optimal asset investment;
- underestimation of projections, resulting in deterioration in service levels in the medium to long term;
- inadequate asset investment;
- inadequate linkages with other planning initiatives;
- inadequate community consultation;
- pressure group action;
- inappropriate asset planning level (e.g. detailed planning when a feasibility plan would have been more appropriate); and
- inadequate financial resources to fund desired asset investments.

Best mitigation of avoidance measure against risk issues on the planning level is higher investment in planning and design activities in order to achieve high quality and benefit from the cost saving potential resulting from technical-economical project optimization processes during project performance.

As better the engineering during the design phase as lower the life cycle costs of the designed system.

5.2 Asset Procurement

This part is intended to provide guidance for service provider and their consultants on the processes involved in establishing and implementing effective asset procurement strategies and procedures and developing associated documentation.

Asset procurement involves asset project delivery and covers the design, construction or installation and asset handover phases of the asset life cycle.

Outcomes: Outcomes from effective asset procurement include:

- delivery of assets at the least live cycle costs;
- “just in time” delivery of asset, within quality and budgetary specifications to meet the requirements of the assets owner, assets operator and the customer;

- Sustainable assets in terms of operation and maintenance requirements and real service life.

Outputs: Outputs from the asset procurement process include:

- Asset Procurement Plan;
- new and rehabilitated assets; and
- documentation (e.g. tender and contract documents), as built documentation.

The asset procurement process: Project-management of the asset procurement process includes all processes required to acquire goods, services and works from outside the assets operator organization according to the identified demand.

Process of purchase of assets:

Planning Department Operation-and-maintenance Department	Identification of demand
Checking of demand and of alternatives Timeframe for realization: - immediate - mid-term - long-term	- newly invested assets - assets to be repaired - assets to be rehabilitated - assets to be replaced Costs for purchase of services, goods and works to satisfy the identified demand
Regular annual budget Budget for special identified invests	Establishing of budget Approval of budget
Assets operator and assets owner	Definition of quality, applied standards as specification for goods and services to be purchased and determination of required quantities including stand-by units/equipment and spare parts. Identification of suitable contractors and suppliers Preparation of tender or quotation Evaluation of bids:
Assets operator and assets owner	- technically recommendation for asset investment - financially recommendation for asset investment
PC	Decision on investment for assets:
PC, DOF, DPI, DOC, assets operator	- new invested projects assets
Assets operator	- repair of existing assets
Assets operator	- rehabilitation of existing assets
PC, DOF, DPI, DOC, assets operator	- replacement of existing assets
PC, DOF, DPI, DOC, asset operator	Contract performance
	Handing over from contractor to owner and assets operator
Asset operator	Operation and maintenance

Each assets operator should set up formalized processes, at an appropriate level, to address each one of these elements.

The asset procurement process is illustrated in Figure 13 and discussed in the sections that follow.

Step 1: Developing and Refining Policies

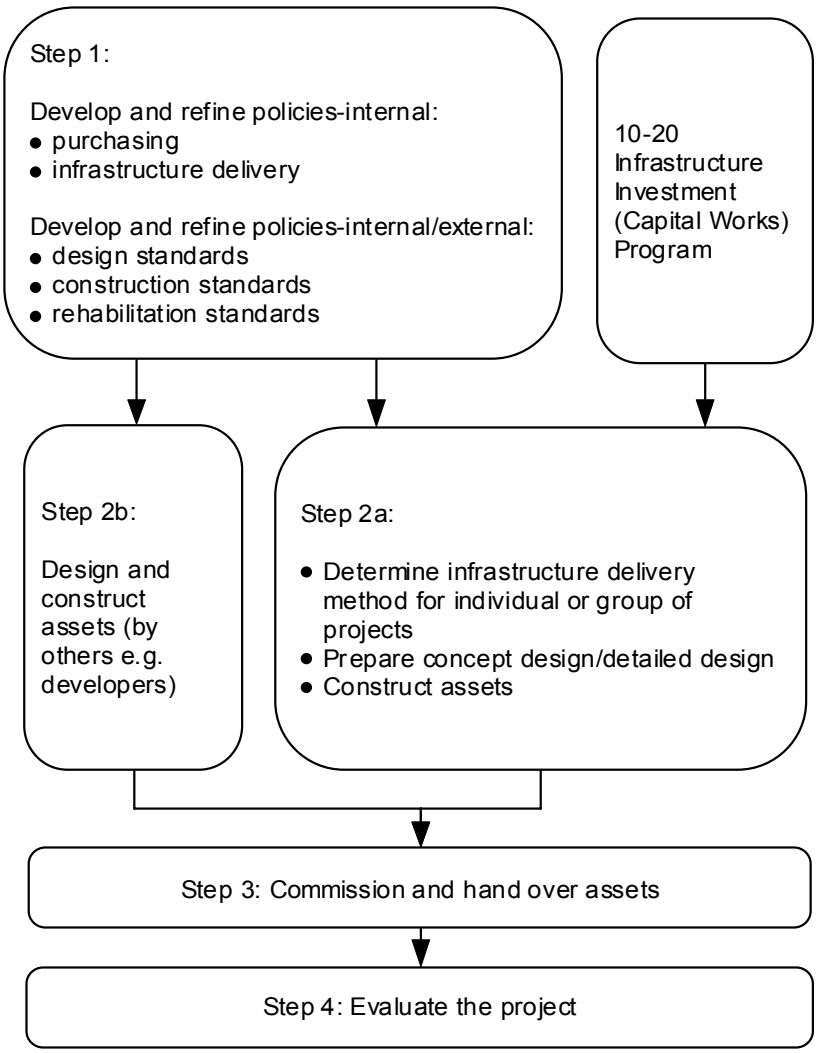
A number of policies should be developed in relation to asset procurement. These include policies such as:

- purchasing policy;
- policy on asset delivery; and
- design, construction and rehabilitation standards.

Most assets operators have a formal purchasing policy, in compliance with the national procurement policies, the objectives of which are to ensure:

- value for money for services; and
- accountability to stakeholders (e.g. shareholders and customers).

Figure 12 The asset procurement process



An asset operator policy on asset design, construction and rehabilitation standards is usually reflected in either:

- a formal asset standards document; or
- reference to generic or national codes

These policies or standards are necessary to:

- minimize life cycle costs;
- clarify requirements within the assets operator;
- clarify the requirements of external consultants, contractors and clients (e.g. developers);
- reflect the assets operator's operation and maintenance experiences and requirements; and
- ensure a consistent approach to asset development.

A formal Asset standards document would cover such issues as:

- design approval processes;
- construction and acceptance of asset;
- design criteria and sizing of components;
- construction materials/standards;
- design details;
- standard drawings;
- construction specifications; and
- asset commissioning and handover procedures.

Step 2a: Determining the Asset Delivery Method

The method of asset delivery may need to be determined in the planning stage, because some options impact on an assets operator's financial projections. For example, the financial impact of funding a treatment plant from revenue or head-works funds will be totally different from that of funding it through a build, own, operate, transfer (BOOT) arrangement.

Asset delivery needs to be consistent with an assets operator's service delivery strategy. A summary of asset delivery issues addressed by other organizations is given in Table 9.

The document from which Table 9 is derived outlines factors that should be considered in selecting the most appropriate asset delivery option. These include:

- net present value of costs and revenues;
- size and complexity of project - as the size and complexity of a project increases, a greater opportunity exists to explore options for asset delivery;
- Assets operator Policies - the assets operator may wish to own and operate assets;
- finance - a BOOT scheme may be attractive where the assets operator wishes to avoid taking on additional debt;
- regulatory approvals - the need for a detailed concept design for regulatory approvals for certain projects may limit options to sequential design and construction;
- timing - D&C may lead to quicker project completion;
- design needs - D&C, BTO, concession or BOOT may be favored if the best design process skills are with a contractor or operator;
- construction - BTO, concession or BOOT may be favored for a "green-fields" site with high project cost and some complexity and scope for innovation;
- operation - sequential or D&C may be favored where a service provider's (SP) operational efficiency for similar facilities is high. BTO, concession or BOOT may be favored where the desired technology is best available through private sector options,

or where the SP wishes to introduce a competitive element to provision of services in its area; and

- risk management - sequential would be favored where detailed site investigations are necessary to adequately develop and cost a concept design, or where there is considerable uncertainty in demand/load projections. BTO, concession or BOOT would be favored where the SP wishes to transfer management of design, construction and operation interface risk to the private sector.

Table 12: Summary of alternative asset delivery options

Option	Process	Applicability
Work designed by the owners or Service Provider (SP)	Involves separate stages for design and construction. These stages could be undertaken by in- house teams or external contractors.	Suited to a large proportion of urban water and sewerage projects, including those where a reasonably detailed concept design needs to be developed (e.g. a dam or a pipeline in an environmentally sensitive area) or where, due to the nature and location of the works, there is little scope for post-tender innovation.
EPC contract work designed by the contractor	A single company is responsible for both design and construction of the project, based on meeting explicit performance requirements. SP takes over and operates asset.	Suited to projects costing over $1m, where there are many options that could meet performance requirements. It is applicable for a group of treatment works or major pumping stations.
Build, transfer, operate (BTO)	A private sector company is responsible for design, construction and operation of a facility (normally 20 - 25 years). Ownership is transferred to the SP after the end of the construction period	Suited to projects over $5m, involving a water treatment works or sewage treatment works, where operational costs are a significant proportion of the total life cycle costs, and where SP wishes to maintain ownership of its facilities.
Build own operate transfer (BOOT)	A private sector consortium is responsible for designing, constructing, operating, owning and financing a facility for the life of the project (normally 20 - 25 years). At the end of this period the project is handed over to the legally responsible owner.	Suited to “green-fields” projects over $20m, involving a water treatment works or sewage treatment works, where operational costs are a significant proportion of the total life cycle costs and where projects are easily separable from the rest of a Service Provider's business.

Option	Process	Applicability
Concession	This is an extension of BTO where a private-sector company is responsible for operation and maintenance of the system, and capital investment required over a certain period.	In special circumstances.

Step 2b: Assets Provided by Others

A significant amount of wastewater disposal assets are donated by others: usually developers arrange for the design and construction of water and wastewater disposal systems.

These assets are designed and constructed in accordance with the assets operator's adopted design and construction standards. Audit inspections are undertaken during the construction phase to ensure that the works conform to the approved drawings and specified construction standards. After completion these wastewater disposal structures are handed over to the project owner and assets operator.

Step 3: Commissioning and Handover of Assets

Formalized procedures should be developed for commissioning and handing over asset. Issues to be addressed include:

- asset inspection, condition and performance assessment;
- compliance tests;
- as built drawings, including digital copies;
- asset register (attribute and cost) information, including digital copies;
- operation and maintenance manuals;
- training of assets operator's operation staff for specialist equipment/processes; and
- project management during the defects liability period.
- Final asset acceptance.

Step 4: Evaluating the Project (Post-Completion Review)

The project must be reviewed to evaluate the level of service provided and to determine opportunities for improvement. Issues to be considered include:

- achievement of project objectives such as:
  - required performance;
  - budget, capital, and operation and maintenance;
  - timeliness; and
  - quality of asset;
- appropriateness of consultants' briefs;
- design performance;
- project management/procedures; and
- comparison of performance and project costs against similar facilities.

Risk issues

Potential risks associated with asset procurement include:

- performance requirements or demand that differ from planned projections;
- approvals; creating delays
- design, construction and operation risks;
- financial risks;
- commercial risks;
- government policy changes;
- political risks;
- environmental impacts of construction activities;
- workplace injuries;
- poor contractor performance;
- business failure of contractor;
- acquisition of substandard assets; and
- inadequate community consultation.

CHAPTER 6: RISKS MANAGEMENT

6.1 Introduction

6.1.1 What Is Risk Management?

Risk management is avoiding or mitigating losses. It is a logical and systematic process of establishing the context, identifying, analyzing, evaluating, treating, monitoring and communicating risks associated with any activity, function or process, in a way that enables an organization to minimize losses.

6.1.2 The Importance of Risk Management

Industry trends: The drive for increased efficiency and limited financial resources has tended to force assets operators into taking a less conservative but more risky approach to service delivery.

In this general environment of continual change and limited resources, the management of risk has become a critical issue. Decision-makers thus need to know about possible outcomes and take steps to control their impact.

Risk management is already widely recognized as an integral part of good management practice. To be most effective, however, risk management should also become part of an organization's culture, by being integrated into its philosophy, practices and business plans rather than viewed or practiced as a separate program. When this is achieved, risk management becomes the business of everyone in the organization.

Consequences of not managing risk: Failure to manage risk effectively can lead to such adverse consequences as:

- financial losses by the organization;
- personal injury;
- community losses;
- loss of professional or technical standing;
- criminal charges;
- environmental damage;
- public health crises; and
- claims for compensation of damages.

This is not to say that risk management is about avoiding risk completely. It is more about knowing what the relative severity of the consequences is likely to be for each level of management response, and making management decisions accordingly.

6.1.3 Corporate Responsibility for Risk Management

For risk management to be effective within an organization it needs to be promoted by the organization at all levels and integrated into the culture and day-to-day operations of the organization.

Mechanisms for managing risk should be important components of every organization's philosophies, goals and accepted practices and they should be reflected in its business plans and training programs.

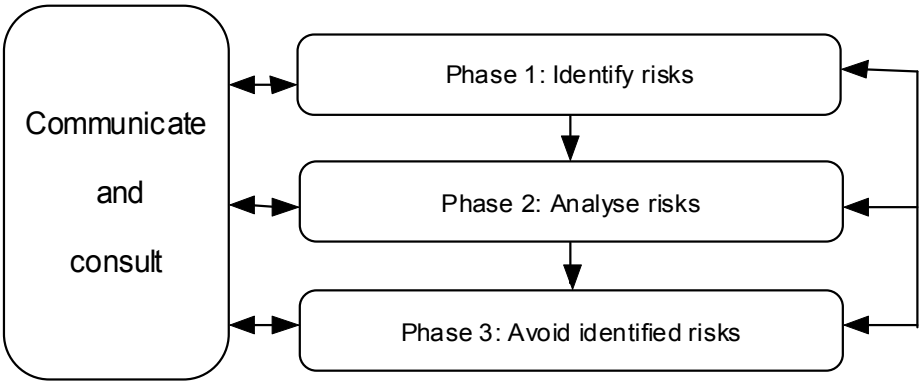
Organizational culture is likely to be a severe impediment to the implementation of risk management programs and senior managers will need to be aware of this and introduce measures to change the culture where and when necessary. Typical measures that could be applied include:

- Empowering managers at all levels to identify risks;
- Acknowledging, rewarding and publishing effective risk management practices;

- Providing opportunities for staff to discuss options for avoiding the recurrence of problems;
- Focusing on positive results rather that minor negative ones;
- Fostering learning from both positive and negative results, including unexpected or untoward ones.

6.2 The Risk Management Process

Figure 13 the risk management process



6.2.1 Phase 1: Identifying Risks

Defining source categories: Each assets operator should select whatever basis of source categorization best suits its needs. The main requirement is that:

- no significant risk is overlooked; and
- each risk can be readily analyzed and evaluated.

In the following table (table 13), the source categories are listed with typical examples of the sorts of risk events associated with each category.

Table 13: Examples of risks events

Source category	Examples of risks events
Political	• Community opposition • State Government opposition • Loss/reduction of subsidy
Regulatory	• More stringent requirements • Statutory non-compliance
Customers	• Excessive complaints • Consistent breach of service standards • Pressure group activity
Environmental	• Habitat destruction • Air/water/soil contamination by SP activities
Economic	• Delays in decisions • Discount rate changes

Source category	Examples of risks events
	• Energy price increases • Salary increase • Inflation rate increases • Exchange rate changes
Commercial/strategic	• Impact of new technologies
Financial	• Rising interest rates • Revenue shortfalls • Significant unforeseen expenditure • Changes of economic conditions
Public health/safety	• Pathogen contamination of water supply sources • Firefighting capacity or of bathing water • Public injury
Infrastructure planning/design	• Unexpected population growth • Water consumption exceeds expectations • Premature capital investment
Procurement/contractual	• Loss of supply • Product obsolescence • Contractor business failure
Construction, O&M	• Workplace injury • Incorrect operational procedure • Incorrect maintenance procedure
Asset failure	• Catastrophic structural failure • Functional failure • Premature ageing of asset
Support service failure	• Invalid/inadequate information base • Information technology failure/inadequacy • Inadequate human resources
Security of assets	• Sabotage • Vandalism • Theft
Litigation	• Public liability actions • Employee actions • Service provider actions
Organizational	• Industrial action • Loss of corporate knowledge/expertise • Excessive downsizing
Natural events	• Lightning strikes • Floods • Fire

It is important to recognize that, while superficially some events might appear to be caused by material or system failure, ultimately all risk events arise as a result of human nature or behavior at some stage in the preceding chain of events. Examples include:

- human error;
- insufficient or limited knowledge;
- failure to properly manage knowledge;
- inadequate experience;
- changes in community perceptions as to the importance of particular issues; and
- uncertainty about the future (e.g. natural events).

Some examples of risks common to many organizations, including those of assets operators, are listed below:

- failure to recognize and take advantage of opportunities;
- failure of a project to reach its objectives;
- failure of physical Asset, equipment etc.;
- customer dissatisfaction;
- un-favorable publicity;
- a threat to physical safety;
- a breach of security;
- mismanagement;
- a breach of legal or contractual responsibility;
- fraud; and
- deficiencies in financial controls and reporting.

6.2.2 Phase 2: Analyzing Risks

Identifying and assessing existing controls: For each significant risk identified the adequacy of existing risk controls should be assessed before the likelihood and consequences of the event is estimated. Failure to take this information into account is likely to distort the evaluation of risks.

Assessing likelihood and consequences by risk event: This involves use of qualitative or quantitative scales of likelihood and consequences of risk events. The use of qualitative scales for this purpose is recommended.

Note that likelihood and consequences should be assessed in the context of the existing controls; i.e. allowing for the effectiveness of existing controls in reducing likelihood and/or consequences.

Appendix 1: Definitions

Active asset: Generally applies to above-ground assets (e.g. reservoir, pump station).

Asset

- An item with an independent physical and functional identity and age, within a facility (e.g. pump, motor, sedimentation tank, main).
- Service potential or future economic benefits controlled by entity as a result of past transactions or other past events.

Asset (modern equivalent): The notional asset that would replace an existing assets service potential, using the latest technology available.

Asset (network): Individual asset which, together with others, performs a service.

Asset (non-current): An asset of a business which is expected to be consumed over more than one financial year.

Asset register: A systematic record of items considered worthy of identification as discrete assets, including information such as construction and technical details about each.

Asset replacement profile: The projected variation over time of capital expenditure on replacement of assets.

Breakdown maintenance: *See* Emergency maintenance.

Component (of asset): An item with an independent physical and functional identity within an asset (e.g. impeller, hydrant).

Condition-based depreciation: The determination of accumulated depreciation as the cost in any reporting period of restoring an assets gross service potential, based on the condition of the asset within the period. Changes from year to year in the cumulative depreciation so determined represent the annual depreciation.

Condition-based maintenance: The preventive maintenance initiated as a result of knowledge of the condition of an item from routine or continuous monitoring. (*May also form part of predictive maintenance.*)

Condition monitoring: The continuous or periodic measurement and interpretation of data to indicate the condition of an item to determine the need for maintenance.

Control: Control of an asset means the capacity of an entity to benefit from the asset in the pursuit of the entity's objectives and to deny or regulate the access of others to that benefit.

Corrective maintenance: The maintenance carried out after a failure has occurred, and intended to restore an item to a state in which it can perform its required function. (*This may include breakdown or reactive maintenance.*)

Cost (current): An asset cost measured by reference to the lowest cost at which the gross service potential of the asset could currently be obtained in the normal course of events.

Cost (replacement): The cost of restoring an existing assets gross service potential on deprival, whether by reproduction of the existing asset or replacement with a reference asset.

Cost (reproduction): The cost of restoring an existing assets gross service potential on deprival by reproducing the existing asset.

Cost (written down current): An assets current cost less, where applicable, accumulated depreciation calculated on the basis of such cost to reflect the already consumed or expired service potential of the asset

Depreciation: In an economic sense, depreciation is equivalent to the rate of consumption of assets. In a practical sense it is a decrease in the value of an asset due to wear and tear, physical degradation, obsolescence or any other cause which reduces its useful economic life. In an accounting sense it is a mechanism for systematically distributing the net cost or other basic value of assets over their useful lives.

Deprival value: *See* Value (current).

Dis-aggregation: The subdivision of composite assets into assemblages and/or components for purposes of registration, valuation, or other purpose.

Emergency maintenance: The maintenance that is necessary to put in hand immediately to avoid serious consequences. (*May also be called breakdown or reactive maintenance.*)

Excessive infiltration/inflow: The quantity of infiltration/inflow that can be cost-effectively eliminated from a sewer.

Facility: A group of assets that provides a function or service (e.g. pump station, reservoir, treatment plant, reticulation system).

Facility: A complex of assets (e.g. a hospital, water treatment plant, sporting complex) that represents a single management unit for financial, operational, maintenance or other purposes.

Gross current cost: *See* Cost (current).

Infiltration/inflow: The combination of groundwater infiltration, stormwater inflow, and rainfall-dependent infiltration.

Life (residual): The difference between useful life and elapsed life.

Life (useful): In relation to a depreciable asset, the estimated total period, from the date of acquisition, over which the service potential of the asset is expected to be used up in the business of the entity.

Life cycle: Life cycle has two meanings:

- The cycle of activities that an asset (or aggregation of assets) goes through while it retains an identity as that asset. These activities include planning, design, acquisition and support, including rehabilitation and disposal.
- The period of time between a selected date and the cut-off year or last year, over which the criteria (e.g. costs) relating to a decision or alternative under study will be assessed.

Life cycle cost: The total cost of an asset throughout its life including planning, design, acquisition, operations, rehabilitation and disposal costs.

Maintenance: The combination of all technical and associated administrative actions intended to retain an item in, or restore it to, a state in which it can perform its required function.

Maintenance history A history record which is used for the purpose of maintenance planning.

Maintenance planning: Deciding in advance the jobs, methods, tools, machines, labour time required, and timing of maintenance actions.

Maintenance program: A time-based plan allocating specific maintenance tasks to specific periods.

Maintenance schedule: A comprehensive list of items and the maintenance required, including the intervals at which maintenance should be performed.

Passive asset: Generally applies to mains and channels.

Planned maintenance: The maintenance organized and carried out with forethought, control and the use of records to a predetermined plan.

Preventive maintenance: The maintenance carried out at predetermined intervals, or corresponding to prescribed criteria, and intended to reduce the probability of failure or the performance degradation of an item.

Reactive maintenance: *See* Emergency maintenance.

Rehabilitation: Works to rebuild, or replace parts of components of, an asset to restore it to the required functional condition and/or extend its life. This could also incorporate some modification. Generally involves repairing the asset to deliver similar function using available techniques and standards (i.e. not a significant upgrade or renewal). Examples include heavy patching of roads and slip-lining of sewer mains.

Reinforcement: Construction of an additional pipeline to supplement the capacity of an existing pipeline or provide an alternative to it.

Reliability: The ability of an item to perform a required function under stated conditions for a stated period of time.

Renewal: Works completed to upgrade facilities significantly from the existing asset.

Renovation: Term frequently used to mean lining of pipelines.

Repair: Action to restore an item after failure or damage.

Replacement: Complete removal and use of another item in place of an asset that has reached the end of its life, so as to provide a similar or agreed level of service.

Scheduled maintenance: Preventive maintenance carried out to a predetermined interval of time, number of operations, kilometers, etc.

Terotechnology: A combination of management, financial, engineering, building and other practices applied to physical assets in pursuit of economic life cycle costs.

Unplanned maintenance: The maintenance carried out to no predetermined plan. (*May also include breakdown or reactive maintenance.*)

Value (current): The current value of a non-current asset of a local government is the loss that it would incur if it were deprived of the assets utility (or service potential).

Value (deprival): The loss that an entity would incur if it were deprived of the assets utility.

Work order: A written instruction detailing work to be carried out.

Work specification: A document describing the way in which work is to be carried out. It may define the materials, tools, time and standards.

Appendix 2: Asset Evaluation and Renewal Plan Content

Sub-plan features	Asset evaluation and renewal plan content
Issues covered in sub-plan	• Asset data capture. • Registration. • Valuation. • Asset condition and performance assessment. • Asset replacement time schedule • Asset replacement cost profile.
Purpose of plan	To provide summary information on: • the assets controlled by the SP (extent, location, value, condition and performance, useful life); • assets register outputs; and future asset evaluation strategies and actions for updating asset registers and refining useful life estimation.
Policies that may be required	• Asset valuation policy.
Other Asset management Plan elements that are intimately linked to this sub-plan	• Financial Management Plan: this requires asset register outputs such as current cost, value and depreciation; replacement cost profiles, and renewals annuity calculations. • Asset Plan: replacement cost profiles will be input into the rehabilitation capital works program.
External issues contributing to the current operating environment that need to be considered	• Relevant accounting standards. • Developments in renewals annuity accounting. • Developments in optimized deprival valuation. • Developments in predictive modeling for asset failure.
Issues that need to be considered in summarizing the status of current operations	An overview (including commentary) of the assets operators Asset should be provided, either as a summary table or graphic output. This might include: • scheme name; • component (e.g. weirs, treatment plants, mains); • quantity (e.g. length, number); • O&M cost; • invested capital; • annual depreciation. A discussion on the current status of asset evaluation should include: • a description of the asset data captured, its accuracy and data capture methodology; • information on the extent of knowledge of asset location; • storage of asset register information (GIS, databases) and the linkage between these databases and other databases (e.g. financial). A flow chart (with

Sub-plan features	Asset evaluation and renewal plan content
	accompanying explanatory notes) would be necessary; • a summary of asset condition and/or performance evaluation methodologies applied to different assets (e.g. mains, pump stations); • a summary of current asset condition/performance by asset type; • asset performance statistics (e.g. main breaks/km, sewer blockages/km); • quantity profile for asset replacement; • a 50-year asset replacement cost profile (with a commentary) that incorporates a 5-year rolling average and 20-year renewals annuity; • a description of any initiatives in predictive modeling of asset failure; and
Strategic basis of the plan	The strategic elements forming the basis of the plan should include: • goal for asset management; • objective(s) for asset evaluation and renewal; • adopted Key Performance Measures (KPMs); and • management strategies and performance targets. The management strategies developed will be based on the identified key strategic issues, including risk assessment, in respect of asset evaluation and renewal, and on the required AMP development level. Many assets operators are likely to require strategies for refining asset residual life estimation. The strategies should be supported by detailed action plans that would cover a period of up to 3 years.
Suggested performance measures	Outcome: • actual asset age by category. • average asset age by category. Output: • % length mains replaced or rehabilitated; • % length of trunk mains/channels at condition level 4 or worse; • % length sewers inspected with CCTV.
Supporting documentation	This will depend on the SP, but would typically include: • asset registers; • asset valuation report; and • specific asset management studies.

Appendix 3: Operation Management Plan Content Concerning Asset Management

Sub-plan features	Operation management plan content
Issues covered in sub-plan	• Operating philosophy. • Operational policies and procedures. • Optimizing system performance. • Delivery of operational services.
Purpose of plan	To provide summary information on: • system operational philosophy and practice; and • planned initiatives in optimizing system operation.
Policies that may be required	• Workplace health and safety; • Delivery of operational services; and • benchmarking and continuous improvement.
Other Asset Management Plan elements that are intimately linked to this sub-plan	• Financial Management Plan: financial projections of operational and maintenance costs will reflect efficiency gains. • Maintenance Management Plan: interaction of operation and maintenance. • Service Standards Plan: service levels will be aligned to the efficiency and effectiveness of system operations. • Information Management Plan: effective information systems are required to support system operations.
External issues contributing to the current operating environment that need to be considered	• Increasing emphasis by the government on improving efficiency and service delivery within the wastewater sector. • Automation of system operation can facilitate improved operations and response times.
Issues that need to be considered in summarizing the status of current operations	• Schematic layout of schemes outlining major facilities, their capacity and how scheme operates. • Brief description of system operation and control and monitoring systems and outputs. • An overview of current operational problems. • Delivery of operational services (e.g. in-house and outsourcing). • Current status of documented operational procedures. • Communication with bulk suppliers and customers. • Wastewater quality monitoring (inflow and effluence). • Tabulation or graphs of critical operational performance indicators.
Strategic basis of the plan	The strategic elements forming the basis of the plan should include: • goal for asset management; • objective(s) for operations management; • adopted Key Performance Measures (KPMs); and

Sub-plan features	Operation management plan content
	• management strategies and performance targets. The management strategies developed will be based on the identified key strategic issues, including risk assessment, in respect of operations management, and on the required AMP development level. Many assets operators are likely to require strategies for optimizing system performance; documenting the operating philosophy and procedures, and establishing an operation performance and benchmarking program. The strategies should be supported by detailed action plans covering a period of up to 3 years.
Suggested performance measures	**Outcome:** • sewerage odor complaints. **Output:** • Operations, Maintenance & Administration (OMA) cost/km main • OMA cost/1000 properties. • OMA cost/m^3. • Administration cost/1000 customers.
Supporting documentation	• Documented operational philosophy, procedures and schedules. • Operation and maintenance manuals.

Appendix 4: Maintenance Management Plan Content

Sub-plan features	Maintenance management plan content
Issues covered in sub-plan	• Maintenance strategies. • Maintenance procedures. • Maintenance management support systems
Purpose of plan	To provide an overview of: • existing maintenance strategies and practices; • status of existing maintenance support (management) systems; and • future initiatives in Asset maintenance.
Policies that may be required	• Delivery of maintenance services. • Philosophy and direction in relation to asset maintenance.
Other Asset management Plan elements that are intimately linked to this sub-plan	• Operations Management Plan: interaction of operation and maintenance. • Asset Evaluation and Renewal Plan: asset register, condition assessment. • Financial Management Plan: higher investment in maintenance can reduce depreciation charges. • Risk Management Plan: maintenance strategies are likely to become more risk-based.
External issues contributing to the current operating environment that need to be considered	• There is an increasing recognition by assets operators and the community that the level of maintenance has an impact on service quantity. • Commercialization and outsourcing of maintenance will require more formal reporting on maintenance activities.
Issues that need to be considered in summarizing the status of current operations	• Overview of maintenance strategies for different asset groups. • Status of existing maintenance documentation. • Status of existing maintenance support systems. • Overview of delivery of maintenance services (e.g. in-house or outsourcing).
Strategic basis of the plan	The strategic elements forming the basis of the plan should include: • goal for asset management; • objective(s) for maintenance management; • adopted KPMs; and • management strategies and performance targets. The management strategies developed will be based on the identified key strategic issues, including risk assessment, in respect of maintenance management, and on the required AMP development level. Many assets operators are likely to require strategies for

Sub-plan features	Maintenance management plan content
	developing maintenance documentation, optimizing maintenance practices and strategies, and implementing a maintenance management support system. The strategies should be supported by detailed action plans covering a period of up to 3 years.
Suggested performance measures include WWTP	Output: • Number of main breaks/km main • Number of sewer blockages/km main • Number of service repairs • Percentage of connections experiencing interruptions • Ratio of planned to total maintenance jobs (by asset type) • Operations, Maintenance & Administration (OMA) cost/km main • OMA cost/1000 customers • OMA cost/m^3
Supporting documentation	This will depend on the SP, but typically would include: • operation and maintenance manuals; and • documented maintenance procedures.

Appendix 5A: Performance Management Plan Content

Sub-plan features	Performance Management Plan content
Issues covered in sub-plan	• Community consultation in setting standards and monitoring performance. • Adopted business performance measures and targets. • Performance monitoring and assessment. • Performance evaluation and reporting. • Business and service performance improvement strategies.
Purpose of plan	• To provide an overview of the SP's current performance. • To outline the SP's future objectives and strategies for managing and improving • business and service performance.
Policies that may be required	• Community consultation. • Definition of performance targets. • Monitoring and reporting of performance levels.
Other Asset Management Plan elements that are intimately linked to this sub-plan	• Financial Management Plan: identifies costs and savings in managing or improving performance. • Operations Management Plan: staff/customer interaction. • Maintenance Management Plan: maintaining asset service standards. • Risk Management Plan: risk management program is predicated on achieving and maintaining adopted performance targets.
External issues contributing to the current operating environment that need to be considered	• Increased community expectations on service reliability. • Commercialization, necessitating efficient performance. • New benchmarking/reporting obligations, which involve defining and monitoring service standards.
Issues that need to be considered in summarizing the status of current operations	• Extent of accountability documentation (e.g, defined performance targets; service • agreements; customer charter/guarantee). • Extent of monitoring, benchmarking and reporting actual business performance.
Strategic basis of the plan	The strategic elements forming the basis of the plan should include: • goals for business and service performance; • objective(s) for performance management; • adopted performance targets; and • organization and service delivery management strategies.

Sub-plan features	Performance Management Plan content
	The management strategies developed will be based on the identified key strategic issues, including risk assessment, in respect of managing performance, and on the required AMP development level. Assets operators are likely to require strategies for setting performance targets, establishing a performance monitoring and benchmarking program and performance assessment. The strategies should be supported by detailed action plans covering a period of up to 3 years.
Suggested performance measures	Outcome and output: The performance measures for this sub-plan are the sum of all sub-plan performance measures.
Supporting documentation	These will depend on the SP, but typically would include: • customer connection contracts; • performance monitoring/benchmarking reports; and • business process audit reports. • performance reporting to the responsible authority.

Appendix 5B: Asset Management Performance Objectives

Level	Key objectives	
Asset strategic planning	Effectiveness	To develop strategic plans that contain realistic targets and ensure assets support service delivery.
	Efficiency	To ensure sufficient budget for required strategic asset planning and applied best practice processes, decision support tools and information systems. This includes investment in new system as well as replacement/renewal of existing assets, operation and maintenance cost as outlined below
	Compliance	To ensure asset strategic planning takes into account relevant policy and legislation.
Asset investment	Effectiveness	To ensure asset investment provides the required level of service in accordance with the approved specifications and the principles of sustainable development.
	Efficiency	To ensure asset investment occurs within agreed budget and utilizes best practice processes, decision support tools and information systems.
	Compliance	To ensure asset investment is carried out in accordance with policy and legislation, following clear lines of accountability.
Asset operations and maintenance	Effectiveness	To manage assets so as to provide the required level of service in line with the principles of sustainable development.
	Efficiency	To manage assets within budget and in accordance with best practice processes, decision support tools and information systems.
	Compliance	To manage assets in accordance with policy and legislation, following clear lines of accountability.
Asset renewal and replacement	Effectiveness	To renew or replace assets so as to sustain the required level of service in line with the principles of sustainable development.
	Efficiency	To renew or replace assets in accordance with best practice processes, decision support tools and information systems and achieve budget targets.
	Compliance	To renew or replace assets in accordance with policy and legislation, following clear lines of accountability.

Appendix 5C: Glossary of Performance Terminology

Benchmarking: A process by which an organization seeks to determine and introduce best practice. Benchmarks can operate as standards or targets for performance levels by using comparisons with products, services, practices and processes with similar programs either within the organization or with another organization or country. When used to assess asset program performance, benchmarks usually operate as challenging or best practice standards.

Effectiveness: The extent to which program outputs are achieving program and project objectives. The effectiveness of an asset program should be distinguished from the adequacy of the administration of the program or project, which concerns efficiency.

Efficiency: Relates to minimizing program inputs for a given level of program outputs (or the extent to which program outputs are maximized for the given level of inputs). Efficiency is concerned with the processes (activities/strategies/operations) by which the program is delivered and which produce the outputs of the program. Efficiency is a relative rather than an absolute concept. It is not possible to say that a program is .efficient.. Rather, it can only be stated that a program is more (or less) efficient than, say, it was at this time last year or a comparable program.

Inputs: Resources, human and other, used to produce program outputs.

Objectives: Concise, realistic, outcome-oriented statements of what the program, sub-program or other element of the program aims to achieve. Objectives must be stated in a way that clearly communicates what is to be achieved and measured.

Outcome: All the impacts or consequences of the program beyond its direct outputs. Outcomes are often delayed or long term and they may be intended or unanticipated. Outcomes should be distinguished from outputs. For example, the output of a training program may be a skills training course, while the (desired) outcome is employment.

As specific outcomes may result from multiple factors, causal relationships between a program and outcomes must be demonstrated before they can be claimed as program outcomes.

Output: The products or services that are produced and delivered by a program. Output and throughput measures (for example, the number of courses run, number of cases processed) are often more readily identifiable than outcomes and may provide useful background information about the program. Generally, they will not by themselves be useful measures of objectives.

Performance information: Evidence about performance that is collected and used systematically. Effective performance information should allow judgments to be made on the extent to which program activities are achieving the desired results.

Performance indicators: Indicators provide a guide on performance where causal links are not obvious and the changes in performance are difficult to measure directly.

Performance measures: Provide a more precise measure of performance than indicators. They relate to outputs and are used when there is a direct causal link between an action and an easily measurable change in performance.

Program: Programs are an approved and funded group of activities that contribute to a common strategic objective. Programs are usually further divided into sub-programs and

components. The arrangement of these constituent parts is called a program structure. A program consists of several elements:

- objectives in terms of intended outcomes in relation to identified needs
- resources, strategies, activities and processes
- management and accountability arrangements
- performance information.

A program should be capable of being described in terms of these various elements and in terms of relationships amongst the elements.

Quality: Quality relates to the characteristics by which an organization, product or delivery is judged by customers or stakeholders. In its broadest sense it incorporates assessment of outputs, processes and outcomes and takes into consideration the relevant objectives and resources. Assessment of quality involves information gathered from key interests (citizens, direct and indirect consumers, staff, professionals and government) to identify differences between the expectations and experience of users.

Standards: Pre-defined levels of excellence or performance specifications that can be set on various aspects of an organization, including inputs, processes, outputs or objectives. Progress in delivering the service can be measured against the standard. Standards can relate to quality and objectives of a service or to aspects of service delivery and can be set at different levels (eg. national/local, minimal/ challenging).

Strategies: Groupings of activities used to achieve an objective (eg. a strategy to raise awareness of an issue can encompass activities like publishing pamphlets, creating networks, holding conferences and meetings).

Targets: Quantifiable performance levels or changes in level to be attained at a specified future date. By enabling a direct judgment of performance, targets can clarify and simplify the process of performance monitoring.

Appendix 5D: Sample of Key Performance Measures (KPM)

Objective 1: The wastewater network and treatment facilities are managed to meet demand		
Sewerage system	**KPM 1**	Number of overflows from sewerage system to fresh or marine waters
	KPM 2	<45 overflows for every 100km of pipe per year of wastewater system. **Current performance**: 75 overflows/100km in 2006
Treatment plant	**KPM 3**	The treatment facilities will fully treat the design flow (average dry weather flow). No. Of discharge events per outlet/year

Objective 2: The wastewater assets are well maintained and reliable		
Sewerage system	**KPM 6**	% Of wastewater flow retained in the network for treatment
	KPM 7	16km of critical wastewater pipeline inspected per year. **Current performance**: km required, km achieved
	KPM 8	No PS overflows into marine environment as a result of mechanical or electrical failure. **Current performance**: 100% compliance
Treatment plant	**KPM 9**	No confirmed odor complaints regarding smell emanating from treatment plants. **Current performance**: 5 complaints lodged

Objective 3: The wastewater network safeguards public health and the environment		
Sewerage system	**KPM 10**	>75% of monitored coastal sites where the median annual level of feacal coliform bacteria counts are less than 2000 per 100ml. **Current performance**: 71%
	KPM 11	100% of monitored freshwater sites where annual feacal coliform bacteria counts are less than 2000 per 100ml. **Current performance**: 75%

Appendix 6: Asset Plan Content

Sub-plan features	Asset Plan content
Issues covered in sub-plan	• Asset planning: strategic and detailed. • Regional asset planning. • The asset planning process. • Local government planning scheme.
Purpose of plan	• To provide an overview of the SP's current asset planning processes and documentation. • To outline issues that need to be addressed in the asset planning process. • To outline future asset planning initiatives.
Policies that may be required	• Asset planning principles. • Asset planning responsibility. • Planning/design standards. • Customer/community consultation. • Compatibility with other planning initiatives. • Responsibilities and processes for asset investment prioritization.
Other Asset Management Plan elements that are intimately linked to this sub- plan	• Financial Management Plan: this requires outputs such as the asset investment program (10 years) for new and replacement assets. • Service Standards: service standards should drive the asset planning process. • Asset Evaluation and Renewal Plan: will provide information on existing assets.
External issues contributing to the current operating environment that need to be considered	• Asset planning within a regional context. • Creative/strategic approach required for asset planning. • Use of real operational data. • Non-asset solutions and other alternatives to be considered before constructing new asset. • Asset planning to be compatible with benchmark development sequencing plan (for local government planning schemes). • Impacts of commercialization on asset investment. • Need for existing asset to operate at maximum capacity. • Need to provide financial returns and meet service standards.

Sub-plan features	Asset Plan content
Issues that need to be considered in summarizing the status of current operations	• Corporate direction for asset planning. • Responsibility for asset planning within the organization. • Regional planning issues that impact on asset investment. • Summary of findings from benchmark development sequencing study, including identified growth areas. • The asset planning process. The discussion should include: - how planning is undertaken: strategic or detailed, and frequency; - the quality of supporting information systems; - system capacity (summary information); - distribution/collection system modeling; and - status of planning documentation (refer to Supporting Documentation below) - this should include an overview of planning for key elements of the SP's asset. • Processes for project evaluation and prioritization. • Broad SWOT analysis of asset reliability.
Strategic basis of the plan	The strategic elements forming the basis of the plan should include: • goal for asset management; • objective(s) for asset planning; • adopted KPMs; and • management strategies and performance targets. The management strategies developed will be based on the projected population growth/decline rate, the identified key strategic issues, including risk assessment, in respect of asset planning, and on the required AMP development level. Many assets operators are likely to require strategies relating to supporting information systems (including modeling) for asset planning, programming future planning studies and maintenance of a 10-year asset investment program. The strategies should be supported by detailed action plans covering a period of up to 3 years.
Suggested performance measures	Outcome: • Number of building approvals refused through service delays. • Asset current cost/m^3 wastewater disposed. Output: • Asset planning expenditure as percentage of total Asset (new works) expenditure.

Sub-plan features	Asset Plan content
Supporting documentation	This will depend on the SP, but typically would include: • 10 - 20 year asset investment (capital works) program; • planning report summaries (larger assets operators) (possibly in separate volume); • listing of planning reports (smaller assets operators); • schematic map of planning studies; • Benchmark Development Sequencing Study (separate); and • Project Evaluation and Prioritization Manual, if developed.

Appendix 7: Prioritizing the Asset Investment Program

Planning studies will identify a range of projects to be incorporated in the asset investment (capital works) program. Good business practice dictates that a SP will only invest in projects that maximize financial and non-financial benefits at least cost with high sustainability.

This is achieved through prioritizing the projects identified in the planning and other studies. These projects may involve non-asset solutions (e.g. demand management) as well as new or replacement asset.

The following is an example of a prioritization methodology. It includes the following:

- Evaluating the NPV, IRR, pay period and NPV/customer for each project.
- Evaluating the improvement impacts if the project proceeds in relation to:
  - reliability;
  - quality (e.g. effluent standards);
  - quantity (e.g. delivery capacity);
  - environmental impact
  - operational efficiency.

So that the relativity of impacts on the SP can be evaluated, the impact factor should be multiplied by a weighting factor. The weighting factor would be determined on basis of the strategic direction for the SP.

The resulting figure becomes the total improvement score. A sample calculation format is shown in Table D1.

Table D1: Determination of total improvement score

	Improvement impact score 0 = Low 5 = High	**Weight 0 - 10**	**Improvement impact (if project proceeds)**	**Comments**
Reliability				
Quality				
Quantity				
Environmental				
Operating efficiency				
Total improvement score				

Evaluating the risks if the project is postponed or does not proceed. This involves evaluating the project in terms of the following consequential risk categories:

- social and political;
- public health;
- safety;
- structure or serviceability failure of assets;
- financial;
- environmental;
- legislative/legal.

For some projects a risk profile versus time might be required to present adequate information for making decisions. Many projects could be deferred for 12 months with limited risks and the risk evaluation could be useless. A reasonable timeframe during which the risk might materialize should be chosen (e.g. What would be the risks if the project is deferred, say, for 5 years?).

Some projects under evaluation may be the result of a risk analysis of the SP, in which case substantive documentation should already exist that quantifies the risk of not proceeding with the project.

Appendix 8: Asset Procurement Plan Content

Sub-plan features	Asset Procurement Plan content
Issues covered in sub-plan	• Project management. • Asset delivery. • Asset design and construction.
Purpose of plan	• To provide an overview of the SP's current asset procurement process. • To outline future initiatives and strategies in asset procurement.
Policies that may be required	• Determination of asset demand • Purchasing policy. • Asset delivery. • Design, construction and rehabilitation standards.
Other Asset management Plan elements that are linked intimately to this sub- plan	• Asset Plan: provides the 10 - 20 year asset investment (capital works) program. • Asset Evaluation and Renewal: "as constructed" and other information will be transferred onto an asset register.
External issues contributing to the current operating environment that need to be considered	• Options that now exist in developing asset, from traditional design/construction to a full BOOT model. • Increased focus on capital expenditure. • Contestability of design and construction services. • The need to have appropriate design and construction standards in place to minimize life cycle costs and to optimize useful life
Issues that need to be considered in summarizing the status of current operations	• Expenditure on asset procurement (10-year Asset investment (capital works) program for new and replacement works). • Current methods of Asset delivery. • Expenditure on design and construction using internal resources and contractors. • Processes for consultant/contractor selection and management. • Project management processes. • Value management processes. • Design, construction and rehabilitation standards. • Processes for minimizing life cycle costs. • Procedures for acquiring, storing and using "as constructed" information. • Asset handover procedures - from day labor works,

Sub-plan features	Asset Procurement Plan content
Strategic basis of the plan	The strategic elements forming the basis of the plan should include: • goal for asset management; • objective(s) for asset procurement; • adopted KPMs; and • management strategies and performance targets. The management strategies developed will be based on the identified key strategic issues, including risk assessment, in respect of asset procurement, and on the required AMP development level. Many assets operators are likely to require strategies for developing appropriate standards, refining project management processes and evaluating asset delivery options. The strategies should be supported by detailed action plans covering a period of up to 3 years.
Suggested performance measures	Outcome: • ratio of realized asset expenditure to programmed asset expenditure Output: • percentage of projects within budget • percentage of project overruns ($ terms)
Supporting documentation	This will depend on the SP, but typically would include: • Asset design, construction and rehabilitation standards document; and • evaluation of asset delivery options.

Appendix 9: Risk Management Plan Content

Sub-plan features	Risk management plan content
Issues covered in sub-plan	• Risk characterization. • Risk assessment. • Minimizing risk exposure. • Risk management programs. • Risk monitoring.
Purpose of plan	• To provide an overview of the risks currently faced by the SP in delivering its services, the likelihood and expected consequences of these risk events, and the means by which the SP manages the threat from them. • To outline the SP's future objectives and initiatives in risk management.
Policies that may be required	• Risk management policy. • Insurance policy. • Knowledge management policy.
Other Asset management Plan elements that are intimately linked to this sub-plan	All aspects of a SP's service delivery involve some risk, so the risk management plan is intimately linked to all other AMP sub-plans, but particularly the Information and Human Resources Management Plans in respect of knowledge sharing.
External issues contributing to the current operating environment that need to be considered	• Increased risk exposure due to reform-driven cost reductions. • Increased community awareness and litigiousness. • Increased community expectations concerning due diligence and accountability. • Increased environmental penalties and opportunities for third-party actions. • Increased potential liability under workplace health and safety legislation. • The accelerating rate of technological change and increasing reliance on technology. • Increased necessity to ensure staff training and development meets industry standards.
Issues that need to be considered in summarizing the status of current operations	• Details of any systematic risk-assessment surveys, including environmental and safety audits. • Current status of risk management practices and programs, including documented contingency plans and other risk-reduction strategies. • Types of insurance cover currently held.

Sub-plan features	Risk management plan content
	• Level of staff awareness and training in risk identification and management.
Strategic basis of the plan	The strategic elements forming the basis of the plan should include: • goal and objective(s) for risk management; • adopted KPMs; and • management strategies and performance targets. The management strategies developed will be based on the identified key strategic issues in respect of risk management, a systematic risk assessment and the required AMP development level. The plan should incorporate a summary risk treatment schedule based on an appropriate evaluation of identified risks. Assets operators will require strategies for reviewing/updating an existing risk management program, or for periodically updating the summary risk treatment schedule developed for the plan. Most will require strategies for implementing risk controls to reduce the likelihood of higher-priority risk events; for developing documented contingency plans for the treatment of higher-priority risk events; and/or rectifying deficiencies in regulatory compliance. Most of the strategies will be incorporated in and implemented under the relevant AMP sub-plan. The strategies should be supported by detailed action plans covering a period of up to 3 years.
Suggested performance measures	**Outcome:** SP's risk exposure minimized. **Output:** Appropriate risk management program.
Supporting documentation	This will depend on the SP, but typically would include: • adopted service standards; • risk-assessment survey reports; • environmental and safety audit reports; • workplace health and safety plan/strategy; • safety procedures manuals; • contingency plans (including counter disaster plans).