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TOWARDS THE MILLENNIUM DEVELOPMENT GOALS

Unaccounted-for-water management in Kwazulu Natal, S. Africa

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MONITORING OF RURAL water supply systems in KwaZulu Natal, South Africa, showed average unaccounted-for water (UAW) levels, sometimes loosely called water losses, of 60%, which were having financially detrimental effects on these, and other, projects. Despite a regulatory requirement for the Water Services Authorities (WSAs) to manage UAW, there was little guidance on rural UAW management.

What follows is an outline of the developed UAW management programme procedure, from an MSc research project that comprised four months' work with two rural communities in KwaZulu Natal; Montebello and Emayelisweni. These communities had fully metered yard tap water supply systems managed through local water committees with support from Partners in Development, a local development engineering consultancy, Umgeni Water, the regional water utility and project Implementing Agent, and the Ilembe District Municipality (the WSA).

Table 1 shows the UAW levels within the four month period of the research. UAW levels will vary month by month and an accurate assessment is only valid with at least 12 months' data.

High percentages are due to low consumption levels, and highlight the sensitivity of rural projects to relatively low volumes of UAW. Volume/tap/day can be understood at a community level and translating these figures into financial equivalents helps to motivate UAW management. The South African Code of Practice (SABS, 1999) prefers the term specific loss, Q_{sl}, in l/km/hr. This term will be useful to Water Service Authorities (WSAs) when comparing different systems but is unlikely to be understood at rural community levels.

The management systems developed used litre/tap/day.

It can be seen that the community level staff have taken ownership of the UAW programme at Emayelisweni, with UAW stable at low levels. The viability of the neighbouring Montebello scheme, however, is much less affected by water losses, and this may partly explain why there has been little if any improvement in UAW there. Montebello has also been adversely affected by several staff changes, and so retraining in UAW management is now required.

Procedure

Figure 1 shows the procedure used in the management of UAW. It is a cyclic procedure with the main management being done at community level on a monthly basis and the local authority assisting in the annual overall management. Developing the management system used the same procedure and was in effect the first cycle.

Continual assessment

The project was assessed on institutional, social, financial and technical aspects, through field observations and by studying project records. Non-consideration of any one of

Table 1. UAW Levels

		% of total supply	l/tap/day (average)	l/km/hr (average)
Emayelisweni	12 month average prior to research	66%	272	41
	After initial field tests/repairs	28%	40	6
	2 months after implementation of UAW management programme	43%	88	13
	6 month average, 18 months after implementation of UAW programme	22 %	32	5
Montebello	12 month average prior to research	77%	411	111
	After initial field tests/repairs	53%	196	53
	2 months after implementation of UAW management programme	47%	130	35
	4 month average, 16 months after implementation of UAW programme	60 %	419	116

these categories may render an inappropriate UAW management procedure.

Metering

Meter Layout: Where bulk meters are to be installed on a system, they should be accessible, affordable, and represent a manageable number of houses and a manageable length of pipeline. A system with adequate bulk metering makes UAW management feasible. Being able to read a bulk meter and all its associated domestic meters within, say, 3 hours improves the accuracy of any assessments of the readings. Locating bulk meters immediately after reservoirs or pipe junctions and at abstraction points breaks the infrastructure into manageable sections. Note that budgets in rural water supply usually preclude the use of the sophisticated continuous data logging which is becoming common in urban UAW management programmes.

Night-flow Readings: Generally people in poorer rural communities do not use water after nightfall. Taking bulk meter readings just before nightfall and at sunrise the following morning enables the night flow on each section to be calculated, giving an indication of leakage levels. At Emayelisweni these night flow readings are now taken once a week. The administrator or bookkeeper then calculates if the night flow is greater than 150 l/tap. If so technical staff investigate the section for UAW. 150 l/tap was considered an acceptable level of night flow, as this may include some consumption late evening or early morning.

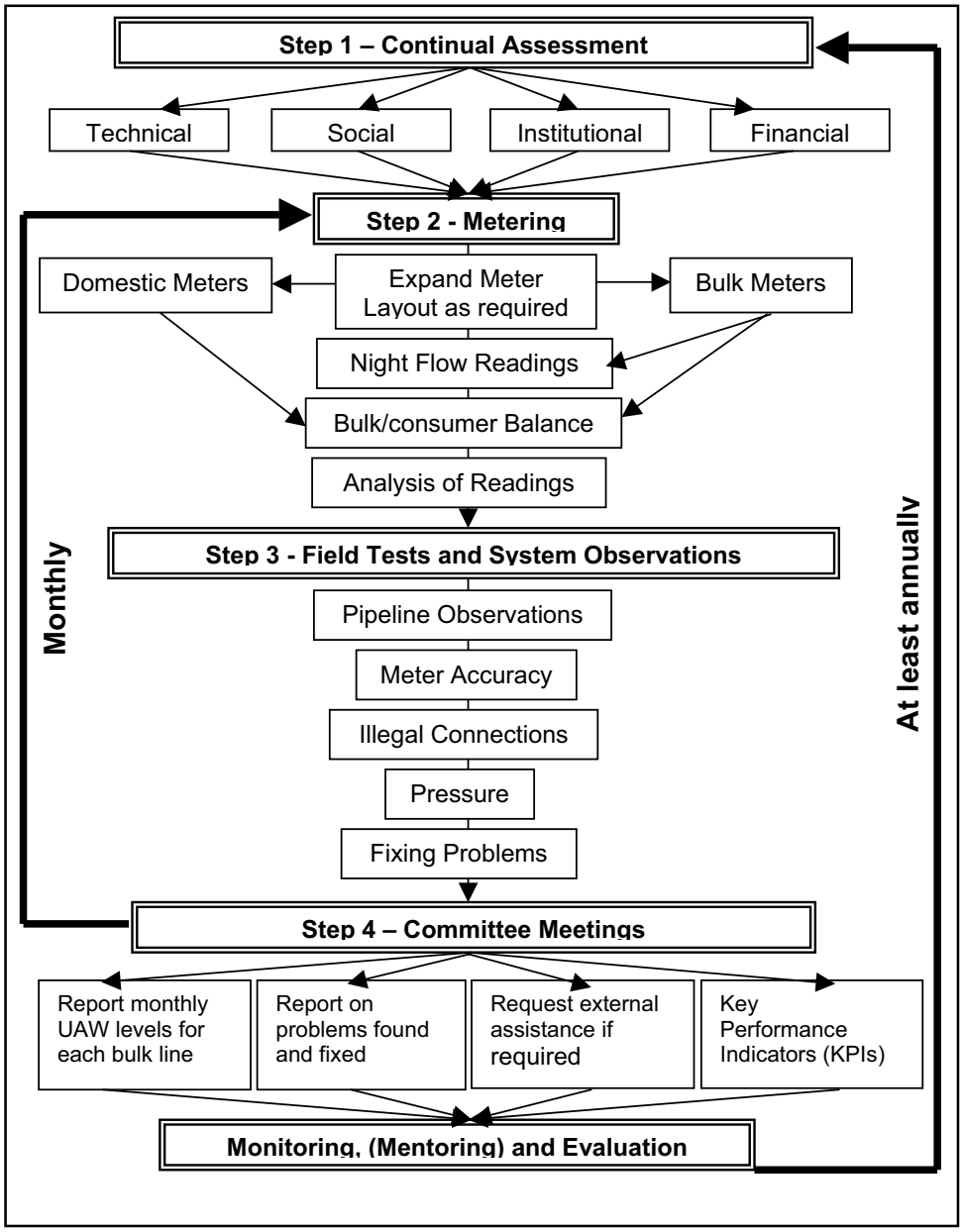

Figure 1. UAW Management Programme

Bulk Meter/Domestic Readings: On a fully metered system a water balance can be carried out by taking bulk meter readings with the domestic meter readings. If systems do not have domestic meter readings then an estimate must be made of the domestic water consumption, probably from a customer or household survey.

Bulk/consumer Balance: The UAW from a water balance could be due to leakage, illegal connections, faulty meters or faulty meter readings. Night flow readings can confirm or eliminate leakage.

Analysis: At Montebello and Emayelisweni a sheet was developed so meter readers could copy the bulk meter face. Figure 2 shows a blank meter reading sheet and an example of a completed sheet. This sheet helps the administrator to check the meter reading. At Emayelisweni and Montebello the determined acceptable level of UAW from the monthly water balance is 100l/tap/day. The water balance is calculated by the administrator/bookkeeper who then informs the committee and the technical staff of any necessary action to be taken.

Many software packages exist which compute acceptable UAW levels but none have been developed for rural situations. Access to these facilities rarely exists in rural communities.

Field tests and system observations

Once the water losses are narrowed down to specific branchlines these lines can be inspected. The methods outlined below should be used in turn until the UAW is reduced to an acceptable level, from the continued meter readings.

Pipeline Observations: Leakage was the most common and greatest cause of UAW. Visual inspection is the least costly method of investigation as little equipment is required and it is therefore wholly appropriate to the rural situation. Each valve chamber, tap, meter or other connection should be visually inspected for leaks, as well as the ground surface for depressions or damp patches. If leaks are not visible on the surface a 1.2 m length of reinforcing bar can be inserted into the ground, initially near each connection or joint, and checked to see if it is wet when withdrawn. If the bar is wet then the ground should be dug to investigate the source. This method requires the ground to be generally dry during the investigation and therefore has limitations.

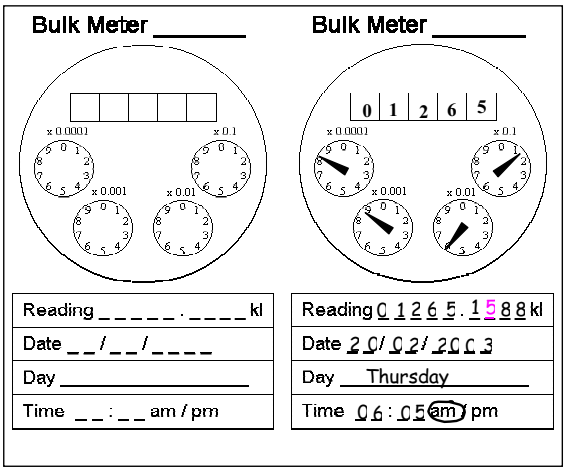

Figure 2. Blank and completed bulk meter reading sheets

Domestic Meter Accuracy Tests: Meters should be checked for accuracy, particularly where the billed consumption is zero or seems low. Meters often under-record at low flows, or fail to record at all, and filling a container of known volume from a tap and recording the volume change on the meter will indicate the accuracy of the meter. Meters will not record a dripping tap so if faulty taps are not reported and fixed, water flowing through the meter may not be recorded, or billed, and is therefore both UAW and a financial loss.

Illegal Connections: Illegal connections are not easy to find and, depending on the perpetrator, not safe to search for. Field searches for illegal connections should be a last resort when all other avenues have been explored. At Emayelisweni and Montebello illegal connections were, surprisingly, not a significant problem. The community perception suggested that illegal connections were high but in reality these claims were highly exaggerated.

Pressure: High pressure will cause any leaks that do develop to increase and lose more water. Lower pressures result in less leaks and smaller leaks. While pipes and fittings can often withstand pressures of 10-16 bar, these pressures invite UAW problems and it is advisable to limit supply pressures to 5 bar where possible. A simple pressure gauge can be temporarily installed onto taps. If the pressure is unacceptable then pressure reducing valves should be installed on the pipeline. Fixed ratio pressure valves are simple and robust. If finances cannot be made available to reduce pressures then potentially high UAW must be accepted.

Fixing Problems: There must be a procedure for fixing leaks, urgently and competently. Where possible, local labour should be used to fix any problems as this enhances understanding and ownership of the system, which increases the self-sustainability. A sense of urgency comes from an understanding of UAW. The level of technical competence depends on the quality of labour and training. A lack of local competence means external support must be available and contactable.

Committee meetings

Committee meetings can be used to continually develop the UAW management programme by reporting on the UAW levels, the problems found and fixed, requesting necessary external assistance and reporting Key Performance Indicators (KPIs).

The committee meeting is where the WSA, local employees and the committee can interact.

Workshops: Workshops during the committee meetings helped to increase understanding of UAW, to develop the

UAW management programme and allowed participation through discussion. These workshops were carried out with the committee members and local personnel including plumbers and the administrator.

The agenda used was as follows:

(i) *Why reduce losses?* An interactive discussion using pictures and asking which scenarios lose the project money. This led to a greater understanding of financial issues.

(ii) *Who lives where?* Participatory mapping aiding understanding of the pipe network. This map was then actually usable by the community.

(iii) *Where does all the water go?* A diagrammatic comparison of the daily household consumption and the equivalent daily UAW per household.

(iv) *What can we do?* Explaining night flow readings, domestic readings, inspections and repairs.

(v) *How we will manage losses*. Developing what they can do long term, including discussions of responsibilities and finances.

Monitoring, mentoring and evaluation

KPIs can be UAW specific. Other KPIs are also useful in monitoring the UAW management programme, e.g. monitoring the bank balance will highlight whether implementation of the UAW management programme is improving financial stability of the project.

Evaluation of the UAW management programme can be carried out by the water committee and the WSA. KPIs can be understood by both parties and serve as a link between them to demonstrate the effectiveness of the UAW management programme. Monthly committee meetings, or further workshops, could be used to discuss and develop the programme further, even by setting targets for system performance.

The administrators at Montebello and Emayelisweni were trained to chart KPIs (Stephen and Still, 2000) using wax crayons and standard blank sheets with a title and gridlines, the y-axis being set according to the chart drawn. Figure 3 shows a typical KPI chart.

It is expected that intensive mentoring will be required for the first two months of implementation of the programme. After this, mentoring will form part of the general project mentoring requirements. If mentoring is required the WSA must ensure that such support is provided and financed.

Learning points

- Development of the UAW management procedure should be started at the outset of the project, not after implementation.
- Participatory approaches, such as mapping, can be used to help the communities understand the infrastructure as the project progresses.
- Using local personnel from the outset, i.e. during the first cycle of developing the system, may result in the initial problems taking longer to be fixed but will increase understanding and reduce the need for later training.
- Simple low cost techniques should be used to record meter readings and to analyse them.
- To ensure ongoing mentoring there must be some level of commitment, both in time and finance, from the WSA.
- Further research could develop UAW management programmes on other systems, use community education techniques, promote the need to report leaks promptly and reduce vandalism, possibly through using local schools.

References

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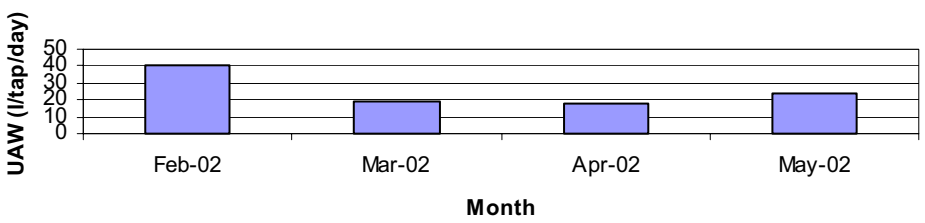

Figure 3. KPI Chart Example