Water Auditing for Wholesale Water Agencies

Wholesale Agencies Can Perform Water Audits, Too

A water audit accounts for the volumes of water supplied to a water distribution system and then used for legitimate purposes in order to estimate volumes of water loss. To accomplish this, a water audit uses a mass balance, commonly referred to as a water balance.

Wholesale water agencies and retail water agencies serve different customers and employ distinct methods of distributing, metering, and billing for water. However, the principle of mass balancing to systematically account for all volumes of supply, consumption, and water loss applies to both wholesale and retail agencies.

All water systems – whether retail or wholesale – experience both Apparent Losses ("paper" losses) and Real Losses (leakage). To cost-effectively manage water losses, both wholesale agencies and retail agencies should first evaluate water loss volumes through a water audit.

As a best practice, retail agencies are advised to use the American Water Works Association (AWWA) Free Water Audit Software to complete a water audit and estimate volumes of Apparent Loss and Real Loss. The AWWA Free Water Audit Software was designed to account for volumes of water and evaluate performance primarily for *retail* water agencies. Nonetheless, the AWWA Free Water Audit Software can be adapted for use by wholesale water agencies. As a result, completing a water audit with the AWWA Free Water Audit Software can provide a wholesale water agency with the fundamental information necessary to proactively engage with system efficiency.

In order for wholesale agency use of the water audit software to be standardized and methodologically sound, this appendix explains:

- How **wholesale volumes** of supply, Authorized Consumption, and Apparent Loss should be captured in the AWWA Free Water Audit Software
- How **wholesale infrastructure and financial information** should be documented in the AWWA Free Water Audit Software
- How **data validity grading criteria** should be interpreted to apply to wholesale agencies
- Which **performance indicators** provide insight into wholesale distribution system performance

Volumes

System Boundaries

Water audits typically document treated water distribution during a twelve-month period, and the AWWA Free Water Audit Software was designed to serve potable water systems. However, water audits can also be performed for raw or recycled water systems.

Regardless of whether water volumes recorded in the water audit are treated, it is essential that distribution system boundaries and corresponding meters are identified before beginning a wholesale water audit. This may require that site visits to key boundary meters are conducted or that a single meter from a series of redundant in-line meters is selected to bound and inform the audit. Additionally, the location of reservoirs, treatment processes, and treatment process meters relative to the water audit must be assessed.

Water Supplied

Like retail agencies, wholesale systems acquire water from various sources, including surface water, groundwater, and imports from other agencies. All sources of supply should be accounted for in the Water Supplied section of the AWWA Free Water Audit Software, as displayed in Figure 1 below.

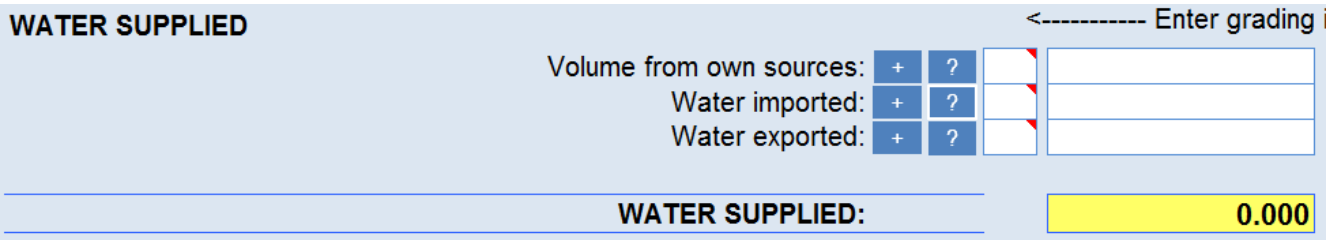

Figure 1: Water Supplied in the AWWA Free Water Audit Software

In a potable water audit, all water that a wholesale agency treats should be considered **Volume from Own Sources**. This is true even for those agencies that import raw water and then conduct the treatment process. If meters capturing Volume from Own Sources are only located prior to the treatment process, treatment process consumption must be estimated to arrive at a volume of potable water supplied to the system.

All treated water that a wholesale agency imports should be catalogued as **Water Imported**.

Most wholesale systems should not allocate any volume to **Water Exported**. Instead, all exports and other approved sales should be treated as Authorized Consumption.

Lastly, any known metering error or inaccuracy in registered volumes of Volume from Own Sources or Water Supplied should be incorporated as a **Master Meter Error Adjustment**. Over-registration is indicated by a positive adjustment; under-registration is indicated by a negative adjustment (see Figure 2). Generally, auditors are advised to only note a Master Meter Error Adjustment when meter error has been diagnosed and quantified through a reliable volumetric test and/or meter calibration.

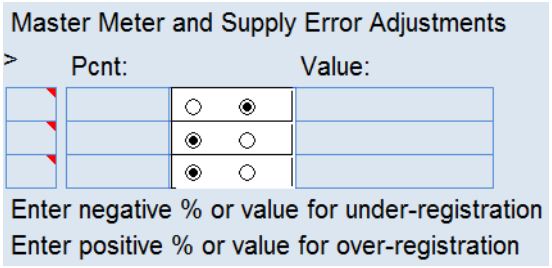

Figure 2: Master Meter Error Adjustment in the AWWA Free Water Audit Software

Authorized Consumption

Authorized Consumption consists of all water that is used for legitimate and permitted purposes. Authorized Consumption is categorized based on whether it is **billed** or **unbilled** and **metered** or **unmetered**. These designations are acknowledged in the AWWA Free Water Audit Software (see Figure 3). It is important that Authorized Consumption categorized as metered is indeed measured with a water meter. Other methods of estimation, though potentially as precise as metering, are nonetheless considered unmetered.

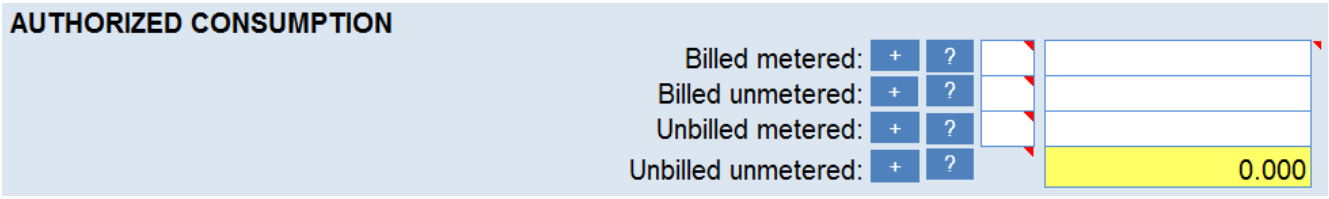

Figure 3: Authorized Consumption in the AWWA Free Water Audit Software

All water that a wholesale agency distributes to customer should be categorized as some form of Authorized Consumption, depending on whether a meter is used to register the volume sold. This is true for all of the wholesaler's customers, whether retail or wholesale in nature.

Like retail agencies completing a water audit, a wholesale agency must also inventory forms of Authorized Consumption that are either unmetered or unbilled (not revenue-generating). Typical examples of unmetered or unbilled use include water used for operational purposes (e.g. tank cleaning) and water granted free-of-charge to cities or civic institutions (e.g. a parks department).

A Note on Defaults

The AWWA Free Water Audit Software supplies default options for **Unbilled Unmetered Authorized Consumption**, **Unauthorized Consumption**, and **Systematic Data Handling Errors**. In the absence of utility-specific data to describe each of these volumes, retail agencies are encouraged to use the default values.

The default values are designed to capture the operations of retail agencies. Their applicability to wholesale system operations has not been studied, though it is likely that the defaults do not apply to most wholesale agencies. Wholesale agencies are encouraged to substitute their own data or estimates in place of default values, though few guidelines currently exist to support wholesale agencies in this process.

Apparent Losses

Apparent Losses, also referred to as "paper" losses, is water that reaches an end user but is not tracked or registered, so a water agency does not have record of its use or receive payment. Apparent Losses are typically incurred in three ways (see Figure 4):

- **Unauthorized Consumption** (theft)
- **Customer Meter Inaccuracies**
- **Systematic Data Handling Errors**

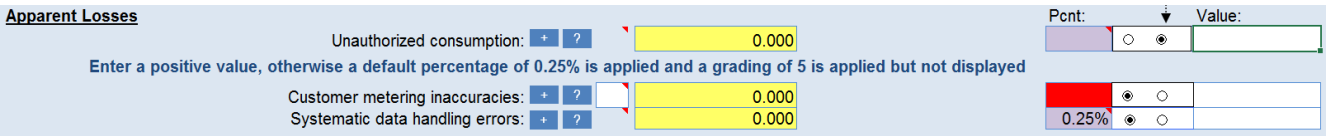

Figure 4: Apparent Losses in the AWWA Free Water Audit Software

Retail agencies often experience enduring, small instances of Unauthorized Consumption at hydrants and service connections, but Unauthorized Consumption in wholesale agency distribution networks depends on system infrastructure and corresponding opportunities for theft (See "A Note on Defaults"). If a wholesale agency has not studied the prevalence of theft in its system, the agency is advised to indicate an Unauthorized Consumption volume of 0.

Customer Meter Inaccuracies capture volume missed by inaccurate customer meters. Customer meter under-registration occurs for all retail agencies who maintain a population of small customer meters. Retail customer meters bias toward under-registration, so some inaccuracy must be acknowledged in the AWWA Free Water Audit Software. Alternatively, a calculated volume of throughput missed due to Customer Meter Inaccuracies can also be incorporated.

However, wholesale agencies typically export water through large meters that may over-register as often as they under-register. Over-registering export meters may produce negative Apparent Losses, indicating that the volume of water registered and billed is greater than actual throughput. To quantify wholesale Customer Meter Inaccuracies, it is important to test meters at their typical operating flow rates. Test results can be incorporated in the AWWA Free Water Audit Software as a Customer Meter Inaccuracy percent or volume input. In contrast to Master Meter Error Adjustment for volume of Water Supplied, a positive Customer Meter Inaccuracies value indicates under-registration, while a negative value indicates over-registration.

In the absence of test results, wholesale Customer Meter Inaccuracies can be difficult to estimate. Little guidance currently exists to support wholesale agencies in estimating Customer Meter Inaccuracies without test results.

Therefore, wholesale agencies who do not have test results are advised to leave Customer Meter Inaccuracies blank in the AWWA Free Water Audit Software.

Systematic Data Handling Errors capture volume lost to billing lapses, estimates, meter read errors, and other comparable accounting omissions. Retail agencies interacting with thousands of accounts typically experience Systematic Data Handling Errors due to the sheer volume of data they interact with. Systematic Data Handling Errors in wholesale systems depend on meter reading practices, data management systems, and bill generation processes and as such must be estimated or quantified on an agency-by-agency basis (see "A Note on Defaults"). In the absence of a Systematic Data Handling Errors study, wholesale agencies are advised to report a Systematic Data Handling Errors volume of 0.

Infrastructure and Financial Information

System Data

The AWWA Free Water Audit Software asks for a handful of figures that describe the infrastructure that is the subject of the audit (see Figure 5). Therefore, each of the System Data inputs should be interpreted as applying to the infrastructure encompassed by the system boundaries established at the beginning of the water audit (see "System Boundaries").

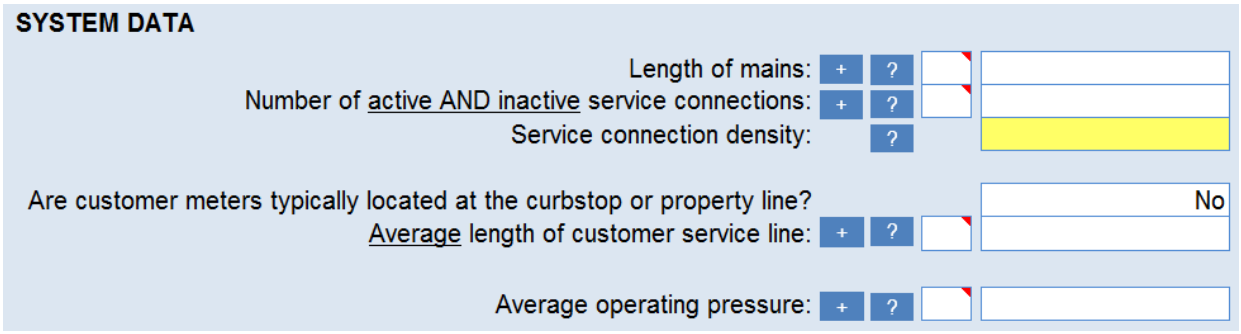

Figure 5: System Data in the AWWA Free Water Audit Software

The **length of mains** captures all transmission and distribution piping between boundary input meters (whether Volume from Own Sources or Water Imported) and boundary Authorized Consumption meters (the point of customer metering).

The **number of active and inactive service connections** typically refers to retail service pipe connections to distribution piping. For wholesale agencies, this input should generally be interpreted to refer to the count of pressurized connections through which water is sold to individual customers and water agencies alike.

If a retail agency does not locate customer meters at the curbstop or property line, they should indicate the additional **length of customer service line** prior to the meter for which the agency is responsible. However, this situation is inapplicable to wholesale agencies who export water through a point of transfer on transmission

infrastructure. Therefore, most wholesale agencies should select "Yes" in response to the question "Are customer meters typically located at the curbstop or property line?" to indicate that they are not responsible for any additional service connection pipe.

Lastly, the water audit software asks for an **average operating pressure**. Retail and wholesale agencies alike must account for the specific pressure dynamics of their system when calculating this figure. Wholesale agencies can use the Department of Water Resources Water Audit manual and AWWA Manual M36 as guides in calculating average operating pressure.

Cost Data

Because Water Loss has financial implications, the AWWA Free Water Audit Software requests three cost figures to value Apparent Losses and Real Losses (see Figure 6).

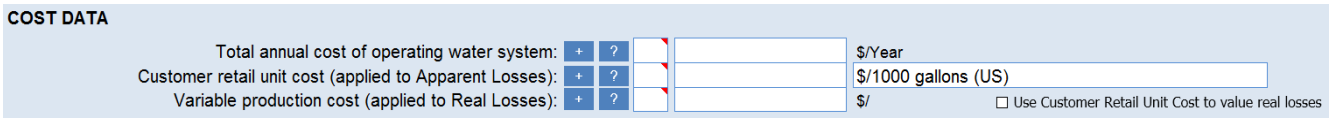

Figure 6: Cost Data in the AWWA Free Water Audit Software

The **total annual cost of operating the system** should capture all costs incurred during the audit period for the system being audited, including annual fixed costs, capital improvement, depreciation, and debt service.

The **customer retail unit cost** is typically calculated by dividing all commodity (volume-based) revenue received during the audit period by the volume of Billed Metered Authorized Consumption sold. This calculation inherently weights all rates, classes, and tiers in a single average cost. Because wholesale exports are considered standard customers in a wholesale water audit, these wholesale export revenues and rates should be incorporated in the customer retail unit cost.

The **variable production cost** captures the costs that a wholesale agency incurs in producing and distributing a unit of water. Typically, direct costs like acquisition, treatment, and pumping expenses are incorporated in a variable production cost. As a result, a wholesale agency's calculation of variable production cost will mirror that of a retail agency.

Data Validity Grades

The AWWA Free Water Audit Software requires that users assign a data validity grade to each audit input. The data validity grades aim to document the practices supporting water audit data using a 1-to-10 scale built on qualitative descriptions of operational practices. Each number grade corresponds to specific criteria; an agency must satisfy *all* criteria for a given grade for that grade to apply.

Data validity grades note a utility's practices of instrument maintenance, data collection, and data review. Understanding how these practices affect water audit data will benefit a wholesale agency aiming to gauge the potential for inaccuracy in a water audit. However, the criteria in the data validity grading matrix specifically cater to retail system management. As a result, the details and mechanics of data validity grading system may not apply to most wholesale agencies.

Wholesale agencies are encouraged to interpret data validity grades as literally as possible, acknowledging that the data validity grade assignment process is an opportunity reflect on operational practices and is necessary to generate performance indicators, but that there may be limits in its applicability to wholesale systems.

Performance Indicators

System Attributes

Once the entire AWWA Free Water Audit Software Reporting Worksheet has been filled out with inputs and data validity grades, the Software generates a suite of performance indicators. The performance indicators are introduced by a summary of system attributes (see Figure 7).

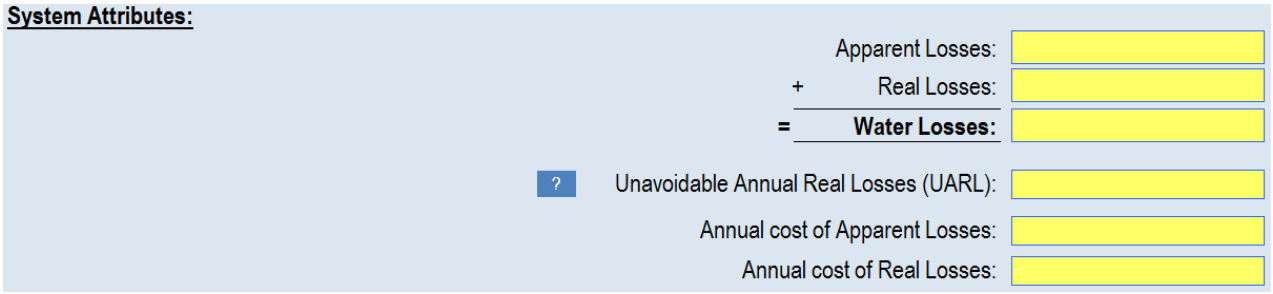

Figure 7: System Attributes in the AWWA Free Water Audit Software

Most system attributes accurately describe both wholesale and retail systems, as the system attributes capture performance in absolute terms. However, the volume of **Unavoidable Annual Real Losses** (UARL) *does not apply* to wholesale systems. The UARL calculation assumes leakage rates typical of retail infrastructure and cannot be adjusted to capture wholesale infrastructure. For most wholesale agencies, the UARL will not be calculated by the software due to low service connection density. Wholesale agencies whose audit displays a numeric value for the UARL should ignore this figure.

Though the actual calculation of the UARL does not apply to wholesale systems, the UARL acknowledges that some minimum volume of leakage is expected for all systems, depending on infrastructure and operating pressure. This concept applies to both wholesale and retail systems. As such, the *total* volume and cost of Real Losses cannot be completely eliminated for wholesale systems, though it may be that a *portion* of the volume and cost of Real Losses can be recovered.

Performance Indicators

Performance indicators are presented as relating to either financial or operational efficiency (see Figure 8). The financial indicators evaluate Non-Revenue Water as a percent of either Water Supplied or Operating Cost. Because both calculations depend in part on the volume of water that customers purchase, it is difficult to attribute change in these indicators to either Non-Revenue Water Performance or customer consumption patterns. As a result, neither performance indicator offers actionable insight to wholesale agencies, and wholesale agencies are discouraged from discussing performance in percent terms.

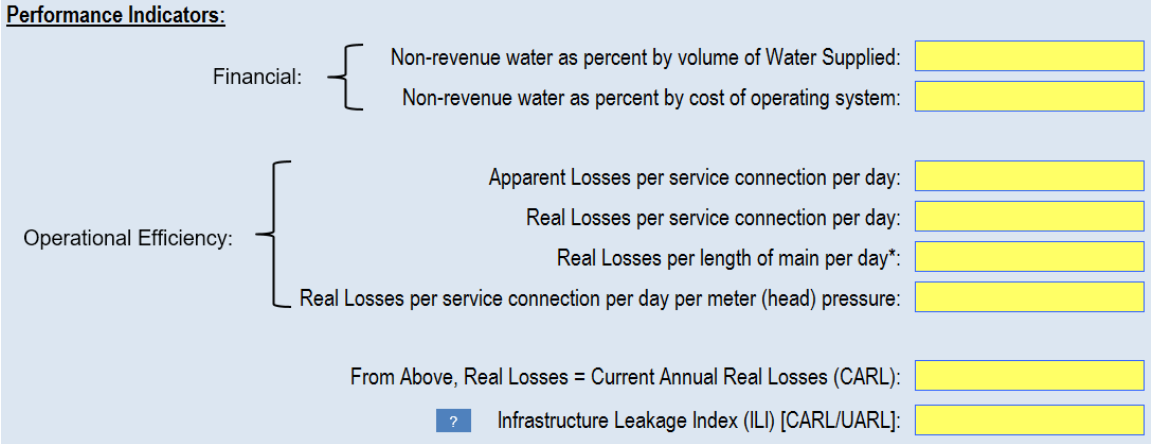

Figure 8: Performance Indicators in the AWWA Free Water Audit Software

Instead, wholesale agencies are advised to discuss Water Loss and Non-Revenue Water performance in terms of volumes (whether total volumes or normalized volumes) and their financial ramifications. The most applicable indicators for wholesale volumetric discussion are **Apparent Losses per Service Connection per Day** and **Real Losses per Length of Main per Day** (see Table 1). Each indicator ties Water Loss to its primary driver (service connection meter accuracy for Apparent Losses and transmission and distribution piping for Real Losses).

The Infrastructure Leakage Index is the ratio of an agency's calculated volume of Real Losses to its UARL. Because the UARL does not apply to wholesale agencies, the Infrastructure Leakage Index also does not apply.

Table 1: Performance Indicators Applicable to Wholesale Agencies

	APPLICABLE?	UNITS
FINANCIAL PERFORMANCE INDICATORS		
Non-Revenue as percent by volume of Water Supplied	**NO**	
Non-Revenue as percent by cost of operating system	**NO**	
annual cost of Apparent Losses	**YES**	*valued at customer retail unit cost*
annual cost of Real Losses	**YES**	*valued at variable production cost*
OPERATIONAL EFFICIENCY PERFORMANCE INDICATORS		
Apparent Losses per service connection per day	**YES**	gal / conn / day
Real Losses per service connection per day	**NO**	gal / conn / day
Real Losses per length of main per day	**YES**	gal / mile / day
Real Losses per service connection per day per PSI of pressure	**NO**	gal / conn / day / PSI
Unavoidable Annual Real Losses (UARL)	**NO**	AF / yr or MG / yr
Current Annual Real Losses (CARL)	**YES**	AF / yr or MG / yr
Infrastructure Leakage Index (CARL/UARL)	**NO**	
DATA VALIDITY PERFORMANCE INDICATOR		
Data Validity Score	**NO**	*weighted overall score out of 100*