# A MONITORING AND EVALUATION MANUAL FOR MUNICIPAL WATER AND SANITATION MANAGEMENT

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Water Research Commission

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Report to the
Water Research Commission

by

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**The researchers would like to thank**
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## Why M&E?

### INTRODUCTION

Why conduct monitoring and evaluation?

The short answer is: If we do not monitor and evaluate our activities, we do not know where we make mistakes, so we cannot rectify them. We also cannot learn from our best practice.

Consider the following examples:

- Virtually all the problems associated with the Enviro-Loo project in Barkly West could have been eliminated at an early stage, with an appropriate system to monitor building standards and community awareness
- The building errors associated with the VIP programme in Philandersbron in the Mier would have been corrected, and the project would have been a success
- Delportshoop would have adjusted its tariff structure, which would have made it financially viable
- The appropriate installation of toilets and taps for farm workers would be verified
- The telemetry system in Noupoort would have been operational.

We cannot afford to be without effective and reliable local government monitoring and evaluation (M&E) systems. This applies to all municipal activities and all types of development projects. This water services M&E project will be the first step in creating a culture of performance management at local government level.

### 1.1. DEFINING TERMS

- **Monitoring** is an integral part of the day-to-day management of projects and programmes (true for departmental managers and those in implementing agencies). In the context of this project it can be defined as the collection and analysis of data to equip management in government departments and their programmes, as well as stakeholders and the public, with accurate data about progress and performance.
- **Evaluation** refers to the periodic assessments of issues such as the efficiency, effectiveness, impact, relevance and sustainability of the programme in relation to the stated objectives. Traditionally this involves the running of baseline surveys, with assessment studies being conducted to measure change. A wide range of methods - qualitative and quantitative - are available.

### 1.2. M&E AND LOCAL GOVERNMENT LEGISLATIVE REQUIREMENTS

The process of drafting these policies and programmes dovetails with requirements in various pieces of legislation:

- These issues will have to be addressed in the *Water Services Development Plans*. Municipalities will need to focus on these issues, to determine goals for them, and to determine M&E systems to measure progress.

- Section 5 of the Municipal Systems Act requires municipalities to regularly *disclose information* regarding the affairs of the municipality, to the public.

- Section 11 of the Municipal Systems Act obliges municipalities to exercise legislative authority by *drafting by-laws*, and by *monitoring the impact* and effectiveness of its policies, programmes and plans. Bylaws must be contained in a "Municipal Code".

- Chapter 6 of the Municipal Systems Act requires municipalities to establish a system of *performance management*, which includes the setting of targets and the creation of Key Performance Indicators (KPIs) to measure performance, including outcomes and impacts (Section 41). Section 41 also requires that municipalities take steps to improve performance where performance targets are not met.

- Section 51 of the Municipal Systems Act *holds the municipal manager accountable* for the overall performance of the municipal administration.

### 1.3. M&E AND LOCAL POLICY CHOICES

The creation of an M&E system in a Municipality requires a Council decision. This will give the system sufficient importance so that all the officials play their part in collecting and reporting information.

> **Policy decision regarding M&E in Karoo-Hoogland Municipality, Northern Cape:**
>
> "A detailed monitoring programme for water and sanitation services will be followed. The programme will be under the supervision of the Head: Technical Services, and monthly reporting will be made to the Council. Evaluation will take place very six months, with reporting to the Council."

### *1. The need to set policy goals*

- M&E can only take place meaningfully if the municipality has set itself specific goals. The measurement of performance can only take place in relation to such goals. Such goals are often expressed in non-technical,

qualitative terms, e.g. "conserve water", or "promote good customer relations".

- The determination of goals is an important and educative political process. It provides an opportunity for Councillors to reflect on what they want to achieve (and whether their goals may be in some tension with one another!), and to build consensus amongst them. The compilation of "Water Services Development Plans" or "Water Services Business Plans" are good opportunities to decide on municipal goals for the water sector.

## 2. *Water services policy questions*

During the next few years, the following issues will be very important for municipalities in the Northern Cape. These issues are:

- Devising and implementing an appropriate tariff policy
- Devising and implementing an effective credit control policy
- Devising and implementing an effective indigent policy
- Devising and implementing an effective Operations and Maintenance (O&M) programme for water/sanitation infrastructure
- Improving customer service
- Devising and implementing an effective environmental health programme
- Promoting sustainable water use, by devising and implementing an effective water balance programme
- Devising and implementing an effective staff recruitment and training policy
- Devising and implementing an appropriate out-sourcing policy
- Using water for Local Economic Development.

Municipal Councils will need to draft policies and set goals for all or these issues.

This does not mean that the Municipality must monitor and evaluate ALL these issue areas. It is the Municipality's right to choose which issues are more important.

## 3. *Water services governance*

Water services, like any other sector, needs to be supervised by Municipal Councils. This is the main reason for the introduction of M&E systems.

However, an M&E system will only function within a *system* of policy-making and supervision. Such a system should include:

- Maintaining a register of by-laws ("Municipal Code") on water services issues
- Maintaining a register of Council decisions and precedents on water services
- Regular Council and committee meetings where water services are discussed

- A dedicated Water and Sanitation Committee on the Council[1], with Councillors who understand water services issues
- Report-backs by Councillors about meetings attended
- Report-backs of ward meetings where water services may be discussed
- Public participation in the budgeting process, so that water services are oriented to serve client interests.

### 4. *The need for policy goals, targets and indicators*

**Policy goals** reflect what a municipality wants to achieve. **Indicators** are the pointers a municipality uses to investigate whether those goals are being achieved. **Targets** are goals expressed in quantifiable terms and specify a timeframe for achieving such goals (e.g. in two years time, all buckets should be replaced by alternative forms of sanitation).

Targets are useful in determining indicators for measuring the success or failure of policies or programmes.

Some outputs are once-off or infrequent activities, and can be referred to as *"milestones"*. Drafting an indigent policy, or revising the valuation roll, are examples of "milestones".

### 5. *The use of M&E in subsequent policy choices*

The purpose of M&E is to provide feedback to decision-makers about the effectiveness of their administration, their programmes and their projects. It is a decision-making tool for policy makers, and makes it possible for decision-makers to be accountable to the public.

## 1.4. A ROADMAP TO M&E

The following are issues that need to be discussed when setting up an M&E system:

- *Methodology*: What theoretical methodologies will be employed? Is data quantitative or qualitative?
- *Administration:* How will information be processed, and how will the reporting system function? Will data be verified for quality?
- *Resources:* What staffing and financial resources will be made available?
- *Analysis*: What level and quality of data analysis will take place?
- *Dissemination*: How, and to whom, will information be distributed?
- *Utilisation*: How will information actually be utilised in Municipal decision-making? How will feedback be ensured?

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[1] Water services may be dealt with as part of an Infrastructure or Public Works committee.

### 1.5. FOCUSING ON DIFFERENT "LEVELS" OF MUNICIPAL ACTIVITY

Municipalities' activities can be divided into different categories or "levels".

1. ***Ongoing management***

Some activities are daily or regular *management* or maintenance activities. Examples are credit control or infrastructure maintenance. These issues relate to the notion of "sustainability" of water services – is the Municipality run in such a way that infrastructure, natural resources (water), financial resources and community commitment is "sustained" in the long term?

2. ***Projects and programmes***

Other activities form part of a specific *project* (often a project lasts for only a few months) or a structured *programme* (often a programme lasts for a few years). Typically, a programme will consist of several projects. Unlike ongoing management, projects and programmes typically have a beginning and an end, which provides a useful framework for measuring the effectiveness of the activities that are undertaken.

This Manual concentrates on M&E of **ongoing management**. Many other reference works give guidance on Project or Programme M&E.

### 1.6. MONITORING AND EVALUATION OF VARIOUS ASPECTS OF MUNICIPAL MANAGEMENT OF WATER SERVICES

This Manual focuses on five aspects of municipal management of water services. Different "Workbooks" will be dedicated to illustrate how these aspects can be monitored and evaluated. The Workbooks[2] are:

Workbook 1: Operations and Maintenance (O&M):
Workbook 2: Water consumption and demand management (WC&DM).

In all these aspects, there are common features of management, which need to be included in the M&E system. These features are financial resources, staffing, and equipment.

O&M and WC&DM are not the only issues that should be included in an M&E system. Other issues in the field of water and sanitation services are credit control, indigent policies and environmental health. In due course, such Workbooks will also be compiled.

[2] The Workbooks are attached as appendices to this report.

## 9 TOPICS FOR M&E OF WATER SERVICES

**There are 9 key topics:**

- **Topic 1:** Selection of policy goals, targets and indicators
- **Topic 2:** Resource Inventories – Counting what you've got (infrastructure, equipment, supplies, finance, staff)
- **Topic 3:** Data collection
- **Topic 4:** Analysis of findings
- **Topic 5:** Reporting procedures
- **Topic 6:** Feedback and dissemination
- **Topic 7:** Public participation in monitoring and evaluation
- **Topic 8:** Budgeting for M&E
- **Topic 9:** Returning to goals: Evaluation.

## TOPIC 1: SELECTION OF GOALS, TARGETS AND INDICATORS

In many municipalities, water services management is done according to long-established habits and customs, which have never been examined for their effectiveness or appropriateness to current conditions.

Effective M&E is only useful to the extent that it provides information to an effective management system and should ideally be part of a performance management system. And a management system is only effective if it sets clear *goals and targets*. These goals and targets should inform the whole Monitoring and Evaluation process. In fact, in the last chapter, on "Evaluation" (Topic 9), the reader will return to the targets determined at the beginning of the process, to check whether they have in fact been met.

The first question for a Municipality is, therefore: "Do we have clear goals, priorities and objectives?" These goals will then indicate what the Municipality should measure.

It may be a useful practice to encourage community participation in the setting of goals. The IDP process is an opportunity to discuss the current performance of the Municipality with community leaders or stakeholders. Such discussions can be guided towards the definition of goals, objectives and targets.

### *1. What kinds of goals and targets?*

Goals and targets can take different forms. Some goals can be described as *intermediate goals*. They usually refer to the *outcomes* of projects or programmes, within a certain time frame. They are also usually quantitative. For example: "We intend building 200 toilets within 6 months", or "Our goal is to reduce monthly household water consumption by an average of 20 kl, over the next year", or "We aim to reduce the number of diarrhoea cases reported at the local clinic by 100 per annum".

Other goals are *final goals*, such as "reducing poverty" or "ensuring equity of access". These final goals tend to refer to the *impacts* of the policy or programme. In general, such goals are typically "qualitative", and are best measured through a process of *evaluation*. A Municipality, which sets a target of "Significantly improving consumer satisfaction during the next financial year", may have to find qualitative methods to determine whether this aim has been reached. In addition to qualitative methods such as household surveys (when each resident's opinions can be quantified), the Municipality may choose to have focus groups to obtain insights about consumers' opinions. Focus groups are a classic form of qualitative research.

Different types of indicators must be established for intermediate and final goals.

## 2. *Selecting indicators*

Indicators are variables used to measure progress or activities.[3] An "indicator" is precisely that – it "indicates" to the municipality whether its goals are being achieved. That is why indicators must always be selected with the municipality's goals and targets in mind.

Indicators can be used in one of two ways:

- The data may be collected at regular intervals (such as weekly, monthly, quarterly, bi-annually or annually), to track the way in which a system is performing or an activity is being done. This is *monitoring*.

- The data may be used to assess the change resulting from a particular activity or project. This is *evaluation*. Evaluation will require information to be collected at the beginning of the project or activity (baseline information) and at the end (to assess the impact of the activity).

## 3. *What makes a good indicator?*

A good indicator[4] - a checklist:

- A good indicator should be matched to the objectives and goals of the institution. The use of the information, which will be derived, should be made clear from the beginning.

- A good indicator is a direct and unambiguous measure of progress – more (or less) is unmistakably better.

- The *definition* of an indicator is often a time-consuming process and should include key stakeholders. Indicators would be suggested, debated, critically analysed, and redefined until a consensus is reached about its meaning. If people disagree about what an indicator means, it serves no purpose!

- A measure of public participation (or participation by key stakeholders) may be useful in defining indicators. In this way, the municipality will know that it is measuring issues that the community finds relevant.

- It varies across areas, groups, over time, etc, and is sensitive to changes in policies, programmes and institutions.

- It is not easily blown off course by unrelated developments, and cannot be easily manipulated to show achievements where none exists.

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3 Objectively Verifiable Indicators (OVIs) are a group of indicators (not necessarily measurable) used to verify inputs, outputs, outcomes and impacts. OVIs can be *quantitative* (and therefore verifiable and measurable) or *qualitative (*and therefore only verifiable*)*.

4 G. Rubio, G. Prennushi and K. Subbarao, "Monitoring and Evaluation chapter", Preliminary draft for comments, March 3 2000, World Bank (check website). Also World Health Organisation (2000): Tools for Assessing the O&M status of water supply and sanitation in developing countries, p. 26.

- Information is available, and it must not be too costly to track. Information must also be available in time to influence decisions.

- It should be verifiable.

There is no fixed set of questions or indicators that can be applied to all situations. Each Municipality should decide on the indicators that are appropriate to its type of infrastructure, water sources, or management system. The indicators suggested in the Workbooks are simply a guide.

### 4. *Different kinds of indicators: Quantitative and qualitative indicators*

It is important to distinguish between Qualitative and Quantitative indicators, because not all phenomena are measurable in numbers. For example, the success of a water services policy can be measured by "consumer satisfaction" (a qualitative indicator) or by reducing (or increasing) the amount of water used (a quantitative indicator).

**Qualitative and quantitative indicators**

- Typical **qualitative indicators** (e.g. "consumer satisfaction" or "empowerment") rely on open-ended interviews and focus groups. Qualitative indicators depend on careful definition, since they can often give rise to disagreements amongst the researchers about their meaning. For example, we need to agree that "consumer satisfaction" means "residents believe that the service meets their needs".[1]

  Qualitative indicators may involve methods, which enable the Municipality to study selected issues, cases or events in-depth. Qualitative methods are generally useful when gathering information on people's attitudes, preferences and perceptions, where the *meaning* has to be explored.

- **Quantitative indicators** produce numerical information.

  Quantitative indicators have the advantage of enabling more precise *measurement*. This, in turn, facilitates *comparisons*. There are two types of comparisons:

  - Comparisons between different time periods within the same organisation (e.g. January's performance compared with that of August), or
  - Comparisons between different organisations (e.g. Karoo-Hoogland Municipality's performance compared with that of Kareeberg Municipality).

Indicators therefore need to be selected according to what needs to be monitored or evaluated. There is a great difference between measuring (1) the amount of water flowing through a pipe, (2) the number of residents who have complaints about services, and (3) residents' understanding of the water services management system. Cases (1) and (2) can be measured by quantitative methods. In contrast, example (3) should be measured by

qualitative methods, so that the *meaning* of residents' understanding can be explored.

In many cases, quantitative and qualitative methodologies complement each other. Quantitative methods show "what?" and "how much?", whereas qualitative methods have explanatory value and answer the question "why?" Finding out whether something is working or not may be insufficient to plan solutions to problems. We often need to know and understand *why* there are problems, to make sure that the root causes can be addressed. This is where qualitative methods are very useful.

## 5. *Different types of indicators: Input, output and impact*

(a) *Input indicators:* Input indicators measure the amounts of money, staff and time, which various activities require. For example, it would be useful to know how much administrative resources a certain administrative activity (e.g. fixing leaks in the reticulation system) requires. This is usually quantitative data, e.g. 2 staff members, each working for 4 hours per day = 80 hours per week.

(b) *Output indicators:* As described in Topic 2, there are two types of goals or targets, which the Municipality can set itself. The first type of goal is *output goals*, and refers to the actual achievements or functioning of a project or management system itself (e.g. "reducing water consumption by x megalitres per month", or "achieving 100% functioning of all pumps each month").

Output indicators are typically (although not always) quantitative.
Measuring outputs for ongoing management would usually refer to information about ongoing tasks, e.g.:

- Levels of payment
- Numbers of residents registered as indigents
- Pipes repaired
- Response times for sanitation complaints.

(c) *Impact indicators*

The second type of target refers to *impact goals*, and refers to the ultimate goals, which the municipality would like to achieve. These are more far-reaching (e.g. "reducing poverty" or "improving health").

Impact indicators are either qualitative or quantitative.

| | **Quantitative** | **Qualitative** |
|---|---|---|
| Input indicators | √ | |
| Output indicators | √ | |
| Impact indicators | √ | √ |

## TOPIC 2: RESOURCE INVENTORIES – COUNTING WHAT YOU'VE GOT

Before starting an M&E system, it is important to get baseline information about what resources the Municipality has. This concerns various aspects of water services functioning. The Municipality should create (and update) various inventories of its resources:

### 1. *Jurisdiction*

Municipalities are spatial entities, functioning in a context where they may well have to co-operate with their neighbouring municipalities, or with other institutions.

In the water sector, inter-jurisdictional relationships are very common. Water infrastructure systems (especially bulk water supply) may well cross municipal boundaries. Water catchment areas often affect several municipalities simultaneously. Water effluent into rivers may well affect municipalities downstream.

Furthermore, there are specialist organisations, which deal with certain aspects of water and sanitation. For example, Water Boards provide water services to rural areas, or provide water in bulk to several municipalities. Water Catchment Associations include all the stakeholders of specific catchment areas. Water Users Associations represent specific users of water – often agricultural enterprises – who co-operate to distribute water to their members.

It is important that the Municipality knows about all the relevant water-related institutions, and has established clear working relationships with them. This is particularly important in the light of the fact that Municipalities' jurisdictions are now much larger (due to re-demarcation), and include rural and agricultural areas.

### 2. *Technical inventories*

These inventories include infrastructure, equipment and supplies. It should include asset registers, vehicle records, buildings and deeds of transfer, lease agreements, inventory of hardware and supplies, and as-built drawings.

Additional information to include is:

- The age of the systems (If they are very old, rehabilitation may be very urgent).
- How well is the capacity utilized? (Low utilization may indicate design over-capacity).
- Are the materials, equipment and plant standardized?
- What levels of supplies are kept in the Municipal stores?

### 3. *Administrative inventories*

There are two types of information to collect:

- Information about individual staff members

- Information about the working relationships between individual staff members, i.e. about the structure of the organisation.

(a) *Individual staff members:* How many technical, administrative and financial staff members are involved in water services? This should include a breakdown of:

  - Age
  - Gender
  - Race
  - Qualifications
  - Language proficiency
  - Full-time or part-time, permanent or temporary
  - Salary
  - Benefits (housing, travel, car allowance, telephone allowance, medical aid, life insurance, pension etc)
  - Leave days (ordinary, study, sick-leave, maternity, etc)
  - Training experienced since acquiring their formal qualifications
  - Additional skills that may be useful (ranging from word-processing to flower-arranging!)

  It is very important for a periodic assessment of staff skills.

(b) *Organisational structure*

  - It is useful to take the opportunity to verify whether organigrams are still up to date, and reflect the actual functioning of the Municipality.

  - How does decision-making take place? How much discretion do senior and middle-level officials have?

  - Are their job descriptions and powers clearly spelt out?

  - Are there clear patterns of supervision? Are there sufficient supervisory staff members, with the necessary skills?

  - Are there incentives to motivate staff to perform competently?

## 4. *Financial resources*

This includes financial records, payrolls, procurement and suppliers, debt collection, insurance policies, valuation roll, loans registers, and lists of investments.

Some of this information may not be available. This is a warning light: The Municipality should find and collate the information. The current amalgamation of local authorities into new municipalities is an excellent opportunities to get inventories up to date.

## TOPIC 3: DATA COLLECTION

Each Municipality is likely to collect a vast amount of information, for a range of purposes, such as:

- Tracking trends
- Informing operators, supervisors and senior staff of on-going management requirements (e.g. cash flow, or number of pump breakages)
- Informing Council on whether its policy goals are being met.

The amount of information, which a Municipality wants to collect is entirely variable. It depends on the complexity of its operations, its policy and programme targets, the nature of the infrastructure, and its ability to manage information (e.g. does it have a viable computerised data processing system?)

### 1. *Methods of collecting data*

A wide variety of methods can be used to collect data. This includes staff reports, computerised data systems, user surveys, or diagnostic evaluation studies.

It is important to use different sources of data, collected through quantitative as well as qualitative methods.

Specific requirements for data collection should be noted:

- Data needs to be collected timeously and continuously, usually by a specified date (daily, weekly, monthly or annually).

- It can be collected by municipal officials, by government officials (e.g. clinics), consultants (e.g. engineering companies) or by NGOs working on projects.

- Regardless of who collects the data, there must be a system of verification.

- Quantitative data can be entered into a computer system. Municipalities can learn from one another about the software packages they use for monitoring purposes.

- Various types of monitoring require specific equipment. For example, monitoring of technical maintenance of infrastructure requires an inventory of the infrastructure, as well as of the stocks held in the municipal stores. Monitoring of payment requires household water meters, as well as computers to process water usage, payments and bills.

### 2. *Recording and filing*

It is important to write down the information that officials collect informally. Often, much of what the Council wants to know is "in the officials' heads"! The real challenge is to *write down* what the officials know and observe. This means that the municipality must develop a system of *recording of information.*

This can be done in a series of files or folders or notebooks. It is possible that a separate file or notebook should be kept for each aspect of infrastructure (e.g. for each pump), thereby recording all the dates when it was serviced, what faulty parts were replaced, what spare parts are likely to be needed in future, etc.

This also means that the Municipality should develop a *filing system* where all the files or notebooks are kept in a specific order. This will make it much easier for the official who must analyse the data and write the reports for Council, to access the information quickly.

This also means that the Municipality must allocate a proper space (e.g. a new bookcase or filing cabinet) for the additional data which will be collected.

### 3. *Verification of data*

It is possible that most data will be collected by front-line officials (technical operators, meter-readers etc). The information must be verified periodically. It is possible that the data-collectors may make errors, or get careless, or spend their afternoon resting under a tree instead of trekking around in the hot sun, visiting the meters! (There are numerous stories about meter-readers who never visit the meters at all, and simply "thumb-suck" the readings!) It is also possible that the meters and other equipment may be faulty, and this needs to be checked every few months.

## TOPIC 4: INTERPRETING AND ANALYSING DATA

Having collected the data, the Municipality then needs to interpret the information it has gathered. In many cases, the information is fairly straight-forward (for example, rainfall figures and water losses). However, qualitative information may require skills and experience in order to draw appropriate conclusions.

Municipal officials need time to do this, on a regular basis. The Chief of Technical Services should be able to figure out what he or she would like to know from the data, and which calculations to make. (The Workbooks give some valuable ideas!)

Officials then need to write meaningful conclusions, which the Council will find useful as a basis for decision-making. Rainfall figures are not very interesting by themselves, but when used as part of a water conservation strategy, those figures can become very important!

There are at least three ways of reporting data:

- **Giving an overview** every month of the findings (For example, "33 water leaks were repaired during May".)

- **"Exception reporting"** – only unusual findings are reported (For example, "An unusually high number of leaks were discovered during May".)

- **Qualitative reporting** – writing down the experiences of the staff, in addition to the "cold hard facts". For example, "The technical staff found that it was difficult to repair the leaks because the equipment was not always available".

The Council and Municipal Manager must decide what kinds of reporting they would like for each type of information. Qualitative information is particularly important, because this helps the Council to take effective decisions.

## TOPIC 5: REPORTING TO SENIOR MANAGEMENT AND COUNCIL

Information is meant to be *used*, and not simply to sit on a shelf. Information is collected and analysed in order to be *used as a management tool*. This means that the reporting of information (the results of the M&E process) is as important as the actual M&E process itself.

Performance reporting helps the Council and senior management to identify problems and figure out solutions. It also shows the Council and senior officials whether planned actions have achieved their objectives.

M&E information should be used as a normal part of municipal planning and implementation of activities. Information should show whether a certain programme or activity is producing the desired results; if not, changes should be made! Senior officials and Councillors need the information to make sensible decisions. For example, based on the information collected, Council can meaningfully decide whether it should replace infrastructure, or repair it; whether it should emphasise staff training as a priority; and how much to budget for O&M.

The reporting process should refer back to the Municipality's goals, targets and indicators. "Input reporting" will tell the Council about the amount of money or staff time, which have been used. "Output reporting" refers to information about *what has actually happened* during the implementation of certain activities. And "impact reporting" will tell the Council whether its goals have been achieved – did the VIP project really lead to consumer satisfaction or not?

*What kinds of reports?*

- At periodic intervals, reports should be compiled to show performance trends. Reports will typically be submitted by junior staff (or outside agencies) to the Municipal Manager, and then submitted to Council. This should be done regularly enough that corrective action can be taken, if necessary.

- The Council may decide on standard reporting formats, so that the required information is provided.

- Some reports are simply "exception reports", which are written when incoming data shows discrepancies (e.g. an unusually large number of pipe blockages in a month, or an unusually low payments level). Such situations can then be further investigated.

Information can also be used to lobby for government or donor funding.

## TOPIC 6: FEEDBACK AND DISSEMINATION

M&E results should be disseminated to several audiences:

- To senior officials – this helps senior officials know what is going on "on the ground"
- To front-line officials – this helps to empower staff to understand the "big picture" of the entire programme or municipal performance
- To Councillors – this helps them to decide on policies, programmes, projects and methods of improving municipal performance
- To the local public- this creates a sense of "buy-in" to the municipality's operations (e.g. by means of a regular newsletter)
- To programme and project beneficiaries – this creates a sense of ownership
- To provincial and national departments, e.g. Department of Water Affairs and Forestry, Department of Local Government and Housing, Department of Provincial Local Government
- To developmental institutions, e.g. Development Bank of SA
- To donors and funders.

Wide dissemination is a positive thing in itself, because it helps to create an outcome-based culture in the municipality.

Dissemination should be in an accessible form, e.g. through meetings, pamphlets, posters, and newsletters.

## TOPIC 7: PUBLIC PARTICIPATION IN MONITORING AND EVALUATION

In any performance measurement system for services such as water and sanitation provision, it is essential to obtain the views of the users of the service.

Encouraging public participation in M&E activities is important, for several reasons:

- Public participation in M&E is important to generate a sense of ownership among different groups in society, thus increasing the acceptance and use of findings.
- Participation can help to build consensus on what outcomes to monitor, and what impacts to evaluate.
- Participation enables the incorporation of individuals' perception of their well-being as a critical outcome to be monitored.
- Participation fosters a strong feedback process.
- Participation can provide a lot of relevant background information about the community. This could be crucially important when planning remedial measures and subsequent improvements.

There are five stages in the monitoring process when participation can be included:

(a) Participation in goal setting, when setting service level targets

(b) Participation in the design of the monitoring process

(c) Choice of methodology, especially through qualitative methods (e.g. focus groups), which enables better understanding of people's situations, opportunities and constraints

(d) Collaboration in data collection and analysis (e.g. by training local people to implement surveys)

(e) Dissemination of findings.

In the choice of methodology, participation can be included in various ways:[5]

| Method | Advantages | Disadvantages | Alternatives/Keep in mind |
|---|---|---|---|
| Public meetings | The audience will contain many different interests, with different levels of understanding and sympathy | • It is difficult to keep to a fixed agenda<br>• Only a few people get a chance to have a say | • Identify and meet key interests informally<br>• Run workshop sessions for different interest groups<br>• Bring people together after the workshop sessions in a report-back seminar |
| Formal survey | Questionnaires, studies and in-depth discussion groups can be a good way to start the participation process | Surveys are insufficient on their own | • Surveys require expert design and piloting<br>• Surveyors need training<br>• Survey design can be a part of a process which leads to action |
| Consultative committee | Some focus of decision-making will be necessary in anything beyond a simple consultation process | •A committee may not be a channel for reaching most people<br>•People invited to join a committee may be uncomfortable about being seen as representatives | • The committee can help to plan the participation process<br>• Surveys, workshops and informal meetings can identify other people who may become actively involved<br>• A range of groups can be formed, working on different issues. |
| Working through NGO's/CBOs | • Voluntary organisations are an important channel of communication, and may have resources to contribute to the participation process<br>• They have a wealth of experience and are essential allies | Voluntary organisations are not "the community". | • There will be many small community groups who are not part of the formal NGO/CBO sector<br>• Voluntary groups have their own agendas – they are not neutral. |
| Participatory rural appraisal (PRA) | If done well, the work belongs to the local people | Care needs to be exercised in choosing appropriate methods | A range of methods are available (see below). |

**Participatory Rapid Appraisal (PRA)** is an important approach to participatory social research. An important feature of using participatory methods is that local people are directly involved in the processes of data-gathering and analysis. If the PRA process is well done, people will feel a sense of ownership of the research and its findings. This contributes to a shared learning and local capacity building.

There are numerous possible PRA methods or techniques:

- Secondary data sources, maps and reports
- Direct observation
- Case studies, work and incident histories from local experts
- Transect walks: Systematically walking through an area with local guides, observing, asking, listening and leaning about relevant issues

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5 World Health Organisation, Geneva, Tools for assessing the O&M status of water supply and sanitation in developing countries (2000).

- Group discussions of different kinds (casual, focused, community)
- Mapping and modelling to show local world views
- Listing organisations which residents feel are most helpful to them
- Matrix scoring and ranking exercises to compare preferences and conditions
- Well-being grouping to establish local criteria for deprivation and disadvantage
- Time-lines and trend and change analysis to show chronologies of events, and to analyse local trends and causes of change
- Seasonal calendars and daily time-use analysis to show work patterns and activities.

There are some *do's and don'ts* in PRA:

**Do's:**

- Find out about local taboos and norms
- Stimulate people to talk
- Provide facts and information
- Build up a dialogue
- Be neutral and objective
- Assist people to evaluate
- Be patient
- Be creative, adaptable, and innovative
- Learn from mistakes
- Use analogy
- Use a variety of PRA techniques
- Cross-check information.

**Don'ts:**

- Violate taboos and norms
- Demand appreciation
- Use abstract language
- Interrupt, blame, suggest or promise
- Side with opinion leaders or agitate
- Manipulate or create needs.

Above all, respect the people, their perceptions and their knowledge. Show this respect by listening and taking an interest in their life world.

To manage a PRA process requires experience in the methodology of PRA. PRA should be carefully managed, to prevent difficult situations arising in the community. It is advisable for Municipalities to recruit the services of a consultant company or research organisation which specialises in PRA. Municipal staff should participate in the PRA research process, so that they can also become familiar with these techniques. Over time, one or more of the municipal staff could enroll in specialised courses to learn the theory and techniques of PRA. This would be a valuable longer-term investment for the Municipality.

## TOPIC 8: BUDGETING FOR M&E

If M&E is not budgeted for, then it will not happen! When municipal budgets are drawn-up, monitoring and evaluation generally do not appear as a budget line. It is often an after-thought.

It is essential that the costs involved in monitoring and evaluation be estimated and that an adequate amount is budgeted for this purpose in the municipal budget.

The costs of M&E will depend on the type of data the Municipality wishes to collect, and the methods it chooses to collect it. For example, collecting information on borehole pumps will not be expensive if it is done as part of the O&M technician's normal duties; but launching a community questionnaire will cost a lot of money.

One of the challenges to achieve affordable M&E will be to combine it with the normal duties of staff. Meter readers, for example, can administer an opinion survey on an ongoing basis, since they have to visit every household every month to read the meter.

M&E may require an additional staff post, or part of a post. If it is added to an existing staff member's job description, then it should be clear that such a person has the time to do the extra work.

Staff involved in M&E will require additional training, e.g. in data collection, computer use or in report-writing.

## TOPIC 9: RETURNING TO GOALS: EVALUATION

The targets (goals) and indicators of any M&E plan should be evaluated a regular basis. The outcomes of the M&E plan should be evaluated against the goal.

Generally when doing an evaluation, the findings serve three primary purposes. These purposes are not inherently conflicting or mutually exclusive. A brief summary is given of two types of findings, together with sample evaluation questions, to illustrate the broad range of choices.

### 1. *Improvement –Oriented Evaluation*

Improvement-orientated forms of evaluation use evaluation results to improve programmes. This is fundamentally very different from rendering judgement about overall effectiveness, merit or worth. In contrast with judgement orientated evaluation, inductive approaches are used in which the criteria are less formal in gathering information about strengths and weaknesses with the expectation of informing an on-going cycle of reflection and innovation. Intended users of findings in improvement-orientated evaluations would tend to ask the following types of questions:

- What are the programme's strengths and weaknesses?
- To what extent are the participants progressing towards the desired outcomes?
- What kind of implementation problems has emerged and how are they being addressed?
- What is happening that was not expected?
- What are staff and beneficiaries' perceptions of the programme?
- What do they like? Dislike? What do they want to change?
- How are funds being used compared to initial expectations?
- How is the programme's external environment affecting internal operations?
- What new ideas are emerging which could be tried and tested?

Information generated in response to these types of questions can be used in decision-making about how to improve a programme. Such decisions are usually made in incremental steps based on specific evaluation findings aimed at instrumental use of evaluation findings.

### 2. *Judgement-Orientated Evaluation*

Evaluations that aim at determining overall merit, worth, or value of something are judgement oriented. Judgement-orientated evaluations, such as programme *auditing* and *summative* evaluations, are aimed at deciding if a programme has been effective enough to be continued or replicated. This usually takes place at the end of a programme cycle. This type of evaluation would answer the following types of questions:

- Did the programme work?
- Did it attain its goals?
- Should the programme be continued?
- Was the implementation in compliance with the original funding objectives?

- Were the funds used appropriately?
- Were the desired outcomes for beneficiaries achieved?

The kind of data that these questions generate supports mainly major decision-making about programmes concerning issues of termination, enlargement and scaling-up.

### 3. *Evaluation as a learning process*

Traditionally evaluation has primarily been about providing accountability and assessing the achievement of project outcomes. However, evaluation can, and should make a further contribution to the development process by building capacity for ongoing *learning* beyond the life of a specific project as well as producing findings that provide *useful* input into current and future planning, policy making and other resource allocation decisions. In order to do this the emphasis or evaluation focus must shift from producing 'knowledge products' (reports of progress and output indicators), to a goal of strengthening the 'learning process'. User-oriented evaluation is inherently participatory and collaborative in actively involving primary intended users in all aspects of the evaluation. Participation and collaboration can lead to an ongoing, longer-term commitment to using evaluation logic and building a culture of learning in a programme or organisation.

### 4. *Interactive evaluation leads to increased capacity building and ownership*

Evaluation is not just about using the findings. The actual process of engaging in evaluation can have as much or even more impact than the findings generated. The processes of participation and collaboration have an impact on participants in the evaluation that go quite beyond whatever they accomplish by working together. In the process of participating they are exposed to and have the opportunity to learn the logic of evaluation and the discipline of evaluation reasoning. Skills are acquired in problem identification, criteria specification and data collection, analysis and interpretation. Acquisition of such skills can have a longer-term impact in terms of capacity building than the use of findings from a particular evaluation study.

Furthermore, active participation in evaluation leads to increased ownership of the findings and, therefore, increases their utility level.

This annual evaluation should be done timeously to ensure that the predicted costs for the next year should be included in the municipal budget for the following year.

# WORKBOOK 1:

## M&E of WATER INFRASTRUCTURE O&M

*It is recommended that the Manual for Monitoring of Water Services by Local Governments is read before and referred to when using the Workbook on M&E of Water Infrastructure O&M.*

## CONTENTS

## 1.7. What is Operations and Maintenance (O&M)?

Before discussing the "M&E" of "O&M", we need to know what "O&M is. It helps to distinguish between the "O" and the "M":

1.7.1. "Operation" refers to the procedures and activities involved in the actual delivery of services, e.g. abstraction, treatment, pumping, transmission and distribution of drinking water.

1.7.2. "Maintenance" refers to activities aimed at keeping existing capital assets in serviceable condition, e.g. by repairing water distribution pipes, pumps and taps.

In this paper, examples of M&E will be provided with reference to the Karoo-Hoogland Municipality in the Northern Cape.

The following tables give an overview of the activities required for "O&M":

## 1.8. TASKS REQUIRED FOR "OPERATIONS"

The Karoo-Hoogland Municipality collected the data filled in below:

| Aspect | Skills/tasks required | Done Anyway | Done – extra admin | Not done – not necessary | Not done – reasons why |
|---|---|---|---|---|---|
| Boreholes | • Monitor the static water level (in the morning before starting of the engine) once a week on a regular basis | √ | | | ( (no meter) |
| | • Monitor the draw down water level just before stopping the engine (to be done once a week on a regular basis) | √ | | | ( (no meter) |
| | • Daily monitoring of pumphead gland packing, check and attend leakages | | | | |
| | • Borehole yard should be kept clean and grass and weeds short; fence and gate in good condition to prevent entry of animals and poultry | | | | |
| Pumps and engines | • Access fuel and lubricants | √ | | | • |
| | • Check system and predict problems | √ | | | |
| | • Troubleshooting | √ | | | |
| | • Clean equipment and facilities | √ | | | |
| Pipelines | • Once a month check all stopcock valves and sluice gate valves (closing and opening them); also check the function of all air release and wash out valves; check and clean valve chambers (make sure covers are in good condition and fit well) | √ | | | • |
| | • Bi-annually check pipeline marker posts | √ | | | |
| | • Monitor the entire pipe network by doing inspection walks talking one section at a time. This should be done regularly once a month and any leakages should be attended to as soon as they are discovered | √ | | | |

| | | | | | |
|---|---|---|---|---|---|
| Reservoirs | • Once a year should be drained and cleaned<br>• Daily the water level should be monitored<br>• Daily checks for any leakages and the fencing around the reservoir to ensure no entry for animals and poultry<br>• Clean the yard and keep grass and weeds short | √<br>√<br>√<br>√ | | | • |
| Taps/standpipes | • Clean the water meter chamber on the soakaway (once a month)<br>• Clean the standpipe slab and its surroundings daily<br>• Monitor the standpipe equipment including of the fence daily<br>• Inspect for leaks<br>• Check that water drains freely<br>• Check taps are securely attached | <br>√<br>√<br>√<br>√ | √ time | | • |
| Water meters | • Read water meters once a month at the same date every month | √ | | | • |
| Monitoring abstraction | • Flow meter reading<br>• Test flow, taste, colour of water<br>• Monitor borehole water levels | √<br>√ | | | <br><br>√ |
| Monitoring consumption | • Keeping records (e.g. pump hrs/day)<br>• Flow meter reading | √<br>√ | | | • |
| Financial system | • Collect tariffs<br>• Issue receipts<br>• Keep a cashbook<br>• Operate a cheque account<br>• Operate a savings account<br>• Doing bank reconciliations<br>• Reporting financial status to Council/Committees<br>• Auditing | √<br>√<br>√<br>√<br>√<br>√<br>√ | | | • |
| Water Quality | 1. Take water sampling for analysis<br>2. Regular testing for:[6]<br>• Electrical conductivity<br>• Fluoride<br>• Nitrate<br>• Faecal coliforms<br>• E. Coli | √<br>√ | | | • |

6. Murray, R and Dindar, M, 1998, "Discussion towards a Framework for Rural Groundwater Management", p.19

## 1.9. TASKS REQUIRED FOR "MAINTENANCE"

The Karoo-Hoogland Municipality collected the data filled in below:

| Aspect | Skills/tasks required | Done Anyway | Done – extra admin | Not done – not necessary | Not done – reasons why |
|---|---|---|---|---|---|
| Boreholes | 1. Check and attend to leakages immediately<br>2. Check and change if necessary:<br>• The pump and its trainer<br>• The columns, shafts, stabilizers and bearings<br>• Cleaning of the borehole may be considered<br>Depending on the geological area, this should be done at 18 months to 3-year intervals.<br>3. Borehole yard fence should be repaired immediately<br>4. Diesel and oil contaminated soil should be removed immediately | √<br>√<br>√<br>√<br>√<br>√ | | | |
| Standpipes | Maintain the standpipe equipment and fencing around it on a daily basis. | √ | | | |
| Pipelines | Maintain (repair/replace pipeline marker posts)<br>Leakages attended to and repaired immediately | √ | | | √ |
| Reservoirs | Repair any leakages immediately<br>Repair fence immediately | √ | | | |
| Water Quality | Any significant variance in water quality should be attended to immediately | √ | | | |

## 1. *O&M Tasks*

For each task, the identification should include information on task name, brief description, and frequency (daily, monthly, annually, biannually).

*Task definitions* should be written up for each task mentioned in the O&M monitoring and evaluation plan. *Task standards* must be developed for planning programming and budgeting purposes, but also to guide actual implementation, and facilitate monitoring and evaluation of performance. The primary purpose of the standards, as opposed to the task descriptions, is to identify the resources (human, material and equipment) necessary to complete a given task. With a predetermined target, workers can be made accountable for their time and expenditures, promoting more efficient work. Managers can easily measure performance and analyse variances, and can be held accountable themselves to the workers they direct.

These task definitions help to determine maintenance-work quality standards, thus, the task definitions define the level of maintenance service that should be provided. For example, the frequency of leak detection efforts on water pipes will define the level of maintenance service, with impacts on service provision and on other infrastructure sectors. Choosing standards will be a difficult trade-off between maintenance expenditure, rehabilitation expense, and capital investment in replacement of the assets.

The definition of tasks or quality standards will be based on information from a number of different sources. For large facilities such as a water- or sewage-treatment plants, designers could have developed a maintenance manual for outlining tasks on all items of equipment. Another source of information would be records or completed work orders giving a profile of previous work. However, such past experience should not be the sole basis for task identification as old procedures may, in fact, be inadequate.

Discussions with other users of the equipment may also be useful, but the same cautions should apply. Thus, the task identification must often start from zero. For vehicle, pumps, engines and other electromechanical equipment, the best place to start would be the recommendations of the manufacturer, which should be able to specify the above data on each task to be done. Engineering handbooks and manuals will also be useful references. A final source of information would be outside consultants with maintenance planning experience with the relevant equipment.

## 2. *Maintenance task standards*

A proper O&M Plan should be drafted, which should specify a maintenance task standard. Such a task standard should include:

- Task name;
- Task description;
- Task code;
- Date of maintenance standard;

- Scheduling criteria or frequency;
- Task steps or work methods;
- Personnel, equipment and materials needed;
- Work measurement unit;
- Estimated productivity (such as work measurement units/day);
- Estimated cost per work unit, based on costs of labor, materials, equipment.

Maintenance standards demand a significant amount of work to develop. Local skills, tools, maintenance practice and costs make standards specific to one location. Thus, standards have to be developed probably at national level, with some allowance for local modifications.

A key source of information for standards development is records of completed work orders giving a profile of previous work. Even if data on past practices are available, they should not be the sole basis for task identification, as old procedures may, in fact, be inefficient and in need of improvement. Discussions with other maintenance agencies are useful, but similar cautions should apply, as conditions vary. Engineering handbooks and manuals are also useful references.

A final source of information would be outside consultants with maintenance planning experience with the relevant equipment. Initial standards will have to be based on engineering experience, judgement and practical assessment.

If experience or ad-hoc studies show that a particular task can be completed in less time, or requires more, new standards and task descriptions can be developed. As maintenance staff members grow more competent, standards should be revised with higher performance targets. Overall, the use of standards must be viewed as a dynamic process, with historical analysis of actual performance as the tool to update and revise standards.

The following table illustrates the tasks, which have been outlined for water management in the remote rural settlements of Namaqualand. (The Shaded Areas indicate the items that are relevant to M&E).

The Karoo-Hoogland Municipality collected the data filled in below:

**Maintenance Schedule for Rural Settlements in Namaqualand**[7]

| | ITEM | WHEN / HOW | BY WHOM | Done any-way | Done – extra admin | Not done - not needed | Not done – reasons why |
|---|---|---|---|---|---|---|---|
| 1 | Borehole<br>Pulling out rising main and water level sensor. Check and change if necessary:<br>• Pump and strainer<br>• Columns, shafts, stabilisers and bearings<br>• Cleaning of the borehole may be considered | Every 3 years | Central Kamiesberg Maintenance Team(CKMT) or contractor | | | √<br>√<br>√ | |
| | Monitoring of:<br>• Static water level (a.m. before starting engine)<br>• Draw down water level (just before stopping engine)<br>• Pumphead gland packing, check and attend leakages | Regularly once a week e.g Monday<br>Daily | Technical Operator(TO)<br>TO | <br>√ | | | √<br>√ (need another meter) |
| 2 | Standpipes<br>• Clean water meter chamber and soakaway<br>• Clean standpipe slab and surroundings<br>• Maintain standpipe equipment<br>• Read water meters | Once a month<br>Daily<br>Daily as routine<br>Once a month (at the same date every month) | TO<br>TO<br>TO<br>TO | √<br>√<br>√<br>√ | | | |
| 3 | Water Meters<br>• Read Bulk Water Meters on pipelines and reservoirs<br>• Read Private Connection water meters<br>• Maintain water meters | Once a month (at the same date every month)<br>Once a month (at the same date every month)<br>Based on monthly inspection and on analysis of readings | TO<br>TO<br>TO | √<br>√<br>√ | | | |

7 Philip Ravenscroft, *Technical Overview of the Operations and Maintenance Activities of the Kamiesberg Municipality*, for Water Research Commission, 2001.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4 | Log books and Reports | | | | | | |
| | • Log books | Recorded Daily | TO | √ | | | |
| | • Reports on Problems | Orally and followed up in writing | TO | | | | √ |
| | • Submit completed log book sheet for each borehole to Maintenance Foreman (MF) | Monthly | TO | | | | √ |
| | • Time sheets | Recorded daily submitted weekly or monthly | TO | | | | √ |
| | • Monthly report from MF to head of department. Log books, time sheets and other reports clearly compiled for further analysis. | Monthly | Maintenance Foreman (MF) | | | | √ (all of these are done but not as yet recorded) |
| 5 | Engine | | | N/A | | | |
| | • Recondition | Every 3 years | CKMT or contractor | | | | |
| | • Decarbonize and test injector | Every 1000 hours (Approx 4-5 mths) | | | | | |
| | • Change oil and filters for oil, air and fuel | Every 250 hrs (approx once a month) | Mechanical team with TO | | | | |
| | • Check foundation bolts, nuts and screws on engine and pumphead | Daily before start | TO | | | | |
| | • Fill up the fuel tank | Daily, after stop | TO | | | | |
| | • Check v-belts | Daily before start | TO | | | | |
| | • Clean engine | Daily before start | TO | | | | |
| | • Check oil level | Daily before start | TO | | | | |
| | • Check exhaust pipe and silencer | Daily before start | TO | | | | |
| | • Check greasing of clutch (if any) – On twin disk clutch: grease the throw out collar. | Daily before start | TO | | | | |
| | • Check clutch greasing – grease quit function bearings | Twice a month | Mechanical team with TO | | | | |
| 6 | Pumphouse and store | | | | | | |
| | • Drain fuel storage tank (if applicable) | Every 3rd Month | TO | N/A | | | |
| | • Check doors, windows, locks and burglar bars | Daily | TO | √ | | | |
| | • Wash pumphouse and floor. | Once a Week | TO | √ | | | |
| | • Clean store | Once a Month | TO | √ | | | |
| | • Check water meter, tap and valves | Daily | TO | √ | | | |
| | • Check tools and equipment issued to TO | Every 6 Months | MF | √ | | | |
| 7 | Borehole yard | | | | | | |
| | • Clean yard and keep grass short | Once a week | TO | √ | | | |
| | • Remove any diesel/oil contamination and report | Immediately Daily | TO | √ | | | |
| | • Check fence and gate / make repairs | | TO | √ | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8 | Pipelines<br>• Check all stopcock valves and sluice/gate valves, closing and opening them<br>• Check function of all air release and wash out valves<br>• Check and maintain route markers<br>• Check and clean valve chambers, make sure covers are alright<br>• Detect and attend to any leakage (check entire network, taking one section at a time) | Once a Month<br>Once a Month<br>Twice a year<br>Once a Month<br>Once a Month.<br>Attend to leaks as soon as they are discovered | TO<br>TO<br>TO<br>TO<br>TO | √<br>√<br>√<br>√ | | | √ |
| 9 | Reservoirs<br>• Drain and clean<br>• Check water level indicator<br>• Clean yard and keep grass short<br>• Check for any leakage and report<br>• Check fence – repair if necessary | Once a year<br>Once a week<br>Once a week<br>Daily<br>Daily | TO<br>TO<br>TO<br>TO<br>TO | √<br>√<br>√<br>√<br>√ | | | |
| 10 | Desalination Plant<br>• Do regular maintenance as per the schedule contained in the operators manual<br>• Monitoring and recording of EC and PH of raw water and desalinated water<br>• Major servicing as per operators manual | As per schedule in operators manual<br>Daily at startup<br>As per schedule in operators manual | TO<br>TO<br>TO with specialist contractor. | √<br>√<br>√ | | | |

## 1.10. DOCUMENTS TO KEEP HANDY!

### 1. *Start up procedures: A checklist*

On start-up of any piece of equipment, certain procedures must be followed to assure that the equipment will not be damaged, that other pieces of equipment are interlocked so they start or stop in tandem with another facility, and that the water produced is of acceptable quality.

A *checklist* for each piece of equipment showing step-by-step the items to be checked at and during start-up should be available.

### 2. *Normal operating conditions: A trouble-shooting guide*

A *troubleshooting guide* should be available to quickly identify problems, probable causes, and a brief description of possible control or prevention techniques.

### 3. *Maintenance: A maintenance schedule*

The objective of a planned maintenance program is to prevent unplanned, reactive maintenance. To accomplish this, the operator must have knowledge of the equipment, its required maintenance, and the spare parts to be stocked.

A *maintenance schedule* for each piece of equipment specifying the maintenance activity, spare parts to use and frequency of maintenance should be available.

Maintenance planning should at least cover:

- Supply of diesel and oil;
- Supply of consumables such as filters and cleaning material;
- Timetable for changing filters and oil;
- Timetable for decarbonising and cleaning of engines;
- Timetable for attending to reticulation systems such as valves, stand pipes, markers, etc;
- Timetable for inspection the different suburbs in town;
- Follow-up of the Water Supply Operators' work performance; and
- Training of staff.

Each Municipality should draft a "Preventative Maintenance Plan". This is an O&M plan that will ensure that ongoing maintenance tasks are done on a regular basis, and will save a lot of money in the longer run. Each Municipality's plan will look somewhat different, due to different technologies and natural resource conditions.

## 1.11. RELIABILITY AND LIFESPAN OF INFRASTRUCTURE

Key concepts of Preventative Maintenance to keep in mind are:

- *"Reliability"*: Adequate O&M is one of the most important factors in ensuring the reliability of systems. In particular, a critical factor is the length of time the system stands idle when it breaks down. A system, which breaks down every 8 months but is easily repaired is more reliable

than one that lasts 18 months before breaking down but then requires several months to fix. Thus a simple system providing 25 litres per head for 95% of the time is providing a higher level of service than one designed for 100 litres per head which works for only an average of 2 hours per day due to leakage, breakdown, fuel shortages or limited water available at the intake.[8]

- *"Life span of systems"*: The useful life of some water supply system components are:[9]

| | |
|---|---|
| Pumps | 10-15 years |
| Pipe lines – cast iron | 40-50 years |
| Pipe lines – plastic | 15-20 years |
| Dams and intakes | 40-50 years |
| Boreholes | 20-25 years |
| Treatment plants | 20-25 years |

This has several implications. Firstly, it means that appropriate O&M levels should be maintained to achieve these life spans. Secondly, capital should be set aside for replacement of equipment and infrastructure. Thirdly, during the latter part of the life span of equipment or infrastructure, O&M requirements are likely to increase. Fourthly, in conditions of unexpectedly rapid population growth, resulting in over-usage of equipment or infrastructure, the life span is likely to be reduced.

Some of the factors that determine the quality of O&M are:

- availability of funds
- quality of municipal staff at supervisor and management level
- availability of reliable transport
- availability and quality of records; and
- the level and quality of analysis of information collected.

Ultimately, decisions about these important issues are "policy decisions", which need to be taken by the Council.

This Workbook refers to large systems that are "centrally managed", i.e. the systems consist of a main source (for example boreholes) that pumps water to a reservoir. Water is then pumped through pipes that lead to private connections on individual plots. Piped water supply and water-borne sewerage are typical centrally managed systems. These systems require supporting external infrastructure.

Such systems may be operated by municipalities, or by specialist agencies such as water boards. In the Northern Cape, for example, most piped water and water-borne sewerage systems are managed by municipalities (who are also the Water Services Authorities).

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8 Sami and Murray, 1998, p. 2.8.

9 Sami and Murray, 1998, p. 5.2.

## 1.12. A SPECIAL NOTE ON SANITATION

Water, sanitation and hygiene promotion cannot be dealt with in isolation.

Sanitation can be divided up into two parts: the physical entities: latrines and sewers; and the management part of it, such as the regulation of sanitation and hygiene promotion. Other areas included are drainage and solid waste management.

Off-site sanitation (urban) uses piped sewers leading to high-tech sewage treatment works where wastes are processed to separate the liquid and solid components, remove nutrients from the liquid, and make the sludge fit for disposal. These systems are hugely expensive. Water is the carriage medium for most of these systems. Potable water is supplied to the house and used for flushing toilets (as much as 40% may be used for this purpose).[10] Therefore most sewer systems heavy user of potable water supplies, which should be kept in mind in water shortage areas such as the Northern Cape Province.

The main sewerage options are:[11]

- Conventional sewerage: series of underground pipes collecting and transporting waste to a point of discharge (septic tank, or treatment plant). Fixtures and fittings required: sewer pipes, household connections, grease traps, interceptor tanks and access chambers. Cost of system may be reduced by limiting number of fittings.

- Simplified sewage systems are modified versions of conventional sewerage designs and are built to reflect the local environment and customer affordability. May involve reducing minimum pipe diameter to 100mm and minimum collector gradient to 1 in 220, increasing spacing between access points and postponing construction of treatment works.

- Condominial sewerage: laying of collector sewers at he rear of properties close to the point of waste generation. Reduces the length and depth of house sewers and also minimizes the amount of pumping required. Total cost of this approximately half the cost of a conventional system, and may be cheaper than on-site systems at high population densities.

- Interceptor tank system: relies on the settlement of solids near the point of generation. Allows the sewerage network to be designed for a much reduced peak capacity: the minimum sewer diameter can be as little as 40mm.

Sewerage does not clean the wastes, it must thus leave the network of pipes to be either treated or discharged into the environment. Installing a sewage treatment plant may almost double the cost of construction. But no doubt that where possible, sewage treatment is preferable as it reduces the environmental damage done by polluted waters and removes potential source of disease. Sewage treatment may be classified into groups of processes according to the function they perform and their complexity:[12]

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10 DFID doc, p.173

11 DFID, p. 185

12 DFID p187.

Preliminary: simple processes such as screening (using bar screens) and grit removal to remove the gross solid pollution

- Primary: plain sedimentation
- Secondary: further treatment and removal of common pollutants (usually by a biological process)
- Tertiary: removal of specific pollutants (nitrogen or phosphorous, industrial pollutants)

The preliminary and primary treatments are common to most sewage treatment works.

Most conventional sewage treatment involves "removing" pollutants and turning it into sludge, which is then either dumped or burned. In developing countries such as SA, the waste stabilizing ponds are used. These provide the best option: good level of treatment at low capital and particularly low O&M costs. Also has significant application potential for the re-use of the treated effluent in irrigation. Disadvantage: significant areas of land are needed for treatment.

It is important to remember: a technology with a high institutional dependency in an area with weak institutions is unlikely to be sustainable.[13]

It is important to involve all sectors of the community when dealing with water and sanitation services provision. Sanitation is extremely important as inadequate and inappropriate sanitation facilities can allow disease to spread.

Urban sanitation functions through a system of pipe-networks, and it is thus important that all of it is in good condition to ensure that service takes place at every level. Although the system's technical feasibility is of the utmost importance, even more important is the institutional capability of the municipality to operate and maintain the system.

Basic technical skills that are needed for urban sanitation maintenance are:

- Pipe and pump maintenance
- solid waste dump-site management, and

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13 DFID, p. 185.

## TOPIC 1: SELECTION OF GOALS AND TARGETS AND INDICATORS

Some Municipalities' O&M objectives may be too vague to be of much use, e.g. "to keep the system working". More precise policy goals should be formulated. Typical goals of a Municipality would be:

- to ensure a constant supply of high quality of water.
- To keep equipment in optimal working order
- To budget sufficient resources for effective maintenance of infrastructure and equipment
- To reduce vandalism of infrastructure to a minimum
- To use staff time as effectively as possible, so that costs can be reduced
- To have 100% of household meters in working condition.

More precise targets can then be set, for example:

- To provide x litres per person per day, with no more than y number of days per year down-time

TheThe indicators suggested in this topic refer primarily to *input and output reporting*. Indicators regarding *impacts* should be formulated separately, according to the ultimate policy goals of the Municipality.

Indicators for an O&M system can be grouped into 5 categories:[14]

a) User opinions and satisfaction
b) Financial aspects of O&M
c) Levels of service (technical or infrastructural issues)
d) Materials, parts and equipment
e) Personnel indicators.

Examples of indicators are provided in the tables below. They are linked closely to the Municipality's goals. For each indicator the type of data and possible quantitative formulae are provided. In addition, qualitative issues are noted, which require some judgement or discretion on the part of the municipality. This is important, because monitoring involves qualitative judgement, in addition to more routine methods of data collection.

The proposed indicators are not "cast in stone". Each municipality should decide which issues, and which indicators, are important to monitor.

### 1. User opinions and satisfaction

The views of the users may be regarded as the most important indication of the success of water services, since they are the municipality's clients and financial resource-base. User surveys are important tools to use, especially in rural areas where there is much less access to a formal complaints system.

The following table suggests six types of indicators for assessing users' opinions and satisfaction about O&M. For each indicator, quantitative formulas are suggested, as well as qualitative issues to keep in mind when designing research methods.

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[14] Drawn from WHO, Geneva, "Tools for assessing the O&M status of water supply and sanitation in developing countries", 2000.

| Possible policy goals | Indicators | Data | Quantitative Formula | Qualitative issues |
|---|---|---|---|---|
| Maximise user satisfaction | User satisfaction | Surveys of users' opinions | % of interviewees satisfied with service operation, classified by degree of satisfaction | Researcher needs to define "satisfied" to reflect different aspects of satisfaction, e.g. water quality, quantity, cost etc. |
| Address the most common O&M problems | Five main O&M problems | Surveys of users' opinions | % of interviewees identifying each of the five most frequently listed O&M problems | Survey sheet needs to be designed so that key areas for possible action are identified, e.g. improve response times, more liaison with community organisations, etc. |
| Clarify the public's perceptions on roles and responsibilities – enhance the public's understanding of O&M | Roles and responsibilities | (1) Who is perceived by users to be responsible for O&M?<br><br>(2) Who is actually responsible for O&M | This is not a quantitative issue. | This is a strongly qualitative issue. It will reveal communities' understanding (or lack of it) about how government works. Participatory methods, which are highly qualitative, are strongly recommended. |
| Promote community ownership of facilities | Care and use of facilities | Evidence of facilities being used and looked after | No. of facilities damaged or vandalized per month<br><br>Frequency of evidence of latrines not being used (e.g. people using the veld) | This is also a strongly qualitative issue, since it reflects the community's sense of care and ownership. Participatory methods are highly recommended to "unpack" users' opinions of facilities. |

| | | | | |
|---|---|---|---|---|
| Improve the accessibility of the Municipality to the public | Approaching formal institutions and outcome | (1) Number of times municipality is approached for assistance in a given period – either from Councillors, or officials.<br><br>(2) Number of successful outcomes | No. of successful outcomes divided by no. of approaches during the time period. | This is also a very qualitative issue, since it reflects how responsive the institutions are from the point of view of the user. Participatory methods should be used to "unpack" users' perceptions. |
| Improve the Municipality's response to public complaints | Complaints dealt with | (1) Number of actions dealing with complaints in a given period<br><br>(2) Number of complaints logged in a given period | No. of actions dealing with complaints in a given period divided by the number of complaints logged in that period | The qualitative aspect is to assess the system of receiving and acting upon complaints. Such systems may be little known to users. Participative methods can be used to "unpack" users' perceptions of how and where to complain. |

## 2. *Financial aspects of O&M*

How much does O&M cost at present? And how much should it cost? These figures require careful monitoring and analysis.

| Possible policy goals | Indicator | Data | Quantitative Formula | Qualitative issues |
|---|---|---|---|---|
| Reduce operating costs | Operating costs per connection | (1) Total O&M cost for water services<br>(2) No. of connections | O&M cost divided by number of connections | The calculations should be done in a format that leaves scope for the question of whether the current operating costs are excessive (compared to previous years). |

| | | | | |
|---|---|---|---|---|
| Reduce operating costs | Operating costs for each aspect of water services, per month | Operating costs for:<br>• Water abstraction<br>• Water purification<br>• Water distribution<br>• Sewerage works<br>• Treatment works<br>Etc. | • Annual O&M cost for each aspect divided by 12.<br>• Percentage ratio of annual maintenance expenditure to total asset value | |
| Determine actual costs for each aspect of water services | Budgeted resources per aspect of water services | Budget breakdown for:<br>• Water abstraction<br>• Water purification<br>• Water distribution<br>• Sewerage work<br>• Treatment works<br>• Etc.<br>Actual operating costs for each aspect. | Budgeted resources divided by actual resources on monthly basis, to determine over- and under-expenditure. | |

### 3. *Levels of service indicators*

Level-of-service indicators show the specific functioning of the water and sanitation systems. Full records should be kept at each point in the system.

| **Possible Policy goals** | **Indicator** | **Data** | **Quantitative Formula** | **Qualitative issues** |
|---|---|---|---|---|
| Promoting effective preventive maintenance | Maintenance activities | All maintenance activities, listed by:<br>• Task name<br>• Brief description<br>Average length of time for completion of task<br>• Frequency (daily, monthly, annually, bi-annually).<br>Maintenance costs. | | Maintenance activities should be categorised:<br>• Preventive maintenance<br>• Common corrective maintenance<br>• Rehabilitation tasks. |
| Promoting reliability and continuity | Reliability/<br><br>Continuity | Functioning time: No. of days in a month or year when the water supply and sanitation service is functioning | • Number of hours of supply per day divided by 24 | Causes for down-time should be listed and analysed |
| Reducing water leaks | Water leakage rate | ?? | ?? | |

| | | | | |
|---|---|---|---|---|
| Creating a system of reliable water metering | Water meters | No of non-functional water meters per month | No of non-functional water meters per annum divided by 12 | An inordinate amount of non-functioning water meters should be investigated as water meters are essential in monitoring water usage and water conservation |
| Reducing/<br><br>increasing water pumped | Pump working hours | No. of hours pumped<br>Electricity usage<br>Flow of water pumped<br>Amount of water pumped per day | Annual statistics divided by 12 and 365 to determine average monthly and daily figures. | Variances on normal statistics enable the Municipality to detect faults with the pumps. |
| Have reliable vehicles available at all times | Service vehicles | No. of days per month when vehicles are out of service | No. of out-of-service days per annum divided by 12 | |
| Providing a high quality of water | • Water quality | • Bactericlogical water quality survey for *E.coli* at the supply points<br>• Number of supply points at which the *E. coli* count is greater than the target value set for the locality | Number of supply points at which *E.coli* sample are greater than the target value, divided by the total number of supply points for which samples are taken | The Municipality, in co-operation with DWAF and the community, should decide on appropriate water quality levels.<br><br>Water quality should be recorded at strategic points (to be decided by the Municipality) so that the treatment process can be adjusted. |
| Promoting water conservation | Flow rating | • Discharge as measured from the tap<br>• Design discharge (either discharge as measured after commissioning the scheme, or theoretical discharge used in the scheme design) | Actual discharge from tap divided by the design discharge. | |

## 4. *Materials, parts and equipment indicators*

| Possible policy goals | Indicator | Data to collect | Quantitative Formula | Qualitative issues |
|---|---|---|---|---|
| Having a reliable supply of spare parts, to promote reliability of service | Outstanding repairs | Number of outstanding repairs due to lack of spare parts | Number of repairs not carried out due to lack of spare parts, per year, divided by 12 | The lack of spare parts can arise due to various causes, e.g. inadequate budgeting, inadequate credit control, unanticipated breakages, difficulty in obtaining spare parts, etc. The reason for the lack of spare parts should be indicated. |
| Having reliable maintenance teams, to promote the reliability of service | Maintenance team indicator | • Number of maintenance team vehicles on the road in a particular week<br>• Number of maintenance workers on the road in a particular week<br>• Number of maintenance work incidents that is reported during a specific week | • Number of vehicles on the road divided by the total number of vehicles in the fleet<br>• Number of maintenance workers on the road (during a specific week) divided by the total number of maintenance workers | |
| Having a reliable supply of spare parts, to promote reliability of service | Accessibility of parts | • Date on which the need for a spare part is identified<br>• Date of arrival of spare part | Time elapsed between identifying the need, ordering, and arrival | |
| Having a reliable supply of spare parts, to promote reliability of service | Spare parts used | Number of spare parts requisitioned for a particular scheme or aspect of a system, over a particular period | Number of spare parts requisitioned, divided by the duration of the period | If very few spare parts are used, this may suggest that O&M is not carried out to the required extent. The results of the formula should be compared to the specifications in the Manual or Maintenance Plan. A qualitative judgement is needed in this regard. |

| | | | | |
|---|---|---|---|---|
| Reducing the time required to perform maintenance tasks (i.e promoting productivity) | Mean time to repair (MTTR) | • No. of repairs undertaken in a given period<br>• Total time spent on repairs in that period | Total time spent on repairs divided by no. of repairs in the given period. | This indicator shows how long it takes to carry out a maintenance job, and reflects the reliability of the system. A low MTTR points to systems that are easy to maintain and efficiently organized maintenance systems.<br><br>Qualitative reasons for findings should be noted, e.g. availability of staff, parts etc. |
| Reducing the number of failures | Mean time before failure (MTBF) | No. of equipment breakdowns in a system in a given period | Duration of the period divided by the number of failures in that period | MTBF is the length of time the system can be expected to operate before some kind of maintenance input is required. The higher the MTBF, the less frequently will breakdowns occur, and the better the performance. This is ideal for measuring the performance of vehicles and pumps. |
| Increasing the effectiveness of leakage repair | Leakage repair rate | No. of leakages repaired in a given period | No. of leakages repaired divided by the duration of the period | This also relates to Water Conservation and Demand Management (see Workbook ??) |

## 5. *Personnel indicators*

| Possible policy goals | Indicator | Data | Quantitative Formula | Qualitative issues |
|---|---|---|---|---|
| Having appropriate levels of staff / rationalizing staff / appointing additional staff | Levels of staff | Total staff per unit of infrastructure or urban service delivery. | Number of staff in the water and sanitation services, divided by total Municipal staff. | |
| Adequate levels of skilled and unskilled staff | Professional/skilled/unskilled staff. | Number of water and sanitation services staff in each category. | Number of water and sanitation services staff in each category, divided by total water services staff. | |

| | | | | |
|---|---|---|---|---|
| Promoting on-the-job training | Training | Number of days spent on training per year | Number of days spent on training divided by 365 | |
| Reducing staff turnover | Staff turnover | Number of staff leaving the Municipality per annum.<br><br>Number of new staff appointed. | Number of staff leaving, divided by total staff complement.<br><br>Number of new staff, divided by total staff complement. | This should be calculated per category of staff, e.g. unskilled, skilled, senior management etc. |
| Providing competitive salaries to municipal staff | Competitiveness of salaries | Current staff salaries (including benefits) | Ratio between salary/benefits in public versus private sector | This should be calculated per category of staff. |
| Reducing the amount of idle time to a minimum | Idle time | • Number of days of idle time per month<br>• Number of days worked in a particular month | Number of days of idle time divided by the number of days worked in a particular month | "Idle time" may refer to workers not working, due to a lack of vehicles or spare parts. It may also refer to underemployed workers, with workers not working to capacity. |
| Reducing amount of overtime worked | Overtime work | • Number of days overtime worked per month<br>• Number of days worked in a particular month | No. of days of overtime divided by no. of days worked in a particular month. | This should be calculated according to different types of workers, e.g. plumbers or meter readers. |
| Removing the backlog of infrastructure maintenance work | Work control indicator | No. of outstanding or unfinished jobs (the backlog) | No. of outstanding or unfinished jobs, per month | This indicator gives advanced warning of problems with future workload. Continued high levels of backlog indicate problems in the system, which need to be reviewed and improved. |
| Having the optimal workload for maintenance staff | Workload | No. of jobs carried out, classified by type, over a particular period | No. of jobs carried out in each category, divided by the duration of the period. | Examples of categories: Handpumps, street taps, toilets, pipelines, fittings, vehicles and buildings. The Municipality should use its discretion to determine categories. |

## TOPIC 2: RESOURCE INVENTORIES – COUNTING WHAT YOU'VE GOT

"Infrastructure" refers to

- source infrastructure (boreholes, spring boxes, earth dams, rain tanks etc),
- pumps and engines (driven by diesel, electricity, solar power, wind, human power, or water)
- water treatment infrastructure,
- storage infrastructure reticulation facilities.

### *1. Jurisdiction*

The initial step in the inventory of resources and the condition assessment process is to determine the jurisdiction of the maintenance authority in question: that is, to determine the geographical and functional zone of infrastructure elements to be maintained. For a local authority, this area would commonly be the municipal limits, but could alternatively cover a smaller or a larger area.

If services are only provided to selected neighbourhoods or zones, then just these are relevant. However, many infrastructure systems could have relevant facilities outside the urban limits, such as a water reservoir, sewage-treatment plant, or garbage-disposal landfill. Boreholes may be located on nearby farms. Also at issue will be the responsibility or other agencies. Sometimes national agencies will have responsibilities for certain facilities.

### *2. Technical inventories*

Establishing a monitoring system of technical maintenance requires a detailed inventory and condition assessment of all assets, fixed or mobile. The purpose of such an inventory is to identify and collect technical information on each asset to be maintained.

The sources of supply for a water system may be surface water supply, groundwater supply or water purchased from another water services provider. Surface water supplies consist of rivers and dams. Groundwater supplies can be borehole or spring. It may happen that a water system has one source of supply or multiple sources.

The distribution system includes the conveyance of water from the source to the customer, including pumping, transmission mains, distribution mains, valves, fire hydrants, customer service lines, and distribution system storage.

The following five issues will be described in this section:

a) Compiling a list of infrastructure and equipment
b) Condition assessment
c) Compiling infrastructure and equipment master schedule

d) Inventory of materials
e) System capacity.

**a) Compile a list of infrastructure and equipment**

The next step is to develop a complete list of all hardware, with relevant technical details. This includes:

- Any existing maps or records: Systems plans should be available to show the locations of source supply(s), treatment plant(s), and the distribution system infrastructure. Records of the locations of transmission and distribution mains, all valves, fire hydrants, and scour valves must be indicated on the system plans. All items should be recorded numerically, so that all information records can be associated with a specific infrastructure item.

  On the system plans, the normal operating pressures should be indicated at typical locations such as fire hydrants and customer services.

  Sometimes a water system must be divided into different pressure zones so that customers at higher locations have adequate pressures for the service they desire. The pressure zones should be clearly marked on the system maps. Also, all valves that normally should be closed to separate the pressure zones should be clearly marked on the plans as normally closed.

  The following table illustrates the inventory of water meters for each zone in De Aar:[15]

| USER | Area | | | |
|---|---|---|---|---|
| | West | East | Nonzwakazi | Waterdal |
| **Business** | 111 | 10 | 10 | 5 |
| **Domestic** | 1450 | 1723 | 1368 | 65 |
| **Army** | 2 | | | |
| **Industrial** | 6 | 27 | | |
| **Schools** | 10 | 5 | 3 | |
| **Etc** | | | | |

- *New infrastructure:* As new systems or facilities are designed and constructed, engineering drawings of infrastructure elements such as pumping stations, sewer lines and drains should be available. The final as-built drawings will help immensely towards establishing this inventory.

  However, there will be many cases where no up-to-date, reliable, drawings exist, so a lengthy inventory process must be undertaken. Simple inventory forms will have to be developed, and completed site-by-site.

[15] This table is adapted and translated from: Municipality de Aar (Mr F.D. Taljaard): *Wateroudit en Verslag vir die Finansiele Jaar: 1 Julie 1999 tot 30 Junie 2000;* September 2000. Annex A

Technical data should be available to describe each facility, infrastructure component or equipment in the system. Typical data required to describe boreholes, pumps, treatment plants and storage tanks in the system follows:

*i. Boreholes:*

A borehole consists of:

- An intake area
- Supportive casing
- An above-ground well head structure, and
- A water lifting or pumping device.

According to Sami and Murray (1998), "The importance of adequate borehole design cannot be over-emphasised as it affects operating costs and the life of the borehole".[16]

A description of the borehole should include:

- The location of the borehole (latitude and longitude)
- The year the borehole was drilled and pump tested
- Drill and borehole development records (borehole depth and diameter, casing type, size and depth, type of sanitary seal provided, water strike depth, the position of the static water levels)
- Pump test records (borehole yield and water levels)
- Water quality records
- The original drill and development cost.

*ii. Pumps (surface water intake, boreholes, lift, booster, treatment plant etc):*

A description of the pumps should include:

- The location of the pump (latitude and longitude)
- The pump installation date
- Pump details (type, make & model, efficiency point)
- Operating point (flow & head)
- Intake levels
- The original cost.

*iii. Treatment plant:*

A description of the treatment plant should include:

- The location of the treatment plant (latitude and longitude)
- The date of installation or construction
- The treatment process used
- The Capacity of the plant
- The original cost of the plant.

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16 P. xxxii.

iv. *Storage & distribution tanks and reservoirs*

A description of the tanks should include:

- The location of the tanks
- The year constructed
- The type (ground-level, elevated)
- Tank details (material, shape, dimensions)
- Capacity of tanks
- The original cost.
- Household storage requirements

v. *Bulk and internal pipeline routes*

Detailed inventory and condition rating of pipes and valves, including:

- Pipeline type and age,
- Pipeline diameter,
- Pipeline length,
- Pipeline flow capacity
- Information about valve locations, and a detailed valve inventory and condition assessment of all the valves installed.

vi. *Sewerage works:*

- Pipes, pumps, filters
- oxidation pond system designs and capacities.

**b) Condition assessment**

The following types of technical information then need to be collected about the existing infrastructure:

- A condition assessment (current condition)
- Data on maintenance, repair and rehabilitation needs
- An inventory of current spare parts kept in the municipal stores
- A list of additional spare parts which should be kept in the stores
- Regular inspections (at least annually) to keep the information up-to-date, and keep maintenance plans tuned to the real needs in the field.

As field data are being collected, condition assessments can be performed, and results noted on the same form as the inventory sheets, or separately. Rating of the condition of infrastructural elements and vehicles and equipment can be made using the following scale:

Good: The utility value of the existing asset is not essentially different from the utility value of a similar new asset.

Fair: Maintenance/rehabilitation is needed, but the condition of the asset does not yet impose severe constraints on its utilization.

Poor: The asset is seriously deteriorated or will deteriorate within several years. Comprehensive rehabilitation or replacement is required.

While this type of approximate condition assessment rating scale will be useful, in many cases more precise indicators are needed.

### c) Compiling infrastructure and equipment master schedule

Once the raw data have been collected, summary lists can be prepared. For example, lists could be developed by *location* (street, water main) and by *function* (pumping stations, reservoirs, treatment facilities etc.). Such data can begin to build a picture of the overall condition of assets in each sector and in the combined infrastructure condition.

### d) Inventory of Materials

An inventory of the physical resources for maintenance should be conducted along with the inventory of physical infrastructure to be maintained. These are the basic inputs required for the planning process.

Indicators to be used to examine materials, equipment and facilities resources in maintenance agencies and departments include:

- Vehicles: inventory with data on type, age, condition and availability
- Workshops and special facilities: inventory and condition
- Workshop tools and equipment: inventory and condition
- Stores for tools, equipment, spares, materials: procedures used, shortfalls incurred.

"*Stores maintenance*" is particularly important. The Municipality should keep a sufficient stock of equipment and spares. Each Municipality should decide for itself how much stock to carry. This will depend on its location and type of infrastructure. Cash flow should not be an obstacle to stores maintenance! If there is not sufficient cash flow, then the Municipality should either improve its O&M budgeting, or it should improve its revenue generation activities.

The following table is an example of a list of spares, in a small rural settlement in Namaqualand:[17]

17 Philip Ravenscroft, *Technical Overview of the Operations and Maintenance Activities of the Kamiesberg Municipality*, for Water Research Commission, 2001.

| | Hondeklipbaai | | | | | |
|---|---|---|---|---|---|---|
| ITEM | DESCRIPTION | UNIT | NUMBER | RATE | TOTAL | COMMENTS |
| 1 | UPVC Pressure Fittings | | | | | |
| 1.1 | Repair Coupling 110mm | No. | 3 | 100 | 300.00 | |
| 1.2 | Repair Coupling 75mm | No. | 10 | 80 | 800.00 | |
| 1.3 | Repair Coupling 50mm | No. | 5 | 50 | 250.00 | |
| 2 | Compression Fittings for HDPe | | | | | |
| 2.1 | Couplings 75mm | No. | 4 | 100 | 400.00 | |
| 2.2 | Saddle 75mm to 3/4" | No. | 5 | 30 | 150.00 | |
| 2.3 | Saddle 110mm to 3/4" | No. | 5 | 40 | 200.00 | |
| 2.4 | 20mm to 3/4" Male adaptors | No. | 10 | 7 | 70.00 | |
| 2.5 | 20mm Couplings | No. | 10 | 12.5 | 125.00 | |
| 3 | Thread tape | Rolls | 10 | 1.5 | 15.00 | |
| 4 | 20mm Cobra Bibtap | No. | 2 | 70 | 140.00 | For temp. taps |
| 5 | 20mm tap Washers | No. | 5 | 1 | 5.00 | For temp. taps |
| | | | | Sub Total | **2,455.00** | |
| | | | | VAT | **343.70** | |
| | | | | TOTAL | **2,798.70** | |

**e) System capacity**

The design life of a scheme should be known. Factors that must be quantified to estimate water demand and system capacity are:

- Design period for which the system was planned
- The population at the end of the design period based on projected growth rates
- Water requirements for institutions and agriculture
- The per capital consumption and the level of service to be provided, and
- Climatological variations that affect the water demand from one year to another.

***3. Administrative inventories***

**a) Individual staff information:**

Important information to collect:

- A list of staff working on infrastructure maintenance.
- Job descriptions.
- Age, gender, race, qualifications, language proficiency.
- Levels of qualifications.
- Individual skills assessments. In particular: does the staff have skills for repairing and restoring the systems and equipment to their original operating condition?

- Salaries, including benefits.

**b) Organisational structure**

A complete organogram of the municipal structure should be compiled, detailing all levels of the organisational structure.

**c) Financial resources**

The main source of information for determining available financial resources is the annual municipal budget. Budget items should be classified according to aspects of the water and sanitation systems, e.g. water extraction, purification, bulk supply lines, reticulation, etc.

## TOPIC 3: DATA COLLECTION

### *Principles of data collection*

- Data collection should take place continuously on a regular basis. Quantitative information could be stored on a computer as part of a database, but this is not essential. The data collected for operations and maintenance can be captured manually in record books.

- Full records should be kept at each point in the system. These records provide a history of the operation and indicate the demands of the system and costs of the operation. A comparison of records can be used to identify suspected system problems such as increased pumping or treatment costs or possible loss of water.

- Staff should be trained to undertake management and inspections carefully and conscientiously. Each staff member should have a worksheet, and his/her work should be monitored regularly.

- Generally there are two specified formats for recording and reporting at municipal level:
  - the municipality water supply log book, which records on a daily basis for all O&M activities
  - the inspection report book, which records the annual thorough inspection of the entire water supply system.

However, there might be a need to have different logbooks for different aspects of the O&M monitoring and evaluation plans. These can be designed in-house to suit the needs of the individual municipalities and the specific target's tasks. Some examples of such log books/sheets are demonstrated below.

- It is necessary to record *pump working hours*, i.e. electricity usage, the flow pulled by the pumps and the amount of water pumped each day. This will enable the Municipality to detect faults with the pumps, so that maintenance can be undertaken before substantial damage is caused.

- All water meters must be read regularly to minimise losses, and to balance water use with the amount of water extracted.

- All maintenance and maintenance costs must be recorded.

- All down times must be recorded.

- Water quality must be determined at strategic points, to determine the types of chemicals required so that the treatment process can be done effectively and economically.

- All systems should be mapped (including each pump, valve, pipe, meter etc). Each item should be recorded numerically, so that all information records can be associated with a specific infrastructure item. This will help the Municipality to determine whether the system is still being operated effectively, or whether some of the items should be replaced.

The following table shows what data should be recorded, at each point in a large-scale water distribution system. The data collected was done by the Karoo Hoogland Municipality:

| Issue | Required equipment | Monitoring information | Done Anyway | Done – extra admin | Not done – not neces-sary | Not done – reasons why |
|---|---|---|---|---|---|---|
| 1. Boreholes: water level recordings | Borehole fittings:<br>• shut-off valves<br>• check valves<br>• air-valves<br>• water meters<br>• pressure gauges<br>• Telemetry system | **Record book:**<br>• Quantity of water extracted<br>• Electricity usage<br>• Borehole maintenance (preventive, corrective, rehabilitation) | √<br>√<br>√<br>√<br>N/A | | | |
| 2. Extracting water from rivers | • Reverse flow valves<br>• Air valves<br>• Telemetry system | *Record book:*<br>• Quantity of water extracted<br>• Electricity usage | N/A | | | |
| 3. Boreholes: Water sampling for quality | • Sampling taps<br>• Borehole base plates must be installed properly and sealed to prevent possible contaminants from entering the groundwater.<br>• Conduit pipes to allow water level recording instruments to pass down the boreholes<br>• Disinfection equipment at storage point | *Record book:*<br>• Water quality (boreholes) | √<br>√ | | | √* |
| 4. Rivers: Water sampling for quality | Water testing equipment (?) | **Record book:**<br>• Water quality (rivers) | | | | √* |
| 5. Pump stations and pipelines to reservoirs and storage tanks | Air valves<br>Valves<br>Pumps | Record book:<br>• Maintenance of pipes<br>• Maintenance of pumps<br>• Leaks on pipeline<br>• Electricity usage of pumps (amperes and KwH of each pump) | | | | √*<br>√*<br>√*<br>√* |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6. Treatment plant | • Valves<br>• Dosage equipment<br>• Telemetry system<br>• Pipelines to reservoirs<br>• Pumps to reservoirs | • *Record book:*<br>• Quality of water before treatment<br>• Quality of water after treatment<br>• Chemicals used<br>• Dosages<br>• Disinfectants<br>• Metering water to reservoir<br>• Maintenance of treatment plant<br>• Leakages on pipelines<br>• Maintenance of pumps and pipes | | | | |
| 7. Storage (reservoirs) | • Metering of water extraction from reservoir (metering of reservoir outlets)<br>• Water level registration<br>• Telemetry | *Record book*:<br>• Calculate water loss<br>• Annual inspections<br>• Preventive storage maintenance policy and schedule<br>• Disinfecting of reservoir<br>• Testing quality of water | | | | √*<br>√*<br>√*<br>√*<br>√* |
| 8. Bulk pipeline routes | • Valves<br>• Water meter<br>• zone meters<br>• Fire hydrants (*brandkrane)*<br>• Bulk water outlets | *Record book*:<br>• Regular meter readings<br>• Leaks on pipeline route<br>• Maintenance on pipeline route<br>• Maintenance of meters and valves | | | | √*<br>√*<br>√*<br>√* |
| 9. Reticulation | • Meters<br>• Valves<br>• Fire hydrants | *Record book*:<br>• Maintenance | | | | √* |
| 10. Yard distribution | • Meters | *Record books*:<br>• Monthly meter readings<br>• Regular verification of meter readings<br>• Regular meter inspections | √ | | | √*<br>√* |

* This is done, but not recorded. No reason was provided.

Here are some examples of data tables/logbooks[18]:

**Log for Manual (generally diesel motorized) Pumps[19]:**

| Settlement Name: | | | | Borehole Number: | | | | | Operator Name: | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Before Pumping | | Time pumping starts | Water Level Before Finishing Pumping (m) | Time pumping stops | Flow Meter After Pumping (m3) | Total hours pumped | Volume pumped (m3) | Rainfall (mm)[20] | EC (mS/m) | Comments |
| | Flow Meter (m3) | Water level below ground (m) | | | | | | | | | |
| | *F1* | | *T1* | | *T2* | *F2* | *(T2-T1)* | *(F2-F1)* | | | |
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[18] As were kindly made available by Phillip Ravenscroft, CSIR.
[19] Assumption: all boreholes have a water meter
[20] These columns could also include a column for any item that is regularly tested, for example: fluoride.

Log for Automatic (generally electric) Pumps[21]:

| Borehole Number: | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Settlement Name: | | | | | Operator Name: | | | TOTALS | |
| Date | Time of Reading | Pump On or Off | Water level below ground (m) | Water Meter Reading (m3) | Hour Meter Reading (hrs) | Rainfall (mm)[22] | EC (mS/m) | Comments | Volume pumped (m3) | Total hours pumped (hrs) |
| | | | | | | | | | | |
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[21] Assumption: all boreholes have a water meter

[22] These columns could also include a column for any item that is regularly tested, for example: fluoride.

The log books should have numbered, duplicate carbonized pages. The original of the duplicate pages should have tear-off serrations, to allow for the original copy to be sent for further processing, while a copy remain with the pump operator.

A still cardboard flap-out sheet can be used to put behind the currently-used sheets to avoid pressing through onto the following pages. The log books should be supplied in a strong plastic zip seal type bag to allow for safe storage in pump house. The log books should be protected from water and dirt. A good idea is to include a few sheets of log paper at the back of the book so as to allow the operator to plot the water levels.[23]

[23] Phillip Ravenscroft, CSIR.

## TOPIC 4: INTERPRETING AND ANALYSING DATA

Once the information is collected and written up, a senior municipal official (the "analyst") should do an overview of the incoming data.

The analyst must have such a good working knowledge of the water and sanitation system, that he or she will be able to notice immediately when some of the information "looks funny". If the information seems unusual, this could be for at least two reasons:

- Mistakes in data collection – i.e. the data should be verified
- Genuine unusual findings, e.g. if there as been a large pipe breakage, which caused a large and unusual water loss.

The analyst should decide which information should be written up in what way:

- Reporting of trends for each month
- "Exception reporting"
- "Qualitative reporting".

The most important consideration is *to make the information as useful as possible to senior officials and Council.* The analyst's role is extremely important in an effective O&M system, because he or she will be able to identify problems and trends, and recommend solutions to senior management and Council.

## TOPIC 5: REPORTING TO SENIOR MANAGEMENT AND COUNCIL

The data collected should provide all necessary information for both short and long term planning. The data should also be used to establish whether the targets/goals set out are being reached. Data gathered should be analysed at this stage, taking into account variables that might have influenced the situation.

On a regular basis, approximately every quarter, every indicator should be re-visited to assess whether it is revealing usable data and what the outcomes of the tasks were. It is also important to assess whether the tasks were the corrected tasks ascribed to the specific indicator and whether the tasks were performed adequately.

## TOPIC 6: FEEDBACK AND DISSEMINATION

The information collected and analysed should be documented in report-form. The following reports should be available on a monthly basis:

- a technical report, which details all the technical information collected during the month;
- a service report, which details the levels of service as recorded during a specific month

A water supply map, which details the location of all pipelines, valves, standpipes, private connections and storage tanks, should be updated on a regular basis.

Regular reporting to the relevant persons/departments within the municipality, as well as to the Council on a regular basis, is essential to ensure proper planning.

As far as possible, the public should be kept informed. Feedback to the communities is very important should they have been involved in a level of service survey or something similar.

## TOPIC 7: PUBLIC PARTICIPATION IN MONITORING AND EVALUATION

Public participation can be included in the monitoring of O&M in numerous ways.

Here are two examples of issues where users' perceptions are important:[24]

(i)What are the O&M activities currently undertaken in the community, and by whom? The answers may include work done by the Municipality, government departments, as well as private people hired to undertake O&M.

(ii)What are the users' attitudes and perceptions concerning the roles and responsibilities for O&M? In particular:

- What are the actual problems with O&M of services?
- Whose responsibility are these problems perceived to be?
- Is there evidence that the facilities are being cared for?
- Is there evidence that the facilities are being misused?
- Are there any mechanisms through which the users can approach Municipal institutions? If so, what are they? How effectively do they work?
- How have O&M problems been resolved? Have local initiatives been taken?
- What is the potential for promoting increased ownership and care of facilities through users becoming more proactive?
- What are the possible routes and mechanisms that could help users become more proactive?

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[24] World Health Organisation, Tools for assessing the O&M status of water supply and sanitation in developing countries, Geneva, 2000, p. 44.

## TOPIC 8: BUDGETING FOR M&E

Operations and maintenance is a large portion of the activities that form part of a water supply system. Problems with O&M have been recognized as key constraints to the sustainability of these systems.[25]

It is thus important that a sufficient amount is budgeted for O&M in a specific budget year. But without an effective M&E plan for O&M, there is no way to reliably monitor the O&M activities or the municipalities O&M goals and targets for the specific year. It is thus vitally important that a portion of the municipal budget should be for M&E activities and that a significant portion of this budget be for tasks to monitor and evaluate O&M.

In order to budget adequately for O&M monitoring and evaluation activities, it should be estimated how much each task would cost.

[25] World Health Organization, 2000, "Tools for assessing the O&M status of water supply and sanitation in developing countries", p.1

## TOPIC 9: RETURNING TO GOALS: EVALUATION

The targets (goals) and indicators of the municipality's operation and maintenance M&E plan should be evaluated once a year. The outcomes of the M&E plan should be evaluated against the goal. In severe cases of neglect and dire need for water conservation a six-monthly evaluation of outcomes measured against the goal would be advisable. This would indicate within the short term whether there is any improvement in the situation or not. Once the situation has stabilized, a yearly evaluation of goals and indicators should be sufficient. Part of this annual (or bi-annual) evaluation should include costing of the next year's (or six month's) monitoring and evaluation costs.

It is important that the evaluation be done prior to the annual municipal budgeting process to ensure that adequate budgeting for M&E will be included.

An example of issues that an evaluation exercise would look at:

- Have all the activities been carried out successfully?
- Are all document sources up to date and is all information verified?
- Did all reporting (written, reporting to council meetings, reporting to community) take place regularly?
- What were the constraints that made it impossible to conduct certain tasks?
- What were contributing factors to a successful (or not successful) M&E plan? (for example: community policing to limit vandalism, lack of spare parts, inefficient planning, unforeseeable lack of funds, labour unrests, severe vandalism, floods, etc)
- Were the indicators the correct ones to use? If no, why not? Which indicators would have been the better choice?
- Are the targets (goals) still relevant or should they be adjusted to suit the changing conditions within this sector of the municipality's service delivery?

## WORKBOOK 2:

## M&E of WATER CONSERVATION AND DEMAND MANAGEMENT

*It is recommended that the Manual for Monitoring of Water Services by Local Governments is read before and referred to when using the Workbook on M&E of Water Conservation and Demand Management.*

CONTENTS

## INTRODUCTION

This Workbook deals with the monitoring of existing water sources used by the municipality and community. These could be groundwater and surface water. Surface water sources consist of rivers and water collected in dams; and groundwater sources are boreholes and springs[26].

It is important to monitor the stability and consumption of these water sources in order to be able to evaluate the availability, consumption from and the quality of the water sources. This will enable the municipality to plan and when necessary look for alternative water sources.

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26 Springs are rarely found in the Northern Cape, but are frequently found in the water richer provinces of South Africa, such as Northern, KwaZulu-Natal and Eastern Cape provinces.

## TOPIC 1: SELECTION OF POLICY GOALS AND TARGETS AND INDICATORS

Effective M&E is only useful to the extent that it provides information to an effective management system. And a management system is only effective if it sets clear *goals and targets*. These goals and targets should inform the whole Monitoring and Evaluation process. In fact, in the last chapter, on "Evaluation" (Topic 9), the reader will return to the targets determined at the beginning of the process, to check whether they have in fact been met.

The first question for a Municipality is, therefore: "Do we have clear goals, priorities and objectives?" These goals will then indicate what the Municipality should measure.

It may be a useful practice to encourage community participation in the setting of goals. The IDP process is an opportunity to discuss the current performance of the Municipality with community leaders or stakeholders. Such discussions can be guided towards the definition of goals, objectives and targets.

Goals and targets can take different forms. For a more in-depth look at goals and targets, please refer to the manual.

It is important that the Council explicitly adopts policy goals for Water Conservation and Demand Management.

**Water Balance policy in Karoo-Hoogland Municipality, Northern Cape**

"The amount of water extracted from the source will be noted on a daily basis, and a monthly reconciliation will be drawn up. Daily readings will also be taken of outflow, so that water losses can be determined".

The targets that will be selected for the conservation of water will be influenced by supply and demand factors. "Water conservation and demand management" is a composite of supply-side and demand-side factors. Supply-side factors refer to the abstraction of water from boreholes (underground water), the abstraction of surface water from rivers and the condition[27] of the infrastructure that will ensure the safe delivery of this water. Demand-side factors refer to issues determining the residents' use of water.

[27] Refers here to possible leaks in pipes and taps and general exposure of infrastructure to environmental factors (refer to Appendix A: Operations and Maintenance).

## 1. *Supply-side factors*

a) *Maximum sustainable yield of boreholes*

Many rural water supply schemes fail due to the *over-abstraction of groundwater* from single boreholes. It is poor management to allow the water level in a borehole to be drawn down to the pump, for several reasons:[28]

- It is a waste of energy to pump water and air
- It is a waste of energy to have unnecessarily high pumping heads
- It can damage the pumps
- It can damage the aquifer if fractures and pore spaces are dewatered (compression can cause closing up of voids)
- It can reduce the efficiency of a borehole (e.g. additional oxygen in the borehole can create suitable conditions for iron bacteria to thrive. These bacteria clog borehole screens and pump inlets).
- It can influence and damage the aquifer's storage and recharge abilities.

It is therefore very important for the Municipality to be aware of appropriate borehole yields, and to adopt abstraction targets which are within these yield limits. (Such limits are usually calculated by geo-hydrologists, using a combination of test pump data, geological data, topographic position of the borehole, and climatic data).

b) *Surface water*

This includes streamflow from small local catchments (exploited through direct abstraction or using some form of storage reservoir), or streamflow in closely adjacent larger rivers (exploited through direct abstraction or above small storage weirs).

If there are no storage or impoundment facilities, then a river's baseflow characteristics control its safe yield. Daily and monthly flow data should be gathered to determine safe yields.

## 2. *Demand-side factors*

Water demand management is another important aspect of water conservation. A community's water demand is the sum of:

- Domestic household demand
- Water for institutional use
- Water for garden watering
- Stock watering, and
- Unaccounted-for water (UAW), which refers to water losses within the system itself through leaks, illicit connections, etc)

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28 Sami and Murray, 1998, p. 7.1

Modification can be achieved in several ways, including metering, charging tariffs, leakage control and flow restriction.

An estimation of future demand will influence the setting of targets. This estimation should be done based on the size of the area to be supplied, the existing population, the economic activity and possible population and economic growth rate of municipal area.

Possible targets for a town would be:

- to list all boreholes (and other water sources used)
- to monitor on a monthly basis the abstraction from each borehole (and other water sources)
- to capture this data in a data base (such as "Groundwater Lite" software for boreholes)
- to find sources of unaccounted-for water
- to limit these sources of unaccounted-for water as far as possible
- to monitor the quality of the water on a weekly basis

### 3. *Selection of indicators*

Indicators are variables used to measure progress or activities.[29] An "indicator" is precisely that – it "indicates" to the municipality whether its goals are being achieved. That is why indicators must always be selected with the municipality's goals and targets in mind.

Indicators can be used in one of two ways:

The data may be collected at regular intervals (such as weekly, monthly, quarterly, bi-annually or annually), to track the way in which a system is performing or an activity is being done. This is *monitoring*.

The data may be used to assess the change resulting from a particular activity or project. This is *evaluation*. Evaluation will require information to be collected at the beginning of the project or activity (baseline information) and at the end (to assess the impact of the activity).

Please refer to the manual for more information on indicators.

The indicators selected must monitor the targets selected, must be attainable through tasks and must be able to be verified. A set of assumptions or risks often underlies targets and indicators.

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29 Objectively Verifiable Indicators (OVIs) are a group of indicators (not necessarily measurable) used to verify inputs, outputs, outcomes and impacts. OVIs can be *quantitative* (and therefore verifiable and measurable) or *qualitative* (and therefore only verifiable).

The following is an example of a logical framework for issues discussed above dealing with water conservation:

| Target (goal) | Indicator | Tasks | Data Source or Means of Verification (MoV) | Assumption/ risk |
|---|---|---|---|---|
| A complete list of boreholes (and other abstraction means – surface water) | Number of boreholes (& other abstraction means) in area | List all boreholes used by the municipality/create a database | A data base of all boreholes (& other abstraction means) | Transport and personnel is available |
| All boreholes used by municipality monitored on a monthly basis | Data collection of abstraction from all boreholes on a monthly basis | Monitor and collect all relevant data with regards to abstraction and yield of all boreholes | A database of abstraction and yield data from all boreholes<br><br>Monthly/quarterly reports | Transport, budget, equipment and personnel is available |
| Identify and limit as far as possible sources of unaccounted-for water | Number of UAW sources identified<br><br>Number of UAW sources stopped | Investigate any incidents of UAW and resolve them | Losses of water reduced and accounted for<br><br>Monthly/quarterly reports. | Reliable O&M<br><br>Cooperation from community<br><br>Limited vandalism |

## TOPIC 2: RESOURCE INVENTORIES – COUNTING WHAT YOU'VE GOT

The foundation of a good M&E system is baseline information. It is important to establish what resources the municipality has in terms of its jurisdiction, its technical, administrative, financial and water sources. To find out more about inventories of available resources, please refer to the manual.

All the available water sources must be accurately quantified:

### 1. *Rainfall*

Collecting rainfall data is important, so that we can calculate:[30]

- the length of critical drought periods,
- the recurrence of droughts,
- the potential for surface runoff generation and its variability,
- the potential for rainwater harvesting,
- and gives an indication of annual groundwater recharge rates.

### 2. *Surface water*

Daily data should be collected to determine safe yields for run-of-river schemes, especially in small river streams where temporal variations in flow are significant. However, where weirs are built, which provide some buffering of daily fluctuations in the short term, up to 7-day average flows may be used.[31]

### 3. *Groundwater*

An aquifer and borehole yield analyses of the area should be done by a hydrogeologist, who will then provide an initial estimate of groundwater available and the groundwater abstraction rates. As the maximum stainable yield of a borehole can only be determined by regular water level monitoring, it is important that this monitoring takes place at regulated intervals[32].

### 4. *The water quality*

The water quality must also be appraised. Although the South African Water Quality Guidelines propose six criteria for rural water quality, the two standards that apply are: preventing the spread of disease (standards concerning measures to select and protect the source) and maintaining health (referring to the limits for constituents found in water). The possible extent of treatment of water is limited by economic, technical and O&M considerations.[33]

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30 Sami and Murray, 1998, p. 6.4.
31 Sami and Murray, 1998, p. 8.1.
32 Sami and Murray, 1998, p. 7.1
33 Sami and Murray, 1998, p. xxix, xxx

There are two types of water quality standard in relation to pollution:

- Ambient water quality objectives for the source (river) set in relation to the intended uses, taking into account the dilution and dispersion capabilities of the water source.

- Effluent discharges may take the form of fixed emission standards – in which the quality standards for discharges are not related to the location of the discharge or to the dilution available – or a more flexible effluent discharge - based on what is necessary to maintain the ambient water quality objectives.[34]

[34] DFID: Guidance manual on water supply and sanitation programmes, 1998, page 90.

## TOPIC 3: DATA COLLECTION

Municipalities collect a vast amount of information, for a range of purposes, such as:

- Tracking trends
- Informing operators, supervisors and senior staff of on-going management requirements (e.g. cash flow, or number of pump breakages)
- Informing Council on whether its policy goals are being met.

The amount of information, which a Municipality wants to collect is entirely variable. It depends on the complexity of its operations, its policy and programme targets, the nature of the infrastructure, and its ability to manage information (e.g. does it have a viable computerised data processing system?)

A wide variety of methods can be used to collect data. This includes staff reports, computerised data systems, user surveys, or diagnostic evaluation studies. Writing down the information that officials know and observe is important in order to record it.

It is important to use different sources of data, collected through quantitative as well as qualitative methods, in order to verify the information collected. Verification of information must occur regularly, at least once every two to three months.

1. ***Deciding what data to collect***

   The type of data collected will be limited by several factors listed in the above table as "assumptions/risks". In the case of monitoring boreholes (and other abstraction sources from surface water) specialized equipment might be necessary. Often financial and human resources are limited and these limitations all play a role in the decision around which data is the most important, viable and economical to collect.

   In the case of the Northern Cape Province where water is scarce, it is important to collect data that will inform planning and decision-making. In the case of water conservation, the following data would be vital, economical and relatively simple to collect:

   - **Rainfall**: should be measured on a daily basis and data-captured on a monthly basis in order to monitor rainfall patterns and to assist with planning.
   - **Borehole (and other abstraction sources from surface water) yields**: should be measured on a monthly basis and recorded for evaluation and analysis purposes.
   - **Calculation of unaccounted-for water**: this is done by calculating the difference between the volume of water abstracted from the source and the amount of water actually utilized by registered consumers. This should be done monthly.

   The following information is also important, but need specialized equipment and/or trained personnel to collect the data:

   - **The quality of the water** yielded by boreholes (and other abstraction sources from surface water): this should be done on a regular basis, preferably on a weekly or bi-monthly basis.

As far as possible, public participation should be encouraged by involving key stakeholders representing the community, when defining and selecting indicators. In this way, the municipality will know that it is measuring issues that the community finds relevant.

2. ***Data Collection***

Data collection should take place continuously on a regular basis. Quantitative information could be stored on a computer as part of a database, but this is not essential. The data collected for water conservation can be captured manually. An example[35]:

**Monthly Abstraction: Boreholes: *Municipality's name***
Period: July 2001 – June 2002

| Borehole name | Borehole capacity | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | March | April | May | June | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

**Monthly Rainfall figures: *Municipality's name***
Period: July 2001 – June 2002

| Month | 2001/2002 | 2002/2003 | 2003/2004 |
|---|---|---|---|
| July | | | |
| August | | | |
| September | | | |
| October | | | |
| November | | | |
| December | | | |
| January | | | |
| February | | | |
| March | | | |
| April | | | |
| May | | | |
| June | | | |
| Total for year | | | |

By entering information in a database (whether electronic or manual) one would be able to monitor the situation of water usage and conservation. Any danger situation (such as over-abstraction of certain boreholes, or huge amounts of unaccounted-for water or unusually low or high rainfall) will be highlighted immediately and would allow the municipality to deal with the situation effectively.

35 This example is taken from water-related data kept by De Aar Municipality (Wateroudit en Verslag vir die Finansiele Jaar 1 Julie 1999 tot 30 Junie 2000), compiled by Mr F. D. Taljaard, Chief: Civil Engineering, September 2000.

## TOPIC 4: INTERPRETING AND ANALYSING DATA

The data collected should be used to establish whether the targets/goals set out are being reached. Data gathered should be analysed at this stage, taking into account variables that might have influenced the situation. Examples of such variables are drought, floods, severe vandalism or an active campaign to get the community to actively save water. This is normally done at regular intervals, such as quarterly or at six-month intervals. The results should be captured in a report.

There are at least three ways of reporting data:

- **Giving an overview** every month of the findings (For example, "33 water leaks were repaired during May".)

- **"Exception reporting"** – only unusual findings are reported (For example, "An unusually high number of leaks were discovered during May".)

- **Qualitative reporting** – writing down the experiences of the staff, in addition to the "cold hard facts". For example, "The technical staff found that it was difficult to repair the leaks because the equipment was not always available".

The Council and Municipal Manager must decide what kinds of reporting they would like for each type of information. Qualitative information is particularly important, because this helps the Council to take effective decisions.

## TOPIC 5: REPORTING TO SENIOR MANAGEMENT AND COUNCIL

Regular reporting is essential for an effective M&E system. The information collected should provide all necessary information for both short and long term planning, and to establish whether the goals are being reached. Regular reports should be made available to senior management and councilors, both in written form and at Council meetings.

The reporting process should refer back to the Municipality's goals, targets and indicators. "Input reporting" will tell the Council about the money or staff time that have been used. "Output reporting" will report on actual events during the implementation of activities. "Impact reporting" will tell the Council whether its goals have been achieved. [36]

Generally the following reports should be available on a monthly basis:

- A technical report that details all the technical information collected, and
- A service report that details the levels of service as recorded during a specific month.

These periodic[37] reports will allow the Council to keep track of their targets and will be aware when it is needed to adapt targets (when assumptions fail) or change or adapt the tasks (when a computer system or specialized equipment is introduced). Reports will typically be submitted by junior staff (or outside agencies) to the Municipal Manager, and then submitted to the Council. It is advised that a standard reporting format is used to ensure that the required information is provided.

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36 To read more about indicators, targets and goals; please refer to the manual.

37 Reports back must happen at regular intervals, preferably monthly, but can also be done quarterly, bi-annually or annually.

## TOPIC 6: FEEDBACK AND DISSEMINATION

Apart from the Councillors and senior management of the municipality, there would be several other stakeholders who would be interested in the data gathered and analysed through the M&E system. These stakeholders should be identified and a feedback and dissemination system should be developed to ensure that the stakeholders are informed and on board at all time.

Some of these stakeholders can be:

- Front-line officials – this helps to empower staff to understand the "big picture" of the entire municipal performance. A possible feedback system could include making available of reports to staff and/or informing them through monthly meetings.
- The local public – this creates a sense of "buy-in" to the municipality's operations. A regular newsletter can accompany monthly municipal accounts, where possible. In those areas where there is a low literacy rate, simplified posters or pictures explaining the progress could be put up at payment points. When necessary, public meetings should be called.
- Provincial and National Departments through reports.
- Donors and funders through regular reports.

## TOPIC 7: PUBLIC PARTICIPATION IN MONITORING AND EVALUATION

Involving the public (clients) in the monitoring and evaluation process ensures that water services are oriented to serve client interests. Public participation is important to provide relevant background information about a community, which is helpful when planning remedial measures and improvements. Participation further generates a sense of ownership among different groups in society, it can also help to build consensus on what outcomes to monitor and what impacts to evaluate.

The following is a table of methods that can be used as tools for public participation:[38]

| Method | Advantages | Disadvantages | Alternatives/Keep in mind |
|---|---|---|---|
| Public meetings | The audience will contain many different interests, with different levels of understanding and sympathy | • It is difficult to keep to a fixed agenda<br>• Only a few people get a chance to have a say | • Identify and meet key interests informally<br>• Run workshop sessions for different interest groups<br>• Bring people together after the workshop sessions in a report-back seminar |
| Formal survey | Questionnaires, studies and in-depth discussion groups can be a good way to start the participation process | Surveys are insufficient on their own | • Surveys require expert design and piloting<br>• Surveyors need training<br>• Survey design can be a part of a process which leads to action |
| Consultative committee | Some focus of decision-making will be necessary in anything beyond a simple consultation process | • A committee may not be a channel for reaching most people<br>• People invited to join a committee may be uncomfortable about being seen as representatives | • The committee can help to plan the participation process<br>• Surveys, workshops and informal meetings can identify other people who may become actively involved<br>• A range of groups can be formed, working on different issues. |
| Working through NGO's/CBOs | • Voluntary organisations are an important channel of communication, and may have resources to contribute to the participation process<br>• They have a wealth of experience and are essential allies | Voluntary organisations are not "the community". | • There will be many small community groups who are not part of the formal NGO/CBO sector<br>• Voluntary groups have their own agendas – they are not neutral. |
| Participatory rural appraisal (PRA)[39] | If done well, the work belongs to the local people | Care needs to be exercised in choosing appropriate methods | A range of methods are available (see below). |

38 World Health Organisation, Geneva, Tools for assessing the O&M status of water supply and sanitation in developing countries (2000)

39 To read more about PRA, please refer to the manual.

Just as it is essential to have public participation in the selection and definition of the indicators, it is essential to keep the community informed of your monitoring results. This can be done through newsletters attached to water invoices, articles in the local "knock-and-drops" or informative posters at public meeting places within the town (local pubs, taxi ranks, bus stops, churches, government offices, municipal offices).

## TOPIC 8: BUDGETING FOR M&E

Budgeting for monitoring and evaluation is essential. Once all the possible costs of monitoring the water conservation of a municipality has been estimated, an estimated budget can be drawn up.

An example of this:

| Activity | Frequency | Cost | Total Cost [40] |
|---|---|---|---|
| List boreholes used by Municipality for water delivery | Once off | Time/fees of official | |
| Data collection of abstraction from boreholes | 1 x per month | Distance (measured in kilometers) plus maintenance costs of vehicle<br>Time/fees of official | |
| Investigate incidents of Unaccounted for water | 1 | | |
| Resolve incidents of unaccounted for water | Immediately | Distance (measured in kilometers) plus maintenance costs of vehicle<br>O&M costs<br>Time/fees of official | |
| Evaluation of water conservation strategy | Once a year before budget for next year is drawn up to ensure that M&E forms part of the budget. | Time/fees of officials | |
| Total costs for water conservation strategy for year: | | | |

40 Due to the poor buy-in from Municipalities, the author has been unable to calculate any costs

## TOPIC 9: RETURNING TO GOALS: EVALUATION

The targets (goals) and indicators of the municipality's water conservation M&E plan should be evaluated once a year. The outcomes of the M&E plan should be evaluated against the goal. In severe cases of neglect and dire need for water conservation a six-monthly evaluation of outcomes measured against the goal would be advisable. This would indicate within the short term whether there is any improvement in the situation or not. Once the situation has stabilized, a yearly evaluation of goals and indicators should be sufficient. Part of this annual (or bi-annual) evaluation should include costing of the next year's (or six month's) monitoring and evaluation costs.

This annual evaluation should be done timeously to ensure that the predicted costs for the next year will be included in the municipal budget for the following year.

An example of issues that an evaluation exercise would look at:

- Have all the activities been carried out successfully?
- Are all document sources up to date and is all information verified?
- Did all reporting (written, reporting to council meetings, reporting to community) take place regularly?
- Was it not possible to conduct certain tasks due to any or some of the assumptions/risks failing?
- What were contributing factors to a successful (or not successful) M&E plan? (for example: community policing to limit vandalism, community efforts to safe water, regular payments for services, unforeseeable lack of funds, labour unrests, severe vandalism, floods, etc)
- Were the indicators the correct ones to use? If no, why not? Which indicators would have been the better choice?
- Are the targets (goals) still relevant or should they be adjusted to suit the changing conditions within this sector of the municipality's service delivery?

Please refer to the manual for a more in-depth look at the topic of evaluation and what the evaluation process entails.

## REFERENCES

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# Other related WRC reports available:

**An assessment of common problems associated with drinking water disinfection in the developing areas**

I Pearson • G Idema

The aims of the project were to assess the problems with present disinfection systems in the developing areas, most of which are chlorine-based systems. The resulting health implications with respect to intermittent disinfection could be serious, and give rise to severe criticism of local authorities.
The results showed that, in many of the water treatment plants and small water supply schemes, existing disinfection practices are unreliable and often not monitored. In a number of systems no chlorination is practised at all. Failure of disinfection is essentially not due to technology problems with equipment (although equipment did fail - after which the alternative of hand addition of chlorine was mostly practised). The reasons for failure and unreliability of disinfection include:

- Lack of chlorine chemicals
- Lack of operator attention
- No provision made for chlorine addition
- Lack of funds for purchasing chlorine
- No monitoring of chlorine residuals to detect chlorine levels.

Probably the most important aspect derived from this study is that the operators controlling the plant do not have the knowledge and understanding of the background of water disinfection, the importance thereof and the possible consequences to the community they are serving. Proper training was, therefore, deemed as being absolutely essential.

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