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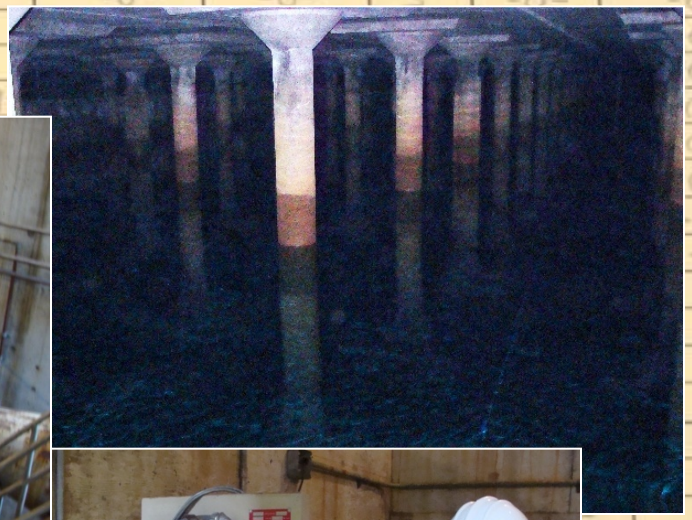
Cutting Our Losses:

The Los Angeles Water Loss Audit Experience



WaterSmart Conference
October 2, 2013

Los Angeles Department of Water & Power

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LADWP: The Nation's Largest Publicly-Owned Utility

- The Los Angeles Department of Water and Power (LADWP) serves approximately 3,900,000 people
- LADWP has over 600,000 customers, over 700,000 meters, and over 7,000 miles of mainline pipe
- LADWP's potable water sources include:
  - LADWP-owned water from the Eastern Sierra via the Los Angeles Aqueduct
  - Local groundwater from the San Fernando Valley and Central Basins
  - Imported water from the Sacramento-San Joaquin Delta and Colorado River via the Metropolitan Water District

Why did we do this project?

- Fulfills requirements of BMP 1.2 in the California Urban Water Conservation Council (CUWCC) Memorandum of Understanding (MOU) that were due by June 30, 2013
- Assembly Bill 1420, passed in 2009, mandates water agencies must be in compliance with the CUWCC BMPs to qualify for State Grants and Loans
- ***Discovering and addressing system water losses can save water and money!***

Loss of water!!!

The LADWP Water Loss Audit Project and Team

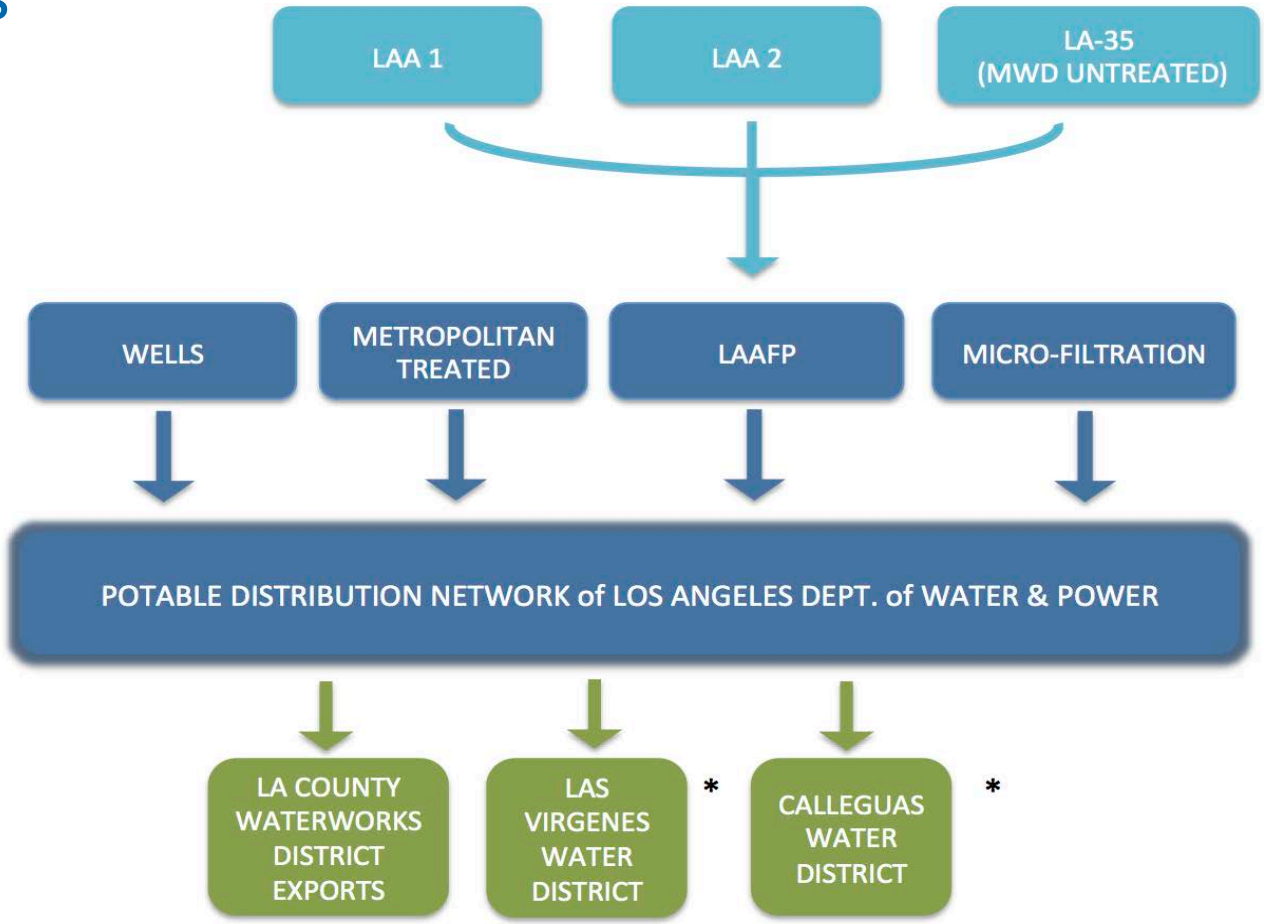
- The Project's major tasks include:
  - System Input and Demand Volume Validation
  - Apparent and Real Loss Determination
  - Economic Analysis
  - Leak Detection in 3 District Metered Areas
- Water Systems Optimization (WSO) contracted as a consultant, and Merlin Mechanical as subconsultant
- Over 200 LADWP staff members were involved on the Project, including:
  - Water Utility Workers
  - Engineers
  - Meter Readers
  - Management

Funding for the Project

- Allocated $300,000 from LADWP's Water Conservation Budget to hire a consultant (WSO)
- Received $100,000 in Water Conservation Field Services Program Grant funding from the U.S. Bureau of Reclamation
- In-kind LADWP staff labor time costs were over $1 million
  - Many staff worked overtime to meet tight deadlines in order to finish the project
- Project took a little over 1 year to complete

System Input Volume Validation

- Analysis of system input volume data and meter accuracies



*no exports during FY 2010-2011

System Input Volume: Groundwater

- LADWP's Groundwater System:
  - 11 well fields
  - 116 wells
  - 6 well collector facilities (pump stations, forebays, etc.)

- Issues Discovered:
  - Well meters read manually
  - Straight pipe length not sufficient
  - Well collector facility meters not accurate

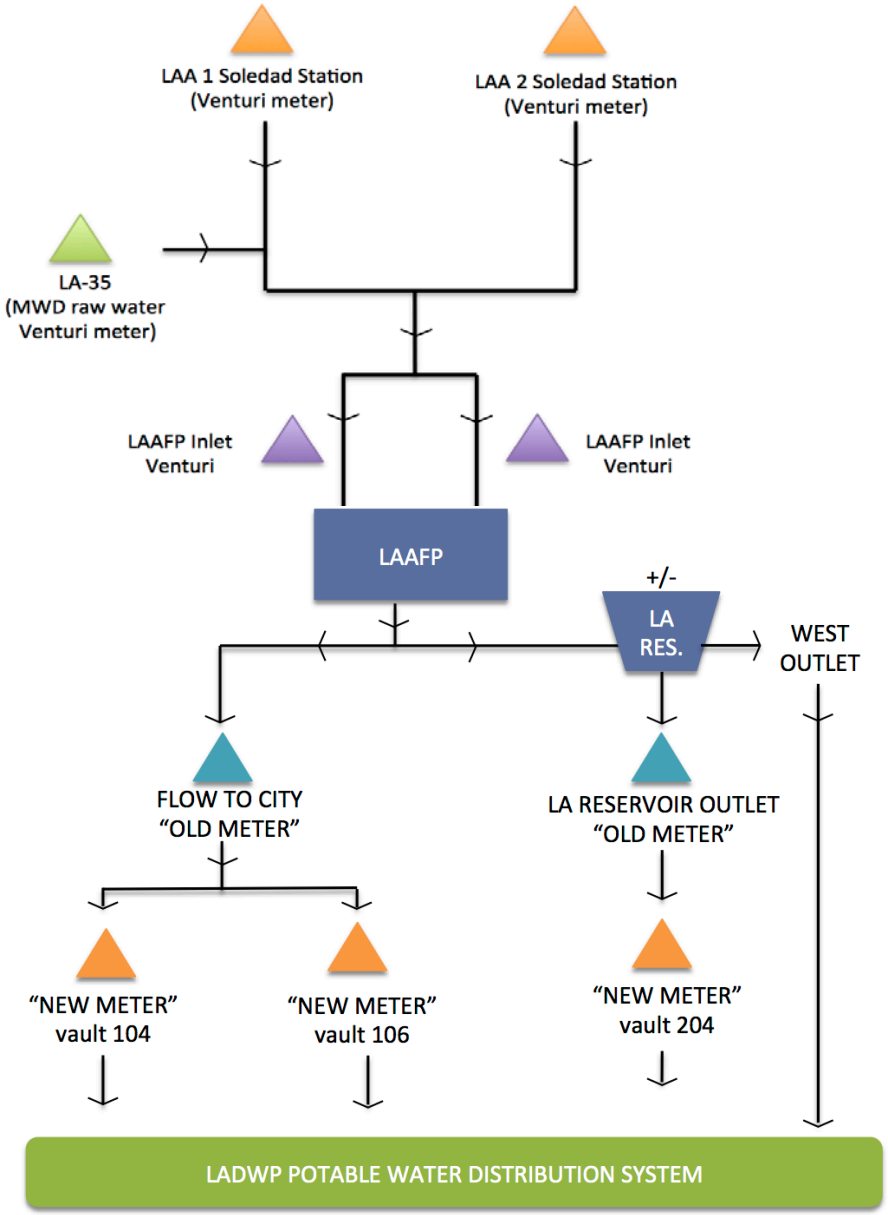
System Input Volume: MWD Purchased Water

- MWD Imported Water:
  - 32 connections
  - Mostly venturi meters
  - MWD's meter calibration procedures sufficient
- Issues Discovered:
  - LA-25 connection has no meter
  - LA-35 historical error
  - MWD billing errors may skew input volume counts

System Input Volume: LADWP-Owned Imports

- LADWP-owned Imported Water:
  - 2 LA Aqueducts with final meters located in Santa Clarita
  - LA Aqueduct Filtration Plant (LAAFP) treats water from the 2 LA Aqueducts and MWD connection LA-35
- Issues Discovered:
  - Input volume and effluent flow into LAAFP difficult to validate

Diagram of LAAFP Area Meters

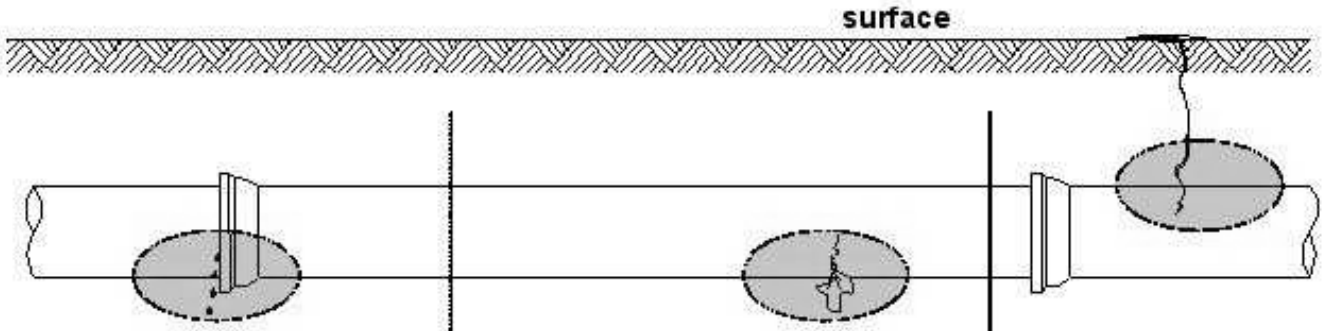


Supply Volume: Summary & Recommendations

- Improve accuracy of the well collector facility meters and use these meters for future supply volume calculations
- Since the LAA meters and LAAFP inlet meters were significantly under-registering (1-7% difference in inlet vs outlet flow), use effluent meters as the most accurate representation of supply volume from LAAFP
- Use the newer, ultrasonic effluent meters installed in 2011 to portray LAAFP supply volume
- Install a meter on the LA Reservoir West Outlet flow

Component Analysis of Real Losses

- Characterize the total volume of **real losses** as background, unreported, and reported leakage



Background leakage

Un-reported and un-detectable using traditional accoustic equipment.

Tools

- Pressure reduction
- Main and service replacement
- Reduction in the number of joints and fittings

Un-reported leakage

Often does not surface but is detectable using traditional accoustic equipment.

Tools

- Pressure reduction
- Main and service replacement
- Reduction in the number of joints and fittings
- Proactive leak detection

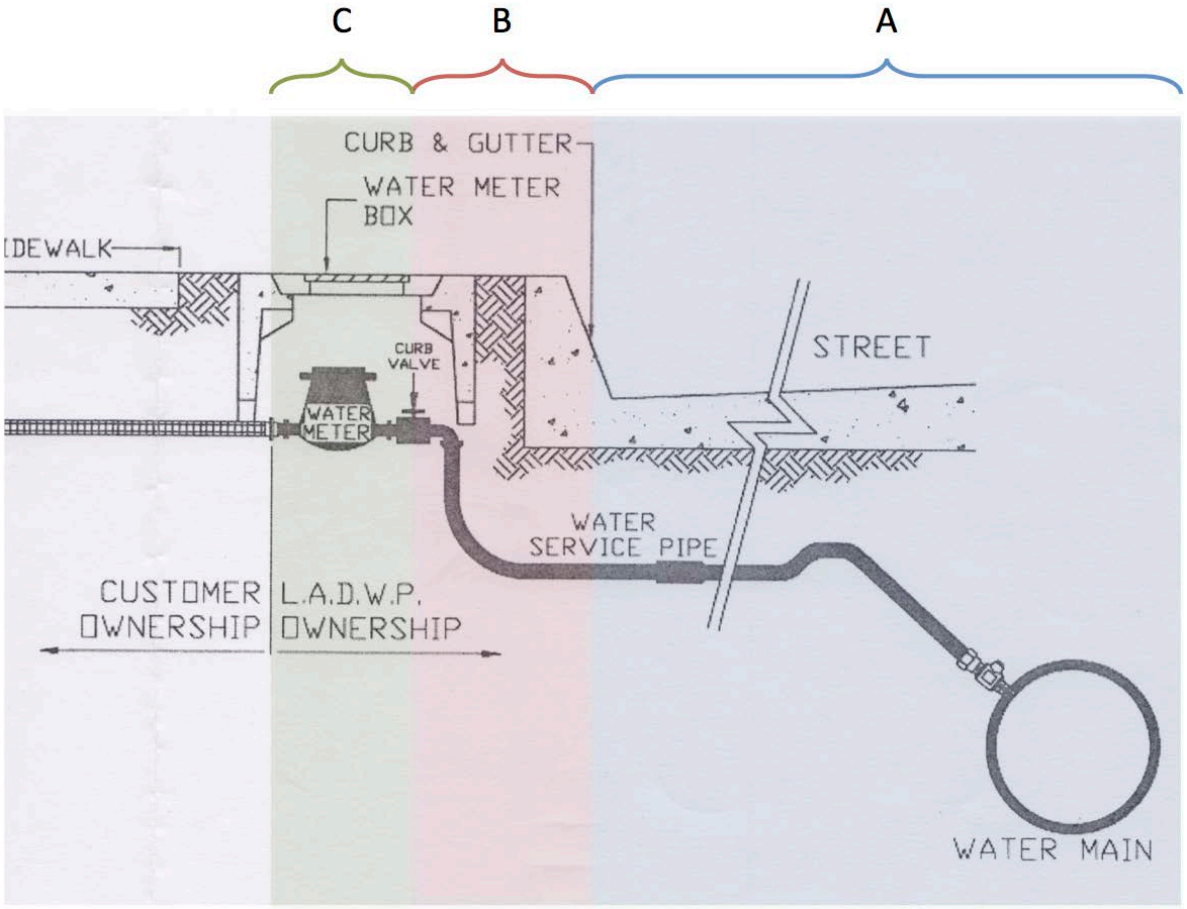
Reported leakage

Often surfaces and is reported by the public or utility workers

Tools

- Pressure reduction
- Main and service replacement
- Optimized repair time

Reported Leaks Data Sources: Too Many Databases!



A - Main Breaks and Service Leaks between the Curb and the Main
Source: GIS and Trouble Board

B - Service Leaks between the Curb and the Meter Box
Source: CPS Reports and Trouble Board

C - Meter Leaks and Flooded Meter Boxes
Source: Water Investigation Report (WIR) or WMIS

Recommendations for Improving Leak Report Data

- Streamline leak/break record information to make future efforts to produce a real losses component analysis much more manageable
- Ensure that each repair record's start and finish times reflect the run-time of the leak from awareness to containment as best as possible
- Improve data linking across all databases with leak info (GIS, Trouble Board, CPS, WIR, WMIS)

District Metered Areas and Leak Detection

- Started planning in late August 2012 – took a month to figure out what LADWP service zones could be easily isolated and used as District Metered Areas (DMAs)
- The 3 DMAs chosen:
  - Zone 517 – Boyle Heights/East LA
  - Zone 540 – Westwood/UCLA area
  - Zone 1960 – Tujunga area in the N.E. San Fernando Valley

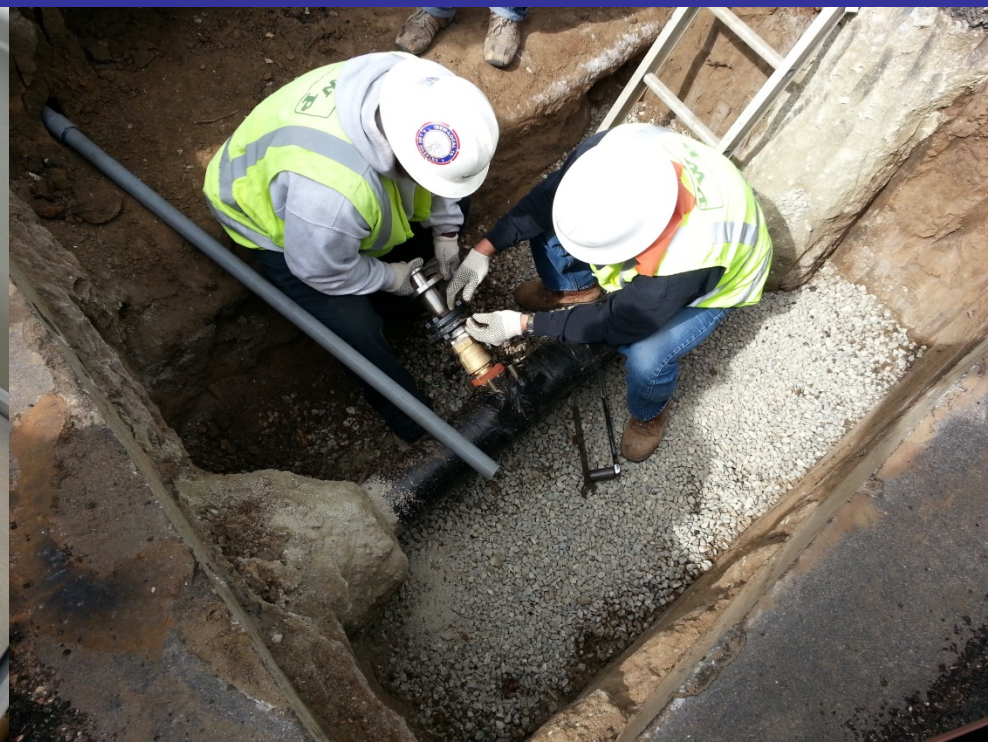
Zone Name	517/Boyle Heights	1960/ Tujunga	540/ Westwood
Length of distribution network (miles)	46.91	25.98	21.48
Total Number of Service Connections	6,285	1,657	1,594
Average Pipe Diameter (in.)	6.9	6.6	7.0
Average Pipe Age	73.5	41.3	65.7

- 9 input points into the DMAs and no exit points from the DMAs into other zones

District Metered Area Planning Efforts

- October to December 2012 – investigation of the 3 DMAs through map review and site visits
- Placed a bid notice in November 2012 for 9 insertion magnetic meters to be installed at the input points:
  - Zone 517 – 2 pressure regulator stations (there was also 1 MWD connection that already had a meter)
  - Zone 540 – 3 pressure regulator stations (1 of the stations required 2 meters due to site conditions)
  - Zone 1960 – 3 pressure regulator stations
- Bid was awarded and purchase order placed on December 3, 2012
- Due to vendor factory delays, did not receive the meter equipment until March 6, 2013

Installation of the Meters and Data Loggers



- Meters were installed through hot tap (no water shut off)
- Data loggers and batteries were installed in toolboxes with locks that were located above ground to protect the equipment from water damage
- Even so… a few of the toolboxes had tampered locks!

Data Collection Period: Details and Issues

- Encountered some installation and reading issues with the meters that took another month to fix
- Test period did not begin until April 7, 2013 – meters running and data collected for one week
- Meter reading of all customer meters in the DMAs required almost 100 staff to read all 9,536 meters within a 3-4 hour period on 2 consecutive Sundays
- Despite all of the troubleshooting in March, still encountered some data quality issues with the meters during the April test period

Data Collection: Meter Reading Findings

- Unexpected findings from the meter reading exercise:
  - Many meters were full of dirt and had to be dug out
  - Discovered some instances of meter tampering and theft – several meters were replaced due to non-functionality
  - Recorded significant consumption on some fire service meters
  - Encountered field conditions that were different from database records and needed updating

Leak Detection

- Leak detection in the 3 DMAs commenced in March and April
- Confirmed the following leaks:
  - Zone 517 – 11 leaks (service, hydrant, and valve leaks)
  - Zone 540 – 1 hydrant leak
  - Zone 1960 – no leaks

DMAs: Summary and Findings

- The DMA task was originally scheduled to be completed in 3 months – due to meter delivery and performance delays, it took over 8 months to complete
- Possible leaking check valves at the DMA boundaries may have skewed system input volume results
- Manually reading meters was extremely time-consuming and difficult for this exercise – recommend AMI for future DMA analyses

The Most Challenging Part of the Project

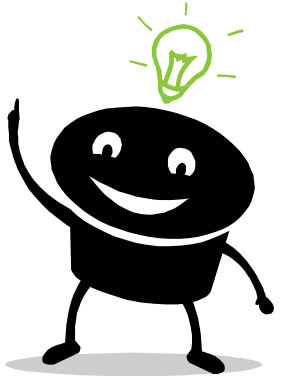
- Coordinating work assignments with hundreds of different LADWP staff
- Finding the time to complete Water Loss Audit work when staff is already overloaded with regular work
- Cross-referencing through several different databases and often finding data errors
- Administrative work in keeping track of work orders, grant reports, invoices, and manager briefings while simultaneously trying to complete the project task work

Lessons Learned

- Make sure to have all of the right staff at the table
- Setup a system to allow lead staff to download data more efficiently
- Database quality checks are very important and need to be prioritized
- The project is an opportunity for sharing overall water system operations with more staff
- The Water Loss Audit and Component Analysis can be a full-time job

Ideas Going Forward

- Improve database quality and accuracy and make more user-friendly
  - LADWP is already in the process of upgrading its customer services and customer billing database
  - Leak database improvements underway
- Track key staff providing assistance and information for future audits
- Train LADWP staff to complete future Water Loss Audits & Component Analyses
- Schedule time necessary to complete future audits during regular work hours



Results: The Good News!

For Fiscal Year 2010-2011:	
Non-Revenue Water as a % of Water Supplied:	5.2%
Real Losses per Service Connection per Day:	23.21 gal/conn/day
Infrastructure Leakage Index (ILI):	1.26

Low overall water loss, but still some work to do

Questions?

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