Investment Planning in the Water Industry

An Overseas Perspective

Levels of Service and Asset Lives

Peter Styles, BSc, CEng, MICE MCIWEM, Consultant STWI
Errol Grimes  BSc Civil, Assistant Director of Operations, WASA, Trinidad and Tobago
Manoherlal Kerof BE Civil (Hons) ME(PHE) MS (Sant Eng), Assistant Director of Operations,
WASA, Trinidad and Tobago

Abstract
Levels of Service criteria have been around in the water industry for over a decade but little has been done to bring them together into a systematic framework. UK criteria are unsuited to international work; being based on a pass or fail they do not address the full range of service levels experienced in the international scene. This paper sets out a comprehensive range of criteria which is flexible within limits. They form the basis to the objective measurement and recording of customer service levels and provide the link with proposed investment on new and replacement assets. Complimentary to this is a set of asset lives for use within a capital investment or accounting system.

Keywords

Introduction
Investment Planning (or ‘Asset Management’) is an essential task carried out, albeit often intuitively, by most organisations. Only with a system for the extension and replacement of assets, when they become obsolete, beyond repair, or overloaded can utilities ensure the efficiency and effectiveness of their businesses. Severn Trent Water has been at the forefront of developing the methodology for such plans in the UK and has worked closely with its partner, Trinidad and Tobago Water Services, in implementing an appropriate system for use by WASA in the Caribbean and by others world-wide.

In the first of this series of papers the overall structure of Asset Management was outlined as a basis for Investment Planning. The first step, in a logical sequence, is to define Levels of Service so that managers can take an objective look at their systems and the failures.

This paper provides an objective set of Levels of Service criteria and discusses the pitfalls in implementing such a scheme. Whilst it is not necessary to implement everything in the first instance, key parameters can be measured and used as other, less essential, issues are be brought in later.

Alongside this, merely for convenience we have appended a suggested set of Asset Lives.

We conclude that, even if a full scheme cannot be set out initially, the improvement in objectivity and overall management that flows from such considerations is, itself, worth the effort due to the concentration of all involved staff on the issue of customer needs. Only by attempting to define those customer needs can an organisation set about improving itself and then take the necessary steps to meet them.

In all considerations, continuity of supply and potable water quality will be over-riding.

Basic considerations
Why do we need Levels of Service (LoS)? Many organisations operate satisfactorily without strictly defined LoS and it is possible to subjectively arrive at the right answers. However, an organised system, with defined Levels, provides a firm basis for investment decisions allowing operators to have their say in the replacement of plant. They also provide a first line defence against undue political interference and a basis for the attraction of outside funding from aid agencies. The advantages can be listed:

- Reflects what the customer is getting
- Measures services and improvements
- Provides a basis for business planning
- Can be used for project planning and financing
- Allows projects to be prioritised
- Can also form a basis for operational maintenance
- Links Operations and Investment through Performance Grades

This latter issue is the fundamental difference between Asset Management and simplistic financial systems.

In any water supply area the key issue is the continuity of the potable water supplied irrespective of other factors. ‘Scheduling’ – the organisation of regular but intermittent supplies is the norm in many developing countries and only when the continuity of supply is considered reasonable will the other issues come to the fore. The most important of these will be potable water quality followed by pressure.

If the implementing organisation wishes to adopt a customer service approach then a ‘customer needs’ survey should be undertaken to determine what standards are being achieved but, just as important, what standards are desired and what is the customer prepared to pay for them.

UK systems assume that a 24 hour service will be provided but this is not generally the case in developing countries where intermittent services are the norm. There is, thus, an argument for tackling the criteria in a structured manner and giving more weight to those of greater priority in the customers’ eyes. Generally sewerage and nuisance aspects are seen as a lower priority but only if water resources are not affected by effluent discharges.

Thus the structure for implementation will tend to resolve itself like this:

**Water Supply LoS Criteria:**
- Continuity of supply
- Water Quality
- Pressure and Flow
- Resource Availability
- Interruptions to Supply

**Sewerage and Environmental LoS**
- Foul Flooding
- Sewer Restrictions
- Effluent Quality
- Environmental Nuisance factors

We have not concerned ourselves here with administrative and support activities which include:

- Response to letters
- New connections
- Billing complaints
- Answering telephones
- Keeping appointments
Public information

Framework

Each LoS criteria is measured against five set levels which must be debated and tested before final adoption. These are intended to allow the full range of services to be described without undue detail. They are always based on the following subjective descriptions:

1. Excellent
2. Good
3. Adequate
4. Poor
5. Awful

No attempt should be made to change this basic structure as simplification makes it too crude and complication gives too many grades to be worthwhile. Any customisation should be at the detailed definition stage when the definitions are attached to the grades.

When setting out the basic grades the ‘excellent’ level 1 definition will be that of the desired aspiration for the service.

The ‘Awful’ grade should describe the lowest standard currently supplied to a significant proportion (say 3-5%) of customers.

The ‘Adequate’ grade will be about halfway between these but is subject to comparison with the results obtained from any customer survey. In practice a certain amount of debate is required to get the grades to settle down. If there is no consensus then a definition will be about right if there are as many arguing for it to go up as there are arguing for it to go down.

Continuity of supply

This service level is crucial to the whole exercise and will depend on the way the system is operated as it will, to a great extent, reflect the imposition of water supply ‘scheduling’ on areas of supply according to the availability of water. It is therefore the first and most important one to measure.

Measurement, in the first instance, may be the operators’ view of the supply but this should be replaced with actual measurement or observation when available. Hours per day, days per month and many other methods may be used but our experience shows hours per week to be the simplest and most objective:

<table>
<thead>
<tr>
<th>CS1</th>
<th>Continuous Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS2</td>
<td>Supply &gt; 120 hours per week</td>
</tr>
<tr>
<td>CS3</td>
<td>Supply &gt; 84 hours per week</td>
</tr>
<tr>
<td>CS4</td>
<td>Supply &gt;48 hours per week</td>
</tr>
<tr>
<td>CS5</td>
<td>Supply &lt; 48 hours per week</td>
</tr>
</tbody>
</table>

Levels of Service for Continuity of Supply (CS)

It can be argued that the lower level (5) should be ‘no water’ and that tankered supplies should be included.

Water Quality
Water Quality has three distinct aspects to it and these have their own sub priorities attached. Initially WQ may address only the key issue of **Bacteriological Quality** as this causes immediate problems. **Toxicological Quality** may be incorporated later followed by **Customer Perception** which is related to the aesthetic aspects of potable water.

<table>
<thead>
<tr>
<th>BQ1</th>
<th>Compliance with National Standard based on WHO*</th>
</tr>
</thead>
<tbody>
<tr>
<td>BQ2</td>
<td>No more than 1 failure per year</td>
</tr>
<tr>
<td>BQ3</td>
<td>No more than 3 failures per year</td>
</tr>
<tr>
<td>BQ4</td>
<td>No more than 12 failures per year</td>
</tr>
<tr>
<td>BQ5</td>
<td>Always needs boiling to make potable</td>
</tr>
</tbody>
</table>

**Levels of Service for Bacteriological Quality (BQ)**

*WHO is now promoted as a guideline for the development of local standards

<table>
<thead>
<tr>
<th>TQ1</th>
<th>Compliance with National Standard based on WHO*</th>
</tr>
</thead>
<tbody>
<tr>
<td>TQ2</td>
<td>Failure against NS for &lt; 1 week per year BNDTSTH*</td>
</tr>
<tr>
<td>TQ3</td>
<td>Failure against NS for &lt; 1 month per year BNDTSTH*</td>
</tr>
<tr>
<td>TQ4</td>
<td>Continuous or regular failure against NS, BNDTSTH*</td>
</tr>
<tr>
<td>TQ5</td>
<td>Continuous risk including short term health</td>
</tr>
</tbody>
</table>

**Levels of Service for Toxicological Quality (TQ)**

*The term BNDTSTH (but not dangerous to short term health) is suggested as a means of distinguishing between immediate risks (e.g. poisoning) and long term effects. Again ‘short term’ needs definition and a period of one month is suggested as a reasonable barrier between short and long term.

<table>
<thead>
<tr>
<th>CP1</th>
<th>No problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP2</td>
<td>Problems up to 1 week per year</td>
</tr>
<tr>
<td>CP3</td>
<td>Problems for up to 1 month per year</td>
</tr>
<tr>
<td>CP4</td>
<td>Continuous problem with one symptom or recurring problems with more than one</td>
</tr>
<tr>
<td>CP5</td>
<td>Continuous problems with more than one symptom</td>
</tr>
</tbody>
</table>

**Levels of Service for Customer Perception (CP)**

The ‘problems’ involved in Customer Perception are ones which arrive via the potable water supplied. Other types of problem are dealt with under Environmental Nuisance. Customer Perception problems would include:

- Discolouration
- Evidence of Animals
- Unusual or severe smell
- Unusual or unpleasant taste

**Interruptions in Supply**

<table>
<thead>
<tr>
<th>IS1</th>
<th>No more than 1 per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS2</td>
<td>No more than 5 per year</td>
</tr>
<tr>
<td>IS3</td>
<td>No more than 10 per year</td>
</tr>
<tr>
<td>IS4</td>
<td>No more than 20 per year</td>
</tr>
<tr>
<td>IS5</td>
<td>More than 20 per year</td>
</tr>
</tbody>
</table>
Levels of Service for Interruptions in Supply (IS)

An ‘interruption’ requires definition which could be: “an unplanned (i.e. not scheduled) interruption in supply due to pipeline or plant failure lasting 8 hours or more”. It is clear, therefore, that this criteria will not be very meaningful until the continuity issue is resolved.

Resource and Treatment Availability

| RA1 | Meets demand 9 years out of 10 |
| RA2 | Meets demand 8 years out of 10 |
| RA3 | Meets demand 5 years out of 10 |
| RA4 | Meets demand 3 years out of 10 |
| RA5 | Meets demand less than 3 years out of 10 |

Levels of Service for Resource and Treatment Availability (RA)

‘Demand’ is difficult to define and probably needs a period of observation after initially setting the criteria. Treatment capacity must be included as a raw resource is not likely to be usable as a potable supply. “The peak hourly demand on the system in the dry season” is suggested as a definition for ‘demand’.

Pressure and Flow

| PS1 | Better than 20m at normal time of day |
| PS2 | Between 15 and 20m |
| PS3 | Between 10 and 15m |
| PS4 | Between 5 and 10m |
| PS5 | Less than 5m at normal time of day |

Levels of Service for Pressure of Supply (PS)

‘Normal time of day’ would exclude the two peak hours and probably the eight hours overnight.

| FL1 | More than 25 lpm |
| FL2 | Between 15 and 25 lpm |
| FL3 | Between 10 and 15 lpm |
| FL4 | Between 5 and 10 lpm |
| FL5 | Less than 5 lpm |

Levels of Service for Flow at first tap (FL)

This is measured at the first tap in the premises, again at normal time of day.

Sewerage

| DQ1 | Compliance with consent (95%ile) |
| DQ2 | 75% compliance but no discernible pollution |
| DQ3 | 50% compliance but no discernible pollution |
| DQ4 | 25% compliance and occasional pollution |
| DQ5 | Non-compliance or occasional pollution |
Levels of Service for Effluent Discharge Quality (DQ)

‘Discernible pollution’ needs definition - “Pollution evident in the water to the naked eye or causing evident effects to the plant life alongside the watercourse”

<table>
<thead>
<tr>
<th>SF</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF1</td>
<td>No risk of flooding of property, gardens or roads from sewers</td>
</tr>
</tbody>
</table>
| SF2  | Property: 1 in 10 years   
Garden/road: 1 in 1 year                                                   |
| SF3  | Property: 2 in 10 years   
Garden/road: 2 per year                                                     |
| SF4  | Property: 5 in 10 years   
Garden/road: 3 per year                                                     |
| SF5  | Property: 10 in 10 years  
Garden/road: 5 per year                                                      |

Levels of Service for Foul Flooding from Sewers (SF)

<table>
<thead>
<tr>
<th>SR</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR1</td>
<td>Less than 1 restriction per year</td>
</tr>
<tr>
<td>SR2</td>
<td>Only 1 restriction per year</td>
</tr>
<tr>
<td>SR3</td>
<td>More than 2 restrictions per year</td>
</tr>
<tr>
<td>SR4</td>
<td>More than 5 restrictions per year</td>
</tr>
<tr>
<td>SR5</td>
<td>More than 10 restrictions per year</td>
</tr>
</tbody>
</table>

Levels of Service for Sewer Restrictions (SF)

‘Restrictions’ are generally blockages but could also be due to inadequate capacity.

Environmental Nuisance

<table>
<thead>
<tr>
<th>EN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN1</td>
<td>No Nuisance</td>
</tr>
<tr>
<td>EN2</td>
<td>Occasional Nuisance but not to cause discomfort</td>
</tr>
<tr>
<td>EN3</td>
<td>Noticeable nuisance for up to 1 month per year</td>
</tr>
<tr>
<td>EN4</td>
<td>Noticeable nuisance for up to 3 months per year</td>
</tr>
<tr>
<td>EN5</td>
<td>Regular, continuous or gross nuisance or risk to health and safety</td>
</tr>
</tbody>
</table>

Levels of Service for Environmental Nuisance (EN)

Nuisance from environmental factors arising from activities of the business/utility would include: flies, litter, noise, vermin, dust, traffic or other environmental disturbances to cause discomfort to the average person.

Asset Lives

The appended table (APPENDIX 1) of suggested asset lives is included to enable those of a conservative disposition to include it within the asset inventory against each item of plant and pipeline. This enables ready comparison to be made with the accounting asset valuation and can be useful in determining profiles of financial requirements for the replacement of assets.

Asset lives can be used in the following processes:

- Depreciation within the accounts
- Traditional method of Evaluating of the business
- Long term investment planning
- As a guide to capital replacement
Assets can be subdivided into types, each with their own lives; the main categories are:

- Land and buildings
- Engineered constructions
- Pipelines
- Mechanical & Electrical plant
- Electronics
- Vehicles and mobile plant

Conclusions

Levels of service criteria can be set up for a water utility or business. They can be used in the assessment of customer service levels by operators and provide an objective link to the planning process for new investment through the use of Performance Grades.

Continuity of supply and water quality are the key measures that must be first addressed; other measures can follow. They can be introduced gradually according to a plan or the availability of information. It is unlikely that all of the measures listed here will be used in any organisation but others can be constructed using the principles outlined.

Objective service level measurement, in this system, does not rely on simple pass or fail criteria but relies on banding of services into the five grades from excellent to awful. The basic five grade structure should not be altered though the definitions for each grade may be amended to suit local circumstances. These service grades can be linked to the assets that provide the service thus they become the basis for Performance Grades and, along with Condition Grades, the foundation for investment plans.

Even without full implementation the activity of considering LoS criteria and the accompanying discussions, are themselves beneficial in providing a focused debate on customer needs.

Acknowledgements

The authors wish to thank:
- Eric Ashcroft, Chief Executive of WASA, Trinidad and Tobago
- Tony Hill, Director, Severn-Trent Water International
- Phil Floate of STW Ltd for the draft table of asset lives
- Brian Green of STW Ltd for his input in developing the initial tables
- Sandra Sammy of WASA for her support and comments on the draft

References


APPENDIX 1 – Asset Lives

Engineering constructions

- Impounding dams 60 years
- Treatment plants 50 years
- Service reservoirs 50 years
- Pumping stations 50 years
• Wells 30 years
• Permanent buildings 50 years

Other Engineering
• Metalled roads 15 years
• Unmetalled roads 10 years
• Internal building works 10 years
• Boundary fencing 10 years

Pipelines
• Steel* 30 years
• Plastic 40 years
• Cast/ductile iron 60 years
• Concrete*/clay/brick 60 years
* considerably less if used unprotected, in sulphide bearing environment and hot climate

Mechanical and Electrical Plant
• Mechanical plant 15 years
• Electrical plant 15 years
• Valves and bulk meters 10 years
• Service meters 5 years

Electronics
• Mainframe computers 5 years
• Networked computers 5 years
• PC’s 3 years
• Communications 5 years
• Instrumentation 5 years

Vehicles and Mobile Plant
• Small vehicles 3 years
• Heavy vehicles 10 years
• Mobile 10 years

Land:
• Freehold Indefinite
• Leasehold Remaining term
Buildings

- Concrete and brick: 50 years
- Steel and cladding: 25 years
- Temporary: 10 years

The lives given above are for guidance only and use under normal conditions. Aggressive conditions, including strong sunlight, humidity, pressure surges, sulphides, and acids will seriously curtail the life of an asset; as will lack of adequate maintenance.