Aqualibre™ - A New Innovative Water Balance Software

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ABSTRACT

In the mid nineties the IWA Operations and Maintenance group has started its work on best practice performance indicators. Part of these efforts was a standard water balance - a very important issue as only an accurate quantification of water losses, both real and apparent, can form the basis for the calculation of appropriate performance indicators.

Meanwhile AWWA and a number of national organisations recommend to use the IWA water balance. BWS has developed a new, innovative water balance software, which is an ideal tool for utility managers, regulators and consultants to accurately and comfortably establish utilities' water balances and calculate the recommended performance indicators for real losses.

This new water balance software is using the latest IWA methodology in conjunction with the Burst and Background Estimate (BABE) approach. The new model offers many new features which are not available on other existing software and offers a standard water balance using a "top-down" approach to estimate the Real and Apparent Losses as well as a BABE based "bottom up" approach to establish a second estimate of Real Losses.

As BWS has started to develop this software, it was intended to use it only for internal purposes - e.g. consultancies. However, the superb functionality and reliability of the Delphi based software formed the basis for the decision to make this product commercially available.

BWS' intention is to provide utilities, consultants, international lending agencies and regulators a tool which is easy to use and helps to promote the IWA best practice recommendations.

KEYWORDS
Water Balance, Water Audit, Performance Indicators

INTRODUCTION

The level of water losses, both real and apparent, is one of the most important efficiency issues for water utilities across the world. One would assume that accurate performance indicators are used for benchmarking, international performance comparison, or target setting for internationally funded projects. But unfortunately this is widely not the case - utility managers, consultants and the International Lending Institutions continue to use a very inappropriate indicator when talking about water losses.

With the exception of the UK water industry, water losses (as well as Unaccounted-for Water (UfW), Non-Revenue Water (NRW) and leakage) are still quoted as % of System Input (or water production), although % water losses are a very misleading indicator (Liemberger R., 2002).

As early as 1980 the UK National Water Council had started to warn that the use of percentages is wrong and misleading (Report 26). The German DVGW followed in 1986 and the subject was discussed in great detail in the UK Managing Leakage Manuals (1994). Meanwhile the IWA, the AWWA as well as national organisations in a number of countries are also discouraging the use of Percentages.

In the mid nineties the IWA Operations and Maintenance group has started its work on best practice performance indicators. Part of these efforts was a standard water balance - a very important issue as only an accurate quantification of water losses, both real and apparent, can form the basis for the calculation of appropriate performance indicators.

Meanwhile AWWA and a number of national organisations (e.g. in Canada, Australia (Carpenter T. et al, 2002)) recommend to use the IWA water balance. BWS has developed a new, innovative water balance software, which is an ideal tool for utility managers, regulators and consultants to accurately and comfortably establish utilities' water balances and calculate the recommended performance indicators for real losses.

THE IWA WATER BALANCE

The IWA water balance form and its definitions (Alegre H. et al., 2000, Hirner W. et al, 2000) form the basis for Aqualibre™:

- *System Input Volume* is the annual volume input to that part of the water supply system to which the water balance calculation relates.
- *Authorised Consumption* is the annual volume of metered and/or non-metered water taken by registered customers, the water supplier and others who are implicitly or explicitly authorised to do so, for residential, commercial and industrial purposes. It includes water exported.
- *Water Losses* is the difference between System Input Volume and Authorised Consumption. It consists of Apparent Losses and Real Losses
- *Apparent Losses* consists of Unauthorised Consumption and all types of inaccuracies associated with metering.
- *Real Losses* on mains, service reservoirs and service connections, up to the point of customer metering. The annual volume lost through all types of leaks, bursts and overflows depends on their individual frequencies, flow rates and duration.
- *Non-Revenue Water (NRW)* is the difference between the System Input Volume and Billed Authorised Consumption. NRW consists of:
  - Unbilled Authorised Consumption (usually a minor component of the Water Balance)
  - Apparent Losses
  - Real Losses
- **Note:** *Unaccounted-for Water (UfW)* should not be used anymore, since all losses can be accounted for. However, if the term UfW is used, its definition should be the same as NRW.

<table>
<tr><td rowspan="8">System Input Volume</td><td rowspan="4">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="6">Non-Revenue Water</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="4">Water Losses</td><td rowspan="2">Apparent Losses</td><td>Unauthorized Consumption</td></tr>
<tr><td>Metering Inaccuracies and Data Handling Errors</td></tr>
<tr><td rowspan="3">Real Losses</td><td>Leakage on Transmission and/or Distribution Mains</td></tr>
<tr><td>Leakae and Overflows at Utility's Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to Point of Customer Metering</td></tr>
</table>

Figure 1: IWA 'Best Practice' Water Balance and Terminology

KEY BENEFITS OF THE AQUALIBRE™ WATER BALANCE SOFTWARE

This new water balance software is the latest software development from BWS to assist water utilities in undertaking a water balance for their system using the latest IWA methodology in conjunction with the Burst and Background Estimate (BABE) approach. The new model offers many new features which are not available on other existing software and offers a standard water balance using a "top-down" approach to estimate the Real and Apparent Losses as well as a BABE based "bottom up" approach to establish a second estimate of Real Losses. Through this dual assessment of Real Losses the users can gain a clearer picture of the water losses in any specific system.

The model is designed to be used at Water Utility level where it is used to assess the overall water balance for a whole utility. It can, however, also be used at zone level within a Utility to identify key problem zones with unusually high levels of leakage. The model brings together a number of key benefits, many of which are not provided by other existing water balance software packages.

Works in Any Units

The software has been designed to allow users to select units for both input and output of data. The most common units used by most water utilities throughout the world have been incorporated in the model while a facility to allow users to create their own unit groups has also been added to allow users to enter data and view results in units of their choice. This means that:

- Data can be entered in whatever units are available from a utility
- Results can be viewed in the units most familiar to the user
- If the client is used to using different units, the results can be readily displayed in units familiar to the client at the touch of a button.

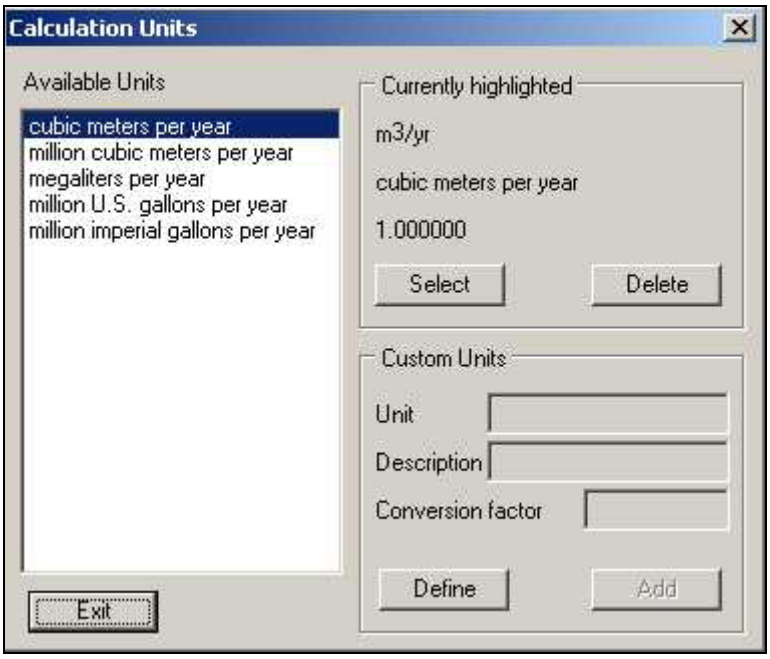

Figure 2: Aqualibre™ Screen shot - Unit Selection

This facility makes the software ideal for Consultants who are having to work with many different units.

Allows for Data Quality

All key data items can be entered with an estimate of the likely error (confidence) of the data and the results are displayed with the 95% confidence limits, showing the likely range of values that the results could lie within. This addresses many concerns of users who are unable to select certain model parameters with confidence and enables the user to test the sensitivity of the result against such parameters. In this manner the users of the model can use the results with greater confidence and can identify areas for which data improvement is important.

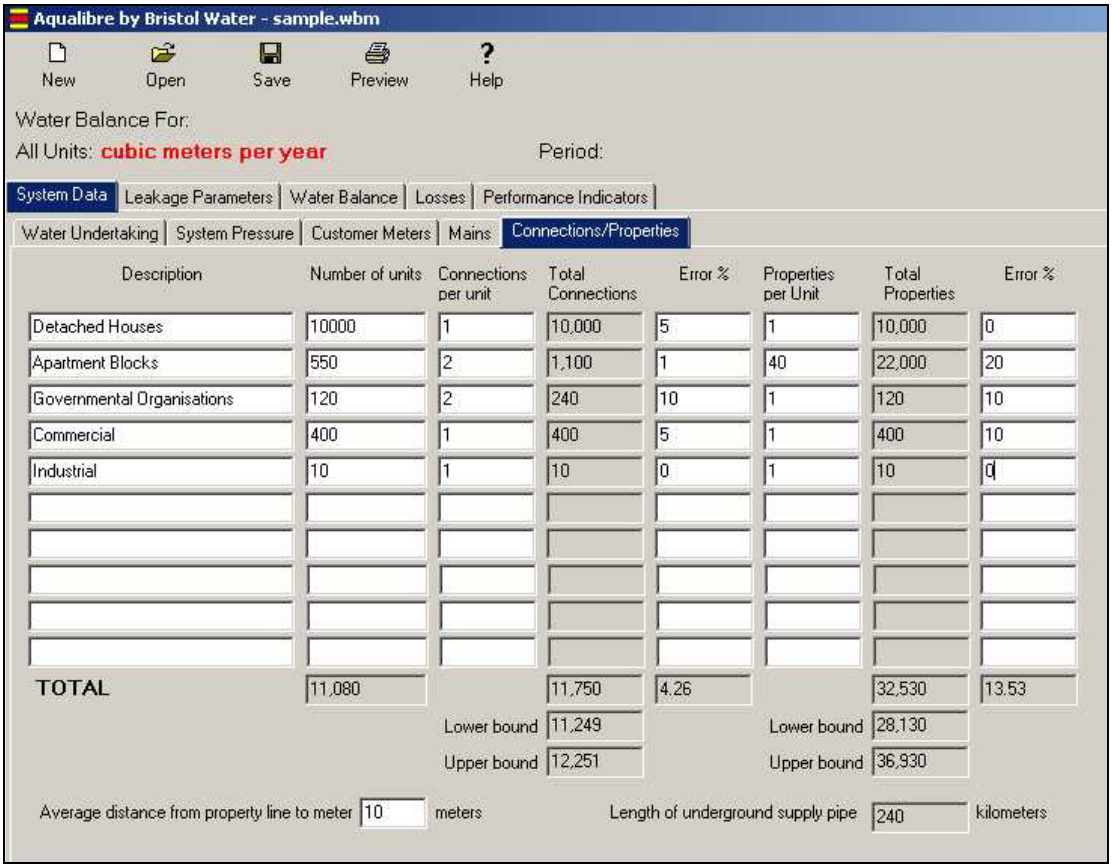

Figure 3: Aqualibre™ Screen shot - data entry form: connections, properties and related error terms

Stand-alone Software

The software is a full Windows based application developed using Delphi which offers many advanced features that are not available through other development platforms. It is a stand-alone package with its own installation shield and requires no third party software to run with the exception of the Windows operating system. This approach provides a more professional product and ensures that the program and associated data files cannot be corrupted through viruses or user errors.

Through the use of Delphi it is also possible to offer a professional graphics environment and through the use of Object Orientated Programming it will be relatively simple to update and enhance the model at regular intervals to keep pace with any new developments in this fast moving field. This approach reduces the scope for errors in the software and will minimise support costs.

Top-down and bottom-up

After doing the normal top-down water balance by entering system input, consumption and making allowances for apparent losses, the balancing error obviously is the amount of real losses.

Now these real losses will be further analysed using a component based leakage assessment (formerly known as BABE) calculate the volumes of water lost for each of the following components:

- background losses (unavoidable losses)
- reported bursts (obvious visible leaks reported by e.g. the public)
- unreported bursts (leaks found by active leakage control)

The total of all these leakage components will very unlikely be exactly the amount calculated by the top-down method.

Is the volume of leakage calculated by the bottom-up method bigger than the amount calculated by the top-down method, there obviously is an error and data, assumptions and error terms have to be checked.

In most cases it will be the other way round, and leakage calculated by the component approach will be less than the top-down figure, the difference being called Hidden or Excess Losses, water losses not identified yet.

These might be either partly be caused by an underestimation of apparent losses, but very often are simply real losses, leaks not detected yet.

Once the apparent loss assumptions are reviewed, the final figure of Excess Losses expresses the volume of water which could potentially be saved. Since undetected leaks are in its vast majority small, mostly service pipe leaks, the Excess Losses will also be expressed in Equivalent Service Pipe Bursts, a theoretical figure which gives an idea of how many leaks have yet to be detected and repaired.

CONCLUSIONS

As BWS has started to develop this software, it was intended to use it only for internal purposes - e.g. consultancies. However, the superb functionality and reliability of the Delphi based software formed the basis for the decision to make this product commercially available.

At present, the beta version is being tested by various partners of BWS in a range of countries, and it is anticipated that the final product will be available for sale mid 2003.

Licenses can be either purchased by individual utilities and consulting companies or arrangements can be made with national organisations to provide it to their members.

BWS' intention is to provide utilities, consultants, international lending agencies and regulators a tool which is easy to use and helps to promote the IWA best practice recommendations.

Check latest update on Aqualibre™ under www.aqualibre.info.

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