Water Loss Audit– How to Maximize the Benefit

Municipal Water Conservation
Texas Water Development Board

Unless specifically noted, this presentation does not necessarily reflect official Board positions or decisions.

Water Loss Audits

What?

Who?

Why?

When?

Where?

How?

WHO? WHEN?

- All retail public water systems by May 1, 2021
- 3,300 or > connections
- Active financial obligation
- Recommend annual

WHY?

- System efficiency
- Extend supply
- Target asset upgrades
- Saves money
- Public Health
- Financial Assistance
- Regional Water Planning

HOW?

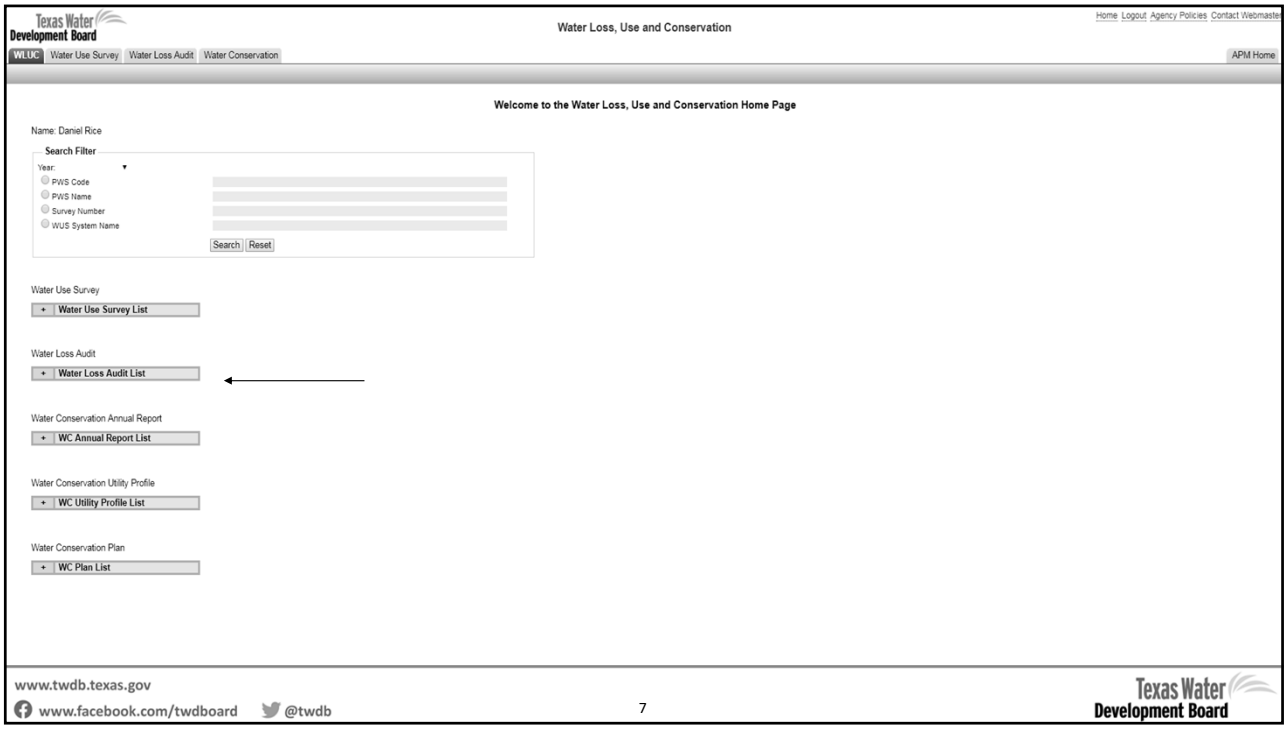
Training Requirement
31 TEXAS ADMINISTRATIVE CODE (TAC)
§ 358.6(b)(4)

- *Effective January 1, 2019, the water loss audit must be performed by a person who has completed water loss audit training……agency website and may also provide such training in person or by video.*
- *The person who completes the water loss audit is required to upload the training acknowledgement with their name on it – not someone else's acknowledgement.*

WHERE?

www.twdb.texas.gov/conservation/municipal/waterloss/index.asp

- Accessing the Water Loss Audit online reporting application (LUC)
- Registered user instructions
- Email address and contact information
- Training webinar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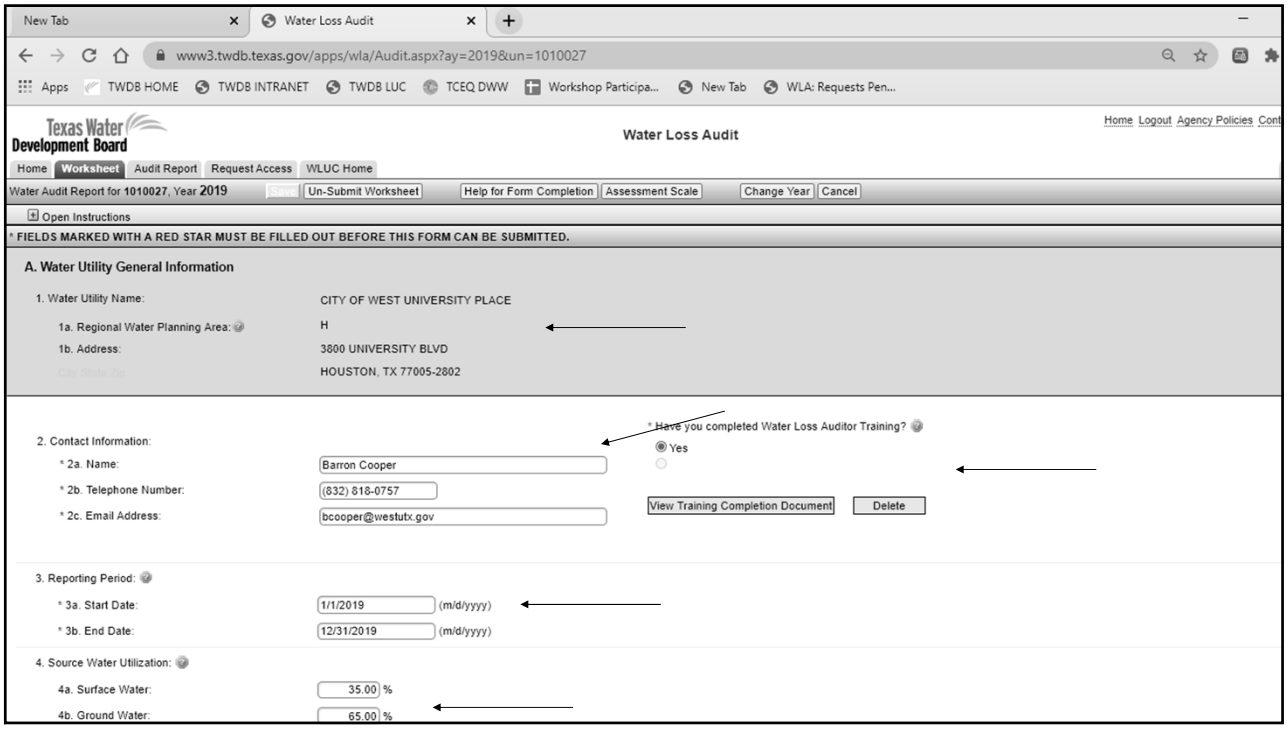
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Open Instructions
* FIELDS MARKED WITH A RED STAR MUST BE FILLED OUT BEFORE THIS FORM CAN BE SUBMITTED.
A. Water Utility General Information
1. Water Utility Name: CITY OF WEST UNIVERSITY PLACE
1a. Regional Water Planning Area: H
1b. Address: 3800 UNIVERSITY BLVD
HOUSTON, TX 77005-2802
2. Contact Information:
* Have you completed Water Loss Auditor Training?
Yes
* 2a. Name: Barron Cooper
* 2b. Telephone Number: (832) 818-0757
* 2c. Email Address: bcooper@westutx.gov
View Training Completion Document Delete
3. Reporting Period:
* 3a. Start Date: 1/1/2019 (m/d/yyyy)
* 3b. End Date: 12/31/2019 (m/d/yyyy)
4. Source Water Utilization:
4a. Surface Water: 35.00 %
4b. Ground Water: 65.00 %

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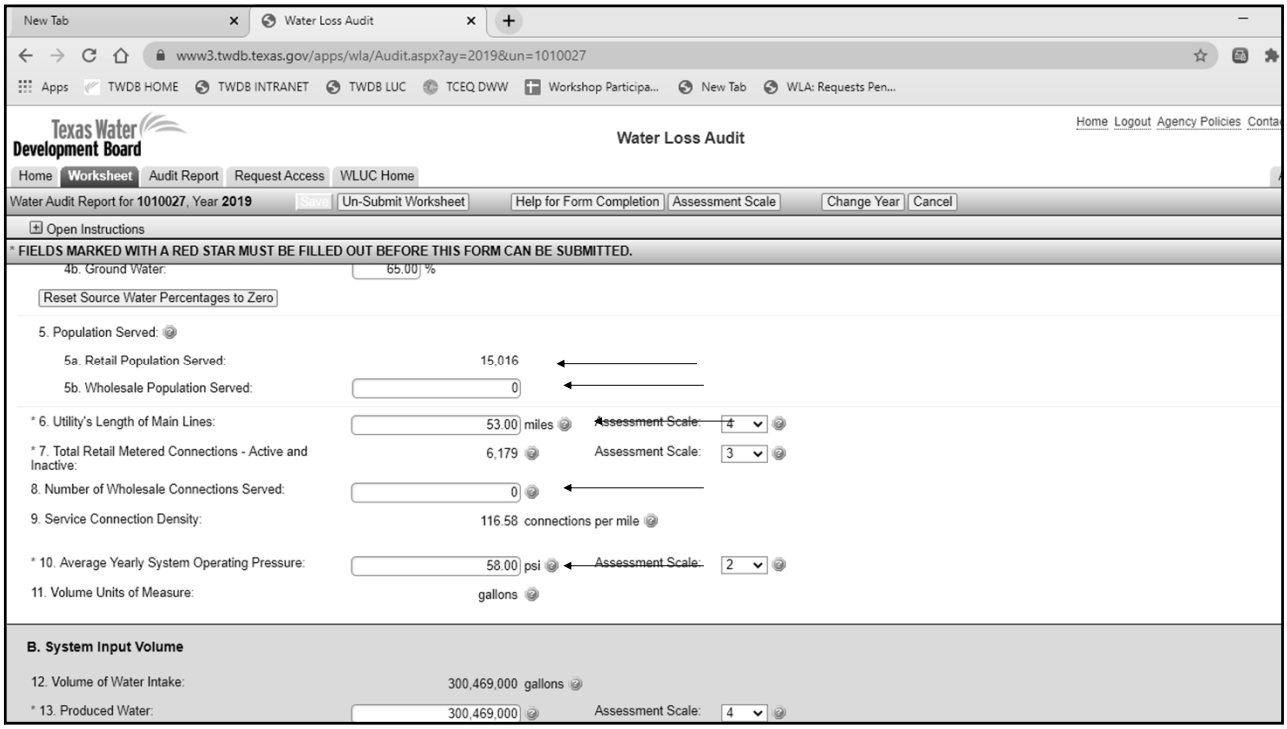

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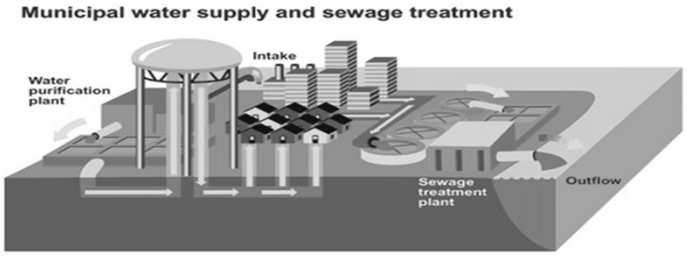
Water Balance

Provides accountability, as all the water placed into a distribution system should, in theory, equal all the water taken out of the distribution system.



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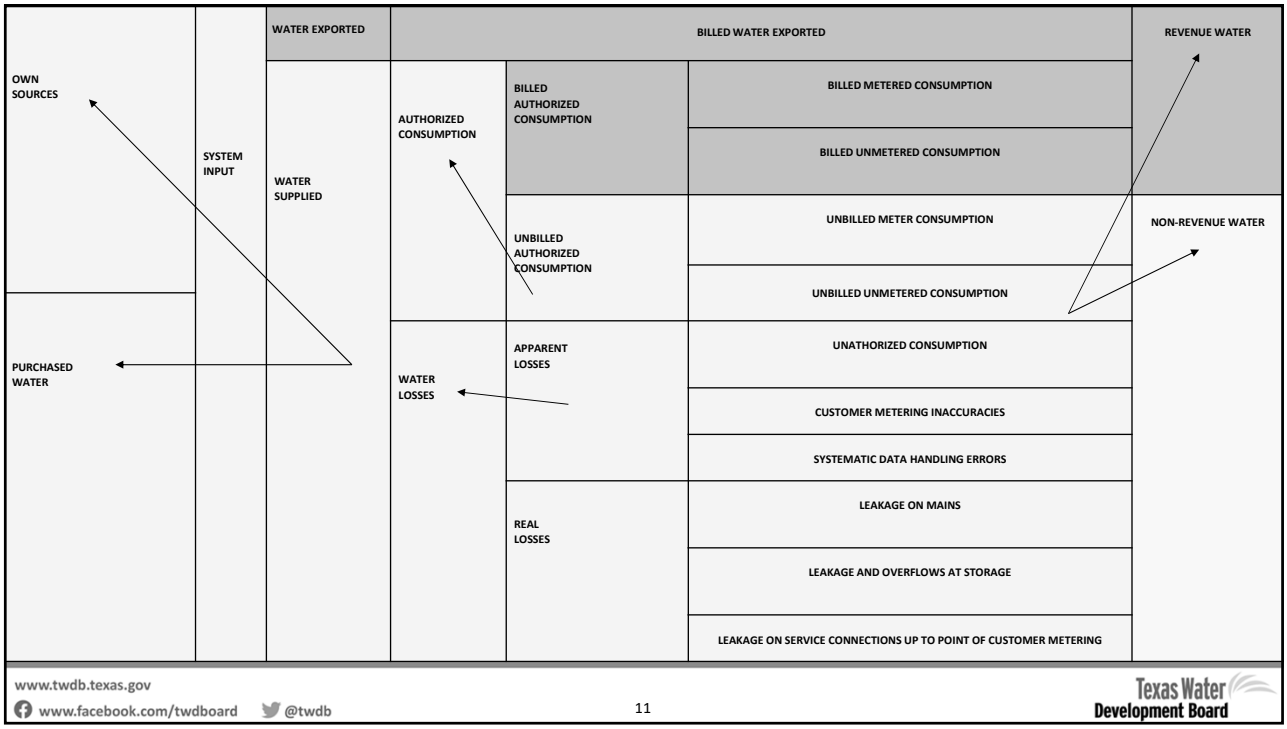
OWN SOURCES
PURCHASED WATER
SYSTEM INPUT
WATER EXPORTED
WATER SUPPLIED
BILLED WATER EXPORTED
AUTHORIZED CONSUMPTION
WATER LOSSES
BILLED AUTHORIZED CONSUMPTION
UNBILLED AUTHORIZED CONSUMPTION
APPARENT LOSSES
REAL LOSSES
BILLED METERED CONSUMPTION
BILLED UNMETERED CONSUMPTION
UNBILLED METER CONSUMPTION
UNBILLED UNMETERED CONSUMPTION
UNATHORIZED CONSUMPTION
CUSTOMER METERING INACCURACIES
SYSTEMATIC DATA HANDLING ERRORS
LEAKAGE ON MAINS
LEAKAGE AND OVERFLOWS AT STORAGE
LEAKAGE ON SERVICE CONNECTIONS UP TO POINT OF CUSTOMER METERING
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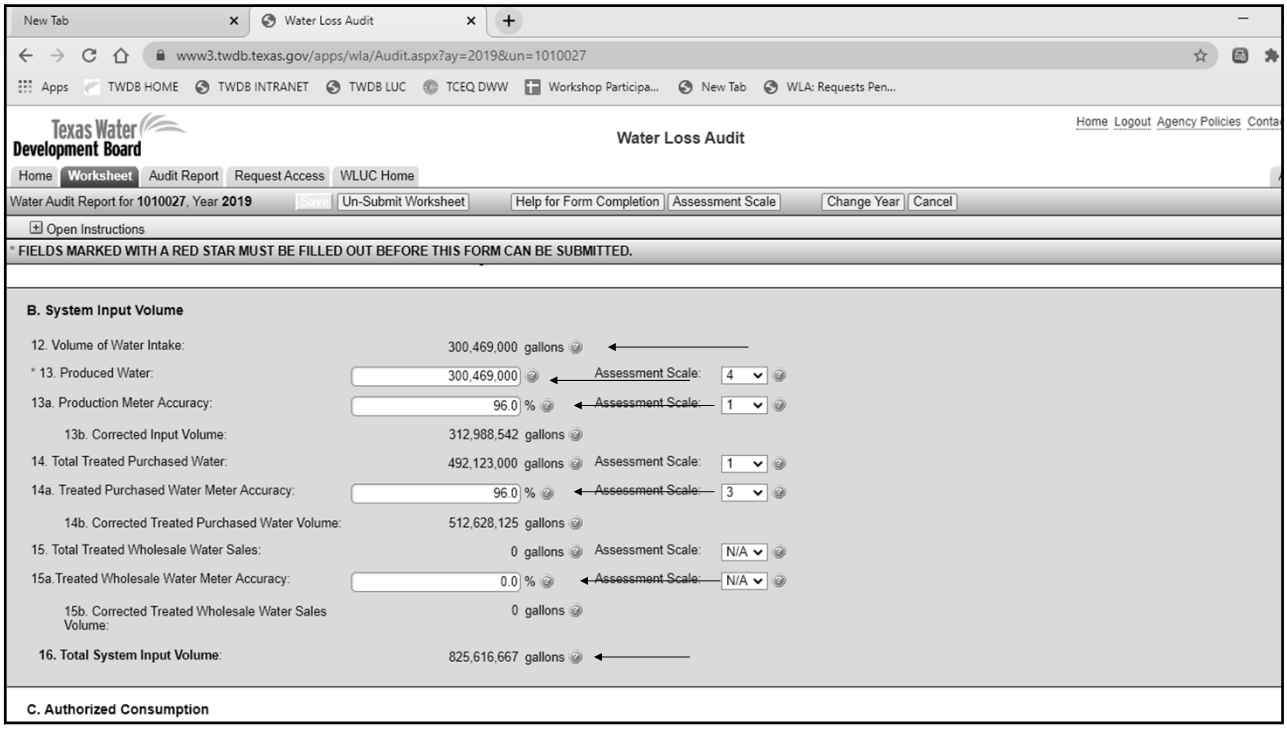
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* FIELDS MARKED WITH A RED STAR MUST BE FILLED OUT BEFORE THIS FORM CAN BE SUBMITTED.
B. System Input Volume
12. Volume of Water Intake: 300,469,000 gallons
* 13. Produced Water: 300,469,000 Assessment Scale: 4
13a. Production Meter Accuracy: 96.0 % Assessment Scale: 1
13b. Corrected Input Volume: 312,988,542 gallons
14. Total Treated Purchased Water: 492,123,000 gallons Assessment Scale: 1
14a. Treated Purchased Water Meter Accuracy: 96.0 % Assessment Scale: 3
14b. Corrected Treated Purchased Water Volume: 512,628,125 gallons
15. Total Treated Wholesale Water Sales: 0 gallons Assessment Scale: N/A
15a.Treated Wholesale Water Meter Accuracy: 0.0 % Assessment Scale: N/A
15b. Corrected Treated Wholesale Water Sales Volume: 0 gallons
16. Total System Input Volume: 825,616,667 gallons
C. Authorized Consumption

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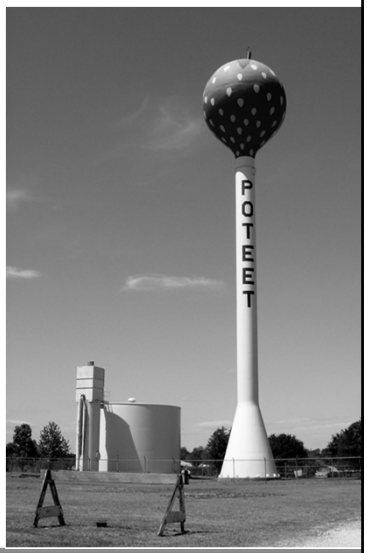
Reviewing Common Errors

- Line 12 should be more or equal to Line 13
  - *Line 12 is 1 Million Gallons and Line 13 is 500,000 gallons*
    - *where did the other 500,000 gallons go?*
  - *Line 13 is 1 Million Gallons and Line 12 is 500,000 gallons*
    - *how are you treating more water than you have?*
  - *Line 12 is 1 Million Gallons and Line 13 is 1 Million Gallons*
    - *is this an error?*

System Input Volume

Total amount of water supplied to the distribution system and should be validated and should include an adjustment for master meter inaccuracy.



Authorized Consumption

Water that is used by customers that are known to the water system.

	Billed Metered
+	Billed Unmetered
+	Unbilled Metered
+	Unbilled Unmetered
=	Authorized Consumption (mg/yr)

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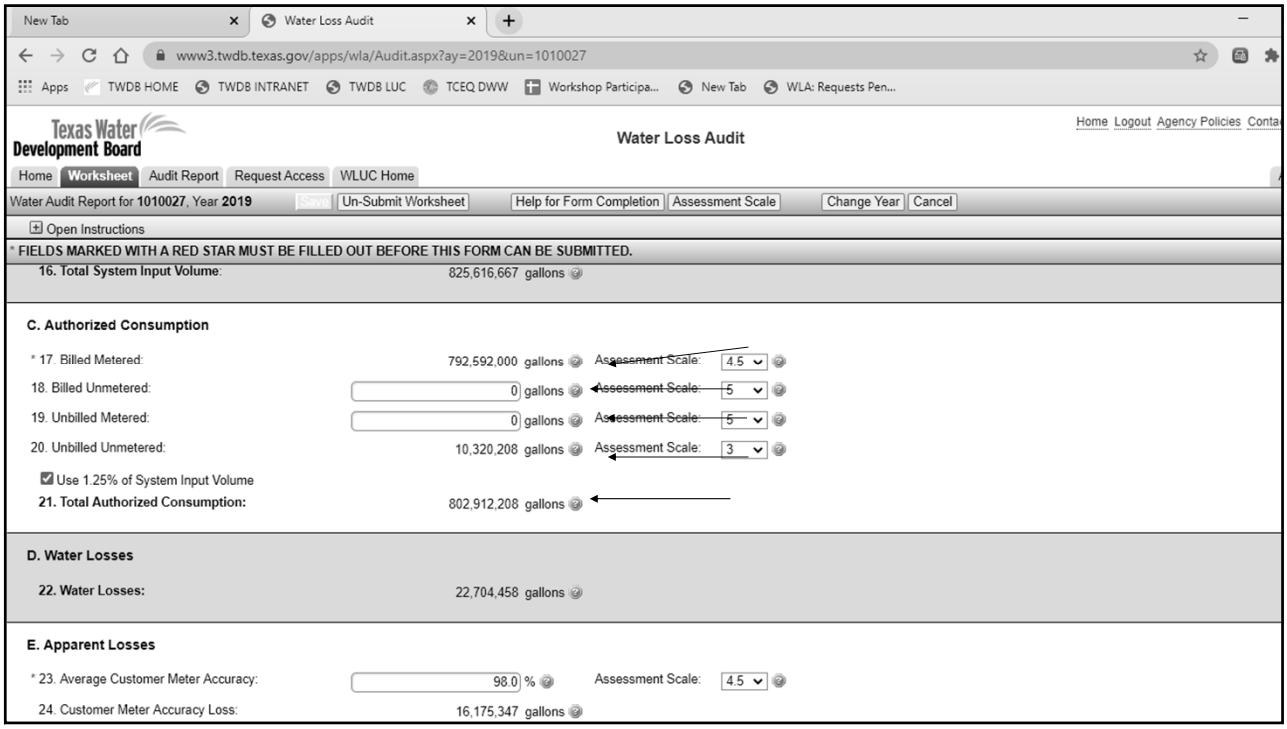

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Reviewing Common Errors

- Line 17 should always be less than Line 16
  - *Line 16 is 1 Million Gallons and Line 17 is 500,000 gallons*
    - *where did the other 500,000 gallons go?*
  - *Line 17 is 1 Million Gallons and Line 16 is 500,000 gallons*
    - *how are you billing out more water than you have?*

Water Losses

Water losses in the distribution system that are not due to authorized consumption and are categorized as either apparent or real losses.

System Input Volume - Authorized Consumption
= Water Loss

Apparent Loss

Commercial or apparent losses are water that is lost that could have been sold. Non-Revenue Water, Water Theft, Slow Meters and Billing Issues

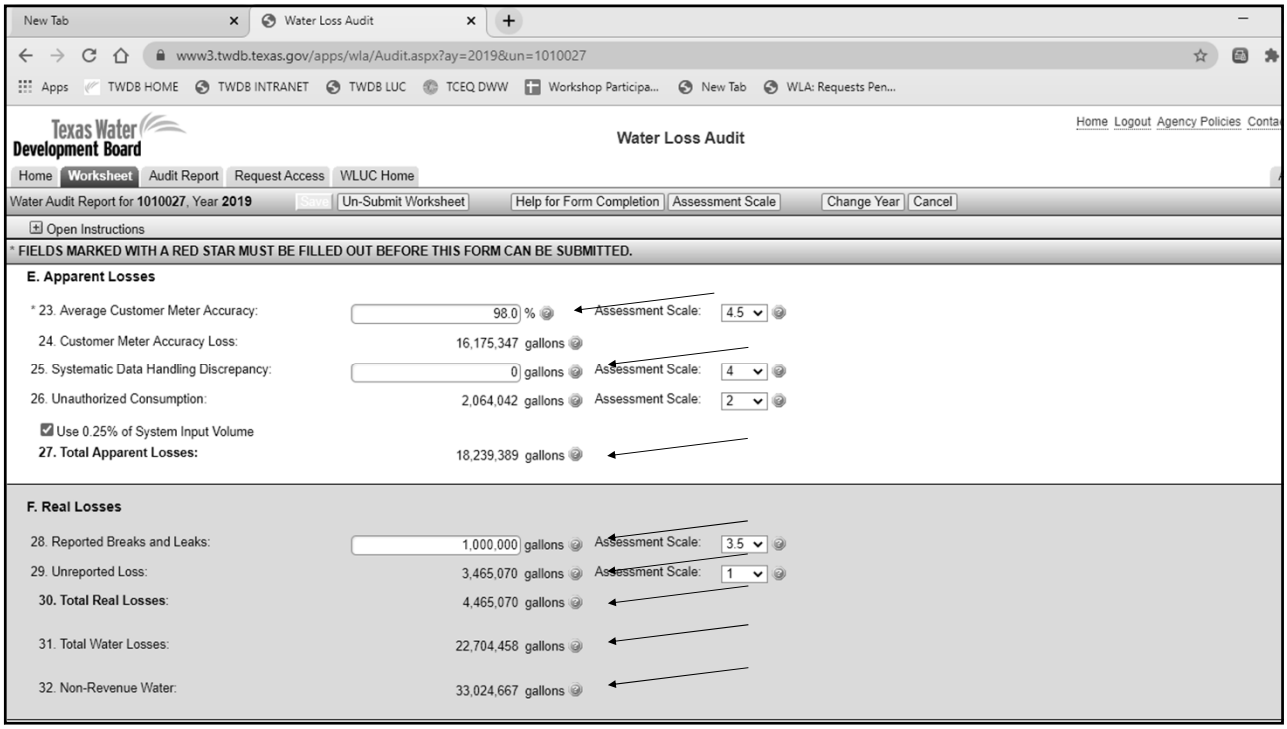
Unauthorized Consumption
+ Customer Meter Inaccuracies
+ Systematic Data handling Errors
= Apparent Loss

Real Loss

Physical Losses – water that enters the distribution system but never reaches a user. Leakage on transmission and distribution mains, storage tank overflows, and service line leak to customer meter.

- *Non revenue water*

Water Losses
- Apparent Losses
= Real Loss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E. Apparent Losses
* 23. Average Customer Meter Accuracy: 98.0 % Assessment Scale: 4.5
24. Customer Meter Accuracy Loss: 16,175,347 gallons
25. Systematic Data Handling Discrepancy: 0 gallons Assessment Scale: 4
26. Unauthorized Consumption: 2,064,042 gallons Assessment Scale: 2
Use 0.25% of System Input Volume
27. Total Apparent Losses: 18,239,389 gallons
F. Real Losses
28. Reported Breaks and Leaks: 1,000,000 gallons Assessment Scale: 3.5
29. Unreported Loss: 3,465,070 gallons Assessment Scale: 1
30. Total Real Losses: 4,465,070 gallons
31. Total Water Losses: 22,704,458 gallons
32. Non-Revenue Water: 33,024,667 gallons

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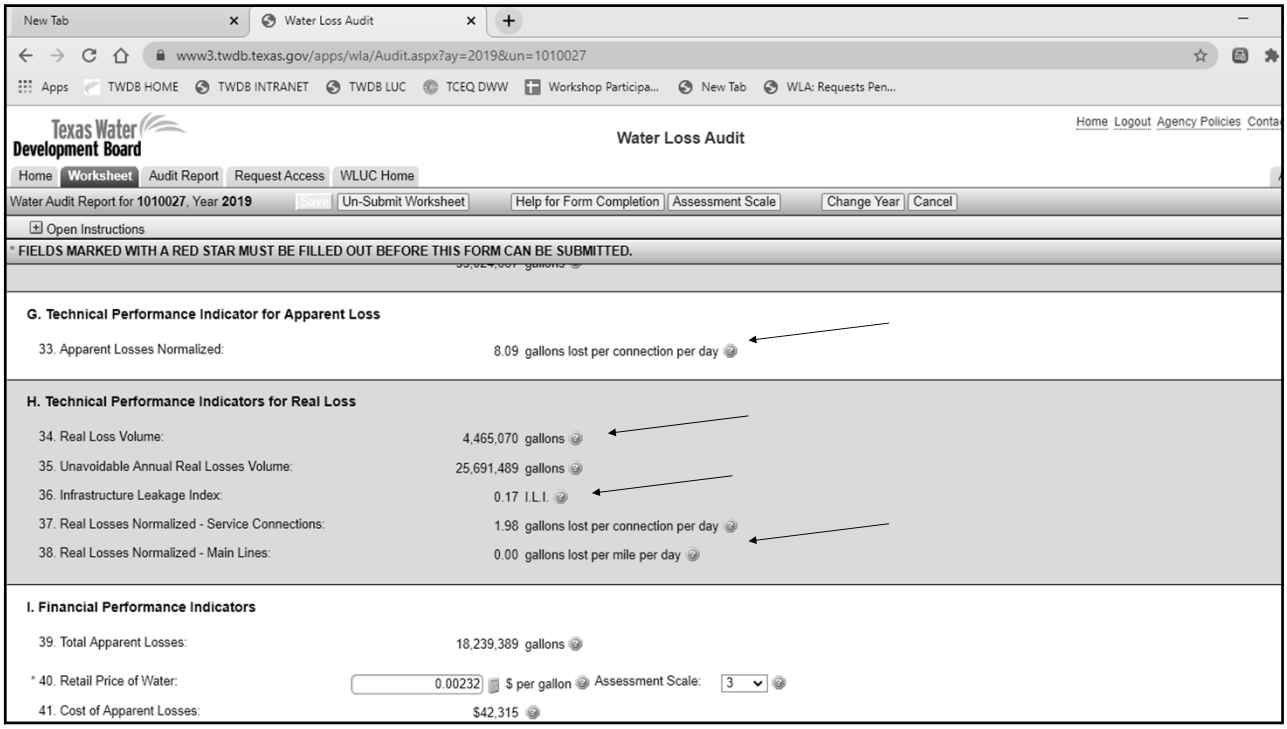
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G. Technical Performance Indicator for Apparent Loss
33. Apparent Losses Normalized: 8.09 gallons lost per connection per day
H. Technical Performance Indicators for Real Loss
34. Real Loss Volume: 4,465,070 gallons
35. Unavoidable Annual Real Losses Volume: 25,691,489 gallons
36. Infrastructure Leakage Index: 0.17 I.L.I.
37. Real Losses Normalized - Service Connections: 1.98 gallons lost per connection per day
38. Real Losses Normalized - Main Lines: 0.00 gallons lost per mile per day
I. Financial Performance Indicators
39. Total Apparent Losses: 18,239,389 gallons
* 40. Retail Price of Water: 0.00232 $ per gallon Assessment Scale: 3
41. Cost of Apparent Losses: $42,315

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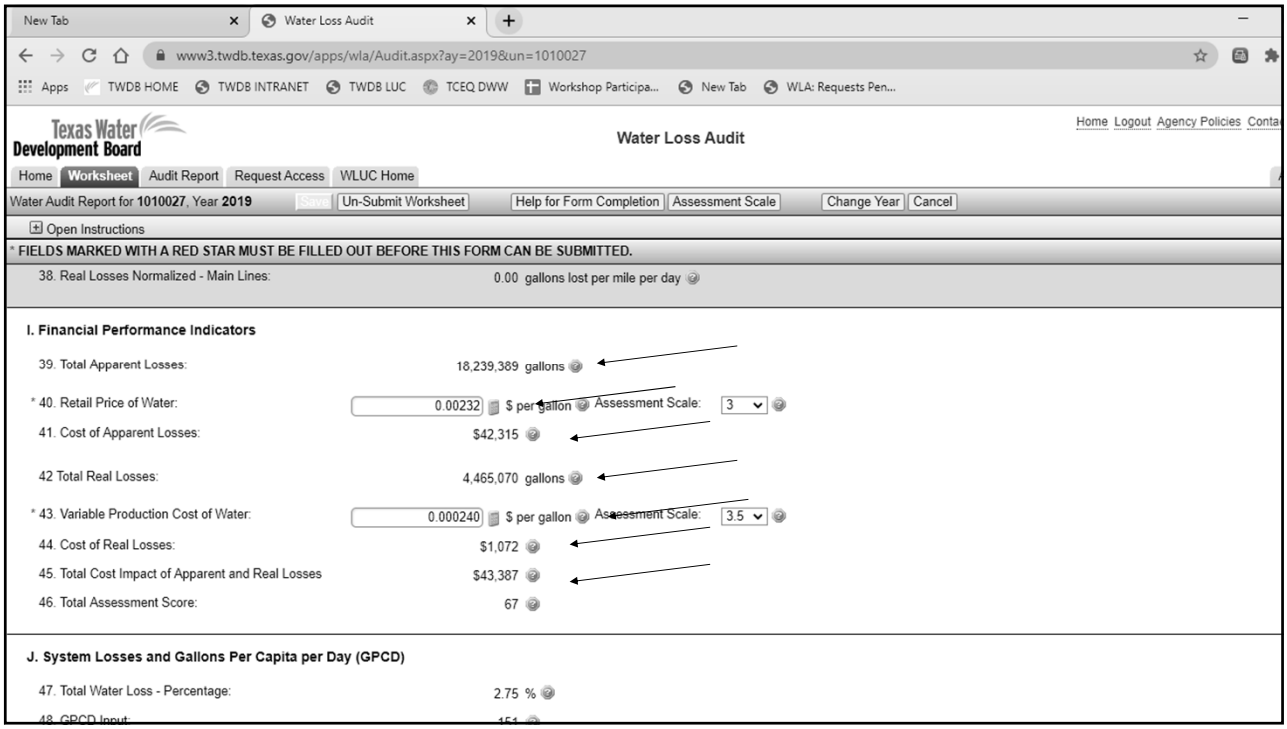
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38. Real Losses Normalized - Main Lines: 0.00 gallons lost per mile per day
I. Financial Performance Indicators
39. Total Apparent Losses: 18,239,389 gallons
* 40. Retail Price of Water: 0.00232 $ per gallon Assessment Scale: 3
41. Cost of Apparent Losses: $42,315
42 Total Real Losses: 4,465,070 gallons
* 43. Variable Production Cost of Water: 0.000240 $ per gallon Assessment Scale: 3.5
44. Cost of Real Losses: $1,072
45. Total Cost Impact of Apparent and Real Losses $43,387
46. Total Assessment Score: 67
J. System Losses and Gallons Per Capita per Day (GPCD)
47. Total Water Loss - Percentage: 2.75 %

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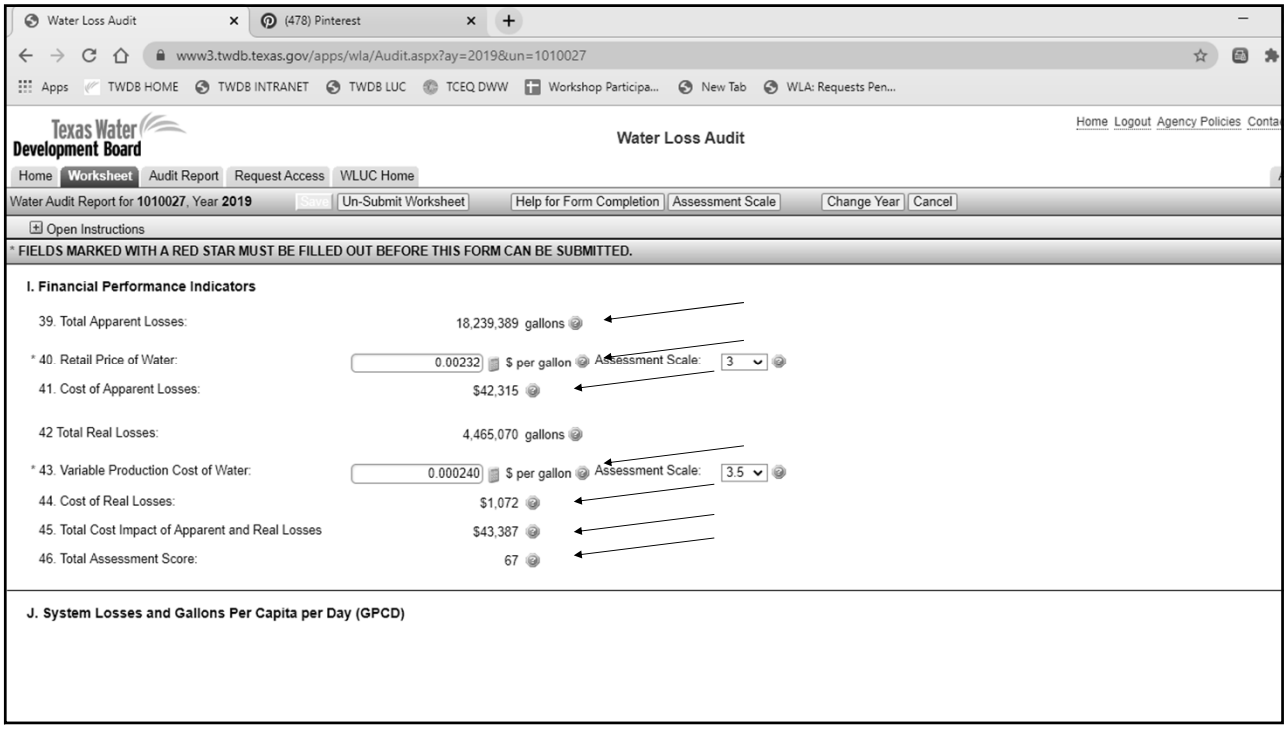
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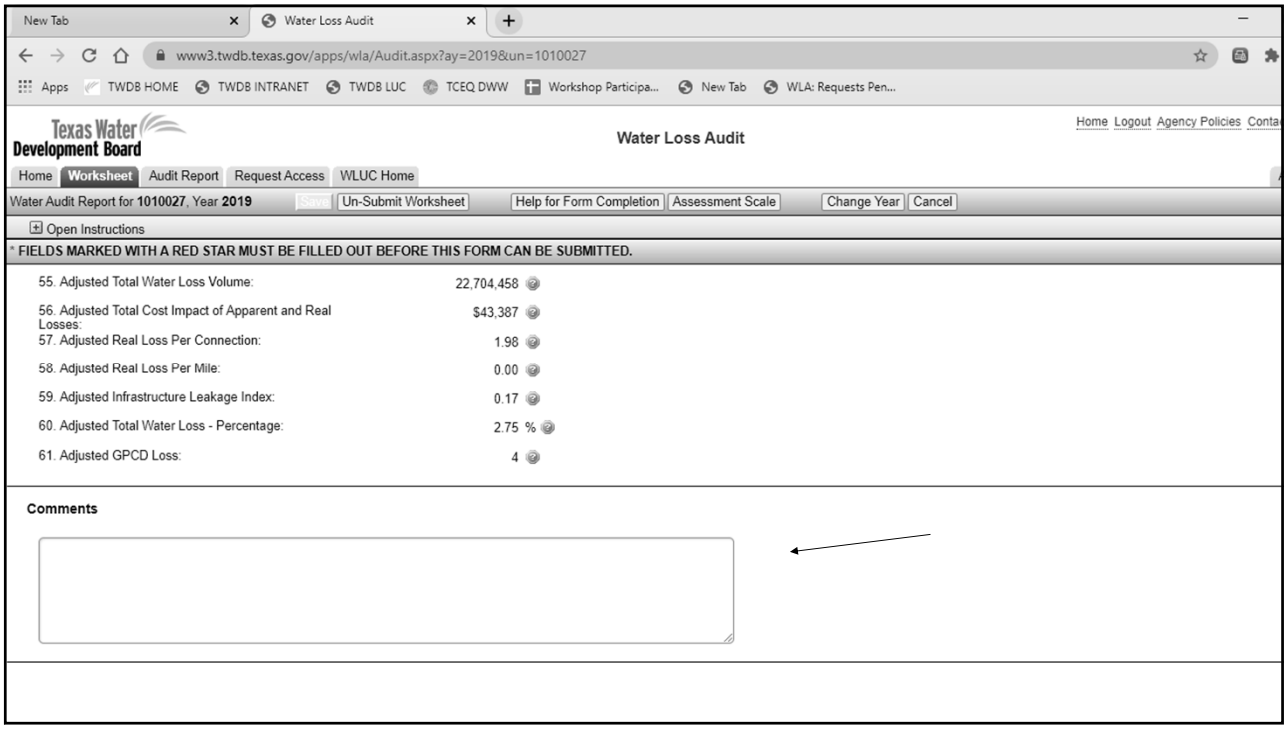

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Performance Indicators

- Line 33 – Apparent Loss, gallons/connection/day
- Line 36 - Infrastructure Leakage Index (ILI): > 3,000 connections
- Line 37 – Real Loss, gallons/connection/day
- Line 41 - Cost of Apparent Loss (Revenue!)
- Line 44 – Cost of Real Loss
- Line 45 – Cost of Water Loss
- Line 46 – Total Assessment Scale
- Line 47 – Total Water Loss, gallons/connection/day
- Line 49 - GPCD (gallons per capita per day)

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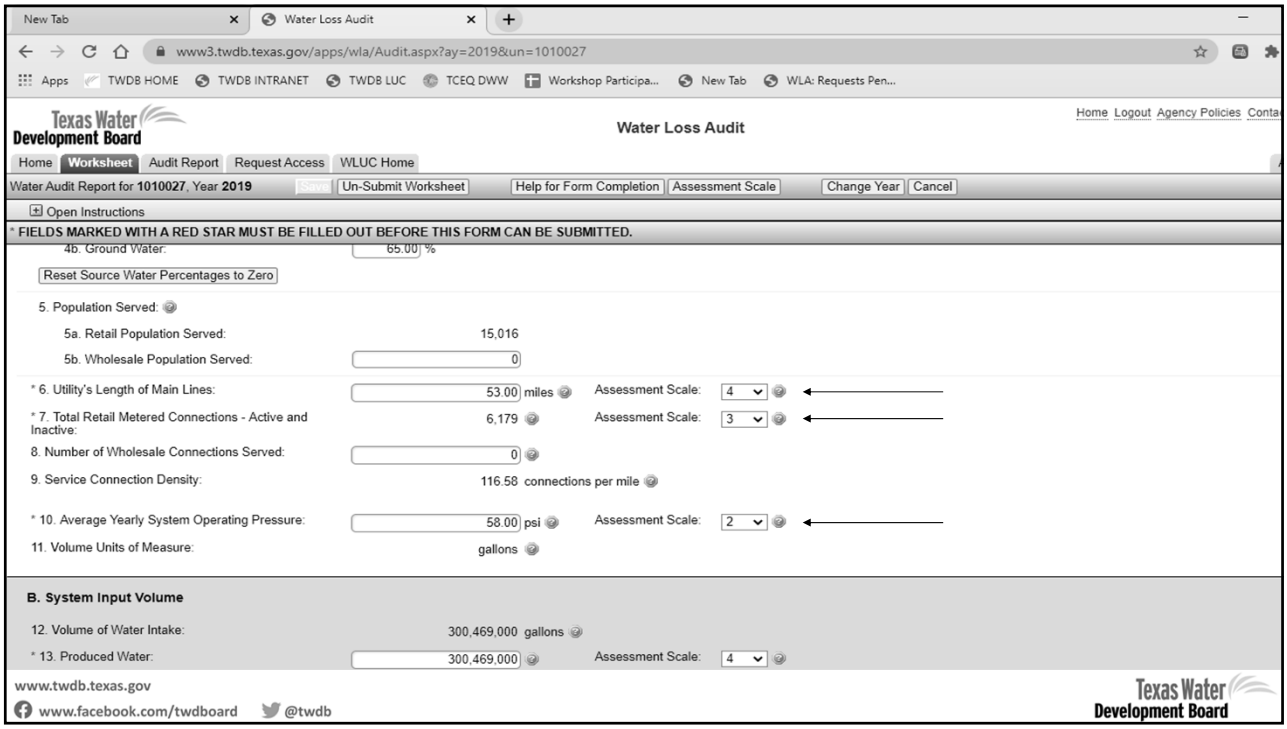
Water Loss Percent

Not a Performance Indicator!

Field on Audit	2019	2020
Total System Input Volume	2,000,000,000 gallons	2,100,000,000 gallons
Total Authorized Consumption	1,650,000,000 gallons	1,750,000,000 gallons
Total Water Loss	350,000,000 gallons	350,000,000 gallons
Percent of Water Loss	17.5%	16.7%
Real Loss per Connection per Day	56.7 gallons per connection per day	56.7 gallons per connections per day
Apparent Loss per Connection per Day	9.8 gallons per connection per day	9.8 gallons per connection per day

Assessment Scale Benefits

- Self-reported Assessments complete the WLA to determine how accurate your data is
- Consider your options and **take action**
- Also known as Water Loss Audit validation
- Bridge from WLA to Action to Conservation Plans



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Component	Length of Main Lines Assessment Scale Table Adapted from American Water Works Association Free Water Audit Software©										
SYSTEM DATA	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	N/A
Line 6 Length of main lines, miles	*Current condition:* Poorly assembled and maintained paper as-built records of existing water main installations makes accurate determination of system pipe length impossible. Length of mains is estimated.	*Current condition:* Paper records in poor or uncertain condition (no annual tracking of installations & abandonments). Poor procedures to ensure that new water mains installed by developers are accurately documented.	*Conditions between 1 and 2*	*Current condition:* Sound written policy and procedures exist for documenting new water main installations, but gaps in management result in a uncertain degree of error in tabulation of mains length.	*Conditions between 2 and 3*	*Current condition:* Sound written policy and procedures exist for permitting and commissioning new water mains. Highly accurate paper records with regular field validation; or electronic records and asset management system in good condition. Includes system backup.	*Conditions between 3 and 4*	*Current condition:* Sound written policy and procedures exist for permitting and commissioning new water mains. Electronic recordkeeping such as a Geographical Information System (GIS) and asset management system are used to store and manage data.	*Conditions between 4 and 5*	*Current condition:* Sound written policy exists for managing water mains extensions and replacements. Geographic Information System (GIS) data and asset management database agree and random field validation proves truth of databases. Records of annual field validation should be available for review.	Not a choice
Improvements in quantifying the length of mains	*To improve to 1:* Assign personnel to inventory current as-built records and compare with customer billing system records and highway plans in order to verify poorly documented pipelines. Assemble policy documents regarding permitting and documentation of water main installations by the utility and building developers; identify gaps in procedures that result in poor	*To improve to 2:* Complete inventory of paper records of water main installations for several years prior to audit year. Review policy and procedures for commissioning and documenting new water main installation.		*To improve to 3:* Finalize updates/improvements to written policy and procedures for permitting/commissioning new main installations. Confirm inventory of records for five years prior to audit year; correct any errors or omissions.		*To improve to 4:* Launch random field checks of limited number of locations. Convert to electronic database such as a Geographic Information System (GIS) with backup as justified. Develop written policy and procedures.		*To improve to 5:* Link Geographic Information System (GIS) and asset management databases, conduct field verification of data. Record field verification information at least annually.		*To maintain a 5:* Continue with standardization and random field validation to improve the completeness and accuracy of the system.	Not a choice

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Component	Number of Retail Connections Assessment Scale Table Adapted from American Water Works Association Free Water Audit Software©										
SYSTEM DATA	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	N/A
Line 7 Number of retail connections, active and inactive *Value for Line 7 is populated from the Water Use Survey*	*Current condition:* Vague permitting (of new service connections) policy and poor paper recordkeeping of customer connections/billings result in suspect determination of the number of service connections, which may be 10-15% in error from actual count.	*Current condition:* General permitting policy exists but paper records, procedural gaps, and weak oversight result in questionable total for number of connections, which may vary 5-10% of actual count.	*Conditions between 1 and 2*	*Current condition:* Written account activation policy and procedures exist, but with some gaps in performance and oversight. Computerized information management system is being brought online to replace dated paper recordkeeping system. Reasonably accurate tracking of service connection installations & abandonments; but count can be up to 5% in error from actual total.	*Conditions between 2 and 3*	*Current condition:* Written new account activation and overall billing policies and procedures are adequate and reviewed periodically. Computerized information management system is in use with annual installations & abandonments totaled. Very limited field verifications and audits. Error in count of number of service connections is believed to be no more than 3%.	*Conditions between 3 and 4*	*Current condition:* Policies and procedures for new account activation and overall billing operations are written, well-structured and reviewed at least biannually. Well-managed computerized information management system exists and routine, periodic field checks and internal system audits are conducted. Counts of connections are no more than 2% in error.	*Conditions between 4 and 5*	*Current condition:* Sound written policy and well managed and audited procedures ensure reliable management of service connection population. Computerized information management system, Customer Billing System, and Geographic Information System (GIS) information agree; field validation proves truth of databases. Count of connections recorded as being in error is less than 1% of the entire population.	Not a choice
Improvements in quantifying the number of retail connections, active and inactive	*To improve to 1:* Draft new policy and procedures for new account activation and overall billing operations. Research and collect paper records of installations & abandonments for several years prior to audit year.	*To improve to 2:* Refine policy and procedures for new account activation and overall billing operations. Research computerized recordkeeping system (Customer Information System or Customer Billing System) to improve documentation format for service connections.		*To improve to 3:* Refine procedures to ensure consistency with new account activation and overall billing policy to establish new service connections or decommission existing connections. Improve process to include all totals for at least five years prior to audit year.		*To improve to 4:* Formalize regular review of new account activation and overall billing operations policies and procedures. Launch random field checks of limited number of locations. Develop reports and auditing mechanisms for computerized information management system.		*To improve to 5:* Close any procedural loopholes that allow installations to go undocumented. Link computerized information management system with Geographic Information System (GIS) and formalize field inspection and information system auditing processes. Documentation of new or decommissioned service connections encounters several levels of checks and balances.		*To maintain a 5:* Continue with standardization and random field validation to improve knowledge of system.	Not a choice

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Total Assessment Score

- Also known as “data validity score” = confidence values are filled in, the program will give you a **Data Validity Score** out of 100
- The score measures the policies used when gathering data for the audit. The score is a number that should be increasing every year.
- Improve the accuracy of the data in order to identify opportunities for water loss reduction.

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Water Loss Control Planning Guide

Functional Focus Area	Level I (0-25)	Level II (26-50)	Level III (51-70)	Level IV (71-90)	Level IV (91-100)
Audit Data Collection	Launch auditing and loss control team; address production meter deficiencies.	Analyze business process for customer metering/billing functions and water supply operation.	Establish/revise policies and procedures for data collection.	Refine data collection practices and establish as routine business process.	Annual water audit is reliable gauge of year-to-year water efficiency standing.
Short-term loss control	Research information on leak detection programs. Begin flowcharting analysis of customer billing system.	Conduct loss assessment investigations on a sample portion of system: customer meter testing, leak survey, theft.	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control, and infrastructure monitoring.	Refine, enhance, or expand ongoing programs based on economic justification.	Stay abreast of improvements in metering, meter reading, billing, leakage management, and infrastructure rehabilitation.
Long-term loss control	N/A	Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement, new customer billing system, or Automatic Meter Reading.	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process.	Conduct detailed planning, budgeting, and launch of comprehensive improvements for metering, billing, or infrastructure management.	Continue incremental improvements in short-term and long-term loss control interventions.
Target-setting	N/A	N/A	Establish long-term apparent and real loss reduction goals (+10 year horizon).	Establish mid-range (5 year horizon) apparent and real loss reduction goals.	Evaluate and refine loss control goals on a yearly basis.
Benchmarking	N/A	N/A	Preliminary Comparisons – can begin to rely upon Infrastructure Leakage Index (ILI) for performance comparison for real losses.	Performance Benchmarking – ILI is meaningful in comparing real loss standing.	Identify Best Practices – the ILI is very reliable as a real loss performance indicator for best in class service.

* Adapted from American Water Works Association©

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From Audit to Action

Understanding water losses through improved data collection

- Don’t copy the data from your last report!
- Do compare it to your last report to note improvements or new areas of deficiency.
- Create a trend analysis.
- Determine and pilot effective approaches and implementation of performance standards.

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Taking Actions

- Refining data gathering and information
- Metering assessment, testing, or a metering replacement program
- Detecting and locating leaks
- Repairing or replacing pipe
- Operation and maintenance programs and changes
- Administrative processes or policy changes

Questions for Review

- Were the goals of the assessment met? If not, why not?
- Where does the system need more information?
- How often should the system repeat the water loss audit steps?
- Is there another performance indicator the system should consider?
- Look at trends by reviewing last water loss audit – has water loss improved?
- How can the system improve water loss performance?
- Is more training required?

Water Loss Resources

LUC Application
www.twdb.texas.gov/conservation/municipal/waterloss/index.asp

Water Loss Auditor Training
www.twdb.texas.gov/conservation/municipal/waterloss/auditor_training.asp

Reports & Data
https://www.twdb.texas.gov/conservation/municipal/waterloss/historical-annual-report.asp

Questions

Municipal Conservation

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Water Loss Audit

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