Little Thompson Water District

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# Completion Report
# For Colorado Water Conservation Board
# Water Efficiency Grant for the Little Thompson Water District
# PO OE PDA #2016-151

**March 25, 2016**

CWCB's guidelines for the Water Efficiency Grants require submission of a completion report to CWCB. In compliance with that requirement, the Little Thompson Water District (LTWD), WaterDM and its subcontractor WSO herewith submit the report.

With nearly 300 square miles of service area, LTWD provides water to a population of approximately 20,000 people in and around portions of Berthoud, Evans, Firestone, Greeley, Johnstown, Longmont, Loveland, Milliken and all of the town of Mead.

## 2014 Water Audit

Peter Mayer, P.E. of WaterDM individually and together with Reinhard Sturm of WSO met with LTWD staff on several occasions to learn how the District tracked water supplied, billed and used for operations as well as how the LTWD water treatment and distribution system is interconnected with Central Weld County Water District (CWCWD).

Over a period of eight months LTWD staff, Peter Mayer and Reinhard Strum generated multiple iterations of water use data, draft M36 water loss audit reports as well as data measurement and collection recommendations. The final 2014 M36 water loss audit submitted to the CWCB represents an excellent foundation for the District to perform future audits, to improve data validity and reduce non-revenue water. The recommendations presented in this report will be implemented as possible given the District's small staff and capital improvement budget.

# Summary Report

# 2014 Water Loss Control Audit for Little Thompson Water District

**March 25, 2016**

**Funding Provided by Colorado Water Conservation Board**

**Water Efficiency Grant PO OE PDA #2016-151**

Little Thompson Water District

**Prepared by:**

WaterDM DEMAND MANAGEMENT

WSO

## Introduction

The goal of this project was to use the IWA/AWWA Water Audit Method published in the AWWA Manual of Practice M36 to conduct the first "top down approach" desktop water audit for the Little Thompson Water District (LTWD). The project included consultation and review from international water loss expert Reinhard Sturm of WSO. The 2014 water audit was completed by District staff, WaterDM and WSO.

This summary report and recommendations along with the completed 2014 water audit spreadsheet constitute the final deliverables for this project.

## Little Thompson Water District

With the nearly 300 square miles of service area, LTWD provides water to a population of approximately 20,000 people in and around portions Berthoud, Evans, Firestone, Greeley, Johnstown, Longmont, Loveland, Milliken and all of the Town of Mead. In addition, LTWD delivers water to rural Boulder, Larimer and Weld residences, business and agricultural and livestock operations.

LTWD obtains its water supplies from the Colorado River through the Colorado- Big Thompson (C-BT) and Windy Gap projects managed by the Northern Colorado Water Conservancy District. LTWD also maintains metered connections with several neighboring water providers including City of Loveland, Fort Collins- Loveland Water District, Town of Berthoud, Longs Peak Water District and North Carter Lake Water District.

LTWD jointly owns and operates two water treatment plants at the south end of Carter Lake with the Central Weld County Water District (CWCWD). The water treatment plants, collectively known as the Carter Lake Filter Plant (CLFP), have a total treatment capacity of 50 MGD. Each District is entitled to one half of this treatment capacity. In addition to sharing a water treatment facility, LTWD and CWCWD have joint transmission lines and connections off of each other's lines to minimize distribution costs and maintain adequate water pressure to their customers.

Although LTWD enjoys an adequate supply of water, sufficient to meet the needs of its current growth well into the future, it experiences an estimated 15% percent "non-revenue" water loss, and is anxious to determine the cause of this loss.

Working with Peter Mayer, P.E. of WaterDM, LTWD obtained a water efficiency implementation grant from the Colorado Water Conservation Board (CWCB) for conducting the 2014 water loss control audit and expert review.

## 2014 Water Loss Audit

Peter Mayer, P.E. of WaterDM met with the staff from LTWD (Nancy Koch, Water Resources Manager, Michel Cook, District Engineer, David Shumpert, Crew Leader, and others) on August 11, 2015 to learn more about their non-revenue water concerns; to establish project goals and timelines; and to begin the data gathering process for the water loss audit. The consulting team gave LTWD personnel a list of data needed to begin analysis, using the AWWA M36 method.

Based on the information provided, Peter Mayer prepared a draft M36 water loss audit using free audit software version 5.0, and Excel spreadsheet developed specifically for utility water loss auditing.

Peter Mayer and Reinhard Sturm of WSO met with the entire management team of LTWD on October 20, 2015 to review the audit and tour specific system input meters and sites. Based on that meeting, additional data were prepared by LTWD staff for the audit and a revised audit prepared.

The revised audit showed substantially improved accountability and results. This audit was again reviewed by Reinhard Sturm of WSO and specific recommendations prepared.

## Water Accountability in the Little Thompson Water District

The key to the success of the 2014 Water Audit was work that LTWD staff did to prepare a water allocation map and worksheet that clearly delineates production and supply meters of different categories that enabled reasonable accountability for the interconnected water systems of LTWD and CWCWD.

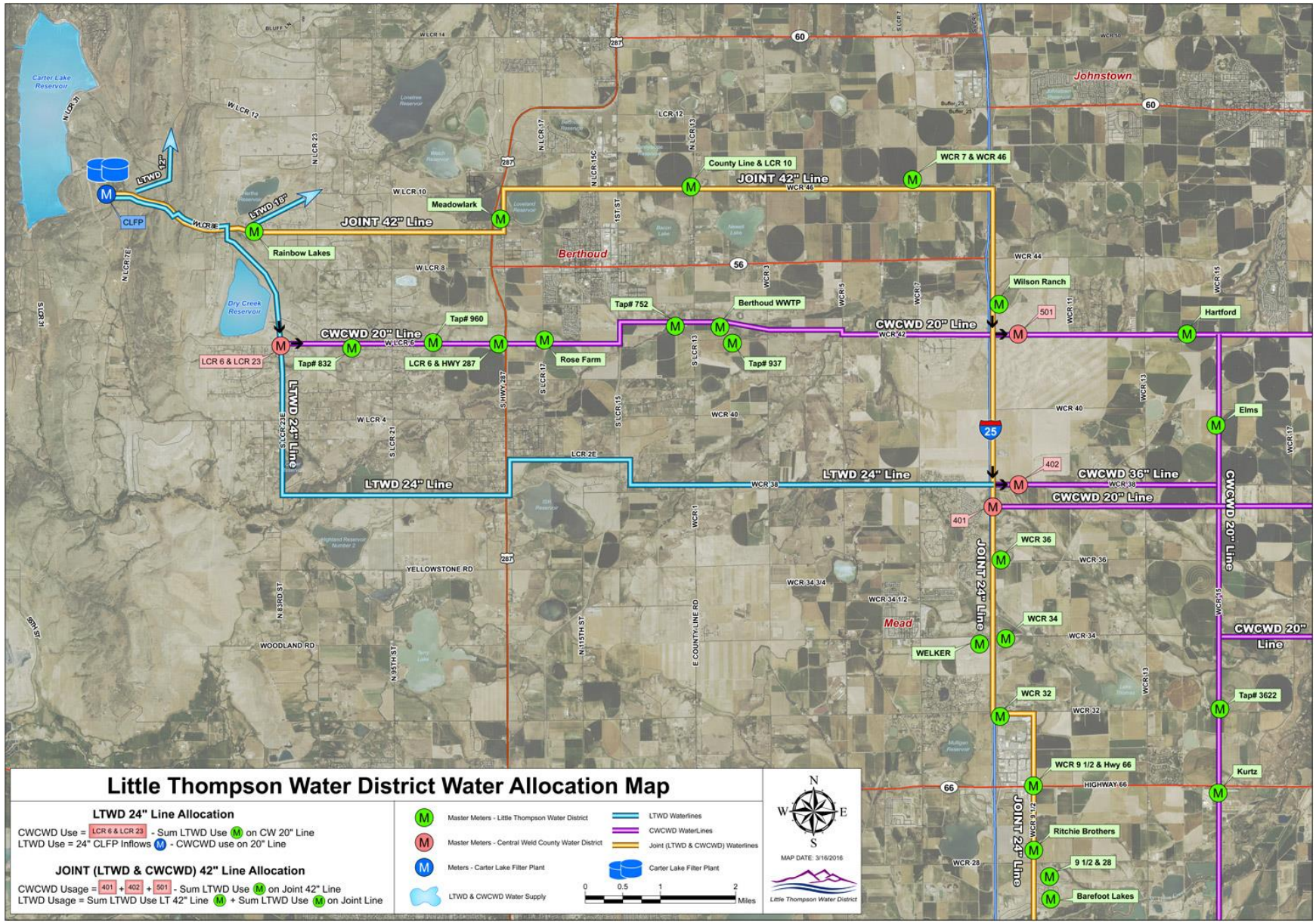
The following categories and subcategories of meters were developed for the audit:

- Water from CLFP to LTWD and CWCWD – **Water supplied from own sources.**
    - CLFP LTWD 12" Line aka Mariana Line
    - CLFP LTWD 18" Line (2 x 10” Meters + 6” Meter)
    - CLFP LTWD 24" Line (18” Meter )
    - CLFP JOINT 42" Line ( 2 x 20” Meters)
- Water to Others (Not Used by LTWD) – **Water exported**
    - CLFP 42" Line (All Water to CWCWD)
    - LCR 6 & LCR 23 (Water from LTWD 24"Line to CWCWD 20"Line)
    - LTWD Water Served to Loveland Customers- Billed by Loveland
    - LTWD Water Served to Berthoud Customers – Billed by Berthoud

- Water From Others for LTWD Use – **Water imported**
    - LTWD Usage on CWCWD 20" Line (From LTWD Meter LCR6 & LCR23 to CWCWD Meter 501)
    - LTWD Usage on CWCWD 20" Line ( Downstream of CWCWD Meter 501)
    - LTWD Usage on Joint 42" Line
    - LTWD Usage on Joint 42" Line (Downstream of CWCWD Meter 401 & 402)
    - Loveland Water to LTWD from Master Meters (Boyd Lake and Outlet Mall)
    - Loveland Water Serving LTWD customers
    - CWCWD to LTWD for Pelican Shores Fire
    - FCLWD Water From Master Meter

These designations were critical to establishing proper accountability and water loss values and the work done to identify each meter must be carried forward into future District Water Audits.

A copy of the LTWD water loss allocation map is shown on this next page. This map was an important visual aid for the project team.


Little Thompson Water District Water Allocation Map
LTWD 24" Line Allocation
CWCWD Use = LCR 6 & LCR 23 - Sum LTWD Use M on CW 20" Line
LTWD Use = 24" CLFP Inflows M - CWCWD use on 20" Line
JOINT (LTWD & CWCWD) 42" Line Allocation
CWCWD Usage = 401 + 402 + 501 - Sum LTWD Use M on Joint 42" Line
LTWD Usage = Sum LTWD Use LT 42" Line M + Sum LTWD Use M on Joint Line
Master Meters - Little Thompson Water District
Master Meters - Central Weld County Water District
Meters - Carter Lake Filter Plant
LTWD & CWCWD Water Supply
LTWD Waterlines
CWCWD WaterLines
Joint (LTWD & CWCWD) Waterlines
Carter Lake Filter Plant
0 0.5 1 2 Miles
MAP DATE: 3/16/2016
Little Thompson Water District
CLFP
LTWD 12"
LTWD 15"
Rainbow Lakes
Meadowlark
JOINT 42" Line
County Line & LCR 10
WCR 7 & WCR 46
Johnstown
Berthoud
Berthoud WWTP
Tap# 752
Tap# 960
Tap# 832
Tap# 937
LCR 6 & LCR 23
LCR 6 & HWY 287
Rose Farm
CWCWD 20" Line
LTWD 24" Line
Wilson Ranch
Hartford
Elms
CWCWD 36" Line
CWCWD 20" Line
JOINT 24" Line
WCR 36
WCR 34
WELKER
Mead
WCR 32
Tap# 3622
WCR 9 1/2 & Hwy 66
HIGHWAY 66
Kurtz
Ritchie Brothers
9 1/2 & 28
Barefoot Lakes
YELLOWSTONE RD
WOODLAND RD
WCR 40
WCR 38
WCR 42
WCR 44
WCR 46
LCR 12
LCR 2E
W LCR 4
W LCR 8
W LCR 10
W LCR 12
W LCR 14
S HWY 257
401
402
501

## Findings from 2014 Water Audit

The 2014 water loss control audit for the Little Thompson Water District calculated that approximately 265.8 million gallons of water were lost from the system. Of which about 20.2 million gallons are apparent losses (mostly attributable to customer meter under-registration) and 245.6 million gallons are real losses (leakage losses). It is estimated that in the Little Thompson Water District water system about 143.1 million gallons per year of real loss is unavoidable even under best-case conditions suggesting that about 102.8 million gallons of real loss could theoretically be addressed through future action.

In 2014 the District lost an average of 1,067 gallons per mile of water main in the system. Over time, this volume of loss could probably be brought down below 600 gallons per mile per year through a systematic water loss control program. It is calculated that in 2014, the annual cost of the Apparent Losses in the system was $68,178 and the annual cost of Real losses to the system was $81,035.

### 2014 Water Loss Control Performance Indicators

#### *Financial Indicators*

- $68,178 – Annual cost of Apparent losses
- $81,035 – Annual cost of Real losses (valued at the variable production cost - $330.00 per MG)
- 15.0% - Non-revenue water as percent by volume of water supplied.
- 2.5% - Non revenue water as percent by cost of operating water system

#### *Alternate Valuation of Real Losses*

New water supply for LTWD is extremely expensive because of the value of CB-T units which currently price reliable water at $25,000 per unit and produce 0.7 AF per year on average. An alternate valuation of real losses in LTWD based on the requirement to purchase new water over a 30 year amortized period puts the annual value of LTWD's real losses at $1.2 million dollars. This suggests that there could be considerably more value to reducing real losses in the LTWD system if new supplies are needed. This should increase the urgency of the Real loss recommendations in this report.

### *Operational Efficiency*

- Apparent losses per service connection – 6.9 gal/connect/day
- Current Real Annual Losses – 245.56 million gallons/year
- Infrastructure Leakage Index (ILI) – 1.72

The ILI is a performance indicator for comparing utilities operational management of Real losses. The AWWA Water Loss Control Committee notes that, an ILI score of in the range of 1-3 is a general indication that a utility is doing a good job managing water loss and recommends this level of system integrity/performance for systems where "water is expensive to deliver and there is limited ability to increase revenue through rates. Supplies are limited and difficult or environmentally unsound to develop."

### *Water Audit Data Validity Score*

The Little Thompson Water District received a 63 out of 100 Water Audit Data Validity Score for their first Water Audit. A score of 63 is a relatively low level of overall water accountability. This score can be improved by implementing as many of the recommendations described below as possible and by reviewing the data validating requirements in the AWWA software (v5.0) provided.

## Recommendations from 2014 Water Audit

The process of conducting the 2014 Water Audit for the Little Thompson Water District resulted in an overall improved understanding of the water system, better accountability for water demand, and better economic measurements of water loss. As part of the process a new map showing the approximate location of water lines and meters in the LTWD system was prepared. This map also shows which water lines are unique to LTWD and CWCWD and which are shared by the Districts. To reduce water loss in the future, leak detection and repair work could be carried out in phases until an economically optimized level of Real losses is achieved.

The following specific recommendations are made to the Little Thompson Water District:

- Continue to perform annual AWWA water audits and to track performance over time which will help inform future decision about where best to invest time and effort in reducing water losses.
- The District's top priority should be to add metering where possible on joint supply lines shared with CWCWD to better account for water demand in each system. Two specific meter locations were identified in a project meeting on February 17, 2016. These locations are:
    - On the 24" joint supply line south of LTWD's final customer meter near Barefoot Lakes. There may be an old vault at this site. Metering is anticipated to be expensive.
    - On a 20" branch off of the 24" joint supply line just south of CWCWD meter #401. This site may have never been metered in the past.

  These sites require further reconnaissance to evaluate suitability. LTWD staff is familiar with these locations and will begin this process as well as necessary discussions with the CWCWD.

- Establish GPS coordinates for all valves and vaults in the system to improve leakage location accuracy. LTWD should continue and expand the process mapping and automating the water system to the extent possible.
- Establish and implement water meter testing, calibration, and replacement protocol as discussed in the three bullet points below. LTWD should set a goal of achieving a validity score in the range of 8 – 10 for the Billed Metered category which in 2014 scored a 7. To improve the validity score of future water audits in the Billed Metered category, LTWD must develop and implement a meter accuracy, testing, and replacement schedule that will help ensure the accuracy of measurements throughout the system.

- **System Input (Production) and Export Meter Testing**
  Following industry best practice, all LTWD (and CWCWD) system input meters and export meters should be tested annually. These tests should either be conducted via a volumetric comparison (change in reservoir/tank volume is compared to the volume registered by the meter subject to being tested) or a secondary meter is installed down or upstream of the meter subject to being tested and used for comparison. These meter tests should be conducted at flow ranges representative of the test meters operational conditions.

- **Small (5/8inch to 2inch) Customer Meter Testing**
  In order to establish an understanding of the small customer meter populations' performance/overall accuracy in LTWD it is necessary to test a random sample of small meters. With no prior test results available, an initial sample set of 50 to 100 meters is suggested. The random sample should be stratified by meter size, make and model, and if possible age. The meters should be tested according to AWWA M6 guidelines at three different flow rates and the calculated average accuracy should be a volume based weighted average.

  For subsequent years it is recommended to continue testing random samples of meters but a much smaller number of meters is needed for an ongoing testing program (around 20 to 30 meters per year), to establish a good understanding of the meter populations accuracy degradation over time.

  The results of the random meter testing program should be used to determine when to replace certain portions of the meter population.

- **Large (3inch and up) Customer Meter Testing**
  For large customer meters it is recommended that LTWD develop a regular testing program that prioritizes the top revenue generating large meters. They should be tested once a year to guarantee accurate meter reading and optimum revenue generation. Other large customer meters which are not the top revenue generating meters should be tested less frequently, once every 2 or three years for example. Ideally a cost benefit analysis provides the basis for the testing interval of each large customer meter.

- Since LTWD's system is significantly interconnected with the CWCWD system, it would be valuable for CWCWD to begin implementing the M36 water audit. If possible, the two

organizations could work together to ensure both system audits are as accurate as possible. There may be significant areas of cooperation between the two Districts.

- In future water audits, the District must pay close attention to the "Unbilled Unmetered" consumption category. In the 2014 audit this volume was based on an estimate. The District can improve on this estimate in future audits by documenting flushing events, flow rate, and duration as follows: Flushed volume = number of flushing events * flow rate * duration. The District should similarly document all unbilled unmetered operational using this same estimation approach in the future. Sometimes LTWD flushing events are metered and start and stop meter reads can be included in documentation.
- Additional metering over the next 5 – 10 years will enable detailed zonal monitoring of the District's water system. Given their rural character of the District's system it's hard to find leaks using traditional methods because the service connection density is so low. Zonal monitoring and SCADA implementation would provide better water accountability and the ability to identify zones where leakage losses are above optimized levels so that leak detection resources can be deployed in a targeted manner. An example of this could be for LTWD and CWCWD to monitor in isolation the Joint 42" Line that runs from West to East along WCR 46. This would enable water loss on that line to be evaluated discreetly.
- In the coming years the District should explore pressure optimization for the water system to reduce water loss and extend infrastructure life. Pressure management is a generally effective method for optimizing pressures in a water distribution system to minimize losses and surge impacts. Pressure management is typically accomplished with a pressure reducing valves (PRVs) that are remotely or manually operated based on a carefully developed optimization routine.

## 2014 Water Loss Control Audit Summary

A summary of the data input and outputs from the 2014 Little Thompson Water District water loss control audit is presented here.

| | | | |
|---|---|---|---|
| **WATER SUPPLIED** | | | |
| Volume from own sources: | 5,241.595 | MG/Yr | |
| Water imported: | 960.610 | MG/Yr | |
| Water exported: | 4,210.655 | MG/Yr | |
| **WATER SUPPLIED:** | **1,991.550** | MG/Yr | |
| **AUTHORIZED CONSUMPTION** | | | |
| Billed metered: | 1,692.993 | MG/Yr | |
| Billed unmetered: | | MG/Yr | |
| Unbilled metered: | 17.765 | MG/Yr | |
| Unbilled unmetered: | 15.000 | MG/Yr | |
| **AUTHORIZED CONSUMPTION:** | **1,725.758** | MG/Yr | |
| **WATER LOSSES (Water Supplied - Authorized Consumption)** | | **265.792** | MG/Yr |
| **Apparent Losses** | | | |
| Unauthorized consumption: | | 4.979 | MG/Yr |
| Customer metering inaccuracies: | | 11.019 | MG/Yr |
| Systematic data handling errors: | | 4.232 | MG/Yr |
| **Apparent Losses:** | | **20.231** | MG/Yr |
| **Real Losses = Water Losses - Apparent Losses:** | | **245.561** | MG/Yr |
| **WATER LOSSES:** | | **265.792** | MG/Yr |
| **NON-REVENUE WATER** | | | |
| **NON-REVENUE WATER:** | | **298.557** | MG/Yr |

= Water Losses + Unbilled Metered + Unbilled Unmetered

**SYSTEM DATA**

| | | |
|---|---|---|
| Length of mains: | 630.0 | miles |
| Number of active AND inactive service connections: | 8,034 | |
| Service connection density: | 13 | conn./mile main |
| Average operating pressure: | 85.0 | psi |

**COST DATA**

| | | |
|---|---|---|
| Total annual cost of operating water system: | $6,500,000 | $/Year |
| Customer retail unit cost (applied to Apparent Losses): | $3.37 | $/1000 gallons (US) |
| Variable production cost (applied to Real Losses): | $330.00 | $/Million gallons |

## 2014 Water Balance

# AWWA Free Water Audit Software: Water Balance

WAS v5.0



| | | |
|---|---|---|
| Water Audit Report for: | Little Thompson Water District | |
| Reporting Year: | 2014 | 1/2014 - 12/2014 |
| Data Validity Score: | 63 | |

| | | | | | |
|---|---|---|---|---|---|
| Own Sources (Adjusted for known errors) 5,241.595 | Water Exported 4,210.655 | Billed Water Exported | | | |
| | | Authorized Consumption 1,725.758 | Billed Authorized Consumption 1,692.993 | Billed Metered Consumption (water exported is removed) 1,692.993 | Revenue Water 1,692.993 |
| | | | | Billed Unmetered Consumption 0.000 | |
| | | | Unbilled Authorized Consumption 32.765 | Unbilled Metered Consumption 17.765 | Non-Revenue Water (NRW) 298.557 |
| | | | | Unbilled Unmetered Consumption 15.000 | |
| | Water Supplied 1,991.550 | Water Losses 265.792 | Apparent Losses 20.231 | Unauthorized Consumption 4.979 | |
| | | | | Customer Metering Inaccuracies 11.019 | |
| | | | | Systematic Data Handling Errors 4.232 | |
| Water Imported 960.610 | | | Real Losses 245.561 | Leakage on Transmission and/or Distribution Mains Not broken down | |
| | | | | Leakage and Overflows at Utility's Storage Tanks Not broken down | |
| | | | | Leakage on Service Connections Not broken down | |

## 2014 Performance Indicators

**AWWA Free Water Audit Software:**
**System Attributes and Performance Indicators**

WAS v5.0



**Water Audit Report for:** Little Thompson Water District
**Reporting Year:** 2014 | 1/2014 - 12/2014

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 63 out of 100 ***

**System Attributes:**

| | | | |
|---|---|---|---|
| | Apparent Losses: | 20.231 | MG/Yr |
| + | Real Losses: | 245.561 | MG/Yr |
| = | **Water Losses:** | **265.792** | MG/Yr |
| ? | Unavoidable Annual Real Losses (UARL): | 143.13 | MG/Yr |
| | Annual cost of Apparent Losses: | $68,178 | |
| | Annual cost of Real Losses: | $81,035 | Valued at **Variable Production Cost** |

Return to Reporting Worksheet to change this assumpiton

**Performance Indicators:**

| | | | |
|---|---|---|---|
| Financial: | Non-revenue water as percent by volume of Water Supplied: | 15.0% | |
| | Non-revenue water as percent by cost of operating system: | 2.5% | Real Losses valued at Variable Production Cost |
| Operational Efficiency: | Apparent Losses per service connection per day: | 6.90 | gallons/connection/day |
| | Real Losses per service connection per day: | N/A | gallons/connection/day |
| | Real Losses per length of main per day*: | 1,067.89 | gallons/mile/day |
| | Real Losses per service connection per day per psi pressure: | N/A | gallons/connection/day/psi |
| | From Above, Real Losses = Current Annual Real Losses (CARL): | 245.56 | million gallons/year |
| ? | Infrastructure Leakage Index (ILI) [CARL/UARL]: | 1.72 | |

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

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