Updating Key Metrics Regarding Outdoor Water Use in Texas Community Water Systems

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Progress Report 1

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Project Goals

1. Characterize changes in outdoor water use during and after the 2011 – 2015 drought.
2. Develop key outdoor water use metrics that incorporate the most recently available data.
3. Evaluate the prospective relationship between outdoor water use and climate drivers.

Project Objectives

1. Analyze annual seasonal single-family residential water use for at least the 259 CWS evaluated in Technical Note 12-01.
2. Determine the annual percentage of outdoor water use for each CWS and by region.
3. Evaluate CWS monthly intake data and predict outdoor use by developing a seasonal use index.
4. Determine 2011 – 2015 drought and post-drought trends in CWS outdoor water use.
5. Identify and document methodological differences from Technical Note 12-01, if any, used to generate updated CWS outdoor water use data.
6. Assess any trends in CWS gallons per capita demand driven by changes in outdoor water use.
7. Evaluate the prospective relationship between outdoor water use and climate drivers.

PROJECT PROGRESS DISCUSSION

Subtask 1. Data Assessment and Collection

The previous outdoor use study (2004–2011) relied on monthly single-family (SF) water use volumes to estimate indoor and outdoor water consumption for each water system. Their methodology assumed that the lowest monthly SF usage represented indoor use, and outdoor use was estimated as the difference between total SF use and indoor use.

Since we aim to extend the outdoor water use study to more recent years (2011–current), we need monthly SF volumes to replicate this methodology. However, unlike the original study which collected this data through direct surveys of the systems, our dataset does not provide monthly SF volumes. Instead, it primarily contains annual SF volumes, total metered volumes, monthly total intake, and retail sales data.

At the start of the study, the primary dataset available to us consisted solely of Monthly Retail Sales (Raw and Treated Water). However, this dataset was incomplete, containing only 153 systems out of the 259 systems analyzed in the previous study. Additionally, many years and months before 2010 were missing data, making it difficult to conduct a continuous analysis over time.

Recognizing the gaps in available water system data, we requested additional data from TWDB. TWDB then provided a more comprehensive dataset which included:

- Total Metered Volumes (but still incomplete, especially pre-2010)

- Monthly Intake Data (a few systems consisting only of data for December and missing prior months for select years)
- SF Annual Volumes (missing some years for some systems)
- SF and Total Metered Connections (contains a few missing years)

Upon review of the additional water system data, we have identified the following challenges:

- Lack of Monthly Data: The provided SF and total metered volumes are annual values, whereas monthly data is needed to estimate seasonal trends
- Incomplete Retail Sales Data: Even with the expanded dataset, monthly retail sales remain incomplete for many systems, with particularly significant gaps before 2010.
- Total Metered Volume Data Gaps: Many systems lack total metered volumes, especially before 2010 and for some systems post-2021; this makes direct calculations challenging and requires alternative estimation methods
- Total SF Volume Gaps: A few systems are still lacking annual totals of SF use data

We have collected and pre-processed preliminary statewide atmospheric data (precipitation, temperature, evapotranspiration, etc.) for the study period. This data is largely ready to be spatially joined with water system data in support of *Subtask 3*. We anticipate spatial joining largely on the basis of water system IDs and the TWDB Water System Boundary shapefiles and supplemented, as necessary, by Certificate of Convenience and Necessity and other water system spatial data as needed.

We have collected and pre-processed water system drought contingency implementation data from TCEQ. However, our current data set runs from April 2011 through September 2022. This encompasses the 2011-15 drought but we are currently working with TCEQ to update this dataset to be comprehensive of our study period.

Status: Upon receipt and review of all appropriate water system data received from TWDB, we consider Subtask 1 **principally complete**. However, in the next three-month reporting period we expect to continue discussing data needs and availability with TWDB and supplement our current data to support our analysis needs in Subtask 2.

Subtask 2. Methodology Development and Water Use Analysis

In order to more fully evaluate the available data and potential data gaps/needs we have begun a preliminary analysis of methods for deriving SF outdoor water use. Thus far, we have developed three primary methods to leverage the available data that are described below and in **Table 1**.

Method 1: SF Monthly from Retail Sales (Step 1)

- Uses reported retail sales data (treated water sales) to derive monthly SF volumes
- Calculation:
    - Compute the SF/Total Metered Ratio (y) = SF Volume / Total Metered Volume
    - Apply this ratio to the proportion of monthly retail sales to annual retail sales
        - SF Monthly Volume = y * (Monthly Retail Sales / Annual Retail Sales)

Method 2: SF Monthly from Total Metered (Step 2)

- Uses total metered volumes to estimate monthly SF use
- Calculation:
    - Compute the Total Metered/Annual Intake Ratio (z) = Total Metered / Annual Intake (sum of monthly intake for a certain year).

- Use this ratio to estimate monthly metered volume: Monthly Metered = z * Monthly Intake
- Apply SF/Total Metered Ratio (y) to derive SF Monthly Volume:
  - SF Monthly = y * Monthly Metered

Method 3: SF Monthly from Monthly Intake Proportions (Step 3)

- Uses monthly intake as a proxy for SF monthly volume where total metered or retail sales data is missing.
- Calculation:
  - Compute the proportion of monthly intake to annual intake: j = Monthly Intake / Annual Intake
  - Scale SF annual volume using j:
    - SF Monthly Volume = j * SF Annual Volume

As anticipated, the available data presents numerous gaps in coverage for the systems reported. We are investigating methods for gap-filling these data.

Filling missing Monthly Intake Data – To ensure reliable intake-based estimates, missing months are filled using a weighted averaging approach:

1. Compute monthly percentage contributions from years with complete data
2. Apply greater weight to years with more reliable data
3. Fill missing months by applying weighted averages scaled to annual intake

Estimating and filling missing Single-Family Volumes – Where SF annual volume is missing, we use:

1. Connections Ratio Method: If Total Metered Volumes are available, SF Volume are estimated using the SF Connections/Total Connections ratio with Total Metered Volumes
2. Annual Intake Proxy: Where Total Metered Volumes are unavailable, we use the SF Connections/Total Connections ratio with Annual Intake
3. Nearest Year Method: Missing SF volumes are estimated using nearest available years. If valid SF Volume data exists for both earlier and later years, the average of these years is used. If only one nearest year has valid data, that year's SF Volume is applied. If no valid nearest years exist, the system is flagged as "No Method Available."

Status: Subtask 2 is ongoing and expected to continue in the next three-month reporting period.

Subtask 3. Climate Driver Assessment

Status: This subtask is dependent on the completion of Subtask 2 and has therefore not yet commenced.

Project Challenges and Opportunities

As previously noted to TWDB, this project anticipated BEG personnel that ultimately were not available when expected. This resulted in a delayed start for much of this project work until the conclusion of the 2024-2025 holiday season. These issues have been resolved by reallocating existing personnel and the onboarding of Mary Eminue. The project is now proceeding apace and we expect no delays in final project completion.

Table 1

Method	How We Derived It	Alignment with Previous Study	Availability	Strengths	Weaknesses
1. SF from Monthly Retail Sales	Used SF/Total Metered Ratio (y) and multiplied it by the proportion of monthly retail sales to annual retail sales.	Most closely mirrors report because it uses actual sales data, similar to how the study used city-reported (and TWDB-reported) monthly SF volumes.	Available for ~150 systems (but missing total metered for some years) mostly post-2011.	Captures real-world consumption patterns for SF households in later years (2011+), using monthly treated water retail sales.	Only covers ~150 systems, missing 100+ others; also, not available pre-2010/2011.
2. SF from Total Metered / Intake Ratio	Used Total Metered / Annual Intake Ratio (z), then multiplied it by monthly intake to get monthly metered, and then multiplied by y.	Not explicitly in the report, but logical for systems with total metered data (similar to how the study used actual reported volumes).	Available for ~105 systems (but many years lack total metered data, especially pre-2010).	Works well when total metered data is available, preserving physical water system relationships.	Only covers ~105 systems, missing 150+ others; not available for many pre-2010 years, and a few post-2021 years.
3. SF from Monthly Intake Proportion	Used monthly intake / total annual intake to get monthly proportion and scaled it using SF volume.	Not explicitly in the report, but the only other proxy for estimating SF monthly volumes in systems without metered or retail data.	Available for all ~260 systems and complete for all years (2004–2023) since it does not rely on total metered data.	The only method that can be applied across all systems and years, ensuring full coverage.	Assumes intake patterns closely represent actual SF usage, which may not always be true.