ASSET MANAGEMENT FOR THE WATER SERVICES SECTOR IN SOUTH AFRICA

by

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EXECUTIVE SUMMARY

General

It is generally recognised that the development and rehabilitation of the water services sector infrastructure is extremely capital intensive. To maximise the productivity of water services infrastructure assets, a sound understanding of the condition and performance of these assets is needed by those who own or administer them. The ownership or administration of water engineering infrastructure assets in the South African water services sector refers primarily to the following groups of assets:

- state-owned assets administered mainly by the Department of Water Affairs and Forestry
- parastatal assets, owned or administered mainly by water boards and divisional authorities
- municipal/local government assets; and
- community/private assets.

The new water legislation, such as the Water Services and National Water Acts, together with the Municipal Systems Act and Municipal Finance Management Bill, refer to the requirements (i.e. water services and integrated development plans) and obligations of the administrators of engineering assets in the South African water services sector.

During the development of this research project, various new initiatives affecting asset management procedures, as for example the DWAF's Water Services-Sector Support Programme (WS-SSP), were introduced to the South African water services sector. The researchers acknowledged relevant most recent developments related directly to the asset management standard procedures. However the requirements with regard particularly to the new water legislation were fully covered in the research project.

The need for research in asset management

The need for an improved management of assets in the South African water services sector was identified on the background of rapidly expanding water services in both urban and rural areas as well as in parallel with international advancement in asset management planning procedures. It was realised that the subject of water asset management has not been properly attended to in South Africa to date and that the research of appropriate methods and techniques is urgently needed. The Water Research Commission recognised these needs and approved a two year research project with the objective of determining guidelines to improve asset management in the water services industry.

Water services management practices in developing or growing communities are, or will in the near future, be in need of logical and appropriate asset management guidelines to protect their growing assets. The research compiled in this report endorsed a belief that in developing societies more pressing issues receive more attention and that assets are created without an adequate programme for their maintenance and upgrading. The research also highlighted a large shortfall in the existence of asset information systems at all levels of the water services industry. The standard concerns included data collection, storage, retrieval and dissemination.

The diversity between water services systems with regard to the level of services and asset management methods was identified as a serious constraint in the South African water services sector. The introduction of standard asset management procedures and the Impahla Asset Management System software emanating from this research project will enable the establishment of the basic procedures of asset management, particularly facilitating small (or emerging) water services providers.

Asset management practices in South Africa and elsewhere

The change in political and socio-economic circumstances in South Africa in 1994 started a new order in reconstruction and development particularly of formerly disadvantaged communities in peri-urban and rural areas. Along with the political and socio-economic changes came water resources management reforms in the form of new water legislation emphasising the principles of equity in access to water and sustainable provision of services. Two water acts were promulgated setting out the conditions and environment for water resources development and management. The approach to asset management in the SA water services sector was set out primarily through the Water Services Act (Act 108 of 1997) by means of requirements regarding the reportability on the state of water services (i.e. water services assets) particularly at the level of local government (i.e. municipalities and divisional councils).

The Department of Water Affairs and Forestry on behalf of the national government have taken the lead in implementing new legislation and enabling the specific requirements for Water Services Development Plans (WSDP) to be compiled and contribute to the development of the National Water Resources Strategy (NWRS). However, most recently promulgated national legislation, such as the Municipal Systems Act (Act No. 32 of 2000) prescribes a framework for compilation of much wider Integrated Development Plans (IDP) dealing with all designated municipal services (as well as water services, i.e. water supply and sanitation).

Following analysis of available WSDPs, the research team realised that asset management principles are only partially observed and hardly attended to by most water services authorities for which these plans were available. At the same time, it was realised that local governments are obliged to follow the principles of asset management as set out in the Generally Accepted Accounting Practices (GAAP) and the national treasury is developing the Generally Accepted Municipal Accounting Policies (GAMAP), which will be implemented in the Municipal Finance Management Bill which will be promulgated during 2001.

These circumstances altered the research direction which was acknowledged by the Water Research Commission's steering committee. The research project analysis and production focussed on determining a generic model for water services infrastructure asset registers and guidelines for a standard asset management planning procedure. The vast diversity in size and technological levels between emerging and established water services authorities and providers had to be taken into consideration in the execution of the research project. The responsibilities and obligations of the water services authorities/providers in the whole water management cycle also differed and this aspect has to be considered in the asset management planning process with regard to asset base size, type of assets, degree of responsibility and affordability in financing asset management programmes.

Past and current international approaches to asset management, methods and techniques application to basic and advanced Asset Management Plans were carefully studied from the literature and electronic data bases in the UK, Australia and New Zealand and to some extent also from the USA. Personal contacts with regard to current asset management practices were made with experts in the UK, Australia and New Zealand. The New Zealand expertise was found to be particularly interesting as the National Asset Management Steering Group NZ recently published an Advanced Infrastructure Management Manual that also included aspects of asset risk assessment and management practices.

Many international parallels were found, particularly with the Australian approaches to asset management in the water industry, as asset management is being adopted concurrently with water resources management reforms. However, the socio-economic conditions within the water services industry in Australia and New Zealand differ significantly from that of South Africa. The research team took cognisance of the differences and adopted or recommended only the principles coinciding with the conditions and situations for the development of asset management practices suitable to the South Africa water services industry situation.

Asset management guidelines

A great deal of research effort has been devoted to establishing the theoretical aspects of the asset management philosophy and the determination of a standard guideline for transfer of knowledge in this field. A review of the framework for basic, advanced and total asset management planning is provided in the research report. The standard asset management planning approach is detailed in Part B: Chapter 7, and supported by practical examples in the Appendix section.

Infrastructure asset management procedures can be defined as the process of managing the creation, acquisition, maintenance, operation, rehabilitation, extension and disposal of the assets of an organisation in order to provide an acceptable level of service in a sustainable and long-term cost-effective manner. This process can only take place if there is adequate data on which to base decisions. An Asset Register is a database that contains all the relevant data on all the significant infrastructure assets owned by the organisation, and that supports an effective Asset Management Plan (AMP). Guidelines on how to develop a standard generic asset register are presented in Part B, Chapter 6 - Asset Management Practice and Registers.

Although organisations and their asset registers will vary considerably, designing a standard register for a particular industry provides a number of advantages, including:

- Allows consistent comparison between different organisations within the sector
- Simplifies data gathering by central monitoring agencies
- Enhances transparency and public access
- Makes it much easier for institutions that do not yet have an asset register in place to implement one. This is especially useful for smaller institutions that do not have the capacity to design and implement an asset register from the ground up.

From the recommendation of the project's steering committee, an introductory booklet on asset management was produced and the WRC is going to distribute the booklet principally to the managers of small and medium-sized community water services systems.

Standard Asset Register

In order to achieve these advantages, and yet allow for the differences between organisations, the definition of a standard asset register would have to be very flexible. It should not, for instance, prescribe the hardware or software that is used to support it. It should, however, define the types of output required and the methods used for calculating performance indicators, condition and risk assessment gradings and asset valuations. The standard definition should also recommend the types of data to record, and present a suggested identification system for the assets. Some of the requirements of an asset register are the following:

- It should record the details necessary to clearly identify each asset;
- It should record a basic set of information that is the same for every asset (e.g. identification, location, age, assessments of the value, performance, condition and risk of the asset);
- It should record for each type of asset, any information over and above the basic set of information that is necessary to effectively manage that asset (i.e. any information for which the value of knowing the information is greater than the cost of obtaining the information);
- It must meet the organisation's management, planning, technical and financial needs, as well as any legislative requirements;
- It must be easy to operate and provide quick and accurate access to information, in the form required, to anyone who has a right to that information;
- It should facilitate accurate and confident decision making;
- It must be secure so as to prevent unauthorised changing of data;
- It should define standard methods of evaluating the condition, performance and risk grading for different types of assets;
- It should define a standard method for estimating the value of different types of assets;
- It should define a methodology for evaluating levels of service required from the assets
- It should also define the measure of accuracy of the data recorded for each asset.

In principle, an asset register contains a picture of the infrastructure assets at an instant in time. However, as time passes, the assets will change. In order for the managers of the system to be able to make informed decisions, the information in the database must be kept up-to-date and reflect these changes. This can be done in one of two ways:

- Periodic surveys of the assets
- Ongoing capturing of changes whenever they occur

The advantage of using periodic surveys of assets is that it is not necessary to maintain information about every change that occurs to the asset, but rather the net result of a number of small changes is recorded when the survey is done. The disadvantage is that regular, usually relatively expensive, surveys are required, and that the data in the register is only as current as the date of the last survey.

The reason for managing assets and therefore for having an asset register is to provide a defined level of service. This implies that an understanding of the levels of service that an organisation should be providing is fundamental for any organisation. Ultimately the objective of asset management planning is to match the level of service provided by each asset, with the level of service that the customer expects and is willing and able to pay for. The level of service provided by an asset is measured by means of one of more performance indicators which are defined for each type of asset.

It is also necessary to measure and record the condition of each asset, as the condition affects the performance and the ability of the asset to provide the defined levels of service.

Condition refers to the structural integrity of the asset, and to start with, should be recorded by means of a simple ranking system. Another item of information that is necessary to record is the level of risk associated with each asset. This involves identifying the possible methods of failure for each type of asset, and estimating the probability and cost of each possible type of failure.

The risk associated with a particular asset is the product of the cost and the probability, and this should also be recorded in the asset register in the form of a ranking.

One of the most important items of information that must be recorded about each asset is the measure of the accuracy of the data that is held on that asset. It is vitally important to ensure that the people who use the asset register have confidence in the data that is stored in it, and this is only possible if the accuracy can be proven. Recording the accuracy of data for individual assets also allows the users to see where the highest need for data verification and improvement should be.

The data should be sufficient to enable benchmarking and maintenance scheduling to be performed.

The asset register must be able to produce output reports that are useful to the organisation. Two key reports are discussed. Asset valuation reports are useful for balance sheets and financial reporting, for accounting and depreciation purposes, and to assist in planning for maintenance, renewal or replacement. Performance and Condition reports are also very useful for planning when and how to upgrade, refurbish or replace assets.

The execution of the research project and its products

Owing to the fact that the subject of water services asset management is in its infancy and considering new water legislation together with all other reforms pressing onto the Water Services Authorities and Providers, the research team received relatively good support on asset management guidelines from all the stakeholders contacted.

Although the responses to the implementation of the infrastructural asset management process in the water industry has been positive, the asset information databases and extent of knowledge were found to be insufficient for direct implementation of standard asset management programmes. In a way, numerous water service authorities/providers will have to go through an evolutionary process in order to develop an adequate Asset Management Plan. A great deal of asset management education in the water services industry will be needed to achieve a reasonable standard amongst all stakeholders.

Overall, this research project identified that the South Africa water services industry is at present without a unitary infrastructure asset management methodology. However, it is more than ready to implement one. It is believed that the standard procedures compiled in this report and availability of standardised asset register software will add valuable products to the process of implementation of infrastructure asset management in the water services industry.

Key issues identified from the case studies are listed below as an illustration of the situation with regard to asset management procedures of the different levels of water services.

- some small systems are not necessarily electrified, therefore application of electronic technology is limited
- teaching in essential asset management is important
- monitoring and recording skills have to be developed
- need for formal training in financial planning emerged
- no capacity in sorting out and evaluating available asset management data
- inability to establish reliability of available data
- no formal Asset Register procedures and software are available
- no idea of extent of assets usually maintained
- shortage of tests for monitoring asset condition
- appalling state and detail of failure and repair registers
- infrequent recording of water flow records
- no knowledge of assets under depreciation
- limited knowledge of assets insured, etc.
- a lack of training workshops on maintenance policies
- breakdowns of assets insured by the state (i.e. DWAF) and a parastatal (e.g. Bloem Water) not updated
- limited know-how on methods of evaluating the condition and performance of the assets
- issues of critical and non-critical assets
- limited knowledge on appropriate asset management planning methods for investment needs
- non-unitary methods for determining the ability of an asset to perform to its intended function
- the consequence of non-payment for services
- limited community consultation and involvement
- there is no distinction made between created (or purchased) and free of charge assets

The key recommendations from this research project

The diversity between water services with regard to level of services cannot easily be reduced. However, with the introduction of a standard asset management software to the water services sector in South Africa, an environment of discipline and logical processes can be adopted particularly by small water service providers.

All possible authorities with know-how in asset management planning in South Africa should be identified and encouraged to disseminate information and to target particularly the small and medium-sized water services (i.e. water committee and municipalities). Workshops should be held and the simple booklet prepared under this contract disseminated.

A series of workshops introducing the standard approach and newly developed asset management software should be arranged for the managers of small and medium water service providers.

Funding should be allocated to a unit to promote and research suitable asset management methods for the South African water services sector. This unit should provide nation-wide support in asset management to the water services industry and could eventually develop into a fully-fledged Asset Management Institute.

Further research should be conducted in line with asset management theories and methods adopted according to several water services delivery models introduced in public/private and public/public partnerships, particularly through implementation of the BOTT contracts by the DWAF. To date, known contract models are as follows:

- Revised BOTT model (i.e. Public/Private partnerships)
- Local government/district council model (i.e. Public/Public partnerships)
- Partnership/Water Board model (i.e. already existing partnerships)
- Community/NGO model
- Groundwater model (i.e. specific private/community partnerships in the North-West Province)
- Emerging contractor model

Issues still to be researched are related mainly to the methods of evaluating the condition and performance of installed assets, critical and non-critical assets, methods for obtaining investment needs, payment and non-payment of services, and community involvement and consultation.

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TERMINOLOGY

ASSET
Means service potential or future common benefit controlled by the entity as a result of past transaction or other past events.

ASSET MANAGEMENT
The integration of asset utilisation and performance with the broader business requirements of those for whom it is intended to serve. It includes consideration of procurement, ongoing support, rehabilitation and disposal and the markets the asset is intended to serve.

ASSET MANAGEMENT INFORMATION SYSTEM
A system for collecting and analysing data on the performance of existing assets including their operating costs.

ASSET REGISTER
A record of items considered worthy of identification as discrete assets, including information such as construction and technical details about each.

BENEFIT-COST RATIO
The sum of the present values of all benefits (including residual value, if any) over the facility life cycle divided by the sum of the present values of all costs.

CASHFLOW
The stream of costs and/or benefits over time resulting from a project investment or ownership of an asset.

COMPONENTS
Specific parts of an asset having independent physical or functional identity and having specific attributes such as different life expectancy, maintenance regimes, risk or criticality.

CONDITION MONITORING
Continuous or periodic inspection, assessment, measurement and interpretation of resulting data to indicate the condition of a specific component so as to determine the need for some preventive or remedial action.

CORRECTIVE MAINTENANCE
The actions performed as a result of failure, to restore an item to a specified condition. Corrective maintenance may or may not be programmed.

CURRENT COST
An asset's cost measured by reference to the lowest cost at which the service potential of that asset could currently be obtained in the normal course of business.

CURRENT REPLACEMENT COST
Reflects the cost of replacing the service potential of an existing asset, by reference to some measure of capacity, with an appropriate modern facility, e.g. modern equivalent asset.

DECOMMISSION
Activities required to take an asset out of service.

DETERIORATION RATE
The rate at which an asset approaches failure

DISCOUNT RATE
A rate used to relate present and future money values, e.g. to convert the value of all future Rand to the value of Rand at a common point in time, usually the present.

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

INFLATION RATE
A rate of increase applied to costs to be incurred at a future date, to reflect the relative purchasing power of money in terms of a chosen time, usually the present.

INTERNAL RATE OF RETURN
The discount rate for which the 'Net Present Value' is zero.

LEVEL OF SERVICE
The level of asset service determined by both the quality and the quantity of services provided by an asset under consideration.

LIFE (MEASURE OF LIFE)
A measure of the anticipated life of an asset, such as time in years, motion in number of cycles, distance in kilometres, interval in terms of designated events, etc.

LIFE CYCLE COST
The total cost of an asset throughout its life including planning, design acquisition, operations, rehabilitation and disposal costs.

MAINTENANCE
All actions necessary for retaining an asset as near as practical to its original condition, but excluding rehabilitation. See also planned and unplanned maintenance.

MAINTENANCE MANAGEMENT
The organisation of maintenance activities within an agreed policy.

MAINTENANCE PRIORITIES
A set of nominated maintenance activities ranked in order of priority based on given criteria (e.g. maintenance management policy, emergency work execution, etc.)

MAINTENANCE STANDARDS
The standards set for the maintenance service such as preventive maintenance schedules, operation and maintenance manuals, codes of practice, estimating criteria, statutory regulations and mandatory requirements in accordance with maintenance quality objectives and the asset standard classification.

NET PRESENT VALUE (NPV)
The value of an asset to the entity from the continued use and subsequent disposal in present monetary values. It is the net amount of discounted total cash inflows arising from the

continued use and subsequent disposal of the asset after deducting the value of the discounted total cash outflows arising therefrom.

NON-CURRENT ASSETS
All assets other than current assets. They include assets held, but not traded, by a business in order to carry out its activities. Such assets are intended for use, not exchange. Physical resources such as land, buildings, drains, parks, water supply and sewerage systems, furniture and fittings are non-current assets.

OPERATION
Active process utilising an asset. It will consume resources including manpower, energy, chemical and materials. Costs are part of life cycle costs of an asset.

PERFORMANCE INDICATOR
A quantitative or qualitative measure of the quality of service, efficiency, productivity, or cost effectiveness of a programme, or activity which enables a comparison to be made, for management purposes, or performance against a standard target or norm.

PREVENTIVE MAINTENANCE
The actions performed to retain an item in a specified condition by providing systematic inspection detection and prevention of incipient failure. Preventive maintenance is normally programmed.

REHABILITATION
Works to rebuild, or replace parts or 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, sliplining of sewer mains, etc.

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.

RESIDUAL VALUE
The net market or recoverable value which would be realised from disposal of an asset or facility at the end of its life.

RISK MANAGEMENT
The application of a formal process to the range of possible values of key factors in order to determine the resultant ranges of outcomes and their probability of occurrence.

SENSITIVITY ANALYSIS
Testing of the variations in the outcome of an evaluation by altering the values of key factors about which there might be uncertainty.

USEFUL LIFE
Means:

(a) The estimated period time over which a depreciable asset is expected to be able to be used, or the benefits represented by the asset are expected to be able to be derived, or

(b) The estimated service potential, expressed in terms of production or similar units that is expected to be obtained from the asset.

VALUATION
Estimated asset value which depends on the purpose for which it is required. For example, it may be replacement value for determining maintenance levels or market value for life cycling costing.

PART A: INTRODUCTION TO ASSET MANAGEMENT

CHAPTER 1 GENERAL

1.1 Introduction

Civil engineering infrastructure systems are becoming increasingly complex and interconnected, however continuously deteriorating in value, reliability and functionality if not looked after. To control this process adequately, new approaches need to be adopted and implemented in the management of civil infrastructure assets and in particular the water engineering assets. The overall civil engineering infrastructure consists primarily of the following components:

- communication (i.e. radio, TV, telephone, Internet, etc.)
- transportation (i.e. roads, highways, bridges, etc.)
- buildings (i.e. public and private buildings, etc.)
- energy production (i.e. power stations, powerlines, etc.)
- water supply and sanitation systems (i.e. dams, pipelines, etc.)
- stormwater systems (i.e. protection structures, etc.)
- recreation facilities (i.e. parks, playgrounds, etc.)
- waste disposal facilities (i.e. solid waste, nuclear, etc.)

All the above infrastructural components are interconnected exclusively by means of water supply and sanitation infrastructural systems. It is perhaps for this reason that water engineering infrastructural assets are most valuable and influence our lives in all essential functions. The deterioration of water engineering infrastructure coincides with new demands and greater customer expectations and with capital shortages.

It is generally recognised that water engineering infrastructure assets development and rehabilitation are the most capital intensive industries. In order to maximise the productivity of water engineering assets, a sound understanding of the condition and performance of all assets is needed. Based on an adequate information base, the prioritised long-term investment needs for a water services system development will be much easier to plan for and existing assets managed in a more efficient way.

1.2 Motivation for the research project

The need for improved management of assets in the water services industry was identified on the background of the rapidly expanding water sector in both urban and rural areas in S.A. as well as from an international advancement in asset management planning and in recognition of new techniques and methods. It was noted that the water services processes and infrastructure components represent the physical side of an asset management system which must also be integrated with risk assessment, standards, financial aspects and consumer services. The lack of adequate knowledge about asset management planning principles and generally poor state of asset monitoring procedures were also strong in motivating this research project.

In addition to the traditional technical approach to asset management, most contemporary water services providers/authorities want to improve their performance. This can be achieved by adhering to the asset management planning concept implementation in the primary operation and maintenance (O & M) of the civil/water engineering infrastructure.

Most civil engineering, and particularly water engineering, systems have to be managed within an integrated social, economic and environmental context. Such a situation needs to draw from conventional engineering disciplines (i.e. the design, construction, operation and maintenance of the lifespan cycle of an infrastructural facility) as well as from other areas of scientific and engineering knowledge. Four such areas were recently identified as important in the implementation of an asset management programme (Bordogna, 1996):

- deterioration science - investigates principally how the materials and structures can break down and wear out (i.e. mechanically, chemically and biologically).
- assessment technologies - using advance technology in determining how durable and safe are the infrastructural facilities within various systems and varying conditions.
- reproductive engineering - determines how to extend and enhance the lifespace of the structural components of various infrastructural systems.
- effectiveness and productivity assessment - determines the usefulness of the infrastructure while considering the economic, social and institutional aspects.

1.3 Methodology in project execution

In order to determine a generic procedure for the management of assets by the water services industry in South Africa, the diversity in size, the technological and managerial capacity of various water services authorities and providers must be taken into consideration.

To accommodate these diverse conditions, the methodology in project execution is based on the generic processes and infrastructure components typical of the water services cycle for a small to medium sized water services authority or provider.

1.3.1 Water cycle processes and infrastructure assets

The ownership of water engineering infrastructure assets in South African water services sector refers primarily to the following groupings:

i) state-owned assets
ii) parastatal assets
iii) municipal/local government assets
iv) community/private assets

Asset management procedures in each asset group are guided, at this stage, by different sets of rules and methods of management. In order to determine a generic asset management system for the water services sector of South Africa, it was decided to investigate asset management procedures according to the infrastructure asset function in relation to the complete water services cycle (i.e. from the water abstraction point to the final disposal point).

Table 1.1 : Water services infrastructure assets in a full water services cycle

Water services system infrastructure assets	Asset function in the water cycle	Water infrastructure major asset components
Water source and associated infrastructure	Storage Abstraction	E.g. dam, borehole(s), intake, pumps, motors, valves, etc.
Water supply infrastructure	Conveyance Purification Pumping Storage	E.g. canal, tunnel, pipeline, filters, pumps, motors, valves, chlorination, meters, reservoirs/tanks, etc.
Distribution network infrastructure	Conveyance Metering Pressure control Fire-fighting	E.g. pipelines, valves, meters, reservoirs, pumps, motors, etc.
Wastewater collection network infrastructure	Concentration Conveyance Pumping	E.g. sewer pipelines, manholes, pumps, motors, outfall, etc.
Wastewater treatment infrastructure	Stormwater attenuation Screening Treatment Conveyance	E.g. screens, grit tanks, metering flumes, settling and balancing tanks, sludge reactor, pumps, meters, etc.
Treated effluent disposal infrastructure	Evaporation Conveyance Reuse Discharge	E.g. ponds, pipelines, pumps, motors, meters, valves, outlets, etc.

The water services systems investigated in the case studies reflected systems with assets providing functions which formed the full or near to full water services cycle.

1.3.2 Asset operation management principles

The operation of infrastructural assets, often referred to as investments, involves activities with regard to the following:

- Planning
- Installation
- Maintenance
- Rehabilitation
- Replacement

The methodology adopted has to take into consideration that in developing or growing communities, the first items may involve most effort while in developed societies, the latter may receive more attention. In either case, economic optimisation is desirable within the standard required to produce the required quantity of good quality water at acceptable pressure with acceptable assurance.

The operation side of the works will receive more attention once the installations are functional. This includes pumping, optimum use of energy, quality control (water quality), planned maintenance, adequate backup (spares, standbys), monitoring (quality control of assets and metering) and technical manpower.

Human resources: Maintaining an adequate level of trained, experienced and motivated staff, ensures efficient operation.

The operational side is of concern in developing communities. They may rely on outside assistance (design and equipment) for installation, but operation and maintenance is an ongoing activity and the community has to manage the appropriate technology. Capacity building ensures sustainability and responsibility. Training in technology and accountability may require a sizeable budget, but is the only means of ensuring sustainability.

Financial: Profitability is measured in economic terms so budget control of financial assets (capital investments) as well as cash flow (billing, expenditure) should be efficient to maximize dividends and minimize costs to consumers.

1.3.3 Information systems

A key element in efficiency and acceptance of water authorities is the ability to manage data. This includes data collection, storage, retrieval and dissemination. The research project was required to concentrate on the available information base at each of the investigated water services authority/provider. Emphasis given to the information systems was as follows:

Hardware:
- Volumes of water and rates of flow available
- Locating pipes, valves and other buried objects
- Maintenance, repair or replacement, i.e. sizes, fittings
- Locating leaks, faults
- Evaluating installations: condition, life (economic or useful), value for sale, whether to replace
- Operation - pump and pipe outputs, reservoir storage
- Responding to complaints
- Risk of pollution
- Environmental conditions

Financial:
- Cash flow forecasts
- Liquidity
- Value for sale
- Necessity to flow loans
- Profitability
- Recovery of debt
- Investment requirements

Human resources:
- Salaries, pensions
- Abilities
- Sale of skills
- Capacity to operate and manage
- Training
- Labour unions

1.3.4 Legislation related to asset management

At the inception of this research project, various pieces of new legislation relating either directly or indirectly to asset management were in place at national level. The legislation concerned was as follows:

i) Local Government Transition Act (Act No. 209 of 1993) (or LGTA).
ii) The Development Facilitation Act (Act No. 67 of 1995).
iii) Water Services Act (Act No. 108 of 1997) (or WSA).
iv) National Water Act (Act No. 36 of 1998) (or NWA).
v) Local Government: Municipal Structures Act (Act No. 117 of 1998).

The WSA and NWA are discussed in detail in section 2.4.

During the course of development of this research project, new legislation relating to asset management system operation was also promulgated:

i) Public Finance Management Act (Act No. 1 of 1999).
ii) Local Government: Municipal Systems Act (Act No. 32 of 2000) (or LGMSA)

The LGMSA consists of a legal request for the provision of Integrated Development Plans (IDP) by each municipal council (i.e. Water Services Authority). The IDPs are to represent a single, inclusive and strategic plan for the development of each municipality. Each IDP is to allow for the linkages, integration and co-ordination of municipal processes, providing thus for a best development scenario considering all the communities under the jurisdiction of a municipality. Water Services Development Plans (WSDPs) as requested by WSA (Act No. 108 of 1997) are to be an integral component of IDPs. A well prepared IDP will form the policy framework and general basis for the annual budget of a municipality. This is where appropriate management practices become invaluable to the services authorities and providers.

Important legislation with regard to the management of assets on all levels of the national economy is being formulated, and the principles are presented in a discussion document entitled "Municipal Finance Management Bill (Department of Finance Notice 2738 of 2000)". This document also provides inter alia an introductory guide to Generally Accepted Municipal Accounting Policies (GAMAP) which will take the place of the Generally Accepted Accounting Practices (GAAP) presently guiding all the services authorities and providers. The designated services referred to in the above-mentioned legislation are as follows:

(a) an electricity reticulation system
(b) a gas reticulation system
(c) a municipal public transport system
(d) a potable water supply system
(e) a domestic wastewater and sewage disposal system; or
(f) any other municipal service that may be prescribed as a designated municipal service.

1.4 Literature search and electronic reviews

In view of Asset Management Planning being a relatively new field in the SA water industry, the local literature pool and electronic databases were found to be rather limited. More relevant international references to asset management associated with the water industry were identified in the UK, Australia and New Zealand. The literature available from the USA refers primarily to infrastructural asset management, methods and techniques in upgrading and rehabilitation of all components of a civil engineering character. Also the asset management terminology encountered in the US literature is rather different to, for example, the UK literature.

The UK experience revealed that the first pass infrastructure asset register had to be elementary and statistically based. It was largely to justify the Capital Investment Programme. Some five years later, the first asset register became the Strategic Business Plan of the components and the update produced a refined investment programme and operational programme. It touched core business, annual operating efficiencies, levels of service, guaranteed standards, unit costs and the evolution of corporate frameworks for measuring performance efficiencies and annual reporting and review. The advance asset register is expected to extend to loss control, serviceability and investment planning. Standardization of Asset Registers is important for serviceability and performance grading.

Since hard assets depreciate over time, some form of replacement or rehabilitation may be needed. This has to be financed out of a contingency fund, raised loans or revenue. Water authorities in the UK are required to estimate what expenditure is required for renewal, up to 20 years hence. Performance targets have to be set and methods of indexing the state of the system developed, e.g. number of leaks or percentage loss per annum, or pressures or water quality.

The system developed for planning for future renewal of assets was termed in the UK an Asset Management Plan (AMP). The plan may go so far as to optimise the future developments, (e.g. decide routes or sizes of replacement pipelines), or plan expenditure sequence. Operating and capital costs for alternatives will be summed and discounted to get the best sequencing. Alternative discount rates and rates of return may be considered as well as a probable range of demands.

The UK practice followed Rumsey and Harris (1990) who suggested three steps in estimating long term expenditure:

1. Establishment of policies and standards.
1. Collect source data on the nature, condition and performance of assets.
1. Determining and costing a strategy to rectify problems and meet requirements.

In the UK, the process of asset management is still catching up with the privatisation. Theoretically, a register of assets (especially hard assets) was available since 1989, but the process of surveying and assessing is an ongoing one.

Information technology approaches were investigated by Ballantine and Williams (1997) who suggested models that could be used for technical audits, information technology and standards. The data for these functions will however be peripheral to the main purpose, namely operational efficiency.

With the restructuring of the South African water sector, foreign interests surfaced in the field of asset management practices, particularly from Australia. SMEC (1997) advertised its services and experiences on water infrastructure asset management by means of a position paper made available to various water services providers in South Africa. This particular paper brought to the attention of the researchers the Australian (1995) and New Zealand (1996) national asset management manuals. Subsequently, direct contacts were made with the NZ Water and Wastewater Association who provided details enabling electronic searches via the Internet and CD-Rom facilities with regard to asset management practices in these countries.

1.5 Field activities and methods of data acquisition

With regard to the realisation that the subject of water asset management has not been to date attended to in South Africa, the researchers decided to gain information from field work and relied heavily on the input of the steering committee members. From the onset of the research project, it became obvious that there was a great difference between the magnitude of assets of the various water services authorities/providers.

The plan of action to determine needs for asset management practices and guidelines in the SA water industry included initially a survey of the six foremost water services providers. The asset management standards and procedures were surveyed by means of a questionnaire. A specimen of this questionnaire is given in Appendix B. An overall gain from this survey pointed to the importance of the extent and reliability of infrastructural asset information available to the water services provider. Subsequently, all other field activities and assets data acquisition and evaluation were conducted according to the following procedure:

- The reliability of the information
- The currency of the information
- The comprehensiveness and level of detail of the information

Together with these procedures, the asset management systems investigated were subjected to a number of questions. These included the following:

- How and when the register is updated
- How the register is used
- How the information in the register can be verified
- How the register is built. This is especially important for existing water service providers that do not have an asset register. This will likely be a process of step-by-step refinement of the information.

In searching for an asset management generic model for the water services industry in South Africa, four case studies were undertaken and these were as follows:

Case study 1: City of Durban water supply to the poorest community (i.e. metropolitan water supply system)

Case study 2: Thaba Nchu peri-urban and rural water supply (regional water supply system)

Case study 3: Municipality of Balfour and Siyathemba (rural town water supply system)

Case study 4: Motlhabe and Ntswana rural water supply system

The choice of water services represented the diversity in water provision and extent of asset management practices in South Africa. Details of each case study are set out in Chapter 4.

Each case study generated valuable information on state-of-the-art asset management methods and basic asset lists were obtained for the two smaller systems and adopted in the research process. At each selected case study, contacts were established and regular communication is being maintained.

CHAPTER 2 VALUE AND MANAGEMENT OF ASSETS

2.1 Current asset management practices in SA

Generally, circumstances in the water industry around the world differ in some ways from country to country. At the time of privatisation of the UK water industry, there was a need to provide investors with information about the condition and investment requirements associated with the takeover process. This is how the asset management principles and methods were introduced to the water industry. In the USA, more recent realisation of the urgent needs for upgrading civil infrastructure in general, brought about the application of an asset management philosophy and principles.

In South Africa, the emphasis on water services provision, a shortage of funding and general water scarcity stimulated interest in asset management planning to enable particularly the water services providers to achieve the most efficient management of available resources. In order to evaluate the state-of-the-art in asset management in the SA water services industry, the researchers selected four case studies, each in a different province and at different levels of community water services. The selection of the various water services was stimulated by inputs from relevant sources and personal communications with members of the WRC's steering committee and institutions such as DBSA, SALGA and Mvula Trust. The water services systems were selected primarily for their differences in level of service and the unique features of such systems. Field investigations indicated the extent and needs for asset management in the South African water industry at the various levels of water services present in the local water sector.

In principle, it has been established by this research so far that all water services authorities/providers have some kind of an asset register, be it simply a list of physical assets. Smaller water supply systems managed by committees have commonly very little technical knowledge or financial resources to compile an adequate asset register. A basic reporting system is needed. Standard forms with some training may enable officers appointed by the service provider to cope with the running of a system. It may not be possible to appoint in-house engineers or even technicians to cope with design, operation and maintenance, so consultants may provide this service, but even then a standard format for documentation of assets is desirable.

It has been firmly established that past experience in the water industry in SA was typified by:

- Public or government ownership
- Little consumer interaction
- Financing by stocks or government loans
- Reporting to government
- Long-term capital interim planning
- Ad hoc maintenance
- Separate technical and financial departments

In addition:

- Less attention was paid to asset management in the past because systems were newer and failures were fewer. Networks were expanding so rapidly there was less attention available for existing assets.
- It was easier to deal personally with problems on smaller scales.
- It was easy to raise capital for installations, rather than for maintenance and operation.
- Staff employment was long-term so experience and knowledge was available in-house.
- Consumers were less aware and less interactive.
- Less access to computers and software for formal procedures.
- Environmental responsibility was not enforced.
- Image was not important because capital was obtained from government
- Reportability was minimal.

The impacts of the above listed constraints initiated changes to the systems. The shortage of government funds and the realisation that links with industry could make the system more efficient.

An important component of asset management in SA will be the upgrading of water and sanitation services to acceptable levels. Many such services have in the past been perceived as inferior in level and standard. There has therefore been a resistance to paying for such services.

Levels of services which could be recognised in the near future as unacceptable may include:

- Installation of communal instead of individual connections.
- Too few standpipes/connections.
- Excessive distance to standpipes.
- Low flow.
- Low pressures.
- Lack of metres.
- Little storage for meeting peaks.
- Little surplus for fire-fighting.

Low standards may include:

- Varying water quality (inadequate quality control).
- Poor quality materials - low class pipes, mechanical breakdown, power failure.
- Lack of management structure, even collection of rates.
- Susceptibility to drought, lowering of water table, etc.

2.2 Asset management practices elsewhere in the world

2.2.1 United Kingdom

During privatisation of the UK water industry, the UK government and the water industry developed an approach for the management of water assets now known as Asset Management Planning (AMP). This approach was based on the four key economic features of the UK water industry (Glynn et al, 1992), namely:

- monopoly in business of water services

- economic externalities regarding the services provided
- potential asset neglect due to its life-span and out-of-sight character
- the lack of differentiation in the product

In addition, a dimension which surfaced during the privatisation process, was the sentiment that the government and funding agencies to the water industry were becoming increasingly interested in securing private sector participation to assist with the delivery of services which traditionally had been the responsibility of government at national, provincial and local level.

Subsequent to the UK experience, a big consideration for the water sector internationally was the question of the extent of private involvement in water companies. There are distinct advantages in many instances, such as improved cash flow and more businesslike efficiency. The adequate depreciation plays an important role. The theoretical approach to depreciation of infrastructure assets is illustrated in Figure 2.1.

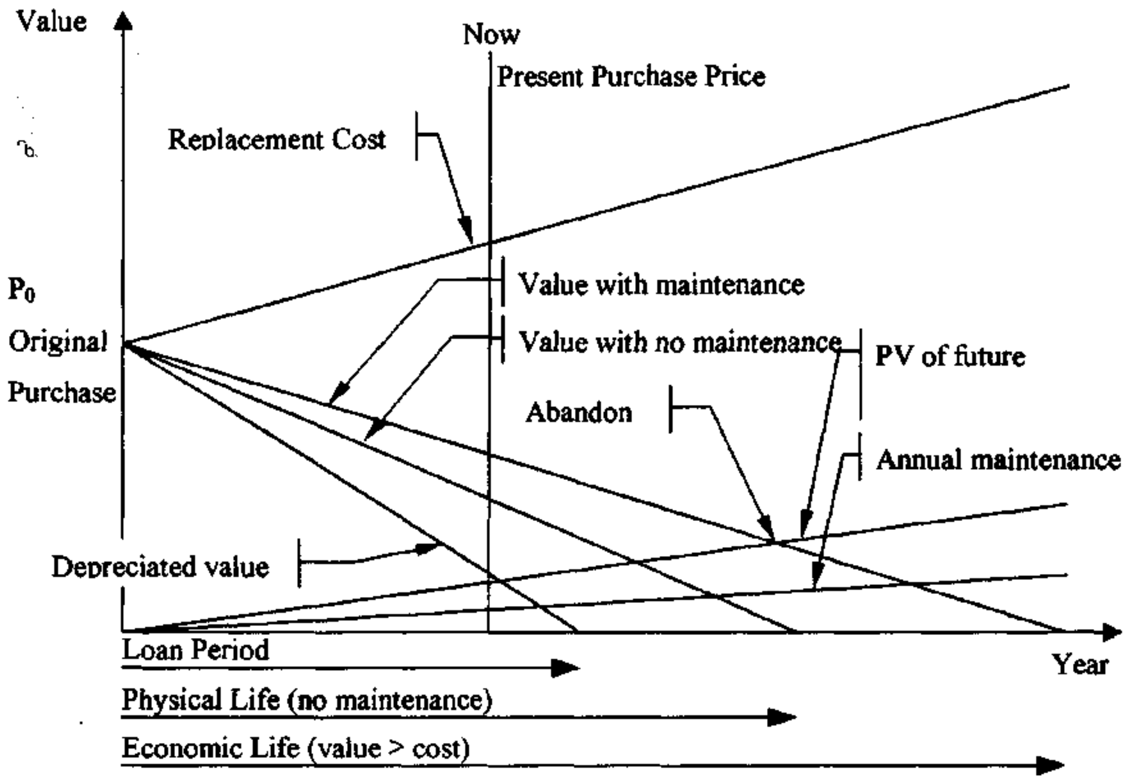

FIGURE 2.1 : Depreciation of infrastructure assets

The question of whether a water services provider can be operated as a truly private or commercial concern may arise. A water services authority/provider may be provided with access to raw water by a national authority, and the cost of this may be beyond its control. The infrastructure (or hard assets) may have been inherited, or dictated by others. Although public accountability and transparency are encouraged, there is no measuring stick to gauge efficiency against.

In the UK, OFWAT (the Office of Water Services) attempted to regulate the water industry economically with regard to standards and procedures, but it can only be compared with other water services providers with different circumstances, or against self-imposed criteria.

It is possibly easier to elect at the outset for a new supply organisation to plan, build, train and/or operate it privately. This only happens for newly supplied communities, e.g. in developing countries, and they have peculiar problems. Capital may be short, expertise absent and there may be even no motivation. Governments may have to subsidize the services and appoint technical assistance to ensure adequate maintenance and financial management in such cases. The standards set by a national watchdog may not be attainable or applicable. This has since been perfected by determining performance indicators and benchmarking procedures.

The current asset management protocols recognised in the UK and internationally are illustrated in Table 2.1.

TABLE 2.1 : Asset Management Protocols

Management protocol	Public utility	Private utility
Approach to capital	*Capital recovery* - float a bond to cover improvements	*Capital formation* - generate money to cover improvements
Performance	*Focus on delivery* - regulatory and capacity requirements drive decisions	*Focus on performance* - delivery is given; attention is focused on getting the highest return
Risk	*Risk avoidance* - use conservative assumptions and build to withstand low probability events	*Risk averse* - evaluate tradeoffs between risks, costs and outcomes
Procurement	*Complex procurement* - multistep with frequent checks and balances; control costs at each point	*Strategic sourcing* - enrol partners in achieving results; control total solution costs

Source: After Rynowecer and Levin (1999)

In developing countries, the philosophy and practices of asset management are primarily adopted through public-public and public-private partnerships as illustrated below:

- DBO (design, build and operate for a defined period)
- BOT (build, operate and transfer)
- BOTT (build, operate, train and transfer)

or on contractual agreements such as:

- concession (operate, maintenance, new investment, billing with controlled prices)
- affermage (or leasing) (conducting all operations without financing capital works)

The popularity of the BOTT multi-disciplinary programmes in South Africa is steadily rising between DWAF and the Programme Implementation Agents (PIA's) who, according to Van der Veld (1999) facilitate successfully the public-private partnership principles in the development of water resources primarily in the rural areas of South Africa.

2.2.2 Australia and New Zealand

The process of asset management planning (AMP) implementation in Australia and New Zealand started primarily from the reform of local government (i.e. at the municipal council level) and the subsequent re-assessment of a typical council's engineering infrastructure assets (e.g. roads, bridges, water supply systems, parks and gardens, stormwater systems, sewerage systems, buildings, and plant and equipment).

In both countries, new local government legislation as the Council of Australian Government (COAG) of 1994 in Australia and Local Government Amendment Act (No. 3) of 1996 in New Zealand, enabled methods and techniques of basic and advanced asset management planning to be entrenched at the most relevant public level and adopted for the largest infrastructure base.

In Australia, the reform of local government coincided with the National Agenda for Water Reform of 1994. There is a certain similarity with the South African situation regarding two new water acts promulgated in 1997 and 1998. However, both Australia and New Zealand have been implementing water quality guidelines since the late 1990s.

2.2.2.1 The Australian asset management (AM) process

The development of an AM process was primarily accelerated by the requirements for advanced infrastructure technical management fully integrated with accounting standards and federal/state regulations. The key objectives were set as follows:

- AM is recognised as vital by local government (WSAs) and water services providers (WSPs)
- WSAs and WSPs are made aware of the benefits to be gained from AM planning implementation
- AM requirements are looked upon as the catalyst for technical, financial and information needs
- AM programmes give priority to the analysis of life cycle costs

The Institute of Municipal Engineering of Australia approved and published the National Asset Management Manual (NAMM) in October 1994. The NAMM deals with the following aspects:

- Why asset management?
- Choosing an appropriate asset management plan
- Asset management principles and concepts
- "How to" guides

The Australian National Asset Management Manual is available for use by local government authorities and recommended for use by all semi-government and private organisations responsible for the management of infrastructural assets.

2.2.2.2 The New Zealand asset management (AM) process

The development of AM process in New Zealand has been primarily accelerated by the following incentives:

- ratepayer pressures to enhance water services infrastructure
- regulatory requirements to meet increased environmental standards
- re-setting of priorities by the local government authorities to meet community demands for improved asset management
- public pressures generated creativity in allocating the costs of development

It should be noted that to a large extent the New Zealand approach to the development of asset management benefited from the Australian initiatives. However, the whole process is much more detailed and represents a wider group of stakeholders.

The key objectives set out by the NZ National Asset Management Steering Group supported by the Association of Local Government Engineers of NZ, the NZ Local Government Association, the NZ Society of Local Government Managers and the Office of the Auditor-General, were as follows:

- observe the reform of local government
- bring about excellence in infrastructure asset management
- implement a realistic approach to asset management
- introduce quality management of infrastructure assets
- develop appropriate infrastructure asset management practices
- improve the long-term performance of assets at the lowest lifetime cost
- infrastructure asset management process has to facilitate strategic financial plans which are prepared by local government
- keep updated developed AM work

The NZ National Asset Management Steering Group published the NZ Infrastructure Asset Management Manual (NZIAMM) in November 1996. The NZIAMM deals with the following aspects:

- The Background - Introducing Asset Management
- The Theory - Asset Management Principles and Concepts
- The Practice - Developing and Using Asset Management Plans
- The Toolbox - Guidelines and Examples.

Between 1996 and 2000, the NZ National Asset Management Steering Group and the Institution of Public Works Engineering Australia worked mutually on the revised Infrastructure Management Manual and are now compiling and presenting a revised Infrastructure Management Manual, New Zealand Edition. The revised IMM provides guidance on:

- Background of IMM (benefits, responsibilities, total AM, LCAM, etc.)
- Implementation tasks (stakeholders, needs analysis, AM plans, auditing AM, organisation issues, etc.)

- Asset management techniques (levels of services, demand forecasting, risk assessment and management, optimisation, O & M, demand and financial management, etc.)
- Information Systems (asset registers, data capture, GIS systems, etc.)
- Country-specific issues

It should be noted that the revised IMM has been prepared with representation from accountants and auditors, local government engineers and managers, water and waste, gas and electricity managers, parks and recreation managers and transportation managers. The evolution of asset management planning methodology is illustrated in Figure 2.2 below.

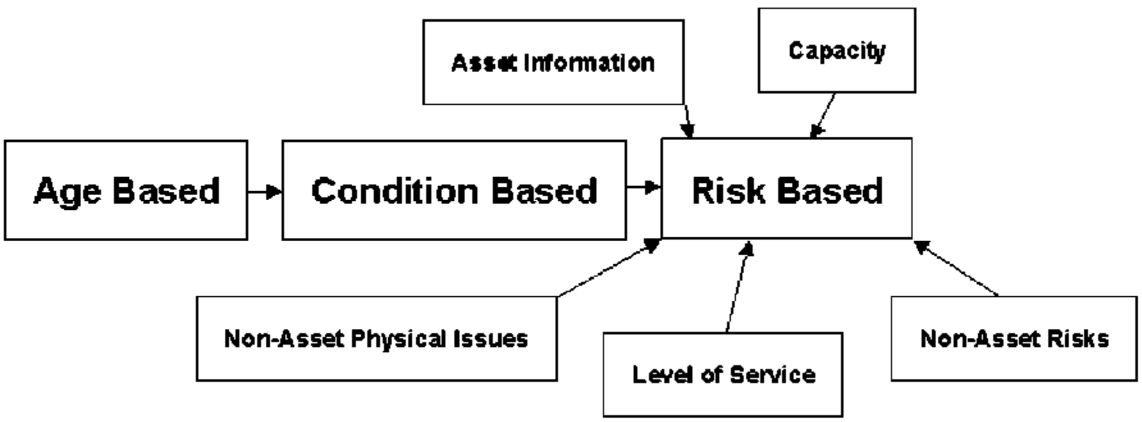

FIGURE 2.2 : Asset management planning methodology

2.2.2.3 Summary on Australian and New Zealand AM processes

There are numerous parallels which can be drawn between the asset management process being implemented particularly in Australia and South Africa. Both countries are implementing new water legislation and experiencing similar water scarcity problems. However, the socio-economic side of the asset management planning process differs significantly. In South Africa, the sequence in implementing an asset management planning philosophy in conjunction with water reforms is the reverse to that of Australia in that water issues have first priority to local government issues in South Africa. The key national asset management parameters for Australia, New Zealand and South Africa are illustrated in Table 2.2.

Table 2.2 : National and asset management parameters in Australia, New Zealand and South Africa

Parameter	Australia	New Zealand	South Africa
Area (million km^2)	7.3	0.3	1.2
Population (million)	18.0	4.0	41.0
GDP (US$ billion)	290	80	120
Total water use (km^3 per annum)	20.1	0.5	20.1
Water use (ℓ/c/d)	3060	2000	1340
Total value of infrastructure (% of GDP)	50	40	40
Investments in support of existing infrastructure (US$ billion p.a.)	8	1.5	?
Investments required in support of newly built water infrastructure (Rand million p.a.)	?	?	105

Source: NZ Water and Wastewater Association (2000) and DBSA (1998)

In both Australia and New Zealand asset management planning methodology has progressed in recent years and particularly in New Zealand where the principles of advanced asset management are being adopted. Figure 2.3 below illustrates the contemporary research level in asset management with regard to risk and life cost management, where notation WOL COST represents Whole of Life Cost.

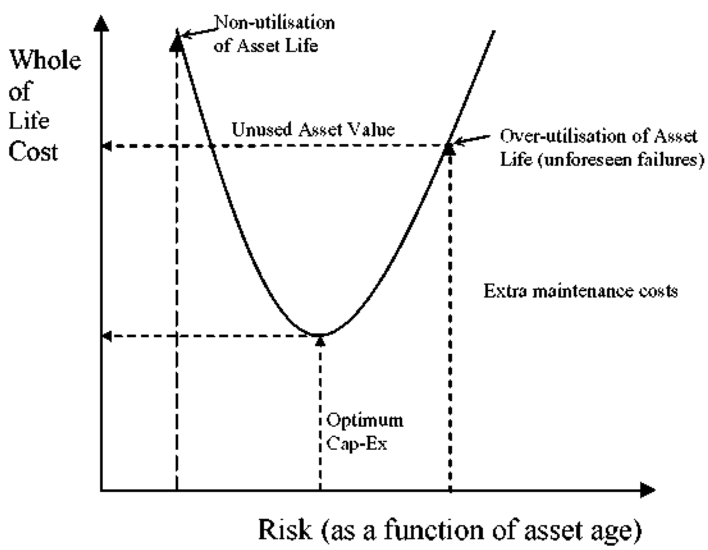

FIGURE 2.3 : Linkage between risk and life cost of infrastructure (NZWWA, 2000)

2.3 The need for asset management

In the past, there were fewer assets to manage, they were often fully visible and they were younger. It was considered not necessary to monitor their condition. Now assets exist in large numbers, they have an immense value to the community and are often hidden from view and more importantly, they have grown much older (NAMM, 1994).

In order to obtain the true worth of physical assets owned by water services authorities or providers, it is necessary to survey the extent and condition of the infrastructure systems. The original physical sizes of the assets, whether they be water works, buildings, pipelines or storage reservoirs, are usually documented at design stage in the way of engineering drawings. Many authorities have also microfilmed their drawings or even put the data in computer-based data banks.

Since every structure has a different configuration, it is practically impossible to obtain by computer the cost of such assets in present day or other time horizon costs. Only simple assessments can be made based on floor areas and an index indicating the type and quality of the structure. These may be sufficient to give an estimate of the building cost if the structure were to be erected at the present time. Often there is also data on the original cost of the structure and this could be converted to present day cost using published escalation. Thus, at least one estimate of present replacement cost could be made.

2.4 S.A.'s legislative environment

2.4.1 National Water Resources Strategy (NWRS)

The change in political circumstances in South Africa in 1994 started a new political and socio-economic order and approach to the development of water resources is now based on the principles of equity in access to water and sustainable provision of services. These principles were formulated and tested in the National Water Policy for South Africa which was adopted in 1997 and promulgated into law by the National Water Act 36 of 1998 (NWA). This was the start of the process of developing and implementing the National Water Resources Strategy (NWRS). The main objective of the NWRS was to determine a strategic framework for water resources management in the Water Management Areas (WMAs), which are in turn determined on the background of the Integrated Catchment Management (ICM) philosophy.

Prior to the inception of the NWRS and NWA, the Water Services Act 108 of 1997 (WSA) was promulgated and Water Services Development Plans (WSDP) were made obligatory for urban and metro councils. Ultimately WSDP plans are to become an integral components of the wider Integrated Development Planning (IDP) process being implemented primarily in urbanised areas.

The fundamental differences in the approach to water use on land as secured by the new water laws are: the provision of access to water, water quantity of acceptable quality for the human basic needs, and the environmental reserve (ER). This reserve constitutes the water resource base which must be also managed in an integrated way of development. The essential problem stems from the fact that the agencies responsible for water affairs do not necessarily have control over the land use. However, the new water law ensures that the ER may not be compromised by any proposed development, even if the demands are very high and active intervention is required if existing developments imply that the needs of the ER cannot be met.

Rabie (1998) pointed out that owing to the inter-relationship between land and water, water resources management without any influence on the land use policy and development, would be rather ineffective. Land use practices affect in one way or another the quantity and in particular the quality of water.

The National Water Resources Strategy (NWRS) is being implemented in the spirit of integrated catchment management determined on the background of simultaneous assessment and management of water and associated land and other resources within a defined catchment area. At present, it is not yet visible how the legal requirements of the new water laws will affect, for example, the catchment management agencies, water use associations, licensing, reserve determination and price strategies in some twenty water management areas (WMAs) straddling all nine provincial areas of South Africa, excluding independent Lesotho and Swaziland.

2.4.2 National Water Act (NWA)

Rapid progress in the implementation of a national water strategy has been accompanied by the publication of a number of new acts and regulations in South Africa.

The National Water Act no. 36 of 1998 replaces the Water Act no. 54 of 1956 as well as a number of related acts. The new act recognises, amongst other things, the fact that many people have been discriminated against in the past in the allocation of water. It therefore accepts a responsibility for providing water for all the people of South Africa. This intention will be accompanied by the creation of organisations to tap water sources and supply water to many people who have not previously had potable water supplied.

The NWA's Chapter 3, Part 3, refers to the determination of a Reserve. The Reserve will cater for environmental requirements as well as basic water requirements to users in the catchment. Also the fact that there is a basic human need could lead to water supply projects at the most elementary level.

In Chapter 4, Part 1, of the NWA, the principles of water use are described. It indicates that water users must be licensed in general which in turn requires reportability. Part 2 covers the authorisation and issue of licenses. This in turn requires the preparation of a water management plan and the payment of charges.

Chapter 8 covers the establishment of water user associations. Although water user associations are primarily for management of water resources, they are in effect local associations of water users and as such will have a reportability function, particularly as they will accumulate assets for the purpose of supplying water.

Chapter 9 covers the establishment of advisory committees for the purpose of assisting water user associations and others. The water users association may be fairly basic with no prior technical expertise, so advisory committees which may comprise officials of the Department of Water Affairs and Forestry as well as other knowledgeable people, will establish some organisational structure and in particular reportability concerning the financial and engineering assets of the association.

In Chapter 14, it is indicated that a national system for monitoring assessment and information be established. Such monitoring systems will provide data on quantity and quality of water and the catchment. Of more relevance to this guideline, the quantification of the water uses and resources will require some formalisation and standard procedure if the data are to be of national use. The data could be used not only to prioritise development but also to establish realistic budgets for development. Therefore, quantification of the existing and proposed infrastructure for water supplies would be part of the information requirement. It may also be prescribed that standard methods be established for monitoring including guidelines and procedures. The nature, type, time period and format of data may also be prescribed. This guideline suggests that this formalisation of data collection should be undertaken at an early stage or else the data might be wasted. The cost and effort in collection of this data would be considerable once established on national scale so the format should be carefully thought out at this stage.

2.4.3 Water Services Act (WSA)

The Water Services Act no. 108 of 1997 is more specific regarding the requirements of reportability regarding water supplies. The requirement for a national information system is echoed in this act with more details being required, particular with regard to assets. The national information system on water services could form part of a larger system relating to water generally; probably that referred to in the National Water Act. The public is entitled to access the information and reasonable steps have to be taken to ensure that the information is provided in an accessible format. This emphasises the necessity for establishing that format at an early stage, as water service providers have to make water service development plans or drafts thereof within a year of commencement of this act.

The Water Services Act allows for the establishment of water services authorities that will be responsible for the establishment of water service providers. The water service providers could comprise water boards, water services committees or water service intermediaries. The water service providers have a duty to report to the Minister on assets and liabilities as well as the development planned. They have to report on progress on the development planning each year and this gives an opportunity for updating the list of assets and liabilities. The deterioration or enhancement of assets would obviously have to be reported on in the regular report.

Since finance is becoming a major constraint in the provision of water, particularly to the poorer sectors of the economy which have hitherto not had access to safe reliable potable water, the available finances will have to be used with circumspection, i.e. the systems installed must be optimised to minimise costs and maximise the rate of installations of new and improved services.

In the case of new water supplies, it may be necessary to establish with assistance a water service provider. This could involve capacity building or a partnership with experienced providers. Water service authorities may even provide that service outside of their area of jurisdiction. A water service intermediary could operate at alternative levels. They have to meet certain minimum standards with regard to quantity and quality of water. Such standards could be prescribed by the Minister or the relevant Water Services Authority. The water services authority may appoint surrogate operators if necessary. In particular, the water services authority has to monitor the performance of the water service providers to ensure standards and norms for tariffs are complied with.

The water services authorities have to make by-laws providing for standards with regard to technical conditions including quality, measurement and quantity. Metering is envisaged. Contracts and joint ventures may be made with water service providers or water service authorities. In the case of outside organisations participating, financial responsibility is even more important as the rate of return on investment needs to be disclosed. More particularly, the establishment of tariffs will have to be considered such that costs are recovered. At this stage, a draft regulation for water services tariffs has been circulated for comment.

Bearing in mind that the Water Services Act is committed to three objectives, namely social equity, financial viability and environmental sustainability, it will be seen that reportability is important. Tariffs will have to be established to generate revenue, to allocate costs and allocate resources. The revenues are required to recover overheads, operation and maintenance as well as capital and depreciation. Depreciation accounting will be required on a straight-line basis and the value of assets needs to be depreciated. Forecasts have to be made for pre-financing and for this financial models are required. These models in turn will require data in the way of existing assets and their condition. That is, the importance of maintenance and upgrading will be revealed provided the correct depreciation and accounting system is used.

2.4.3.1 Water Services Development Plan (WSDP)

The feedback from the second steering committee meeting held at Water Research Commission in March 1999 on this subject indicated that the issue of asset management implementation in the SA water services industry will be a complicated task. Various reasons were identified to be relevant to this issue:

1. Privatisation in the water industry, which has been the driving force behind asset management implementation elsewhere, does not seem to be taking off in SA.

2. Vast differences between small and large water providers, where some self-supplied systems (mostly community-based) are not necessarily operating according to economic principles in a business-like environment.

3. Most of the large water services providers (i.e. water boards and metro councils) have developed certain asset management systems that they consider to be adequate due to lack of competitiveness in performance requirements.

4. Many water services providers control water supply only and wastewater collection treatment and disposal is done by another authority. For that reason, there is no full responsibility for the whole water balance and quality of return flows.

However the major outcome from the steering committee proceedings pointed to the provision of a standardised asset register framework and development procedure of an asset management programme guideline suited generically to most water services authorities and providers in SA's water industry. The economic aspects of an asset management programme were strongly emphasised.

The current water services legislation leaves out from the Water Services Development Plans' compilation all Water Services Providers, Intermediaries and Water Services Committees. However, the targeted group (i.e. Water Services Authorities) operates the largest portion of water services infrastructure assets, spanning from water treatment, transport, storage and distribution to wastewater collection, treatment and disposal. With regard to their functions and responsibilities in the SA water industry, an asset management programme (AMP) is most essential for their future existence. The WSDPs compiled by the WSAs should essentially comprise an asset management programme component or at least a single asset register. The Water Services Development Plans (WSDPs) are presently the most relevant mechanisms for an introduction and implementation of an asset management philosophy within the SA water industry.

It has been established from research of available WSDP pre-draft responses that an asset management philosophy is absent from the WSDP framework. This is primarily because of different terminology and language used as well as the specific issues and benefits of an asset management that are not addressed at most of the WSAs. More comprehensive WSDP drafts received by the DWAF (e.g. drafts from the Greater Pretoria Metro Council and the Midrand Metro Local Council) comprise fundamental information for an infrastructure asset management register and relevant financial and institutional information for an embryonic asset management programme. However, most available WSDP drafts investigated to date do not consist of any asset management information as is going to be requested by the GAMAP procedures.

Now with the Municipal System Act (Act No. 32 of 2000) in place, the whole situation with preparation of the Water Services Development Plans (WSDPs) has changed, placing the emphasis to more global Integrated Development Plans (IDPs) legally requested from each municipal council (i.e. in principle water service authority). The WSDPs are nevertheless becoming the integral and most important component of the process in developing of the policy framework at each municipality, based on well prepared IDPs.

It is anticipated that when the Municipal Finance Management Bill is promulgated into law, the Generally Accepted Municipal Accounting Policies (GAMAP) will intensify the attention of asset management planning. However, the scope of AMP will embrace all designated municipal services.

The basic comparison between an internationally recognised Asset Management Plan (AMP) framework and a typical Water Services Development Plant framework is given in Table 2.3 below.

TABLE 2.3 : Framework for an Asset Management Plan vs a typical Water Services Development Plan framework

ASSET MANAGEMENT PLAN	WATER SERVICES DEV. PLAN
Introduction	Introduction
Background	Relationship to the broader process
Goals and objectives of asset ownership	Status Quo Analysis
Plan framework	Overall context
Basic and advanced asset management	The current customer profile
Level of service	Economic/household growth
Customer expectations	Current service provision
Strategic and corporate goals	Future consumers to be served
Legislative requirements	Description of existing infra-structure
Current levels of service	Infrastructure to be provided
Desired levels of service	Water services management
Growth forecasts	Financial management
Demand management plan	Expenditure requirements for future services provision
Demand forecasts	Institutional arrangements
Changes in technology	Customer care services
Capital work programme	Development problems/issues
Asset management systems (by service area)	Water resources management
Accounting systems	Infrastructure finance
Asset management systems	Institutional arrangements
Information requirements & processes	Evaluation of customer care services
Standards and guidelines	Consumer education on services maintenance
Lifecycle management plans (by service area)	Possible non-payment for services
Physical parameters	
Asset capacity/performance	
Asset condition	
Asset valuation	
Asset register	
Routine maintenance plan	
Renewal/replacement plan	
Creation/acquisition/augmentation plan	
Disposal plan	
Financial summary	
Financial forecasts	
Funding strategy	
Valuation forecasts	
Key assumption	
Plan improvement programme	
Performance measures	
Improvement plan	
Monitoring and review procedures	
Specific issues	
Legislative requirements	
Industry initiative and reforms	
Technological advancement	

Note: There is no doubt that with the availability of standardised asset register and relevant software, it would be possible to incorporate the key framework components into the process of WSDPs compilation at each relevant WSA.

2.4.3.2. National Information System for water services

The NWA's Chapter 14 outlines the framework on monitoring, recording, assessing and disseminating information on water resources. The information on water services is the key component of the whole future national information system. In particular the NWA deals with the framework components as follows:

i) establishment of national information systems
ii) objectives of national information system
iii) provision of information
iv) access to information
v) regulation for monitoring, assessment and information

The responsibility for the development of the National Information System (NIS) is vested with the DWAF. The DWAF has outlined that the NIS will be used for development, implementation and monitoring of a national policy on water services, and more specifically to provide information to water service institutions, consumers and the public to enable them to monitor the performance of water services institutions. This will require a relatively detailed report, table or register and this is one of the considerations of this guideline. Whereas the Minister of Water Affairs and Forestry may fund reasonable expenditure incurred in establishing and maintaining the National Information System, he may also charge a reasonable fee for making the information available, presumably to the public.

The Department of Water Affairs and Forestry created a facility within its institutional framework for water services planning. The objective of the facility is to create the NIS and facilitate and support the various processes associated with the creation and function of the NIS. Contacts had been made with the DWAF to verify the standard aspects of the NIS and asset management register objectives.

CHAPTER 3 ASSET MANAGEMENT PLANS

3.1 What is an Asset Management Plan?

An Asset Management Plan is a programme about capital works and other expenditure associated with maintaining the conditions and performance of the water services authority/provider's assets.

3.1.1 What should a typical Asset Management Plan comprise?

- Procedures for preparing and updating the asset management programme
- A statement of the water services authorities (or providers) relevant standards and policies
- A list and description of all asset subsystems, land assets and their use, water supply, water distribution, sewerage, sewage treatment and disposal
- A physical **infrastructure asset register** containing information on the performance and condition of the principal components of each subsystem
- A short-term, say 5-year, relatively detailed investment plan to meet shortfalls in the performance and conditions determined for each subsystem.
- A medium to long-term investment estimate with regard to performance and condition of a whole system considering the likely future demand for services.

3.1.2 What should a typical Asset Management Plan deal with?

- summarise existing physical infrastructure assets including physical description
- determine how old they are
- determine what they are worth now and how much will they cost to be replaced
- determine the costs of operation and maintenance for available assets
- assess the structural/hydraulic condition of all relevant assets
- establish the economic life before possible failure to overloading or deterioration or uneconomic operation
- determine extent of infrastructure assets capacities compared to demand for services
- assess the risks associated with infrastructure assets failure or overloading
- assess the cost of operation and maintenance, both passive and active

Further to information compiled in the infrastructure asset register, a programme should deal with:

- standard of services that the customer expects (Water Services Authority or Provider decides what standards should apply)
- determine future services provision to meet adopted standards with regard to procurement, rehabilitation or replacement
- methods of creating or acquiring new assets
- methods for disposal of "surplus" assets
- determine strategies for financing future services provision
- determine the true cost of services based on available assets
- establish the Whole-Life-Costing (WLC) for the water services system components (i.e. not only the initial costs and energy consumption during operation, but also the down-time due to premature failure and planned maintenance)

- determine procedures for economical operating and maintaining of assets under acceptable level of risk
- propose monitoring procedures for assessing the performance and condition of assets
- establish risks with regard to public safety and security associated with the ownership of assets
- evaluate asset management practices and procedures most relevant to the Water Services Authority (or Provider)

International experience gained in recent years indicated that the initial infrastructure asset registers evolved over about a 10-year period into the asset management programme consisting usually of three stages of development:

1st stage: Elementary and statistically based asset register for capital investment.
2nd stage: Refined investment and operational programme – serving as a strategic business plan.
3rd stage: Advanced loss control serviceability and investment planning programme.

3.1.3 Benefits from implementing an Asset Management Programme

Development and implementation of an asset management programme can bring several general and specific benefits for a Water Services Authority or Provider. Such programmes would enable them to benefit from the following:

- All assets are identified in a single "asset register" as per water services authority/provider's efforts in compiling it
- all assets will be systematically categorised and allocated specific code, allowing thus for general orientation and electronic monitoring of a specific asset or group of assets (i.e. standardised procedures and nomenclature)
- detailed valuation of all registered assets will allow for a refined assessment of a WSA's or WSP's financial position
- the programme will set the preconditions for a critical risk assessment procedures
- available capacity can be logically compared with demands on the water service system
- the programme will provide a background for determining the true system costs and more appropriate customer charges
- the emergency procedures for a system components can be better determined and verified
- the programme enables preparation of a maintenance management plan based on pro-active procedures
- the programme will allow for rehabilitation and replacement strategies to be determined
- the programme provides a vital linkage between financial and technical responsibilities of the top management of a WSA or WSP
- the programme allows for betterment in quality control within a water services system
- the programme will produce common databases for different departments of a WSA or WSP
- the risk of fraud within a WSA or WSP will be reduced.

3.2 Types of asset management plans

3.2.1 Basic Asset Management Plan

In principle, the Basic Asset Management plan is designed to meet minimum requirements for services and financial planning. It attends to a basic technical replacement programme and cash flow projections.

The Basic Asset Management plan comprises primarily an asset register, operation and maintenance regulations according to designated service levels, simple condition and performance monitoring and reporting. The object of a Basic Asset Management plan is to attend to financial returns and social benefits.

3.2.2 Advanced Asset Management Plan

The Advanced Asset Management plan aspires to optimise processes and activities by means of detailed monitoring and activities by means of detailed monitoring and analysis of data on asset condition, performances, lifecycle costs and various options considering improved processes.

The main differences between the Basic Asset Management and Advanced Asset Management plans refer to risk management, employment of optimisation techniques to enable evaluating of various options at specific levels of service attended in the Advanced Asset Management Plan.

3.2.3 Standard Asset Management Plan

Taking into consideration the vast diversity of water services in South Africa, it is practically impossible to determine what would be a standard asset management plan to be recommended for application as both extremes (i.e. basic or rudimentary and advanced plans) exist. It appears that above all, the standard approach in preparation of an asset management plan should attend to the essential steps as follows:

- the levels of services and the extent of the assets controlled would determine at what level (i.e. basic or advanced Asset Management Plan) the water services authority should prepare the Asset Management Plan,
- currently existing or required asset management processes and data acquisition methods to be established,
- required level of services and associated performance measures to be confirmed by the community (or consumers),
- the capacity expansion based on the service demand prediction to be balanced with the available resources,
- the options for providing the required level of service, associated risks and trade-offs should be reviewed in-house by the water services authority/provider or in association with a specialised consultant,
- the Whole Life Costing (WLC) of most of the important components of a water services system (i.e. not only the initial costs and energy consumption during the operation but also the downtime due to premature failure and planned maintenance) should be considered in a plan compilation,
- the asset reproductive technical and financial options to be proposed,

- the programme shows how to monitor and upgrade the present asset management plan from one to another stage by introducing more advanced methodology and techniques.

Essentially, an asset management plan developed by a water services authority/provider has to evolve from a "standard approach" designed plan into a plan advancing according to the desired level of services.

3.2.4 Total Asset Management Plan

The Total Asset Management plan is a comprehensive programme incorporating a substantial improvement in the operation and maintenance of plant and equipment. This totally integrated approach to asset management is primarily used in the manufacturing sector and applies modern principles of operation and maintenance management.

In the water industry, the level of service is a function of the following measures:

- quality of water
- quantity of water
- water availability
- standard (or legislative) requirements
- maintainability (a probability of restoration)
- reliability and performance
- capacity of a system
- environmental issues
- cost/affordability
- comfort
- safety

If the Total Asset Management methodology is applied in the water services industry, then all the above listed measures and attributes have to be represented in asset management planning for a water services authority/provider.

The Total Asset Management implementation is based on so-called modular training performed by specialists in each relevant module. This is a rather expensive approach to asset management, however up to 30 percent reductions in maintenance can be anticipated.

CHAPTER 4 ASSET MANAGEMENT - APPROPRIATE CASE STUDIES

4.1 The field case studies

As described in the introductory part to this report, four case studies were conducted under this project to obtain relevant understanding of asset management state-of-the-art in the water services sector. The selection of the case study systems also allowed to establish contacts at the appropriate level in the water services sector to enable researchers in testing of their research approach and subsequently also in application of the software called the Impahla Asset Management System. The case studies conducted during the span of this project were as follows:

Case study 1:	City of Durban water supply to the poorest community (i.e. metropolitan water supply system)
Case study 2:	Thaba Nchu peri-urban and rural water supply (regional water supply system)
Case study 3:	Municipality of Balfour and Siyathemba (rural town water supply system)
Case study 4:	Motlhabe and Ntswana rural water supply system

The choice of these water services systems and water engineering assets represented the diversity in water provision and the extent of asset management practices in South Africa. Each case study generated water services asset information data and the knowledge of essential constraints with regard to the institutional and managerial spheres within the chosen case study system. Case studies 3 and 4 were investigated for most of the duration of the research project and numerous visits were made to these systems.

4.2 Case study 1 - City of Durban water supply to the poorest communities (metropolitan water supply system)

4.2.1 Background

The Durban Metro Water Services (DMWS) was approached to provide information on asset management applications within its limits of services. The unique features of water services in this urban area promoted an interest in further investigation of asset management practices.

The coastal city of Durban in Kwa-Zulu Natal province has a supply limit providing at present some 3 million inhabitants with water services. Over and above water services to the metropolitan area of the central city and suburban communities, numerous peri-urban settlements situated on the fringes of the developed urban area have to be provided also with essential services. Innovative but well suited water services were developed for the low-income communities. This approach in water supply has been praised internationally.

The water tank system option has been adopted by some 50 000 low income people so far. The capital outlay is some 30 percent lower than the full pressure system. The water conservation requirements are also enhanced by this method of water service.

4.2.2 Infrastructure assets value and level of service

The infrastructure assets value of the DMWS is on parity with the large services providers (e.g. Johannesburg Metro, Umgeni Water, etc.). The levels of service and asset performance indicators are primarily as follows:

i) demand for services (i.e. potable water and sanitation)
ii) supply and distribution
iii) collection of wastewater
iv) wastewater treatment
v) waste disposal

4.2.3 Asset management practice and capacity

Durban's department has a well established asset management system and the researchers gained valuable information about their system. However, the magnitude of the water services systems far outstripped most other systems needing to implement an asset management planning philosophy and to develop an asset register.

4.2.4 Asset management implementation issues

The field evaluation of DMWS asset management system indicated that the service provider of this magnitude is not in a particular need of advice in improving management of assets. However, the issues identified were as follows:

i) Methods of evaluating the condition and performance of the assets
ii) Issues of critical and non-critical assets
iii) Appropriate AM planning methods for investment needs
iv) Methods for determining the ability of an asset to perform to its intended function
v) Non-payment for services
vi) Community consultation and involvement

4.3 Case study 2 - Thaba Nchu peri-urban and rural water supply (regional water supply system)

4.3.1 Background

This case study area was decided upon on the recommendation of the WRC Steering Committee. The following investigation was carried out in this area.

Prior to 1994, water supply developments in the rural areas of the former independent homeland of Bophuthatswana was the responsibility of the local water supply corporation. Numerous boreholes were drilled and equipped with handpumps, diesel pumping plants and in some places submersible pumps. The new political order re-incorporated the homelands and all people, civil institutions and the relevant infrastructures into the new South Africa.

The water services in the former homeland were taken over by the state through the Department of Water Affairs and Forestry and eventually by the parastatal Bloem Water Board. The Thaba Nchu urban area and surrounding villages together with various other urban and peri-urban water users are now supplied by Bloem Water. The average daily water demand of Thaba Nchu limits of supply is at present about 7.5 Ml, which is some 7 percent of the total water supplies of the Board's production.

4.3.2 Infrastructure assets value and level of service

The function of the services provider is vested in Bloem Water, which is a typical inland water supply system depending on inter-basin water transfers, catering for the rapidly expanding urban areas around Bloemfontein in the Free State province. The central Thaba Nchu area is regarded as urbanised with some 60 000 inhabitants. There are another 37 villages situated in the district, however only some 20 000 inhabitants reside in a rural setting using local groundwater sources. The quality of the groundwater is not very good with a high presence of fluoride and nitrates. The Board sells potable water to consumers on a prepaid basis. The transitional Local Council of Thaba Nchu has the status of a water services authority and oversees the overall land development objectives for the area. However, it was envisaged that after the local government elections in November 2000, the Council would assume the responsibility of the water services provider, catering for some 100 000 inhabitants.

The extent and complexity of this water services system far exceeded the research objectives with regard to determining an asset management generic model for a medium sized water services authority or provider.

4.3.3 Asset management practice and capacity

There is no central asset register available for this regional water services system. The asset registers in existence are purely for accounting purposes and listed only an asset's identification and a value, either the current book value or the insured value.

4.3.4 Asset management implementation issues

The field evaluation of the Thaba Nchu water services system led to a decision that this system was not sufficiently representative for further research. However, asset management issues identified within this system were as follows:

i) extent of assets usually maintained
ii) type of tests for monitoring asset condition
iii) state and detail of failure registers
iv) recording of water flow records
v) assets under depreciation
vi) assets insured, etc.
vii) training workshops on maintenance policies
viii) break-downs of assets insured by the state (i.e. DWAF) and the parastatal (i.e. Bloem Water).

4.4 Case study 3 - Municipality of Balfour and Siyathemba (rural town water services system)

4.4.1 Background

The rural town of Balfour and the adjacent township of Siyathemba are situated in the south-west corner of the Mpumulanga province. This rural town, some one and a half hours from central Johannesburg, became over the years a dormitory town for many African families seeking work opportunities in the city, during the separate development era. The pass laws did not allow at that time for city workers to keep their families in the metropolitan area.

During the early 1990s, the town's water services infrastructure started to become inadequate in coping with the growing population. Between 1985 and 1995, the population grew from some 8 000 to 24 000 inhabitants (i.e. threefold) although the daily water supply increased only from 1.4 Ml to 1.9 Ml (i.e. one and a half times) over the same period of time.

4.4.2 Infrastructure assets value and level of service

The Town Council of Balfour/Siyathemba is in charge of a large water engineering infrastructure asset base on behalf of the communities residing in the municipal area. The provision of water services varies from the storage and treatment of raw water to the night-soil collection and operation of a modern domestic sewage treatment plant. The municipal water services system operates along the whole services cycle.

The emphasis in responsibility of this water services authority shifted in recent years from capital investment mode into operation and maintenance mode.

4.4.3 Asset management practice and capacity

The researchers received full co-operation from the Town Council and the Town Engineer's Department. At present, there is no asset management system adopted by this local authority, although a basic list of assets was made available for research purposes.

The municipal infrastructure management practices developed and settled over the years for the designated services are as follows:

i) water supply and sanitation
ii) electricity
iii) civil assets (i.e. roads and stormwater)
iv) mechanical assets (i.e. movable and fixed)

In comparison to the extent of existing infrastructure asset base, the Town Council at this stage does not have sufficient capacity to concentrate on development and operation of an adequate asset management plan. Each municipal department (i.e. technical, treasury and administrative) is running its activities separately, without sharing or contributing specifically to a central data pool (i.e. asset register). GAAP procedures are observed, however, infrastructure capacity expansion, operation and maintenance planning are done mainly by contracted-out consultants.

4.4.4 Asset management implementation issues

During the process of this research project, numerous visits were made to the Balfour/Siyathemba water services system. Each visit proved that the Town Council is most interested to participate in the process of implementation of asset management planning procedures and asset management software presentation.

The researchers tested the Impahla Asset Management program at the Town Council and concluded that this water services authority is sufficiently representative to be encouraged in a pilot implementation of the research findings and software designed. However, the under-capacity for implementing of the AMP is primarily acute in the following spheres:

i) sorting out and evaluating the available asset management data
ii) establishing the reliability of the available data
iii) design and inputs into the Asset Register enabled by the software available from the research project.

At the conclusion of their research, the WSRG arranged a presentation of the Impahla Asset Management system to the Town Engineer's office of Balfour/Siyathemba in March 2001. The presentation was beneficial to both parties and generated a number of issues which were either directly or indirectly related to asset management planning and software implementation such as:

Technical: Chemical dosages at Fortuna water purification plant.
Sludge disposal considerations from waste water treatment works.

Economic: Debt recovery, issues regarding non-payment, free water (6 kl per household per month)

Social: Continual blockages of sewers in Siyathemba
Vandalism

Suggestions as to possible plans to optimise systems:

Technical: Obtain expertise or train staff, and obtain dosing equipment in order to use exact volumes of chemicals in order to achieve required water quality standards
Investigate possibilities of selling sludge as compost to local farmers. Possible usage of sludge on municipal grounds. Investigate quality of sludge in terms of health of standards.

Economic: Embark on a debt recovery program. Ensure that people understand the situation and that political leaders support and endorse the program.

Social: Investigate reasons for sewer blockages, investigate possible solutions to the problem, are the solutions, social/cultural or technical.
Establish the reasons why vandalism is occurring; obtain community support in solving the problem.

The types of water services assets and information on some of the parameters readily available currently are presented in Table 4.1 below.

Table 4.1 : Types of assets of the Balfour/Siyathemba Water Services System

Type of asset	Process	Service area	Asset component	Parameter	Remarks
General	Housing	Land		?	?
		Horticulture	Grassed area	?	?
			Garden beds	?	?
		Buildings	Houses & offices	?	?
			Furniture	?	?
			Fences	?	?
			Roads	?	?
			Security	?	?
	Access/ servitude roads	Land/servitude carriageway	Base course	?	?
			Pavement	?	?
Water	Source/storage	Balfour Dam	Impoundment	?	?
		Petrus van der Merwe Haarhoff Dam	Impoundment	?	?
		Groundwater	Boreholes	?	?
		Grootdraai power station (ESKOM)	Pipeline	?	?
	Treatment plant	P vd Merwe/ Haarhoff Dam	Structure and equipment	?	?
		ESKOM`s Grootvlei T/P	Structure and equipment	?	?
	Pumping stations	P vd Merwe/ Haarhoff Dam	Structure and equipment	?	?
		Balfour booster station	Structure and equipment	?	?
		Grootvlei P/S (ESKOM)	Structure and equipment	?	?
	Pumping mains	P vd Merwe/ Haarhoff dam to Balfour	Pipeline	150 mm	
		P vd Merwe/ Haarhoff dam to Balfour	Pipeline	300 mm	
		Grootvlei to Balfour	Pipeline	200 mm	
	Reservoir storage	Balfour site	Reservoir	0.5 Ml	Disused
		Balfour site	Reservoir	1,0 Ml	
		Balfour site	Reservoir	1,1 Ml	
		Balfour new site	Reservoir	6,0 Ml	
		Balfour new site	Reservoir	3,0 Ml	
		Siyathemba site	Reservoir	1,3 Ml	
		Siyathemba site	Elevated steel tank	60 m^3	
		Siyathemba new site	Reservoir	?	
	Reticulation network	Balfour network	Pipeline	50 mm	?
			Pipeline	75 mm	?
			Pipeline	100 mm	?
			Pipeline	150 mm	?
			Pipeline	200 mm	?
Wastewater	Details not available				
Stormwater	Details not available				

4.5 Case study 4 - Motlhabe and Ntswana-le-Metsing village water supply

4.5.1 Background

This rural water supply system was recommended to the researchers by the Mvula Trust as one most representative of some 1 400 similar water supply systems developed since 1994. A community water supply scheme was developed for two rural villages, Motlhabe and Ntswana, situated some 80 km NW of Rustenburg in the Mankwe district of the North West province.

The scheme comprises two diesel powered pumping sets pumping from two existing boreholes, a rising main 4 km long connecting the boreholes to an elevated steel tank. There are 43 standpipes at 200 to 500 metres centres connected by some 16 km of water reticulation piping. Some 760 households in both villages are now serviced by this system.

The scheme was constructed entirely by the community using labour intensive construction methods involving installation primarily of uPVC piping (sizes 63 to 200 mm OD), erection of 170 kl net capacity prefabricated pressed steel water tank on a 10 metres high platform. The concrete and brickwork were related to the construction of two pump houses and installation of the standpipes. The diesel plants and auxiliary pipework were installed by a contractor from outside of the villages. State RDP project funding was made available to the community through the contractor having responsibility to the State for quality control. A labour desk was manned by the contractor to assist and advise on issues regarding conditions of employment, wages and possible disputes.

The prime objective of this approach was to minimize the complexities in augmentation of the scheme, tap the community efforts and potential, and to develop a sense of ownership within the community towards the scheme and water value issues. The Water Committee installed by the community and later converted into the Village Services Committee, was developed during approximately one year of the project duration. They have obtained a sufficient capacity and the know-how to adequately operate and maintain of the scheme. All the operation and maintenance activities, including cost recovery, are done in-house by the community. The project was completed about one year ahead of schedule and about 3 percent of the original budget was returned to the State.

4.5.2 Infrastructure asset value and level of service

The type and magnitude of various basic water service assets owned and managed by the Motlhabe Water Committee can be seen from Table 4.2. In comparison to the other three case studies, this rural water services system is of marginal size, however there are some 2000 similar systems in existence around South Africa at present. Their number is growing almost exponentially according to the progress in rural water services delivery by the Government RDP and NGO programmes.

Table 4.2 : Types of assets for the rural water supply of Motlhabe and Ntswana

Asset	Item	Quantity	Parameter	Remarks
1.	**Land**	?	Community	
2.	**Water source**		Boreholes	
2.1	Boreholes/powered	2	Community	
2.2	Boreholes/hand pumps	5	Private	
3.	**Water supply**			
3.1	Pump house	2	Brick and mortar	
3.2	Powered borehole pumps	2	Diesel	
3.2.1	Fuel tanks	4		
3.2.2	Associated pipeworks	2 sets		
3.3	Water treatment housing			
3.3.1	Disinfection	2	Chlorine dosage	
3.3.2	Associated equipment	2 sets		
3.4	Rising main		U PVC pipes	
3.4.1	Pipeline	About 4200m	160mm OD	
3.4.2	Valve chambers	?	Brick and mortar	
3.4.3	Anchor blocks	?	Concrete	
3.5	Water storage		Elevated tank	
3.5.1	Prefabricated pressed steel Water tank	1	Steel	
3.5.2	Tank stand and platform	10m	Steel	
3.5.3	Associated pipework	1 set		
4.	**Reticulation system**		U PVC pipes	
4.1	Distribution pipeline	About 3 400m	110, 160 and 200mm OD	
4.2	Distribution pipes	About 13 000m	63,75 and 90mm OD	
4.3	Standpipes	43	At 200m centres	
5.	**Office and store rooms**		**Brick and mortar**	
5.1	Water committee office	1	Daily occupation	
5.2	Store rooms	2	Spare parts	
6.	**Transport means**		**Casual**	
6.1	Bicycles	4	Daily use	
6.2	Casual private vehicles	?	Emergency	
7.	**Sundry items**			
7.1	Tools	Various	Plumbing mainly	
7.2	Furniture	Various		
7.3	Spares	Various	Pipes, fittings, etc.	
8.	**Other assets**			

4.5.3 Asset management practices and capacity

The asset management practices and capacity are both rather embryonic at the Motlhabe Water Committee. For most of the operation of the system during the past three years, the Committee has obtained managerial support from outside of this system (i.e. consulting support on urgent issues). The daily technical operation of the system and cost recovery aspects are fully handled by the Committee.

4.5.4 Asset management implementation issues

The Impahla Asset Management System might be rather luxurious at the onset of implementation of a water scheme such as that at Motlhabe and Ntswana-le-Metsing, taking into consideration the extent and magnitude of the asset base. However in order to start the capacity building process it is ideal for a system which will ultimately grow into a fully fledged water services system

The issues identified as critical are as follows:

i) the system is not electrified, therefore limiting application of electronic technology
ii) teaching in essential asset management is absolutely crucial
iii) monitoring and recording skills have to be developed
iv) need for formal training in financial planning

CHAPTER 5 CONCLUSIONS

Water services infrastructures have to be managed within an integrated social, economic and environmental context. This means that the conventional technical reliability approach is no longer sufficient to keep water services systems operational, profitable and sustainable. The infrastructure asset management principles and methods can help a great deal to introduce discipline and logical processes into the planning activities of the South African water services industry.

The management of small to medium sized community water services systems should be particularly targeted as the assets base and extent are usually new, not very large and manageable. Also the skills base is usually in its infancy and in need of suitable guidelines.

One of the findings of the case studies is the great diversity between institutions. Each institution uses very different processes and methodologies. Also, the current state of asset management at most institutions is very poor. Institutions typically have no central asset register, or if they do it is purely for accounting purposes and lists only the assets' identification and a value, either the current book value, or the insured value.

There is typically no institution-wide identification system for assets, and there are no standardised measurements for asset types. Each department in each institution typically refers to each asset by means of a text name. These are usually the same between departments, but often show slight, and sometimes significant, variations. One of the first steps required by most institutions in setting up a centralised asset management system would be to create a consistent, institution-wide system of asset identification.

This research project only unearthed the essential constraints of non-existent rather than the existence of asset management planning in the local water services sector. It must be noted that the large water services providers (i.e. mainly water boards) are managing their asset base reasonably well. However, there is no unitary approach to asset management planning. Local authorities (i.e. Water Services Authorities) are dependent on their ratepayers to manage their infrastructure asset base, which is usually larger as far as the type of assets are concerned (i.e. next to water infrastructure they are responsible also for the assets with regard to electricity, roads, parks and recreation, etc.) than is usually the asset base of a typical water services provider. A typical municipal water services authority has a unique responsibility for practically the whole water cycle process and all associated services.

There are also no standards reports for particular institutions, and particularly no reports that were found to be common between two or more institutions. In order to develop an industry-wide set of standard reports, it would be necessary to do a detailed study of the reports used in all the different departments across a fairly large number of institutions in order to distil the elements and information that is common to all.

The research project identified from the field case studies that the magnitude of an asset base differs from one water services systems to another a great deal. This aspect influenced the extent of the proposed standard Asset Management Plan and design of the Asset Register software, not only to suit a water committee to Mothlabe operating a very limited asset base, but also to suit medium-sized municipal water services system. The Impahla Asset Management System software includes some examples of system codes in order to give the user some idea how to set these up. However, the actual system and location codes used by any particular institution would have to be set up uniquely for that institution. The IAMS software includes a few example reports that will help the users understand how to create their own reports, but it will be necessary for each institution to create reports that reflect the way they run their own businesses.

Strong international parallels were found particularly between the Australian approaches to asset management planning, for the fact that asset management is being adopted concurrently with water reforms. However, the socio-economic conditions within the water services industry in Australia and New Zealand differ significantly to that of South Africa. Although there were differences in implementing asset management planning internationally, valuable foreign experiences were evaluated and some were adopted in this research project.

It is believed that the benefits of this research project will contribute particularly to the process of compilation of Water Services Development Plans (WSDP) as required by the Water Services Act of 1997 and also for the benefit of the Integrated Development Plans required by the Municipal Systems Act of 2000 for the water services authorities and providers.

PART B: GUIDELINES

CHAPTER 6 ASSET MANAGEMENT PRACTICE AND REGISTERS

6.1 Introduction

Infrastructure Asset Management can be defined as the process of managing the creation, acquisition, maintenance, operation, rehabilitation, extension and disposal of the infrastructure assets of an organisation, in order to provide a defined level of service in a sustainable and long-term cost-effective manner. This process can only take place if there is adequate data on which to base decisions. Adequate data implies sufficient data that is accurate and up-to-date. The Asset Register is the database that contains all the relevant information on all the infrastructure assets owned by the organisation, and it is on this database that the entire Asset Management Plan depends. For this reason, it is vitally important that a well designed asset register is put into place during the implementation of an Infrastructure Asset Management Plan.

Typically, asset registers will differ significantly from one organisation to another, as their infrastructure assets and management plans differ, but there will be common elements to all asset registers. There are a number of advantages to be had from designing a standard asset register for a particular sector, such as the water services sector. These advantages include the following:

- Allows consistent comparisons between different organisation within the sector
- Simplifies data gathering by central monitoring agencies
- Enhances transparency and public access
- Makes it much easier for institutions that do not yet have an asset register in place to implement one. This is especially useful for smaller institutions that do not have the capacity to design and implement an asset register from the ground up.

Although a standard asset register definition for all Water Service Institutions (WSI's) in the nation will be extremely useful, it will not be simple to design. The following section discusses some of the aspects that would need to be taken into account when designing a national standard for asset registers for the water services sector.

6.2 Definition of a national standard for asset registers

As has been discussed earlier in these guidelines, there are a number of advantages and benefits to be obtained from a National Standard for asset registers. The main problem with establishing a national standard is the fact that Water Services Institutions (WSI's) vary a great deal in their size, in the number, value and types of assets under their control, and in many other aspects. This seems to be especially true in South Africa. It would not be possible to define and implement a perfect National Standard for asset registers, but this could be achieved through an evolutionary process. An initial standard needs to be decided upon and implementation begun. As the advantages and weak points of the standard become evident, it can be refined and improved.

6.2.1 Requirements of an asset register

Because the WSI's in South Africa vary such a great deal, a national standard for assets registers would need to be very flexible. It should not, for instance, prescribe the hardware or software that is used to support it. It should, however, define the types of output required and the methods used for calculating performance indicators, condition and risk assessment gradings and asset valuations. The national standard should also recommend the types of data to record, and present a default identification system for the assets. These will be to assist WSI's in setting up asset registers, but should not be restrictive on those WSI's who have already implemented an asset register.

Some of the requirements of an asset register are the following:

- It should record the details necessary to clearly identify each asset
- It should record a basic set of information that is the same for every asset. This would include the identification, the location, the age, and assessments of the value, performance, condition and risk of the asset.
- It should record, for each type of asset, any information over and above the basic set of information that is necessary to effectively manage that asset. The information that should be recorded is any information for which the value of knowing the information is greater than the cost of obtaining the information.
- It must meet the organisation's management, planning, technical and financial needs, as well as any legislative requirements.
- It must be easy to operate and provide quick and accurate access to information, in the form required, to anyone who has a right to that information
- It should facilitate accurate and confident decision making
- It must be secure so as to prevent unauthorised changing of data.

6.2.2 Components of a national standard for asset registers

A National Standard for asset registers would have to be flexible enough to allow the implementation of an asset register by all WSI's, and yet accurate enough to ensure that the benefits of a national standard are achieved. The National Standard should define at least the following:

- Which assets should be included in the asset register
- The minimum set of data that should be recorded for each asset
- A flexible scheme of asset classification and identification
- A standard method of evaluating the condition grading of the asset. This will be different for different classes of assets.
- A methodology of evaluating the performance grading of the asset. As with the condition grading, this will also be different for different classes of assets.
- A standard method for defining the value of an asset. This can be different for different classes of assets. It may also allow the WSI some freedom of choice in the method they use, as long as they use one of the standard methods, and clearly state which method has in fact been used.
- A method for evaluating the risk associated with the asset, and acceptable levels of risk.
- A definition of, and methodology for evaluating levels of service required form the assets.

- A measure of the accuracy of the data recorded for each asset.

6.2.3 Which assets should be on the register?

It is not feasible, nor is it necessary to record the assets of an organisation down to the last pencil and bolt owned by the organisation. It is therefore necessary to decide what level of assets will be recorded. The ultimate criterion for deciding is that the value of the information should be greater than the cost of obtaining and maintaining it. This is, however, not easy to establish, because the value of the information depends on the use to which it is put.

The line between which assets are recorded and which are not can be drawn purely on the basis of the value of the asset, for example, any asset with a value of over R1000 should be recorded. There are two main problems with this approach. The first is that a standard definition of the value of an asset must be in place before this method can be used. The second problem is that the value of the does not necessarily give an accurate indication of the importance of the asset to the organisation. Although this method does have problems, it is still probably the easiest, and most accurate, and thus the most commonly used.

A National Standard for Asset Registers would have to establish a common method for the valuation of the assets, and then establish a cut-off value such that assets with a value greater than the cut-off must be included in the asset register. This could be a maximum cut-off value, leaving WSI's the freedom to establish lower cut-off values if they choose to.

6.2.4 The minimum set of information to be recorded

The National Standard for Asset Registers would have to define a minimum set of data that should be recorded for each class of asset. This will have two components, the data that is common to all assets, and the data that is specific to the class of asset.

The data that is common to all assets include the following:

- A unique identifier for the asset. This will be discussed in more detail later.
- A name for the asset.
- The location of the asset. This should include reference to a standard system such as latitude and longitude, or the South African Co-ordinate system. The location information should also be such that it can be imported into a GIS system.
- The date of acquisition or commissioning of the asset. This is necessary to calculate the age of the asset as well as its condition and value.
- An initial cost. This could be either the original purchase price if known, or an evaluation made at some point in the assets life. If it is the latter, then the date of the evaluation must also be recorded.
- The current value of the asset, as well as the methodology used to calculate the current value.
- The current condition of the asset and the methodology used to evaluate this.
- The current performance grading of the asset and the methodology used.
- The risk currently associated with the asset and the procedure used to calculate its risk.
- A measure of the accuracy of the data recorded for this asset.

6.2.5 Recording the changes to assets

The asset register contains a picture of the infrastructure assets at an instant in time. However, as time passes the assets will change. Pumps wear, pipes develop cracks, and all manner of changes occur to the assets. In order for the managers of the system to be able to make informed decisions, the information in the database must be kept up-to-data and reflect these changes. This can be done in one of two ways:

- Periodic surveys of the assets.
- Ongoing capturing of changes whenever they occur.

The advantage of using periodic surveys of assets is that it is not necessary to maintain information about every change that occurs to the asset, but rather the net result of a number of small changes is recorded when the survey is done. The disadvantage is that regular, usually relatively expensive, surveys are required, and that the data in the register is only as current as the date of the last survey.

Ongoing capturing of changes has the advantage that the register is always kept up-to-date. It also has the advantage that trends in the performance or condition of the assets can be tracked and analysed. The main disadvantage is the fact that this required recording a relatively large quantity of data in the register. However, most institutions already record data regarding most changes to their assets such as maintenance or repair work.

Sometimes it is not possible to record the individual changes and surveys are the only way to keep the database up-to-date. For example, Pretoria Local Council uses closed circuit TV to perform surveys of their sewer pipes. The deterioration in pipe condition cannot be monitored on an ongoing basis so surveys must be used. However, they also record events such as maintenance call-outs on sewer pipes each time they occur. This information gives them an indication of the relative condition of the sewers, and they can then schedule their surveys to examine the sewers with the highest rate of maintenance call-outs.

It is thus recommended that changes to assets are recorded on an ongoing basis wherever possible, and using surveys to establish the condition of the asset when the performance of the asset indicates that this is necessary. This implies recording two types of data in the register, namely asset data on the physical assets, and event data on the events that indicate changes in the condition or performance of the asset.

An example of an event that indicates a change in the condition of an asset would be a maintenance event. Most institutions already record maintenance event information in the form of a job card and an action report, so no new information would need to be recorded. These are often captured into a Maintenance Management Tool, so to record this information in the asset register would only require linking the Maintenance Management Tool with the Asset Register.

An example of an event that could indicate a change in the performance of an asset is a regular water quality sample. If this shows a deterioration in the water quality, then the performance of the purification plant might need attention. Again, these events are usually recorded by most WSI's, so no new information would need to be recorded, it would just need to be linked into the asset register. Ideally, the asset register would be the central repository for all data regarding the assets and the events that affect them for the entire institution.

Different reporting modules would then be used to extract maintenance, or water quality, or billing information, etc.

6.2.6 Capturing the data

As discussed above, the asset register will contain a large amount of data, both on the assets themselves, and on the events that affect them. It is necessary to continuously capture event data, and to regularly capture asset condition data via surveys. These are two basic methods of creating asset registers, depending on the capacity and resources of the WSI.

Entirely manual systems would be applicable for very small WSI's that have neither the capacity nor the technology to use computer based asset registers. Typically, the operator will have a book of forms, in which he will write down the events that are relevant to the system when they occur, as well as the results of the regular surveys that they may conduct.

An example of this would be the Motlhabe case study discussed in detail in Chapter 6 of this report. Each day, the operator runs the pump for a certain number of hours to fill the storage tank. His book might include fields for the starting and ending levels on the tank, the number of hours for which the pump was run, and the quantity of fuel that was used. This information could then be used to monitor the performance of the diesel motor and the pump, as well as the consumption by the community. He might also fill in a weekly inspection register to monitor the condition of the motor, pump, pipes and tank. All of this information will be very useful when it becomes necessary to replace the pump or motor, or to extend the system.

Computer based systems will vary considerably with the size and complexity of the system used from a single desktop machine to a large network, but they would all function similarly in terms of the data capture and storage. The data would be stored in a central database, which is accessible to those who need it, and the data would be captured using some or all of the following methods:

- Manual recording and subsequent capture would typically be used in smaller WSI's for meter readings and maintenance job-cards.
- Hand-held capture tools, such as hand-held meter readers and portable water quality measuring instruments. These tools allow data to be captured only once and then imported directly into the asset register. They reduce capture errors and save time.
- Loggers continuously monitor data outputs from meters and other monitoring devices. That data is then periodically dumped into the register. Human intervention is only required for the periodic moving of data from the logger to the asset register.
- Remote monitoring uses some form of communication between the monitoring device and the computer network that houses the asset register. Data is automatically added to the register, and human intervention is only required if something goes wrong.

Once the data has been captured into a computer-based system, it would be available for use by a number of different reporting and analysis modules that would provide information such a water balance analyses, performance and condition reports, maintenance plans, etc.

6.3 System analysis and setting up the register

6.3.1 Service levels

An understanding of the levels of service that an organisation should be providing is fundamental for any organisation. These define what the organisation should be doing, and it is only when these are known that an organisation will be able to judge how well it is doing. Ultimately, the objective of asset management planning is to match the level of service provided by an asset with the expectation of the customer. Asset management planning will allow the determination of the relationship between levels of service and the cost of such service. This relationship can then be evaluated in consultation with the customers to determine the level of service for which they are prepared to pay.

The first step in determining levels of service is to determine the level of service currently being delivered by the organisation. Then next step is to determine what levels of service are sought by the customers. This will then reveal a number of service level gaps as indicated in the following figure.

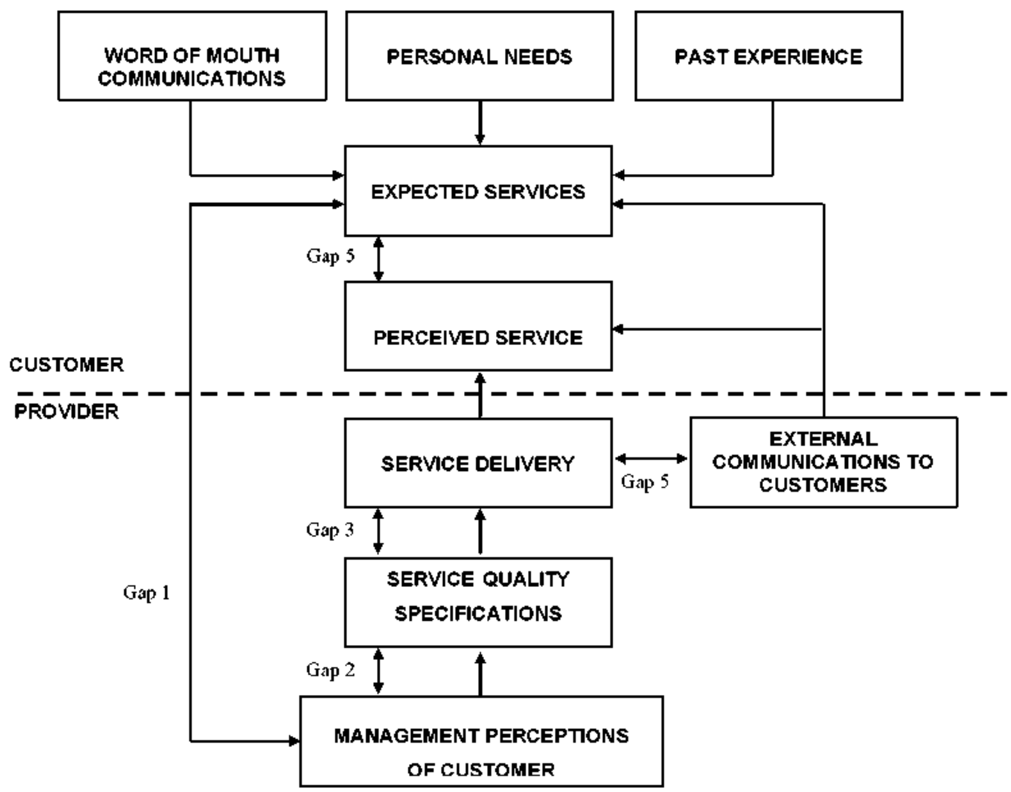

FIGURE 6.1 : Service level gaps

A national standard for asset registers should give methods for evaluation levels of service, and minimum levels that are required, consistent with Government policy, the Reconstruction and Development Programme, and customers' expectations, willingness and ability to pay.

6.3.2 Asset identification and classification

A classification system is necessary to break up the organisation's assets into a hierarchical system of identification. This system can be based on function, type or location, or multiple systems can be used that cover all three of the above. The system used should:

- Be logical and easily understood.
- Facilitate the collection and recording of data.
- Compliment the financial accounting procedures.
- Recognise the synergies in asset management activities.

An identification system is necessary to assign each asset with a unique identifier. These identifiers must be unique throughout the entire organisation, and be used wherever the asset is referred to. Identifiers fall into three major categories:

- Unintelligent – a sequential number that is assigned when the asset is added to the asset register, that tells the user nothing about the asset.
- Semi-intelligent – a code that includes some reference to the asset classification. For example, if a functional classification system is used, the code may have two letters to specify that the asset is a pump and a specific type of pump, and then a sequential number assigned when the pump was added to the register.
- Fully intelligent – a code that is made up entirely from the classification system and which allows the user to know immediately which asset is referred to just from the code.

A classification and identification system of assets is proposed below. This system is recommended for asset registers, but should not be enforced by a national standard. WSI's should be free to use any classification system, as long as each asset owned has a unique identifier, and the identifiers can fit into the same number of characters as used by the national standard. The proposed system uses a largely intelligent numbering system, and multiple hierarchical classification as follows:

The asset identifications have the form show below:

L_1	L_2	L_3	—	F_1	F_2	F_3	—	T_1	T_2	T_3	—	N_1	N_2	N_3	N_4

The classification structure and codes used by each WSI will have to be planned and decided upon during the design phase of implementing an asset register. The proposed system uses the following values for each of the characters:

- L_1 1 character code for the District,
- L_2 1 character code for the Sub-district,
- L_3 1 character code for the Zone,

where the districts, sub-districts and zones are defined according to SABS 0306:1999.

It would also be possible to use other hierarchical classification systems. For example, instead of using the hydraulic classification system shown above, a WSI could choose to use a political hierachy structure with L_1 representing the Local Council, and L_2 and L_3 representing the suburb.

F_1 - F_3 : Function Codes

Three characters form a hierarchicial description of the function of each asset. Examples of some of the proposed functional codes are as follows:

Level 1 Code (F1)	Level 2 Code (F2)	Description
P		Potable water distribution
	C	Intermediate chemical dosing
	D	Distribution and piping
	P	Pumping
	S	Balancing and intermediate storage
R		Raw water abstraction and purification
	A	Abstraction
	C	Purification
	D	Distribution
	P	Pumping
	S	Storage
W		Waste water collection, purification and disposal
	C	Purification
	D	Collection and piping
	O	Outlets and disposal
	P	Pumping
	S	Storage

T_1 - T_3 : Type Codes

Three characters forming a hierarchical description of the type of each asset. Assets should only be separated into different types if it is necessary to record different attributes for each type. For example, ball valves and butterfly valves could both be of the asset type 'Isolating Valves', and one of the attributes of the asset type 'Isolating Valves' might be the type of valve. Some examples of type codes could be the following:

Level 1 Code	Level 2 Code	Description
VH		Motor vehicles
	L	Light motor vehicles
	P	Passenger vehicles
	C	Commercial/Goods vehicles
RV		Reservoir
	C	Concrete reservoirs
	T	Fabricated tanks

N_1 - N_4 : Sequential Number

The last part of the number would be the sequential number. These would be assigned as the assets are added to the asset register. These numbers must be such that unique identifiers are assigned to each asset.

6.3.3 Performance indicators

Performance indicators are clearly defined measures of how effectively an asset is meeting the service criteria defined for that asset. Performance indicators require that the method in which they are measured be clearly and unambiguously defined, and that the service criteria expected from each asset also be defined and documented. The Water Research Commission is currently funding a project on developing Key Performance Indicators for the Water Services Sector.

Some examples of Performance Indicators are the following:

> Water Quality Compliance (%) = Samples in compliance with specifications / Total number of samples
>
> Pumping Efficiency (%) = Design Head ÷ Design Flow / Actual Head ÷ Actual Flow
>
> Unit Production Cost (R/kl) = Total Production Cost / Total Water Sold

These can be applied to individual assets, groups of assets, or to the entire institution. Many others could be defined, and there should be at least one performance indicator per type of asset.

6.3.4 Condition grading

The objective of Condition and Performance grading is to provide a consistent method of measuring and reporting on the condition and performance of each asset. These gradings may also be used in the valuation of the asset.

Condition refers to the structural integrity of the asset, performance refers to the capability of the asset to meet defined service criteria. A multi-stage approach is proposed where the first stage is ranks each asset according to a simple condition grading system. An example of a simple ranking system is shown in the following table:

Rank	Description of Condition
0	Asset is absent or no longer exists
1	Excellent condition - Only normal maintenance required
2	Minor defects only - Minor maintenance required (5%)
3	Backlog maintenance required - Significant maintenance required (10-20%)
4	Requires major renewal - Significant renewal/upgrade required (20-40%)
5	Asset unserviceable - over 50% of asset requires replacement.

The second stage would be to refine this grading system, especially for grades 3, 4, and 5 where major work is required. The third stage would be to develop multi-faceted grading systems with deterioration curves for each class of asset.

6.3.5 Risk assessment

Risk assessment for an organisation involves identifying the possible methods by which an asset could fail to perform the service it is intended to perform, estimating the probability of occurrence for each of these methods, and evaluating the cost of such a failure. The risk cost for a particular mode of failure is the probability of that mode occurring, multiplied by the cost of the failure.

The risk cost can be reduced by two methods. The first way is by reducing the probability that the failure will occur. This usually involves improving the condition of the asset so that it is less likely to beak down. The second method is to reduce the cost should the asset fail. This usually involves identifying and implementing risk mitigation measures.

Risk cannot be completely avoided by any organisation, especially WSI's, so it will be necessary for a National Standard for Asset Registers to define what is an acceptable level of risk. A standard method of assessing this risk will also be necessary. Both the methods used and the acceptable level will be different for different classes of asset.

6.4 Register maintenance

It is important for any asset management plan that the organisation that is using it have confidence in the plan. This is especially true of the asset register. If the users cannot trust the data in the register, then they will not use it, and the register becomes useless. For this reason, some measure of accuracy must be applied to each item of data in the register, and this measure recorded. It is proposed that one of the items of data that is common to all types of assets in the register is a measure of the accuracy of the data for that asset.

When the register is first compiled, some of the data may be estimated from statistical surveys or user knowledge. This is adequate for a first pass at creating the register, but the accuracy of the estimate must be recorded. This type of register will have a relatively low level of accuracy. As the benefits of the register, and the plan in general, are realised, and the budget becomes available, further work can be done to improve the accuracy. An important function of recording the accuracy of the data is that it can immediately be seen when the accuracy is the poorest, and so where to start on improving it. The accuracy of the data can then be improved by doing field surveys, starting where it is known that the accuracy is poor.

Another way of continuously improving the accuracy of the data in the register is to include a process of verification whenever maintenance work is done. For example, part of the job card for a maintenance job could include tasks for the maintenance personnel to check on the accuracy of data in the register. If they find inaccuracies, these can be corrected in the register, and the level of accuracy improved.

The asset register is itself one of the assets of the institution, and the measure of the accuracy of the data in the register is a key performance indicator for that asset. A proposed grading system for the accuracy of the data in the register is shown below:

Rank	Description of Data Accuracy	Confidence Limits
1	Data entirely accurate	> 99%
2	Minor concerns	> 95%
3	Medium items of concerrn	> 80%
4	Major items unknown	> 70%
5	Full estimated	> 50%

By using a measure of the accuracy of data in the register, it will be possible to prove to the users the absolute level of accuracy and to show the improvement that is occurring with time. This will go a long way towards instilling confidence in the register and the asset management plan in general.

6.5 Asset register outputs

6.5.1 Asset valuations

This is probably one of the most important functions of an asset register, as well as one of the most difficult. A valuation of the assets of an organisation is necessary for a number of reasons:

- For balance sheets and financial reporting.
- For accounting purposes, i.e. to determine the period over which assets should be written off.
- For asset management purposes, i.e. to plan for maintenance and renewal.

For some of the assets it is possible to obtain a market value for the asset. This is only possible for those assets that it is possible to trade on an open market, for example, the vehicles owned by an organisation. For many of the assets, however, there is no market, so the concept of market value cannot be used. In this situation it is often possible to use the replacement cost, where this is the cost of supplying and installing a similar asset under similar circumstances.

Once a value has been obtained for an asset, it has to be depreciated to take account of the age, condition, performance and remaining life of the asset. A National Standard for Asset Registers would need to define what type of value is used for each class of asset, as well as how these values can be depreciated.

The method of asset valuation must have the following characteristics:

- It must comply with statutory requirements and accepted accounting standards.
- It must accurately reflect the value of the asset to the organisation.
- It must provide consistent valuations.
- It must be well-defined and relatively easy to use.
- The information required by the valuation method must be stored in the asset register.
- It should be fully integrated with normal asset management systems and practices.

6.5.2 Performance and condition upgrading

One of the most common uses for specialised asset registers at present is to assist in the decision of when and how to upgrade the performance or condition of an asset. This upgrading can take the form of maintenance, refurbishment, replacement or expanding the asset. Pretoria Metropolitan Council are using an asset register to store the results of their closed circuit TV monitoring of their sewers, while Rand Water have developed a register of all their pipes, with a view to refurbishment and expanding their network.

In both cases, the data in the registers was obtained first from available documentation, and then from field surveys. This information is then used to evaluate the condition of the assets. Condition and performance indicators are then calculated for each of the assets, and these are used to indicate when upgrading of the assets should occur, and what form of upgrading is best. This information is then fed into the organisation's long-term budget and development planning.

CHAPTER 7 PREPARATION OF ASSET MANAGEMENT PLANS FOR WATER SERVICES

7.1 Asset management planning in S.A. water services sector

The diversities and complexities entrenched in the SA water services sector do not allow for a straight forward proposal in the implementation of an Asset Management Plan. However, the key objective for any organisation wanting to follow a route for standard asset management planning should be as follows:

An Asset Management Plan (AMP) will serve as a management tool to introduce discipline and logical processes into the planning of an organisation's activities and interaction with its customers.

If implemented, an Asset Management Plan brings about beneficial uses and advantages primarily with regard to the following:

- justify funding requirements to internal and external parties
- demonstrate responsible stewardship of assets on behalf of customers and stakeholders
- establish and evaluate performance measures
- improve understanding of service level options, costs and risks
- comply with regulatory requirements for financial management
- improve decision-making based on the costs and benefits of alternatives

7.2 How to prepare a standard Asset Management Plan

Based on the research of local state of the art and international Asset Management Planning processes, eight essential steps need to be taken in preparation of a standard Asset Management Plan.

Step 1:	Identify objectives of organisation
Step 2:	Define depth of detail for the Asset Management Plan
Step 3:	Compile Asset Management Plan from existing financial information of assets of organisation (i.e. basic asset register)
Step 4:	Define existing levels of service to the customers
Step 5:	Outline future alternatives in service to the customers
Step 6:	Review Asset Management Plan for completeness, objectivity, logic, presentation and communication effectiveness
Step 7:	Set up schedule for regular updating of Asset Management Plan
Step 8:	Set out Asset Management system

7.3 Extent of Asset Management Plan

The extent of the Asset Management Plan is related to the organisation's function in the water services cycle (i.e. abstraction, supply, distribution and wastewater disposal) or related to a specific responsibility with regard to various water services cycle processes (e.g. water treatment, pumping, conveyance, storage, metering, etc.). Thus, the key issues to be attended to in the standard Asset Management Plan are listed under the following principle modules:

Module 1. The purpose of plan
- To demonstrate responsible management
- To communicate and justify funding requirements
- To comply with regulatory requirements

Module 2. Asset Description/Asset Register
- Brief details of assets covered by the plan
- Location, overall valuation, condition, performance

Module 3. Levels of Service
- Summarise levels of service that the plan is based on
- Summarise how levels of service were set
- Details of service performance measures

Module 4. Asset Management Systems
- Details of asset management data, information systems and processes
- Decision making methodology

Module 5. Life Cycle Management Plan
- Demand management plan
- Routine maintenance plan
- Renewal/rehabilitation plan
- Acquisition plan
- Disposal plan

Module 6. Financial Summary
- Long-term income and expenditure (cash flow) projections
- Sources of funding

Module 7. Monitoring and Improvement
- Details of how performance of AMP will be monitored
- Summary of actions required to improve accuracy and confidence in AMP
- Timetable for review of AMP

Module 8. Specific Issues
- Legislative requirements
- Water services industry initiates and reforms
- Technological advancement

It must be noted that the organisation AMP should be fully integrated with the requirements of the Water Services Development Plans as per the Water Services Act (Act 108 of 1997), complying with Generally Accepted Accounting Practices (GAAP) and in future also with Generally Accepted Municipal Accounting Policies (GAMAP).

7.4 Life cycle asset management

The life cycle management component of the Asset Management Plan is, together with an Asset Register, the most important as it outlines what is planned to keep assets managed and operating at the agreed level of service while optimising life cycle costs. Asset life costs determine the total costs of ownership over the life of an asset for the purposes of:

- Evaluating options for the procurement of new assets
- On-going management decision-making throughout the life of an asset
- Benchmarking the actual cost performance of an asset
- Reviewing the process for future design/acquisition decisions

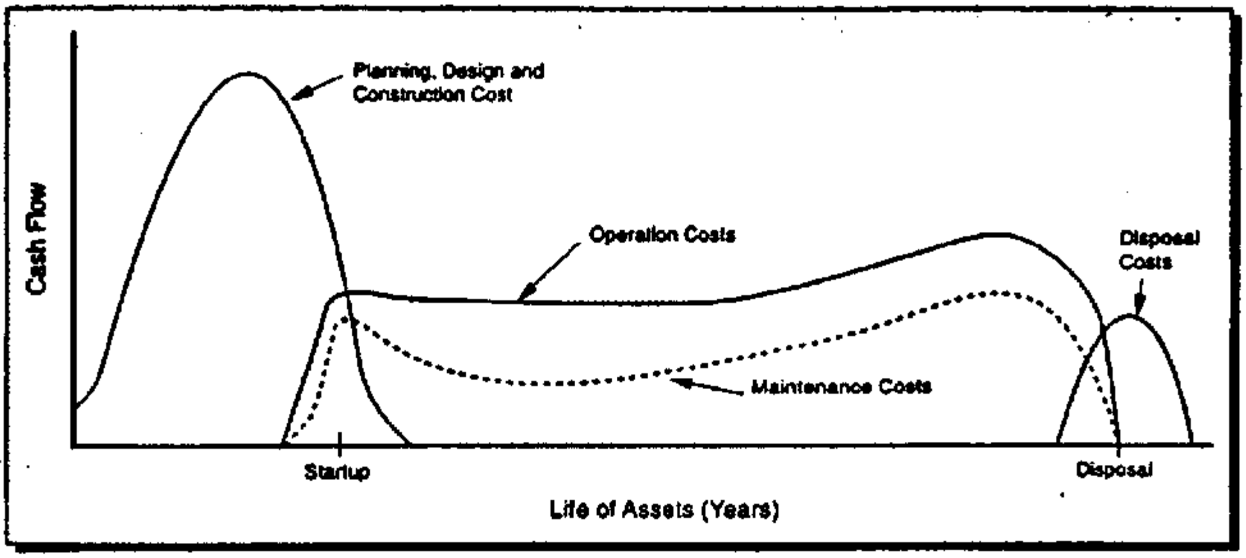

FIGURE 7.1 : Life cycle cost profile (Source: NZ Infrastructure Asset Management Manual (1996)

7.4.1 Whole life cycle principle

The typical project development is made up of four generic phases, consisting of concept, development, implementation and termination. For different types of project development, these stages are usually broken down into stages specific to the industry or area of project application. This concept is adopted in the life cycle asset management (LCAM) methodology. The LCAM is about all consequences of owning and operating the assets. The principle is illustrated in Figure 7.2, however, also accounting for increases in risk due to the age of a project (or asset).

It must be noted that the asset whole life cycle principle should not be mixed with the Process Analysis and Life Cycle Assessment (PA&LCA) which has been developed primarily as an environmental management tool for product development from a raw material state to the state of product disposal or recycling. The PA&LCA considers the whole material and energy supply chain including treatment and any reuse of wastes.

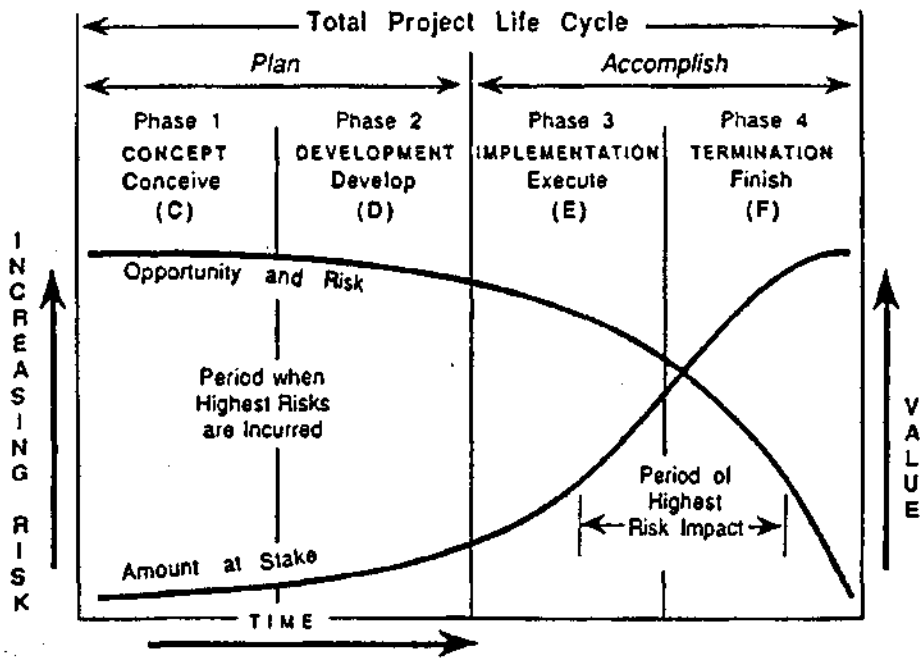

Figure 7.2 : Typical life cycle profiles - Risk vs. Amount at stake (Source: After Wideman (1992))

The costs relating to the life cycle of the asset include the following:

- preliminary investigation and feasibility study costs
- design and construction costs/or acquisition costs
- operation and maintenance costs
- ultimate replacement costs
- disposal costs
- depreciation costs

To determine these costs, which occur at different stages of the life of an asset, Table 7.1 illustrates the most important cost areas for Asset Life Cycle Management (ALCM) and the life cycle cost components.

It must be pointed out that for most assets, the total life cycle costs will be more than twice the initial capital cost. However, there are opportunities to reduce the life cycle cost, primarily in the planning stage, where most of the factors affecting the size of life cycle costs are decided upon. The cost reduction in the later stages of the life of an asset (e.g. construction, operation and maintenance) is harder to achieve. The cost reduction related to rehabilitation and disposal should be well analysed.

TABLE 7.1 : Cost areas for asset life cycle

Cost component	Life phase	Cost area examples
Capital costs	Planning	Feasibility studies Research/concept development Programme planning
	Design	Functional design Detailed design Documentation
	Construction	Site and land Construction/purchase Management Quality control Commissioning
Recurrent costs	Operations	Operations personnel Training Energy
	Maintenance	Maintenance personnel Planned maintenance Spares Training
	Renewal/Rehabilitation	Detailed design Construction costs Management costs Quality control
	Financial	Cost of finance Depreciation
Residual value	Disposal	Decommissioning Sale value Asset disposal/salvage costs Site decontamination

Source: NZ Infrastructure Asset Management Manual (1996)

To illustrate how to determine the whole life cost, an example of four options for a small community pumping station is investigated in Table 7.2. The composition is illustrative only, hence units instead of monetary values are used. The asset register of an organisation should provide most physical and costing data needed for an analysis of this kind. It should be noted that the physical size and operational demand on the community pumping station will dictate the choice of asset whole life cost option.

Table 7.2 : Comparison of asset whole life cost options

Asset component	Option 1	Option 2	Option 3	Option 4
Pipe diameter (mm)	150	200	300	400
Duty flow (*l*/s)	25	40	100	180
Duty head (m)	36,9	25,2	21,3	20,6
Hours to pump (hr)	3,2	2,0	0,8	0,4
Capital cost/Civils (units)	50 000	71 000	83 000	98 000
Capital costs/Mech/Elect (units)	7 000	10 000	14 000	19 000
Total capital cost (units)	57 000	81 000	97 000	117 000
Pumping costs (unit/year)	4 000	2 100	1 600	1 400
Net present value (units)	56 000	29 400	22 400	19 600
Whole life cost (units)	**113 000**	**110 400**	**119 400**	**136 600**

7.4.2 Life cycle cost reduction

The life cycle cost can be reduced by changing the economic life of one or more asset components. This is illustrated with a hypothetical case of a small community water supply pumping scheme for 10 years and alternatively for 20 years of design life of the pump installation. Note that the capital investment of the pump is changing.

TABLE 7.3 : 10 year design life

Asset item	Cost estimate (Rand)	Economic life (yrs)	Annual depreciation (Rand)
Intake	12 000	30	400
House	18 000	40	450
Pump	34 000	10	3 400
Tank and stand	12 000	30	400
Chlorination equipment	5 000	10	500
Total	**81 000**	**-**	**5 150**

TABLE 7.4 : 20 year design life

Asset item	Cost estimate (Rand)	Economic life (yrs)	Annual depreciation (Rand)
Intake	12 000	30	400
House	18 000	40	450
Pump	45 000	20	2 250
Tank and stand	12 000	30	400
Chlorination equipment	5 000	10	500
Total	**92 000**	**-**	**4 000**

7.5 Asset valuation guidelines

In South Africa, the asset valuation should follow the methodology indicated in the Generally Accepted Accounting Practices (GAAP) and Generally Accepted Municipal Accounting Policies (GAMAP). Both GAAP and GAMAP consist of an accounting framework that defines assets, liabilities, revenue, expenditure and own capital, and sets out the criteria for introducing these in the financial statement of a municipality (i.e. Water Services Authority). An excerpt from the GAMAP on asset definition and examples are illustrated in Table 7.5.

According to An Introductory Guide to GAMAP, it is crucial that the water services authorities (i.e. municipalities) undertake an inventory of fixed assets before the GAMAP will be introduced (sometime in 2001) to create their fixed asset registers. Without a fixed assets register, it will be extremely difficult to depreciate fixed assets.

TABLE 7.5 : Summary of the elements of financial statements

Element	Definition	Examples
Assets	An asset is a resource controlled by a municipality which will result in future economic benefits (usually cash) or will enable the municipality to provide services in the future	• Short and long-term debtors, as these amounts are the amount of money that should be received in the future. • Fixed assets, as these enable the municipality to render services. • Stores, as these reflect goods purchases that will be used to provide services in the future or can be sold for cash. • Cash and investments, as these can be used to purchase goods or earn interest income in the future.

Source: GAMAP

It needs to be pointed out that the new South African constitution also requires that the National Treasury develop and prescribe generally recognised accounting practices for all spheres of government. The Generally Accepted Municipal Accounting Policies (GAMAP) have been devised for municipalities in accordance with this constitutional requirement. These policies define for local government how they should set out and manage their accounts, and local governments will probably be required to institute these by 30 June 2002. One of the significant aspects of GAMAP is that it requires a comprehensive and accurate register of all the assets owned by the local government. The water infrastructure assets form a significant portion of the overall municipal assets.

An internationally recognised approach in asset valuations focuses on the productive capacity of the asset as a measure of its value. Five rather broad approaches are usually considered in asset valuation. Table 7.6 illustrates recognised standard asset valuation approaches recommended for application in preparation of an Asset Management Plan for community water services systems.

TABLE 7.6 : Summary on approaches to asset valuation

Asset valuation approach	Asset situation	Information needed	Examples
Reproduction cost	Not available in market but not technologically obsolete	Historical cost, price indices, current cost of reproducing	Dams, pump stations, water treatment plants
Replacement cost	Not available and technologically obsolete	Service potential, capacity, etc.	Water sewer reticulation, roads, etc.
Market buying price	Available in the market and up-to-date	Cost to purchase including the installation	Off the shelf items, e.g. pumps, etc.
Recoverable amount	Asset is in surplus but not yet at the end of its life	Net present value of future cash flows from the sales/ current market value	Asset no longer required or with inadequate return
Disposal value	Asset at end of its life and will not be replaced	Valuation for a disposal value/market value	Vehicles, plant and equipment, computers, etc.

Source: NZ Infrastructure Asset Management Manual (1996)

It has to be noted that there are two groups of assets which require special attention:

(i) newly purchased or created assets - they are initially valued at acquisition cost which should include cost for investigation, design and supervision.
(ii) physical assets received free of charge - they should have an acquisition cost of zero and can be revalued at current cost valuation, probably at replacement value.

For water infrastructure assets (i.e. water supply, sewerage, stormwater, etc.), current cost valuation is the best based on the replacement cost approach with the written down value considering percentage of effective asset life. The assets related to land, buildings, and plant and machinery, are usually written down according to the market value.

7.6 Asset condition assessment guidelines

It is assumed that for the South African water infrastructure assets situation, a simple approach will be sufficient for condition assessment. Both passive assets (e.g. trunk mains, pipe networks, etc.) as well as dynamic assets (e.g. pumps, plant and equipment) can be assessed according to five categories and condition as illustrated in Table 7.7. In following this method, it can be successfully determined if the asset condition is critical or not yet critical. The rank categories 4 and 5 given in the table are usually detailed in accordance with the importance of the asset to the water services authority/provider.

TABLE 7.7 : Ranking of asset condition

Rank	**Description of condition**
1	**Perfect/excellent condition** Only normal maintenance required
2	**Minor defects only** Minor maintenance required (5%)
3	**Backlog maintenance required** Significant maintenance required (10 - 20%)
4	**Requires major renewal** Significant renewal/upgrade required (20 - 40%)
5	**Asset unserviceable** Over 50% of asset requires replacement

Source: NZ Infrastructure Asset Management Manual (1996)

Subsequent to the ranking of asset condition, an asset with limited useful life should be depreciated on a regular basis (say once a year). The method suitable to use for asset depreciation is illustrated in Figure 7.3 below.

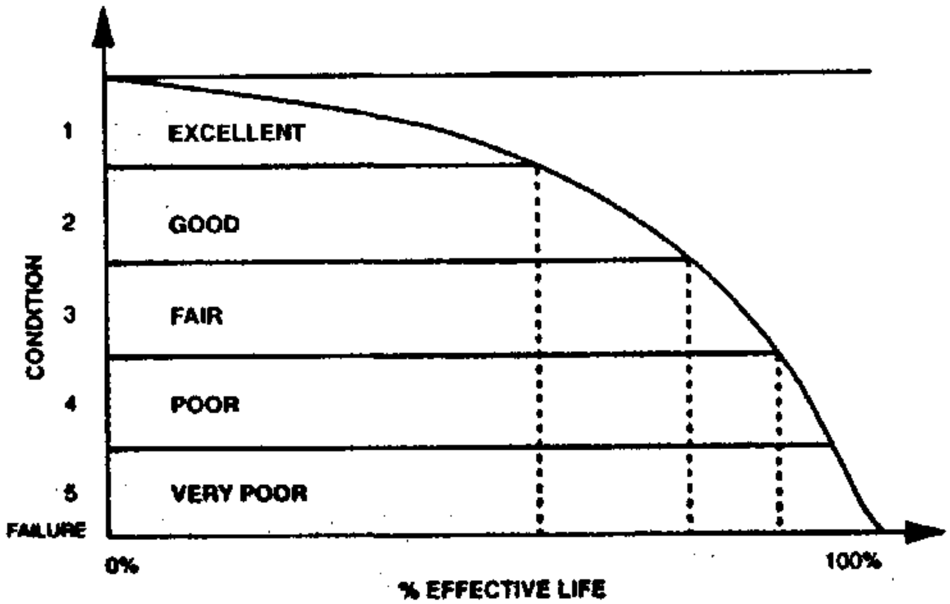

FIGURE 7.3 : Typical condition decay curve for infrastructure assets

Using straight line depreciation, the written down value (WDV) can be determined as follows:

WDV = (effective life - life to date) * replacement value / effective life

The values of effective life recommended for various water infrastructure assets are illustrated in Appendix A. However, various other sources, as for example GAAP and GAMAP, provide similar information.

7.7 The role of Asset Register in asset life cycle costing

The asset register development procedure and software produced under this research work are most valuable tools for a community water services system (CWSS) management. The assets identified, classified and evaluated in the Asset Register by means of available software enable to calculate the whole life costs of various water infrastructure assets owned or intended to be acquired by the CWSS. The total current costs of assets registered in the Asset Register will allow for the necessary calculations to be made. Practical examples of the asset whole life cost calculations are illustrated in Appendix B and Appendix. C.

7.8 Capacity expansion and prediction of demand for services

An adequate standard AMP requires next to the asset life cycle costing also good predictions of the demand for services leading to timely capacity expansion of water infrastructure. Taking into consideration the vast diversity of water services technological levels and socio-economic conditions within communities, the task of demand prediction for services is not an easy one. In most instances it is necessary to call upon qualified consultants to provide relevant expertise. This aspect is one of a few to be further researched and standard practices to be established.

CHAPTER 8 RECOMMENDATIONS

This research project identified numerous recommendations to highlight the need for various actions to be taken to implement standard asset management procedures in the South African water services sector. These are as follows:

1. The Water Research Commission should disseminate knowledge about asset management by means of an introductory booklet produced from this research project.

2. A series of workshops, supported by the WRC prior to the legal adoption of GAMAP, should be arranged with the purpose of introducing the standardised asset management approach and software to the managers of small and medium water services systems.

3. The process of asset management principles and methodology to be incorporated into the provision of Water Services Development Plans and subsequent improvement of the Integrated Development Plans as required by existing legislation should be supported by the DWAF, DPLG and SALGA.

4. It is recommended that an Independent Water Sector Regulator (IWSR) or Advisory Office be established to oversee inter alia formalisation process of asset registers for state-owned, parastatal and local government water infrastructure assets

5. All possible sources of the know-how in asset management planning in South Africa should be identified and encouraged by the IWSR or Advisory Office to pass on their knowledge by informing the small and medium water service authorities/providers (i.e. water committees and municipalities).

6. It is also recommended that if available local and international expertise in asset management is to be efficiently utilised, tertiary teaching courses to enhance standard approach but primarily to build-up capacity for advanced asset management planning should be introduced and funded.

7. Further detailed research of the asset management reports used by different departments across a fairly large number of water services systems in order to distil the elements and type of information that is common to all (e.g. benchmarking on performance assessment, risk standards and upgrading).

8. Tertiary educational institutions should promote and research asset management methods suitable for the South African water services sector. The aim will be to provide nation-wide support in asset management to the water services industry.

9. Further research should be conducted in line with asset management theories and methods adopted according to several water services delivery models introduced in the public-private partnerships, particularly through implementation of the BOTT contracts by the DWAF. To date known contract models are as follows:

   - Revised BOTT model (i.e. public/private partnership)
   - Local Government/District Council model (i.e. public/public partnership)
   - Partnership/Water Board model (i.e. existing partnership/board)
   - Community/NGO model

- Groundwater model (i.e. specific private/community partnership in the North-West Province)
- Emerging contractor model

10. Use of the Asset Management software to prepare a decision support system for smaller authorities, including the extent of public/private participation.

Further numerous specific issues to be researched are related mainly to the methods of evaluating the condition and performance of installed assets, critical and non-critical assets, methods of obtaining for investments needs, payment and non-payment of services, and community involvement and consultation.

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APPENDICES

A to D

APPENDIX A : Recommended values of useful life for assets of a typical Water Services Authority/Provider

Type of asset		**Useful life (years)**
General assets	Buildings	50 - 100
	Houses/toilet blocks	50 - 100
	Access roads:	
	Unsealed surfaces	-
	Wearing surfaces	20
	Bridges	38 - 80
	Culverts	10
Water assets	Storage reservoirs/dams	20
	Treatment plants: Civil	60 - 70
	Mechanical/electrical	15 - 25
	Trunk mains	65 - 95
	Service reservoirs	50 - 80
	Pumping station: Civil	60 - 70
	Mechanical/electrical	25
	Reticulation mains	65 - 95
	Telemetry	10
Wastewater assets	Reticulation mains	70
	Manholes	20 - 50
	Trunk mains	90 - 100
	Pumping stations: Civil	50
	Mechanical/electrical	15
	Rising mains	
	Treatment plants: Civil	50
	Mechanical/electrical	15 - 25
Stormwater assets	Drains (underground)	50 - 80
	Culverts	50 - 80
	Manholes	20 - 50
	Detention dams	50 - 100
	Pumping stations: Civil	50
	Mechanical/electrical	25

APPENDIX B : Practical example of asset valuation for a service reservoir (2 Ml)

Date constructed: 1979

Attribute	**Facility**	**Asset**
Reproduction/replacement value	R1,75 million	R1,75 million
Effective/useful life	60 years	
Life to date	20 years	20 years
Written down value	R1,165 million	R1,010 million

Asset	**Value (R1 000)**	**Effective life**	**Written down value (R1 000)**
Land	60	-	60
Earthworks	100	-	100
Access road	120	35	52
Foundation	120	100	96
Reservoir floor	480	80	210
Reservoir walls	460	60	306
Reservoir roof and ventilation	280	40	93
Valves and pipework	150	40	75
Level control valve	52	25	10
Telemetry	35	15	-
Landscaping	50	20	-
Fencing	60	25	12
TOTAL	**1 750**	**47,3 (wt. av.)**	**1 010**

APPENDIX C : Practical example of life cycle asset costing : pumping station (very small system)

Capital cost: R120 000
Interest/opportunity cost: R120 000 @ 6% = (ANNUAL COST) **R7 200**

Depreciation:

Asset	**Estimated cost (Rand)**	**Estimated life (yrs)**	**R/p.a.**
Civil works	60 000	50	1 200
Electrical	15 000	15	1 000
Mechanical	30 000	20	1 500
Telemetry	15 000	10	1 500
ANNUAL COST			**5 200**

Operating cost:

Item	**Quantity**	**Rate (Rands)**	**Amount (Rands)**
Labour	2 hrs/week	30	3 120
Materials	sum	1 000	1 000
Licences	sum	600	600
Power	12 months	200	2 400
ANNUAL COST			**7 120**

Maintenance cost:

Item	**Estimated cost (Rands)**	**(%)**	**Amount (Rands)**
Civil	60 000	3	1 800
Electrical	15 000	3	450
Mechanical	30 000	3	900
Telemetry	15 000	3	300
ANNUAL COST			**3 450**

Rehabilitation cost: Funded from depreciation provision
Decommissioning: R20 000 at 50 years period **R 400**

TOTAL COSTS **R23 370**

APPENDIX D : Recommended contents of a more advanced Asset Management Plan

The following framework of contents is recommended to be considered as more advanced to a standard AMP. The recommended modules are based on international and local research and the recommended contents should be used in consultation with relevant AM consultant in the compilation of an AMP. Recommended modules are as follows and should be read in conjunction with Table 2.3 of this report.

A. Introduction

A.1 Background

- Purpose of the plan
- Relationship with other planning documents
- Assets covered
- Key stakeholders in the plan

A.2 Goals and objectives of asset ownership

- Reasons and justification for asset ownership
- Links to organisation vision, mission, goals and objectives

A.3 Plan framework

- Key elements of the plan

A.4 Basic and advanced AM

- Outline basic to advanced approach
- Sophistication/limitations of this AMP

B. Levels of service

B.1 Customer research and expectations

- Background and customer research undertaken
- Details of how research translates into levels of services

B.2 Strategic and corporate goals

- Organisation strategic goals and impacts on AMP

B.3 Legislative requirements

- Background legislation or regulations which affect asset operation or require certain levels of service (i.e. Resource Management Act, Local Government Act, Resource Consents, etc.)

B.4 Current level of service

- Define current levels of service being provided by the asset
- Identify related performance measures

B.5 Desired level of service

- Provide details on the level of service desired if different from what is currently being provided

B.6 Gap analysis
- Provide details of differences between 'current' and 'desired' levels of service

C. Growth forecasts

C.1 Demand management plan
- Describe non-asset solutions available as alternatives to asset based solutions (i.e. demand management, insurance, managed failures)

C.2 Demand forecast
- Details of projected growth or decline of demands on services
- Anticipated changes in customer expectations
- Demand management initiatives

C.3 Changes in technology
- Use of new technology and effects on providing future services
- Obsolescence

C.4 Capital works programmes
- Summarise capital works programmes, and costs

D. Asset management system

D.1 Accounting systems
- Details of accounting system and any changes as a consequence of the AMP
- Define differences between maintenance, renewal and capital expenditure
- Provide details of accounting standards/guidelines that must be complied with
- The guide to Generally Accepted Municipal Accounting Policies (GAMAP)

D.2 Asset management systems
- What type of data is available on assets to help AM decision making?
- What is the quality/reliability/adequacy of the data?
- Is any software used to store and analyse asset data?
- Where is the information stored?
- How often is the information collected?

D.3 Information flow requirements and processes
- What are the key information flows to and from the AMP?
- What processes are used to make decisions on AM, replacements/renewals and acquisitions?
- Is there a formal project ranking system?
- How is the best decision made?
- Does it take into account:
  - risk cost?
  - life cycle costs (NPV)?
  - Performance prediction?
  - Optimised renewal decision making (ORDM)?
- How can existing processes be improved?

D.4 Standards and guidelines

- What are the key standards and guidelines which influence AM attributes?

E. Life cycle management plan

E.1 Physical parameters

- General comments on asset mix, age, size, material, location, etc.
- Summary of total asset parameters in table or graphical formats, i.e. age, distribution, size, etc.
- Include an overall plan of asset system or network
- How to obtain part by part asset information (i.e. database)

E.2 Asset capacity/performance

- Design capacity, actual measured capacity and current utilisation of assets
- Summary of details and statistics (i.e. percent and distribution of assets under capacity – if known)
- Refer to location of detailed information (i.e. computer modes, calculations and analyses)
- Asset capacity deterioration graphs and failure modes

E.3 Asset condition

- Summary of current asset condition based on best information currently available
- Brief details on how condition is monitored
- Age profile graphs

E.4 Asset valuations

- Current asset replacement valuation summary
- Description of valuation method
- Details of historical valuations

E.5 Historical data

Summary of type of historical data available and location
Relevant financial information (historical expenditure)

E.6 Routine maintenance plan

It must be noted that routine maintenance is the regular ongoing day-to-day work necessary to keep assets operating, including instances where portions of the asset fail and need immediate repair to make the asset operational again.

(i) Maintenance plan

- Tends (i.e. spending, complaints) and analysis
- Current and past LOS
- Maintenance decision making process (planned and unplanned)

(ii) Standards and specifications

- Define materials, methods, service standards to meet required LOS
- Risk associated with alternative standards

(iii) Maintenance needs, costs and timing

- Forecast of planned maintenance work

- Forecast magnitude of unplanned maintenance (reactionary work)
- Cash flow forecasts of costs

(iv) Deferred maintenance
- Note any maintenance deferred
- Risk analysis (i.e. risk and long-term effects of deferral)

(v) Funding strategy
- Outline how maintenance will be funded

E.7 Renewal/replacement plan

N.B. Renewal expenditure is major work which does not increase the assets' design capacity but restores, rehabilitates, replaces or renews an existing asset to its original capacity. Work over and above restoring an asset to original capacity is capital expenditure.

(i) Renewal plan
- Identify how replacements/renewals are identified and to what standards they are replaced (i.e. modes of failure, options for treatment, risk)
- End of life projections
- Renewal decision making process

(ii) Renewal standards
- Define materials, methods, service standards to meet required LOS
- Risks associated with alternative standards

(iii) Replacement needs, costs and timing
- Forecast programme of replacements
- Cash flow forecast of costs

(iv) Deferred renewals
- Note any renewals that are deferred
- Risk analysis (i.e. risks and long-term effects of deferral)

(v) Funding strategy
- Identify how replacements will be funded

E.8 Creation/Acquisition/Augmentation Plan

(i) Selection criteria
- Formal procedure to rank asset creation/acquisition projects

(ii) Standards and specifications
- Define materials, methods, design standards to meet LOS
- Risks associated with alternatives

(iii) Forecast acquisition needs, costs and timing
- Forecast future needs for acquisition and/or purchase of infrastructural assets based on demand forecasts
- Cash flow forecast

(iv) Funding strategy
- Total cost of acquisition proposals
- Cost apportionment, i.e. transit, developers, TLA, etc.

E.9 Disposal plan

(i) Forecast disposal needs, costs and timing
- Forecast future disposal assets including timing and costs

(ii) Financial requirements
- Cash flow forecast of income from asset disposal
- Cash flow forecast of expenditure
- Source funding for expenditure
- Destination of disposal proceeds

F. Financial summary

F.1 Financial statements and projections

These should be prepared for at least 10 years and include:
- Cash flow forecasts by year
- Breakdown of expenditure by service area (i.e. pavements, footpaths, bridges, etc.)
- Breakdown of expenditure into routine maintenance, renewal and capital expenditure
- Trends from the previous 2-3 years

F.2 Funding strategy
- Provide details of how expenditure will be funded
- Do you plan to smooth out any variations in cash flow?

F.3 Valuation forecasts
- Forecast of future value of asset
- Details of any depreciation due to deferred maintenance or renewals
- Provide details of valuation methodology

F.4 What are the key assumptions made in financial forecasts and how good are these assumptions?

G. Improvement and monitoring planning

G.1 Performance measures
- Outline of performance measures for the AM system
- How will the effectiveness of the ASMP be measured?

G.2 Improvement programme
- Details of actions proposed and timetables for improving accuracy and confidence in AMP indicating responsibility for each action
- Details of resources required to implement the improvement programme

G.3 Monitoring and review procedures

- Procedures and timetable for performance reporting (3 yearly review of AMP)
- Timetable for external audit and review (or process, data integrity, level of service)

H. Specific issues

H.1 Legislative requirements

- Water Services Act (Act 108 of 1997)
- National Water Act (Act 36 of 1998)
- Other legislative requirements

H.2 Industry initiatives and reforms

- Organisation adjustment proposals to reforms

H.3 Technological advancement

- Organisation adjustment to technological changes

I. Addendum

Appendices may include:

- Levels of service review/market research
- CAPEX programmes
- Relevant legislation
- Financial information
- Asset data (condition, valuation, etc.)
- Relevant strategic/tactical plans
- Demand management strategies
- Operating procedures
- Emergency response plans
- Contract information

APPENDIX E

User Guide to the IMPAHLA Software

APPENDIX E : User Guide to the IMPAHLA Software

CONTENTS

MOTLHABE VILLAGE EXAMPLES

TABLES

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USER GUIDE TO THE IMPAHLA ASSET MANAGEMENT SYSTEM (IMPAHLA)

1 *INTRODUCTION*

The IMPAHLA Asset Management System (hereafter referred to as Impahla) is a guide intended to help organisations to set up an asset management system, and to implement the asset register using Impahla. Sections 1 to 7 of this document explain what asset management is, why it is useful, and the steps that are required to set up an asset register. Section 8 explains how to use the Impahla software to implement a default asset register. This will include information on how to capture the necessary data using the default asset and event types and functions, and how to output the default reports. Section 9 explains how to customize the Impahla software for use in situations where the defaults are not adequate.

In order to help explain the concepts in this guide, reference will be made to an example system, which will be appear in a boxed format.

Box 1 Example - Motlhabe Village

Introduction

Motlhabe Village is a rural community of about 4 600 people in the Northwest province. Their small, stand-alone, water supply system consists of the following.

- Two boreholes with two diesel driven pumps.
- 4.2 kilometres of rising main
- An elevated storage tank.
- 16 kilometres of distribution pipe work.
- 43 Standpipes

The reason this particular example was chosen is twofold. Firstly, a simple example makes it easier for the reader to understand the points being explained. Secondly, a simple system was chosen to show that asset management is not only the responsibility of large institutions with strong resources, but that it can also be achieved by the very smallest as well.

2 WHAT ARE ASSETS?

In this context the definition of 'assets' is very broad. Anything that is used by an organisation in order for it to achieve its function can be considered an asset of the organisation. This will include a number of different types of assets, some more obvious than others. Table 1 below, lists and describes each Asset Type.

Table 1: Asset Type and Description

Type of Asset	Description
Fixed Assets	Assets which the organisation will keep for more than one year.
Movable Fixed Assets	Fixed assets which are mobile, or can easily be moved around, such as vehicles or office furniture.
Non-Moveable Fixed Assets	These are fixed assets which are permanent and cannot me moved with ease, such as land, buildings, pipes and pumps.
Current Assets	These are assets which have a short life which the organisation will keep for less than a year, such as financial investments, cash on hand, and any stock that the organisation may hold before selling it.
Information	Software and information stored with the organisation either stored on paper in a filing cabinet or on a computer system.
Knowledge, Experience, Expertise	The knowledge and expertise developed by the organisation that gives value to the organisations in its current position.
Organisational Staff	The people who work for the organisation, their level of training, competence and knowledge.
Customers	The people being served by the organisation who are the organisation's main source of revenue.

Box 2: Example - Asset Types

Asset Types in Motlhabe

Asset Type	Asset in Example System
Moveable Fixed Assets	The system operator in Motlhabe has a bicycle and a small set of tools and spares which he uses to perform his duties.
Non-Moveable Fixed Assets	Consist of two diesel pumps, about 4,2 km of rising main, a storage tank, about 16 km of distribution pipework, and 43 standpipes.
Current Assets	The Motlhabe Community has R15 000 saved from water tariffs which is invested with a local bank.
Information	The Motlhabe community has no computers, but they do have written records of their assets, which is in itself an asset.
Knowledge, Experience, Expertise	The water system is managed by a Project Steering Committee drawn from the local community. These people attended formal training for six months, and the knowledge they have gained both from this training and 'on the job' experience is an asset of the organisation.
Organisational Staff	These are the chairperson, the secretary, the treasurer, the bookkeeper, and two system operators.
Customers	These are approximately 2000 people who use the public stand pipes daily, and who pay the organisation for the up keep of the system.

All of these things can help an organisation do its job in a better way if they are well managed. Good management of assets enhances community life, and increases the useful life of available resources. These things can also make it difficult for an organisation to function properly if they are badly managed.

How then should an organisation manage its assets to achieve maximum value? Answering this question is the goal of asset management.

3 *WHAT IS ASSET MANAGEMENT?*

Asset management can be broken down into two main components.

1. Creating an asset register or inventory of assets defining exactly what assets are owned by the organisation.
2. Creating a plan detailing what the objectives of asset management should be and how these objectives should be achieved.

Impahla is primarily an asset register application.

3.1 Asset Registers

In its simplest form an asset register is just a list of all the assets owned by an organisation. Small organisations sometimes rely on a few people to remember the details of the assets owned by the organisation. This is inadequate and some form of asset register must be used.

Large organisations often have many different lists; for example, the finance department might have a list of the value of all the assets, while the maintenance department might have a list of when certain assets need to be serviced. Problems arise in that these lists usually don't agree, leading to doubt as to what information is actually correct. Additional problems arise because all the information is not kept together in a central location.

3.1.1 Selecting which assets to include on the asset register

It is not feasible for an organisation to include every single thing it owns on the asset register. Ultimately, the value of the information recorded must be greater than the cost of obtaining and maintaining it. Three basic levels of which assets to include in the register are prescribed.

- Low Level: Includes physical assets only, assets which are critical to the functional operation of the organisations core activities only. These are assets which are used continuously.
- Moderate Level: This level of asset registration, includes all critical assets as well as the assets supporting the organisations critical functions. These are assets which are used continuously and assets which are used part of the time.
- Complete Level: This level of asset registration includes all assets that the organisation owns currently being used or not.

It is recommended that an organisation starts with a low level of asset registration, and only once the system is running effectively, then expand to higher levels of asset registration.

When deciding which assets to include in the register the organisation should consider the following when looking at each asset type:

- The value of the type of asset to the organisation.
- The information required to effectively manage that type of asset.
- The cost of obtaining and maintaining the required information.

3.1.2 Updating the Asset Register

In order for the managers of the Asset Management System to be able to make informed decisions, the information in the database must be kept up-to-date and reflect all significant changes in the condition of an asset. Obtaining information about these changes can be approached in two ways.

- Periodic surveys of the assets
- Ongoing capturing of changes whenever they occur

The advantage of using periodic surveys of assets is that it is not necessary to maintain information about every change that occurs to the asset, but rather the net result of a number of small changes is recorded when the survey is done. The disadvantage is that regular, usually relatively expensive, surveys are required, and that the data in the register is only as current as the date of the last survey.

Ongoing capturing of changes has the advantage that the register is always kept up-to-date. It also has the advantage that trends in the performance or condition of the assets can be tracked and analysed. The main disadvantage is the fact that this requires recording a relatively large amount of data in the register. However, most institutions already record data regarding most changes to their assets such as maintenance or repair work.

Sometimes, it is not possible to record the individual changes, and surveys are the only way to keep the database up-to-date. For example, a large urban local council uses closed circuit TV to perform surveys of their sewer pipes. The deterioration in pipe condition cannot be monitored on an ongoing basis so surveys must be used. However, they also record events such as maintenance call-outs on sewer pipes each time they occur. This information gives them an indication of the relative condition of the sewers, and they can then schedule their surveys to examine the sewers with the highest rate of maintenance call-outs first.

Recommended Option

It is recommended that a combination of the two approaches be used. Changes to assets should be recorded on an ongoing basis wherever possible, and surveys should be used to establish the condition of the assets whenever asset performance is below par.

3.1.3 Information to be recorded in the Asset Register

3.1.3.1 Physical Information

For an asset register to be useful, it has to contain enough information on each asset so that the asset can be effectively managed. As a minimum the following information about each asset should be contained in the asset register:

- Unique Name and Identification Code. Each asset must have a unique name that clearly identifies the asset throughout the entire organisation. (See Section 7.6.1 for the Identification system that Impahla uses.)
- Asset Data. There should be a basic set of data that is the same for all the assets within the organisation. There must also be recorded a measure of the accuracy of the

information that is currently held on each asset. The minimum amount of data for each asset must include the following:

- Location
- Age
- Assessed Value
- Performance
- Capacity
- Condition

- Additional Asset Information. The register should also record for each asset any information over and above the basic set of data that is necessary to effectively manage the asset. This data will generally relate to operation of the asset and will be user defined. For example: Date of last service, Asset Utilization, et cetera.

The information required for each asset will be dependent on the type of asset. For example, with a pump, the pressure and flow ratings would be required, whereas for a car engine size and kilometres travelled would be relevant. Also, the way in which the asset's value, performance, condition and risk are measured will be different for each type of asset. Impahla defines both the minimum required asset data and a number of standard asset types, including definitions of the extra information for each asset type.

Box 3: Example - Physical Information to Record

<u>Motlhabe Village Physical Asset Information</u>

Example of the assets in Mothlabe that are recorded, and the information about each assets physical condition. (Refer to Section 6.1, Decide on an Identification and Classification System, to understand the Assets Identification Code,Specifically Refer to Box 8)

Asset Name and Identification Code	Location	Age	Assessed Value	Performance	Capacity	Condition
Diesel Pump #1 ID Number: NCMM – WPP – BP – 001	On Borehole #1 Corner Mopani and Mbeni Street.	Commis-sioned in 1997	R 10 000	Currently pumping 20 kl per day over 5 hours.	Maximum specified = 4 kl per hour	As new
Diesel Pump #2 ID Number: SASS – WRP – BP – 001	On Borehole # 2, At Acacia Secondary School	Commis-sioned in 1991	R 2 000	Currently pumping 10 kl per day over 5 hours.	Maximum specified = 4 kl per hour	Running at 50% of capacity, needs attention.
Rising Main # 1 ID Number: NBHT – WPP – PS – 001	From Borehole # 1 to Reservoir #1.	Commis-sioned in 1985	R 15 000	Currently carries 20 kl per day. Losses = 25%	Capacity = 4 kl per hour	Aged and rusting, several leaks, needs attention.

3.1.3.2 Event Information

Event Asset Information is data that indicates changes in the condition or performance of the asset. Impahla defines a number of standard event types that can be used to record events that affect the performance, condition or value of the assets. The user can also create custom event types.

Events require the monitoring of two basic types of information:

- Information common to all events (typically the asset ID to which the event occurs, and the date and time of the event)
- Information specific to each type of event. This information is naturally dependent on the type of event.

For example:

A pipe leak event would include common information (i.e. the pipes ID number, the date and time of the leak) and specific information (i.e. the type of leak, the size of the leak and the time required to repair the leak).

A meter reading event's specific information would be just the meter reading at the time the event occurred.

An example of an event that indicates a change in the condition of an asset would be a maintenance event. Most institutions already record maintenance event information in the form of a job-card and an action report, so no new information would need to be recorded. These are often captured into a Maintenance Management Tool, so to record this information in the asset register would only require linking the Maintenance Management Tool with the Asset Register.

An example of an event that could indicate a change in the performance of an asset is a regular water quality sample. If this shows deterioration in the water quality, then the performance of the purification plant might need attention. Again, these events are usually recorded by most water service institutions, so no new information would need to be recorded; it would just need to be linked into the asset register. Ideally, the asset register would be the central repository for all data regarding the assets and the events that affect them for the entire institution. Different reporting modules would then be used to extract maintenance, or water quality, or billing information, etc.

As mentioned earlier, asset management is not only the responsibility of the large water services institutions, but also that of small institutions. Motlhabe Village uses an entirely manual, paper-based asset management system. The asset register consists of a small filing system with a file for each type of asset, in which all the relevant information is stored.

Box 4: Example - Event Information to Record

Mothlabe Asset Event Information

At Motlhabe Village monitoring of the events that affect the assets takes place by means of pre-printed logbooks. Extracts from the Daily and Monthly Meter Reading Logbook follow.

Date	Water Tank		Fuel Tank		Motor	
	Start Level (m)	End Level (m)	Start Vol. (l)	End Vol. (l)	Start Time	End Time
15/02/1993	1.2	2.5	25	18	8:00	10:30
16/02/1993	1.35	2.8	18	11	7:30	9:45

Daily Pumping Logbook

Date	Meter 1		Meter 2	
	Reading (m^3)	Consumption (m^3)	Reading (m^3)	Consumption (m^3)
31/01/1993	10159	324	00587	256
28/02/1993	10463	304	00874	287

Monthly Meter Reading Logbook

The register and these logbooks would provide a basic level of asset management information that allows the Project Steering Committee that manages the example Village Scheme to monitor and effectively manage their assets.

For example, using the Daily Pumping Logbook, the system operator of the example village regularly calculates the efficiency of the system pumps, and the fuel consumption of the diesel motors. If these values begin to decline, it indicates that maintenance is necessary on the equipment. This information can then be used schedule maintenance and to plan how much to charge the consumers in the following year.

The asset register by itself is not particularly useful to an organisation. It must be kept up-to-date, and it must provide useful information to the organisation.

An Asset Management Plan draws on the information in the Asset Register in order to effectively plan the management of the organisations assets.

3.2 Asset Management Plan

The Asset Management Plan (AMP) is the set of rules and procedures that govern the creation, use and maintenance of the asset register and its information. It will include elements like who is responsible for the collection and maintenance of data. This will be different for different types of assets and for different types of data. The AMP will also govern who has access to which data. This will be much broader access for reading data than for modifying data. Typically an AMP would allow only the maintenance department to modify data on the condition of a pump, but would allow anyone in the organisation to view that information.

Box 5: Example - Information Access Levels

<u>Motlhabe Village Data Access Levels</u>

- At Motlhabe Village only the System Operator, or the standby operator should be allowed to fill in the system logbook.
- In order to make significant changes to past log book records the System operator should gain authority from the Project Steering Committee.
- Any community member who uses the system should be allowed access to view the log book records, and system information.

At our example village, for instance, only the system operator, or the stand-by operator should fill in the logbooks, or make changes to the information in the asset register files, but anyone in the community should be able to view the information.

The AMP must also lay down policies and procedures for maintaining the information in the asset register. The asset register, and the AMP based upon it is only as good as the information stored in the register. If this information is not maintained then it will quickly become out-of-date, redundant and possibly misleading. The data in the register is also an asset of the organisation, and as such the value, performance, condition and risk associated with the register must be measured and recorded.

The AMP will also include financial planning based on the values of assets as recorded in the asset register. This will include short term plans to meet shortfalls in the performance and condition of various assets or types of asset, as well as longer term plans to meet the growth in demand for services, repair and replacement of assets as they deteriorate with time, etc.

Asset management plans are not static, but they evolve with the organisation. As the organisation becomes more familiar with the Asset Management Plan, and as more detailed data on the assets becomes available, so the plan should become more detailed and more accurate.

For more information on Asset Management Planning, please refer to the main section of this report.

4 BENEFITS OF AN ASSET MANAGEMENT PLAN

Accurate and efficient asset management will help any organisation in two main ways, namely the provision of financial and management benefits, and by helping the organisation comply with its legal requirements. These are discussed in detail below.

4.1 Financial and Management Benefits

The main reason for implementing Asset Management is the financial and management benefits that it will deliver. An example of the financial benefits that can be realised by effectively managing the assets of an organisation is the management of water meters. It is only through the accurate metering of the water delivered to its customers that a water supply organisation can provide the required level of service, thus it is vitally important that the meters are effectively managed. To manage the meters effectively it is necessary to know how much water has passed through each meter, when the meter was last serviced, when the meter was last calibrated and what the results of the calibration were. By keeping a record of the calibration results of each meter the organisation can estimate the time it takes for meters to go out of calibration, and therefore, how often they should be recalibrated.

Most water supply organisations do calibrate and service their meters regularly, but they generally have no idea if they are doing it too often, and wasting money on calibration, or doing it too seldom, and wasting money on inaccurate meter readings. It is only through an accurate and up-to-date register of meters, which includes information about service and calibration history that an analysis of the optimum calibration frequency could be carried out. This register will also tell the organisation when the meters are next due for calibration, and how much money should be planned for the replacement of meters.

By relating the meter information to other information on, for instance, the water quality in different regions of supply, the organisation can also analyse the effect of water quality on the service life of different types of meters. This kind of analysis is necessary to achieve 'best practice' management of an organisation, and is only possible with accurate data.

Box 6: Example - Management Benefits

Motlhabe Village Asset Management Benefits

The simple logbooks used by the Motlhabe Village System can provide the following asset analyses and management information. (Examples of these logbooks are given in Box 4, in Section 3.1.3.2 Event Information)

- The volume pumped versus time taken can be used to calculate the pump efficiency, a decrease in which would indicate that maintenance is required.
- The fuel consumption information can also be used to calculate the efficiency of the diesel motor.
- The volume of water pumped each day can be reconciled with the monthly meter readings to check that there are no leaks in the system, or other sources of unaccounted for water such as illegal connections, inaccurate meters, etc.
- The volume of fuel used can also be reconciled with the amount purchased to ensure that all fuel is accounted for.

The calculations required for these analyses would require only a very basic level of mathematical skill, and could thus be taught to the system operator. The information produced would help the community to effectively manage their water system.

4.2 Legislative Benefits

The Water Act No. 54 of 1956 and its numerous amendments were recently replaced by two pieces of new water legislation, namely the Water Services Act No. 108 of 1997 and the National Water Act No. 36 of 1998. Both acts contain extensive requirements for consultation by the water services authorities and providers with water users and stakeholders. These authorities are also responsible to the general public and to government to provide water services in the most cost effective and sustainable manner possible.

Standard asset management practices are currently being implemented in many countries across the world. The local governments in Australia, New Zealand and the United Kingdom are the leaders in implementing and standardising asset management programmes. At present the legislative requirements in the South African water industry call for the provision of Water Services Development Plans by water services authorities and water services providers. These plans are equivalent to basic Asset Management Plans and are designed to meet the minimum requirements for services and financial planning. However, a proactive Water Services Institution should adopt a more advanced Asset Management Plan, which could be used to generate the Water Services Development Plan required by government.

The new South African constitution also requires that the National Treasury develop and prescribe generally recognised accounting practices for all spheres of government. The Generally Accepted Municipal Accounting Policies (GAMAP) have been devised for municipalities in accordance with this constitutional requirement. These policies define for local government how they should set out and manage their accounts, and local governments will probably be required to institute these by 30 June 2002. One of the significant aspects of GAMAP is that it requires a comprehensive and accurate register of all the assets owned by the local government. If the local government already has an asset management plan in place, it will be simple to export the necessary information from the general asset register to create the register required by GAMAP. If however, the organisation does not have an asset register in place, it would be an ideal time to create a full asset register when creating the register required by GAMAP.

5 *HOW TO IMPLEMENT ASSET MANAGEMENT*

Because Water Services Institutions vary so widely, it is practically impossible to say what a 'Standard' Asset Management Plan should be. However, the preparation of an Asset Management Plan should include at least the following essential steps. Note that these steps are not necessarily sequential. You can do more than one of the steps at the same time, and sometimes you will have to come back to a step and refine the results.

1. Contact an asset management professional who can advise you on Asset Management, and the creation of Asset Management Plans.

2. Establish the Goals, Objectives and Framework of the AMP.

3. Establish what asset management processes and data acquisition methods currently exist, and are required.

4. Determine what level of AMP is required, based on the level of services and assets controlled by the institution.

5. Establish what levels of service are required, based on customer expectations, and willingness and ability to pay for services.

6. Prepare an Asset Register, including conditions, performance measures and valuations. How Impahla can be used to do this is discussed in detail in the following section.

7. Evaluate existing levels of service, and compare with required levels to determine gaps.

8. Examine demand management plans and prepare demand growth predictions.

9. Determine required capacity expansion based on demand growth predictions, service level gaps and available resources.

10. Prepare a financial summary, including financial forecasts, funding strategies and valuation forecasts.

11. Prepare an AMP improvement programme including performance measures for the plan itself, and monitoring and review procedures.

This last step mentioned indicates that the AMP is not a static document. It is a 'living' tool that needs to be constantly reviewed and updated as the institution grows and develops.

6 *SETTING UP AN EFFECTIVE ASSET REGISTER*

Any Asset Management Plan as discussed above is entirely dependent on an accurate and up-to-date knowledge of all the assets owned and used by the organisation. Having an effective Asset Register best provides this knowledge. The sections below discuss the major steps required to set up an effective asset register. Some of these steps will be repeated, for instance, when listing all the types of assets it may become obvious that the identification system is slightly inadequate and will have to be extended. Also, it may not be necessary for every institution to perform all these steps, as it may be possible to reuse some information between different organisations. The steps discussed below are general, and not related to any specific tool used to implement the register. However, reference will also be made to how the IMPAHLA Asset Management System can be used for each of the steps.

6.1 Decide on an Identification and Classification System

Because it is so necessary for each asset to be uniquely identified the development of a comprehensive and detailed classification and identification system is the first step. The simplest form of identification system is just to give each asset a sequential number. This is easy to implement, but gives the users no information about what type of asset a particular number refers to.

A more useful form of identification classifies each asset according to one or more criteria, and then assigns a code to each classification. An individual asset's identification number is then made up of the classification codes, and a sequential number to distinguish it from any other assets that are identically classified. An example of a classification system may be to classify assets according to their physical location, their type and their function or cost centre within the organisation.

Impahla uses a three criteria classification system. Each asset is classified according to its location, its function and its type.

$$\mathbf{RSSS - S_1S_2S_3 - T_1T_2 - N_1N_2N_3}$$

The asset numbers are thus made up as follows:

The first four letters (**RSSS**) in the asset identification number indicate where the asset is, or where it is based if it is a moveable asset. This tells the user where the asset is. The **R** indicates the Region, and the **SSS** indicates the specific site within that region.

<u>Definitions</u>

Region: A region is a geographical area within the Water Service Institutions area of jurisdiction. The WSI could divide up its jurisdiction into regions according to different suburbs, major roadways, or natural geographical characteristics (e.g. mountains rivers etc.).

Site: A site is a specific location within a region. This could be a specific pump station or reservoir location.

Box 7: Example - Regions & Sites

Regions in Motlhabe Village

Motlhabe Village has a stream that separates the village into a Northerly and Southerly region. Hence in the Motlhabe system all the assets Identification Codes begin with either a 'N' or a 'S', indicating whether they lie on the Northerly or Southerly side of the stream.

Sites in Northern Region of Motlhabe Village

The location of the Borehole Pump on the Corner of Mopani and Mbeni Streets, and the location of the reservoir on the hill top just on the edge of the village both represent sites within the northern region of Motlhabe Village

The next three letters (**$S_1S_2S_3$**) indicate the functional system to which the asset belongs. This tells the user what the asset does. Impahla defines a hierarchical classification system where **S_1** indicate the first level, **S_2** the second and **S_3** the third level. Some examples of default functional systems are shown below:

TABLE 2 : Hierarchical classification of assets

Level 1		**Level 2**		**Level 3**	
Code (S_1)	Description	Code (S_2)	Description	Code (S_3)	Description
W	Water Supply System				
		P	Potable Water		
				G	Gravity Supply System
				P	Pressurised Supply System
				S	Potable Water Storage
W	Water Supply System				
		R	Raw Water		
				P	Pressurised Raw Water System
				S	Raw Water Storage

The next two characters (T_1T_2) define the asset type. They tell the user what the asset is. Again, Impahla defines a hierarchical classification system with two levels to define the asset types, where T_1 indicates the first level and T_2 the second. Some examples of default asset types are shown below:

TABLE 3 : Definition of asset type

Level 1 Code (T_1)	Level 1 Description	Level 2 Code (T_2)	Level 2 Description
B	Borehole pumps		
		M	Manual
		P	Powered
F	Flow Meters		
		B	Bulk Flow Meters
		S	Standpipe Flow Meters
M	Motors		
		D	Diesel Motors
		P	Petrol Motors
P	Pipelines		
		P	Plastic Pipes
		S	Steel Pipes
S	Water Sources		
		B	Borehole Water Source
		P	Purchased Water
T	Storage Tanks		
		D	Diesel Tanks
		P	Petrol Tanks
		W	Water Tanks

The last three numbers ($N_1N_2N_3$) are used to distinguish between assets that have identical classifications for the location, system and type criteria. An example of where this would be necessary is three identical pumps in a single pump station. All three exist at the same site and are of the same type. They are also doing the same job, so their classifications would be identical. They must thus be assigned different numbers so that they can be told apart in the register.

Box 8: Example - Asset Identification Codes

Motlhabe Village Asset Identification Codes

Asset Name and ID	Breakdown of Asset Identification Code				
	Region	Site	Functional System	Asset Type / Description	Item number.
Diesel Pump #1 ID Number: NCMM – WPP – BP – 001	N (on Northern side of the village)	CMM (corner Mbeni and Mopani roads)	W = Water Supply P = Potable Water P = Pressurised Supply System	B = Borehole Pump P = Powered	001
Diesel Pump # 2 ID Number: SASS – WRP – BP – 001	S (on southern side of village)	ASS (Acacia Secondary School)	W = Water Supply R= Raw Water P = Presurised System	B = Borehole Pump P = Powered	001
Rising Main # 1 ID Number: NBHT – WPP – PS – 001	N (on Northern side of the village)	BHT (From Borehole to hilltop reservoir)	W = Water Supply P = Potable Water P = Pressurised Supply System	P = Pipeline S = Steel	001

6.2 Determine Boundaries for the Identification System

Once the classification system has been decided upon, it is necessary to determine exactly what types of assets fall into which class, and to assign a code to each class.

Impahla classifies assets according to their type, function and location. The types of assets that fall into each of the default classes defined by Impahla are specified within the program. The program also makes available a set of default function classifications that can be used by any organisation.

The location classifications will, however, have to be local to each institution. Each institution would thus have to decide on the exact boundaries of each region and site, and assign unique codes to those regions and sites. This needs to be completed before any data is captured into the asset register.

6.3 Determine the Asset Types, Event Types and their Measures

A list of all the different types of assets must be drawn up. This may have been done as part of the classification system, if that system classifies assets according to their type. Part of this exercise will also be to determine which assets will be included in the register, and which ones will be left out.

For each type of asset it would then be necessary to determine exactly what information about that asset type would need to be recorded, the units of measure and the level of accuracy necessary. It would also be necessary to draw up unambiguous and effective measures for the value, performance, condition and risk assessment of each type of asset. As mentioned earlier, in order to calculate many of the asset measures, it will be necessary to record the events that cause changes to the assets. So it will also be necessary to draw up a list of all the event types that will be recorded and the information that must be monitored for each type.

Assets that require exactly the same information to be recorded, and that can use the same measures of value, performance, condition and risk should be grouped into the same type of asset. For example, it may be possible to group all types of valves into a single class of assets called 'Valves'. One of the items of information recorded for each member of the asset class 'Valves' would then be the type of valve, say 'Butterfly' or 'Gate'. Similarly, events that require the same information to be recorded should be classified as the same type of event.

Impahla defines a set of default asset and event types that can be used directly. If the user needs further types of assets or events, custom types can easily be defined, as described in Section on Customising the Software (6.7).

6.3.1 Determine required values for Asset Measures

Once measures of performance, condition and risk have been determined for each type of asset, it is necessary to determine the required values of these measures. The required levels of service set in the AMP will determine these required values. Levels of service will have to be determined for specific functions of the organisation, for example, minimum pressures and quantities to be delivered. These levels of service must then be translated into required values for the performance, condition and risk for the individual assets that are required to provide that service, i.e. the pumps and pipelines.

Often it is difficult to set the required values of these measures at first. For some types of assets and events it may be necessary to just calculate the value of the measures without comparing the measured values to some absolute standard. Often just the trend of the data is sufficient to give the organisation valuable management guidance.

The desired values of the asset measures are also usually specific to each organisation, and so are difficult to standardise. For this reason, no absolute values of asset measures are specified in Impahla.

6.3.2 Capture data and a measure of data accuracy for all assets

Once all of the above definitions have been completed, it will be necessary to capture the information on all the assets in the organisation. To start with this can be done from existing information such as drawings, insurance reports, etc. The accuracy of this information must then be verified, by means of field surveys. The accuracy can should then be continuously upgraded by checking it whenever possible, such as during maintenance. By keeping careful records of the accuracy of the data in the register it is possible to determine where verification is most needed, and to prove to the users that the data is accurate and can be used for effective decision making.

Depending on the size of the organisation, and the nature of the equipment, it may well be necessary to employ sophisticated tools such as surveys and Geographic Information Systems (GIS). It will also often be necessary to use technicians and engineers to gather the data and to assess the performance, condition, risk and value of assets. This is the most time consuming and expensive part of setting up an asset register.

6.3.3 Register Maintenance and Use

Setting up an asset register is a once off process, but the register cannot be left there. To be useful the register must be kept up-to-date and the accuracy must be continuously verified. An important part of creating the register is to determine who is responsible for maintaining what data, and setting out the policies and procedures for this maintenance.

At this stage it is also necessary to determine the outputs of the register, in the form of what reports are to be produced, and to determine who has access to which reports. These policies, procedures and reports will not be static, but will usually grow and develop over time. Impahla makes available a number of default reports based upon the default asset and event types. It is also possible to easily create custom reports for individual organisations needs.

7 *CONCLUSION*

In summary, an Asset Management Plan is a document that helps an institution to answer the following questions:

- What do we own and manage?
- Are we meeting our customers' needs in the most sustainable, cost-effective manner?
- Where are we now?
- Where do we want to be in the future?
- How are we going to get there?

Not only will an Asset Management Plan help to answer the above questions from a planning point of view, but the information in the plan will also help an institution manage its day-to-day activities in a sustainable, cost-effective and efficient manner.

8 *USING THE SOFTWARE*

The Impahla software package was developed as part of a research project funded by the Water Research Commission of South Africa. It is designed to implement a simple asset register for small water services institutions. It contains a number of default assets and event types, as well as many standard reports. However, it is very flexible, and can be adapted to the needs of most small water services institutions, or even other institutions that have a number of assets to manage. The guide is presented to assist the user in installing the software, capturing assets and event data, generating reports and customising it for their needs.

8.1 Installation

To install the software, copy the file **ImpSetup.exe** into a temporary folder on the computer where you want to install it. Run **ImpSetup.exe** and follow the instructions on the screen. It is recommended that a dedicated computer be used exclusively for maintaining an asset register and data base.

8.2 Setting up the software for your Organisation

Once you have installed Impahla onto your computer, you can explore the software. You will see that a number of **default** asset and **event** types, and reports based upon these, have been defined. However, no assets or events have yet been created. Before you can create any assets or events, it is necessary to create the location data.

Firstly, you need to **create** at least one **region**. This can be done as follows:

1. Click on **Create|Location**.

2. Click on the + near the bottom of the Region box.

3. Fill in the **Region name** and **code**.

4. Click on the ✓ to save the information to the database.

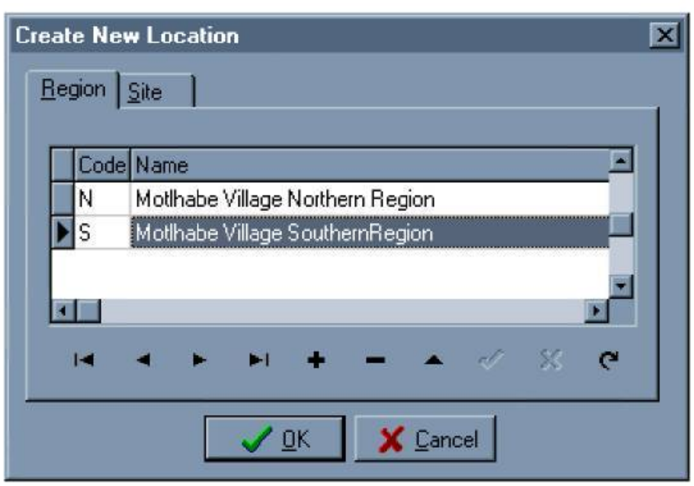

FIGURE 1 : Create New Location screen 1 - Region

5. Repeat steps 2 to 4 for each Region you want to create.

Once you have created all the necessary **regions**, you can begin to create the individual sites. This is very similar to creating regions above, except for step 2.

1. If the **Create New Location** dialog box is not open, click on **Create|Location**.

2. **IMPORTANT**! First, select the region that the site you are about to create belongs to.

3. Next, click on the + at the bottom of the Site box.

4. Fill in the **Site name** and **code**.

5. Click on the ✓ to save the information to the database.

6. Repeat steps 2 to 5 for each Site you want to create.

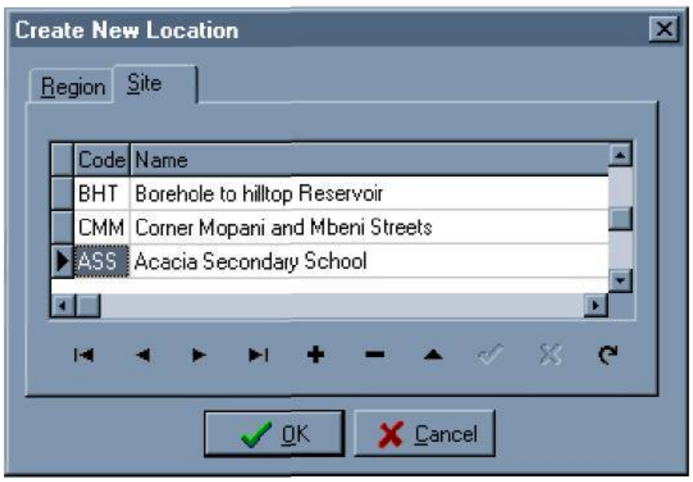

FIGURE 2 : Create New Location screen 2 – Site

This is all that is necessary to set up the Impahla for your organisation. You can now begin to capture the asset and event information.

8.3 Creating Assets and Events

Capturing all the asset data into the register is a time consuming and costly process, even for a fairly small institution, but doing it right is the most important step in setting up any kind of asset management system. If the asset data is not accurately, consistently and comprehensively captured, it is not worth having the register at all. Impahla however makes it easy to create assets and events, as discussed below.

8.3.1 Creating Assets

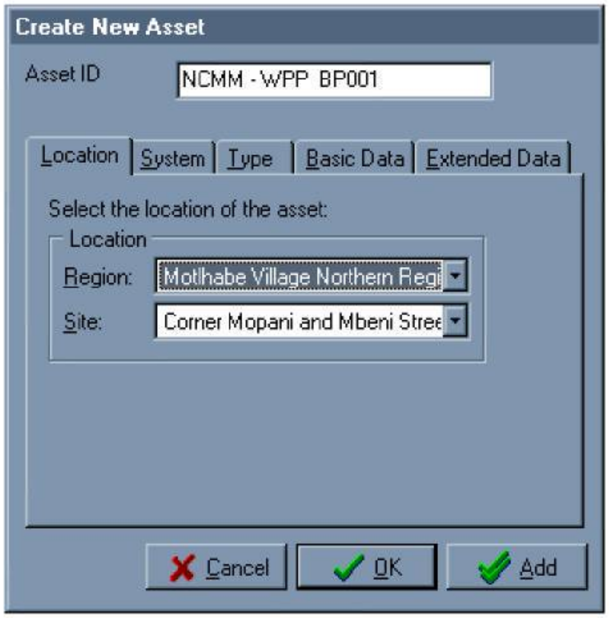

FIGURE 3 : Create New Asset screen 1 – Location

1. To create a new **asset**, click on **Create|Asset**.

2. Make sure that the Location Tab is selected. Select the Region and Site at which the asset exists, or where it is based or 'owned', if it is a moveable asset. You can change between selected Tabs at any stage to change the data you have entered.

3. Click on the Systems Tab. Select the three levels of the assets function.

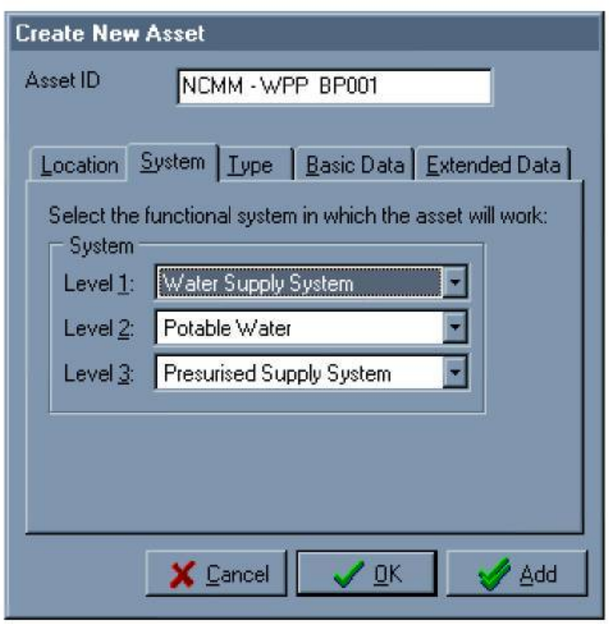

FIGURE 4 : Create New Asset screen 2 – System

4. Click on the Type Tab and select the two levels of the assets type.

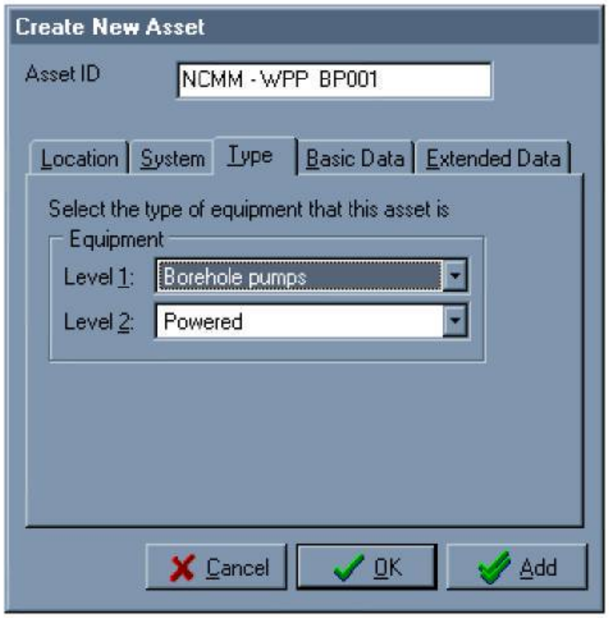

FIGURE 5 : Create New Asset screen 3 - Type

5. The asset's default sequential number is displayed in the Asset ID field. To accept this number, just click on the Basic Data Tab; otherwise type in a new number. If you enter a number that already belongs to an existing asset, you will get an error message, and you will need to choose a different number.

6. Enter the start date. This is the date on which the asset was purchased, installed, or commissioned, i.e. the date from which the asset first started operating.

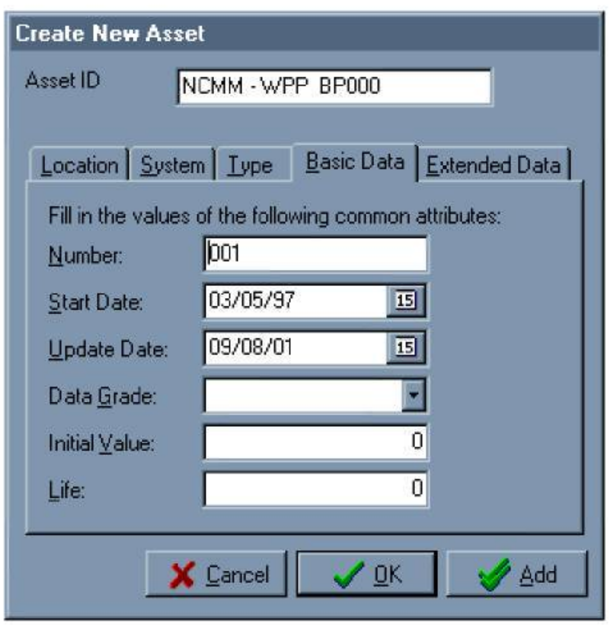

FIGURE 6 : Create New Asset screen 4 – Basic data

7. Enter the date on which the information regarding this asset was last modified. By default, this will be the current date.

8. Select a data grade. This gives an indication of the accuracy of the data currently stored in the register.

9. Click on the Extended Data Tab. Scroll through and enter all the extra data that is applicable to the type of asset you are creating.

10. When you are done, and are sure that all the information you have entered is correct, click the Add button to add the data to the database and start a new asset, or click the OK button if you are finished adding assets to the register.

8.3.2 Creating Events

1. Click on **Create|Event**.

2. Either select the asset to which this event occurs, or enter its ID number.

3. Enter the date and time at which the event occurred, and click on the Next→ button.

4. Scroll through and enter all the extra data that is applicable to the type of event you are creating.

5. When you are done, and are sure that all the information you have entered is correct, click the Add button to add the data to the database and start a new event, or click the Done button if you are finished adding events to the register.

8.4 Generating Reports

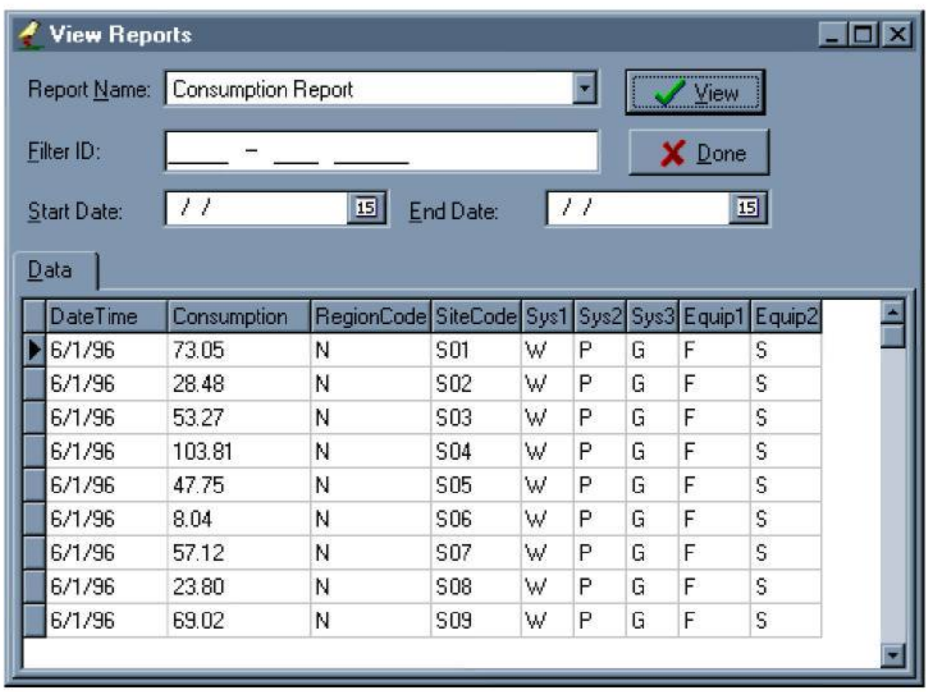

FIGURE 7 : View Reports screen

To generate a report, click on **Reports/View Reports** and select the report you would like to see.

8.5 Database Maintenance

Impahla is a database application, and like all other database applications, it requires a certain amount of maintenance. The most important maintenance task is backing up the data, and this is discussed below. To ensure the security of the database, it is also necessary keep the user and password information current.

8.5.1 Backing up your Data

The most critical file in Impahla is the **.mdb** file that was created during the installation of the program. This file contains all the data relating to your institution. To back up your data, this file should be copied onto a removable media such as a diskette or CD-ROM and this should be stored at a different location to the computer on which the system runs. This backup should take place at least once a week, but preferably every day.

Impahla also creates a **.bak** file, that is an exact copy of the **.mdb** file, every time the program starts. If the **.mdb** file ever becomes corrupt for any reason, simply rename the **.bak** file to **.mdb**, and restart the program.

8.5.2 Security

Currently, the program includes security, and will allow for the creation of the following four classes of users:

- Program Administrators, who will have complete access to all aspects of the program, and who will be able to create all other classes of users. One program administrator will be created during the installation process.
- Supervisors, who will be able to create and edit asset and event types, add and edit reports, and delete assets and events.
- Update users, who will be able to create and edit assets and events.
- Browsers, who will only have read access to the database.

Each user will have their own user ID and password, and the dates and times that they used the program will be logged.

8.5.3 Importing and Exporting

In order to allow subsystems to maintain their own registers, which can be combined into a master register, tools to allow the data to be exported and imported will be provided in the final release version of the software.

9. CUSTOMISING THE SOFTWARE

Once you have been using Impahla for a while you may find that it cannot do all the things you would like it to do. It may not include an asset or event type you would like, or it may not be able to generate a particular report that you would find useful. Because Water Services Institutions are so varied, Impahla has been specifically designed to be flexible and customisable. The following three sections give details on how to create new asset and event types, and on how to create new reports, based either on existing asset types or on asset types that have been newly created.

9.1 Asset Types

To create a **new asset type**, click on **Create|Asset** Type. In the dialog that is displayed, select or enter a new first level type code and description. Then select the first level code and enter a second level code and description. Then for each item of extra data that needs to be recorded for this new type of asset, fill in the Name, select the Data type and Display format and click on the Add button. That's all there is to it.

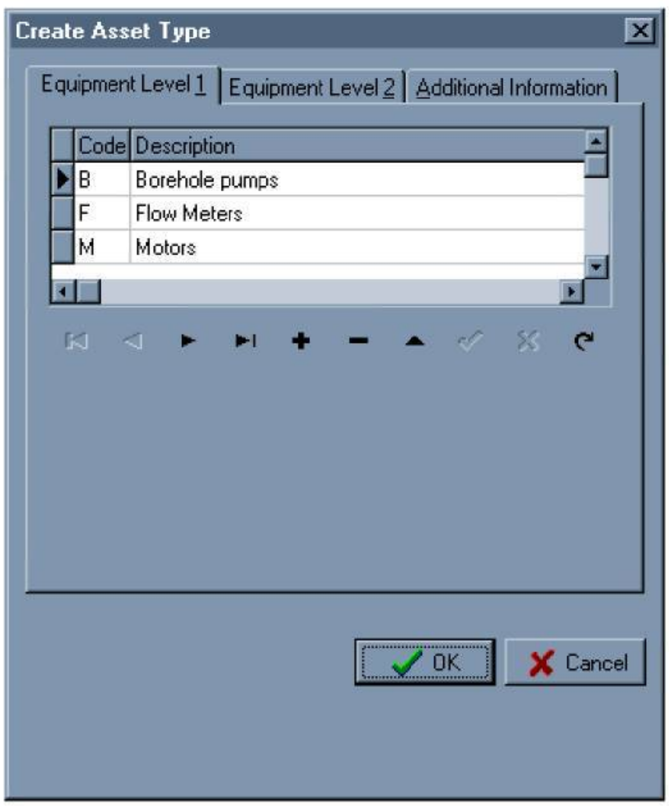

FIGURE 8 : Create Asset Type screen – Equipment Level 1

9.2 Event Types

To create a **new event type**, click on **Create|Event** Type. In the Event Type box, click on the + sign to add a new record. Fill in the Type ID number and a description. Then for each item of extra data that needs to be recorded for this new type of asset, fill in the Name, select the Data type and Display format and click on the Add button.

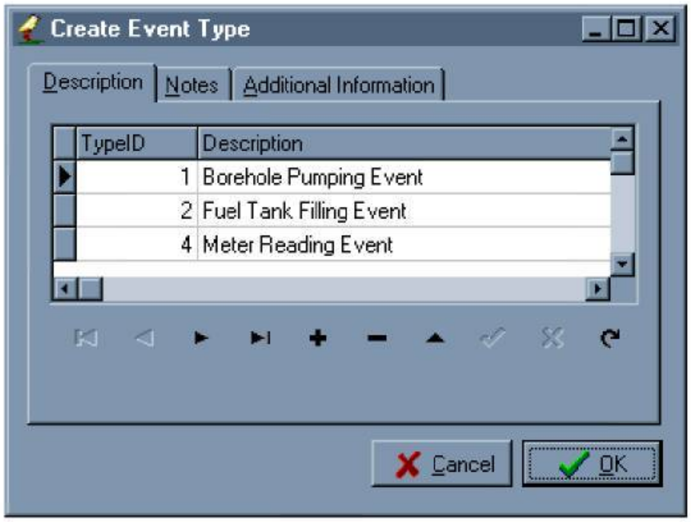

FIGURE 9 : Create Event Type screen - Description

9.3 Reports

Creating custom reports is somewhat more complex than creating new asset or event types. Click on **Reports/Create Report.** Follow the instructions on screen under each Tab in order to create Reports. It is recommended that someone familiar with Impahla creates new reports.

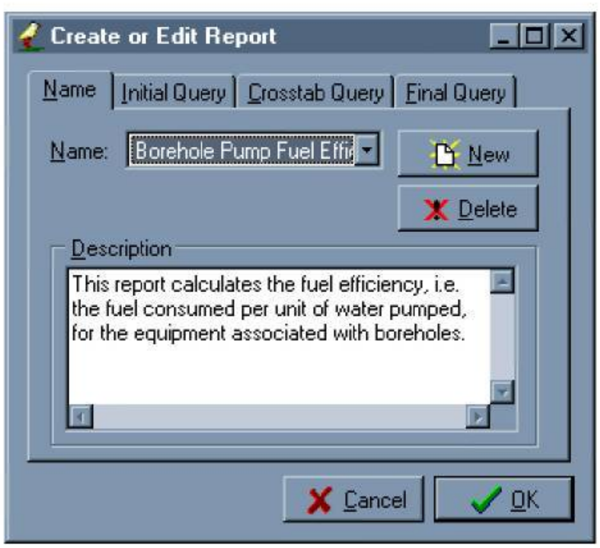

FIGURE 10 : Create or Edit Report screen – Name and description