# California Department of Water Resources
## Water Use and Efficiency Branch

## Draft Technical Methodologies and Criteria for Compliance Year Adjustment

## Presented at the Urban Stakeholder Committee May 18, 2010

# Introduction

SBx7-7, enacted in November of 2009, includes provisions on water conservation, and reporting activities for urban retail water suppliers. The Department of Water Resources (DWR)is coordinating with the California Urban Water Conservation Council (CUWCC) and this Urban Stakeholder Committee (USC) to develop methodologies that urban water suppliers will use to develop baseline water use, set targets for future water use, and measure compliance (i.e., whether they are meeting the target). The legislation specifically calls for seven methodologies and a set of criteria for compliance year adjustment to be developed by DWR:

> *Section 10608.20(h) (1) The department, through a public process and in consultation with the California Urban Water Conservation Council, shall develop technical methodologies and criteria for the consistent implementation of this part, including, but not limited to, both of the following:*
>
> *(A) Methodologies for calculating base daily per capita water use, baseline commercial, industrial, and institutional water use, compliance daily per capita water use, gross water use, service area population, indoor residential water use, and landscaped area water use.*
>
> (B) Criteria for adjustments pursuant to subdivisions (d) and (e) of Section 10608.24.

The set of Draft Methodologies and Criteria for Compliance Year Adjustment provide a starting point for discussions of the Draft Methodologies. DWR anticipates that changes and revisions will be made to each of the documents through several rounds of meetings with the USC and the public.

Each Draft Methodology defines the terms to which the methodology's calculations apply, with direct reference to the applicable language in SBx7-7. The major portion of each Draft Methodology describes the calculations, data needed, and, where applicable, optional approaches that water suppliers may use.

The methodologies for indoor residential water use, landscaped area water use, and baseline commercial, industrial and institutional water use (Draft Methodologies numbered 5, 6, and 7) apply only to urban retail water suppliers who use Method 2 to set a water use target.

**Methodology 1: Gross Water Use**
Draft Methodology
May 14, 2010

**Definition of Gross Water Use**
Subdivision (g) of Section 10608.12 of SBx7-7 defines "Gross Water Use" as the total volume of water, whether treated or untreated, entering the distribution system of an urban retail water supplier, excluding all of the following:

1. Recycled water that is delivered within the service area of an urban retail water supplier or its urban wholesale water supplier
2. The net volume of water that the urban retail water supplier places into long-term storage
3. The volume of water the urban retail water supplier conveys for use by another urban water supplier
4. The volume of water delivered for agricultural use, except as otherwise provided in subdivision (f) of Section 10608.24 of SBx7-7

**Calculation of Gross Water Use**
Gross Water Use is a measure of water supplied to the distribution system over a 12-month period and adjusted for changes in distribution system storage and deliveries to other water suppliers that pass through the distribution system. Recycled water deliveries are to be excluded from the calculation of Gross Water Use. Water delivered through the distribution system for agricultural use may be deducted from the calculation of Gross Water Use. Under certain conditions, industrial process water use may also be deducted from Gross Water Use.

The methodology for calculating Gross Water Use broadly follows American Water Works Association (AWWA)Manual M36 guidance for calculating *Distribution System Input Volume*.[1] Calculating Gross Water Use entails eleven basic steps, two of which are optional:[2]

*Step 1: Define the 12-month period for which Gross Water Use will be calculated*. Gross Water Use should be calculated over a continuous 12-month period. This period can be based on the calendar year or the utility's fiscal year.[3] The same 12-month period must be used in

[1] American Water Works Association, Manual of Water Supply Practices – M36: Water Audits and Loss Control Programs, 3rd Edition, 2009. M36 defines *Distribution System Input Volume* as the volume of water entering the distribution system to provide service to customers. It is equal to the water volume derived from the water utility's own source waters, plus water imported or purchased, plus or minus the net change in water storage (if applicable and significant).
[2] AWWA Manual M36 contains several forms and worksheets that retail urban water suppliers can use to compile and organize data required to calculate Gross Water Use.
[3] As stipulated in paragraph (1) of subdivision (a) of Section 10608.20 of SBx7-7.

calculations of Gross Water Use for determining Base Daily Per Capita Water Use and Compliance Daily Per Capita Water Use.

*Step 2: Delineate Distribution System Boundary*. A typical urban retail water supply system may consist of (1) a raw water transmission network for conveying raw water to points of treatment, (2) treatment works for treating water to meet applicable standards for intended end uses, and (3) a distribution system for delivering finished water to customers. Wherever possible, distribution system boundary limits should be defined by points of metering of the water supply. Typical metering locations for distribution include exit points for treatment plants, treated water reservoirs, wells feeding directly into the distribution network, and imported water entering directly into the distribution network. A schematic of a typical urban retail water supply system is shown in Figure 1. The shaded region indicates the distribution system boundary. The same decision rules for delineating the distribution system boundary should be used for calculations of Gross Water Use for determining Base Daily Per Capita Water Use and Compliance Daily Per Capita Water Use. Although it is recognized that the physical boundaries of the distribution system may change over time, the differentiation of the distribution system from other parts of the water supply system must be consistent between base and compliance periods.

*Step 3: Compile the volume of water from own sources*. Water sources that are owned or managed by the urban retail water supplier to supply water to the distribution system should be identified and tallied. For systems that provide only treated water, this may consist mostly or entirely of water entering the distribution system from treatment plants (see Figure 1). It may also include water from wells or other sources owned by the supplier that directly supply the distribution network (see Figure 1).

Recycled water, as defined in subdivision (m) of Section 10608.12 of SBx7-7, directly entering the distribution system should not be included in the tally of own sources. Deduction from the calculation of Gross Water Use of indirect potable reuse recycled water entering the distribution system through blending with raw surface or groundwater supply (see Figure 1) is addressed in Step 8.

Meter records for each source should be compiled into annual volumes. AWWA's M36 manual should be consulted in situations where water sources are unmetered or the water meters have not been routinely calibrated. Volumes for each source should be reviewed and corrected for known errors that may exist in the raw metering data. Results of meter tests should be compared to applicable AWWA standards and guidance manuals.[4] Uncorrected metered volumes should be adjusted based on the registration accuracy of the meter, as follows:[5]

$$\text{metered volume correction} = \frac{\text{uncorrected metered volume}}{\text{registration accuracy expressed as a decimal}} - \text{uncorrected meter volume}$$

[4] Meters with errors exceeding AWWA standards should be recalibrated, repaired, or replaced.
[5] AWWA Manual M36 should be consulted if additional guidance on correcting raw meter data for meter registration inaccuracy is needed.

*Step 4: Compile the volume of water imported from outside sources*. Outside sources of finished water imported directly into the distribution system should be identified and tabulated (see Figure 1), excluding the following:

1. Recycled water, as defined in subdivision (m) of Section 10608.12 of SBx7-7, imported from another supplier.
2. Imported raw water passing through the urban retail water supplier's treatment works, since it would already have been counted under step 3 (see Figure 1).

The raw metering data should be corrected for known errors in the same manner as for own source water.[6]

*Step 5: Compile the volume of water exported to outside water utilities or jurisdictions*. Any water volumes sent through the distribution system to another water utility should be identified and tabulated (see Figure 1). Recycled water, as defined in subdivision (m) of Section 10608.12 of SBx7-7, exiting the distribution system should not be included in the tabulation.[7] Bulk water exports that do not pass through the distribution system should not be counted. The raw metering data should be corrected for known errors in the same manner as for own source and imported water.

*Step 6: Calculate the net change in distribution system storage*. Calculate the difference between the storage volume at the beginning and end of the year for each storage tank and reservoir within the distribution system (see Figure 1). Sum the calculated amounts. Be sure to preserve the sign (negative/positive) of the result.[8] Do not include changes in storage tanks and reservoirs residing outside the distribution system.

*Step 7: Calculate Gross Water Use Before Indirect Recycled Water Use Deductions*. This equals the volume of water from own sources entering the distribution system determined in Step 3 plus the volume of water from imported water sources entering the distribution system determined in Step 4 less the volume of water delivered via the distribution system to other utilities determined in Step 5 less the net change in distribution system storage determined in Step 6.[9] Table 1 shows an example calculation of Gross Water Use Before Indirect Recycled Water Use Deductions.

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[6] Generally, bulk water sale meters are routinely monitored for accuracy since they provide the basis for payment between the wholesaler and retailer.

[7] It is necessary to subtract recycled water exiting the system only if it was included in the tabulations of water entering the distribution system done in steps 3 and 4. However, the easiest way to handle recycled water in the calculation of Gross Water Use is to exclude it entirely from the each calculation step.

[8] A negative change in storage means customer demand was partly met by drawing down storage. The absolute value of the negative change will be added to the Gross Water Use calculation. Conversely, a positive change in storage means some of the water entering the distribution system went into long-term storage and should be subtracted from the Gross Water Use calculation.

[9] If the net change is negative this will cause Gross Water Use to increase. If it is positive, it will cause Gross Water Use to decrease.

*Step 8: Deduct recycled water used for indirect potable reuse from Gross Water Use.* This step is necessary only if the urban retail water supplier conjunctively uses recycled water with raw surface or groundwater for indirect potable reuse. The deduction requires the urban retail water supplier to estimate the amount of recycled water indirectly entering the distribution system through a surface or groundwater source (see Figure 1). This requires (1) estimating the amount of recycled water in conjunctively operated surface reservoir sources of supply, (2) estimating the amount of recycled water in conjunctively operated groundwater sources of supply, and (3) adjusting these volumes for losses during transmission and treatment prior to the water entering the distribution system.

1. *Recycled water used for surface reservoir augmentation*. The allowable deduction depends on the recycled water blend percentage in the surface reservoir water entering the treatment plant. For example, if the raw surface water source is 95% raw water and 5% recycled water, no more than 5% of the volume from this water source can be deducted from Gross Water Use calculated in Step 7. If the blend percentage of a surface water source is unknown, it may be estimated based on the measured or estimated volumes of recycled water, local runoff, and imported water that entered the reservoir for the three years prior to the year for which Gross Water Use is being calculated. For example, if Gross Water Use is being calculated for 2005, the blend percentage can be estimated by dividing the volume of recycled water that entered the reservoir by the total volume of water that entered the reservoir over the period 2002–2004.

2. *Recycled water used for groundwater recharge.* The allowable deduction depends on the product of three factors:

    a. The average annual volume of recycled water recharged into the groundwater basin for the purpose of indirect potable reuse over the 5 years prior to the year for which Gross Water Use is being calculated.
    b. [A generic loss factor will be developed based on extraction rules from other groundwater storage facilities in California]
    c. The volume of water pumped from the basin by the urban retail water supplier expressed as a percentage of the total volume of water pumped from the basin in the year for which Gross Water Use is being calculated.

    For example, if the average annual recharge of recycled water for the 5 years prior to the year for which Gross Water Use is being calculated is 1,500 AF and the urban retail water supplier accounted for 30% of the volume of water pumped from the basin in the year for which Gross Water Use is being calculated, then no more than XX AF from this supply source can be deducted from Gross Water Use calculated in Step 7.[10]

3. Only deduct the volume of recycled water used for indirect potable reuse that enters the distribution system from Gross Water Use calculated in Step 7. Loss

[10] [insert calc once generic loss factor is established]

factors for transmission and treatment based on recent system audit data, or other reliable sources for estimating transmission and treatment losses, should be applied to the estimated volumes of recycled water. For example, if the volume of recycled water prior to transmission and treatment is estimated to be 1,000 AF, and combined losses from transmission and treatment are estimated at 3%, only 970 AF should be deducted from Gross Water Use calculated in Step 7.

Table 2 shows an example calculation of the volume of recycled water used for indirect potable reuse.

*Step 9: Calculate Gross Water Use After Indirect Recycled Water Use Deductions*. This equals the volume of water determined in Step 7 less the volume of water determined in Step 8. Table 1 shows an example calculation of Gross Water Use After Indirect Recycled Water Use Deductions.

*Step 10 (Optional): Deduct from Gross Water Use the volume of water delivered for agricultural use.* This step is necessary only if the urban retail water supplier has chosen to exclude from the calculation of Gross Water Use water delivered for agricultural water uses per subdivision (f) of Section 10608.24 of SBx7-7. Agricultural water use must be treated the same way for calculations of Gross Water Use for determining Base Daily Per Capita Water Use and Compliance Daily Per Capita Water Use.

Identify and tabulate the volume of water delivered through the distribution system for agricultural water uses. Do not include deliveries that bypass the distribution system (see Figure 1). Delivery volumes should be based on account records and meter data for connections within the distribution system used to supply water for the commercial production of agricultural crops or livestock.[11]

*Step 11 (Optional): Deduct the volume of water delivered for process water use*. This step is necessary only if the urban retail water supplier has elected to exclude process water from the calculation of Gross Water Use *and* it is eligible to do so. An urban retail water supplier is eligible to exclude process water from the calculation of Gross Water Use only if its industrial water use comprises a substantial percentage of total water use. Industrial water use is considered to be a substantial percentage of total water use only if one or more of the following conditions are true:

1. Industrial water uses *supplied* by the urban retail water supplier through the distribution system are at least 4% of Gross Water Use Before Indirect Recycled Water Use Deductions (as determined in Step 7).

[11] The standard used to identify distribution system connections supplying agricultural water uses is based on subdivision (b) of Section 535 of the California Water Code. For the purposes of calculating Gross Water Use, retail nursery water use is not considered to be an agricultural water use.

2. Industrial and commercial water uses *supplied* by the urban retail water supplier through the distribution system are at least 20% of Gross Water Use Before Indirect Recycled Water Use Deductions (as determined in Step 7).

If neither condition is true, industrial water use is not considered a substantial percentage of total water use and process water use cannot be deducted from Gross Water Use calculations. Process water use must be treated the same way when determining Base Daily Per Capita Water Use and Compliance Daily Per Capita Water Use.

For purposes of implementing this calculation step, the following definitions apply:

> *Industrial Water Use*: Industrial water users are typically involved in product manufacturing and processing activities, such as those related to chemicals, food, beverage bottling, paper and allied products, steel, electronics and computers, metal finishing, petroleum refining, and transportation equipment. Subdivision (h) of Section 10608.12 of SBx7-7 defines an industrial water user as a manufacturer or processor of materials as defined by the North American Industry Classification System (NAICS) code sectors 31 to 33, inclusive, or an entity that is a water user primarily engaged in research and development.
>
> *Commercial Water Use*: Commercial water users typically provide or distribute a retail service or product. Examples include commercial businesses and retail stores, office buildings, restaurants, hotels and motels, laundries, food stores, and car washes. Water is used mainly for sanitation, food preparation, cooling, heating, cleaning, and landscape irrigation. Water used by multi-family residences, institutional water users, and dedicated irrigation accounts should be excluded from the tally of commercial water uses.
>
> *Process Water Use*: Process water means water used for producing a product or product content or water used for research and development, including, but not limited to, continuous manufacturing processes, water used for testing and maintaining equipment used in producing a product or product content, and water used in combined heat and power facilities used in producing a product or product content. The following water uses are not considered to be process water: incidental water uses not related to the production of a product or product content, including, but not limited to, water used for restrooms, landscaping, air conditioning, heating, kitchens, and laundry.[12]

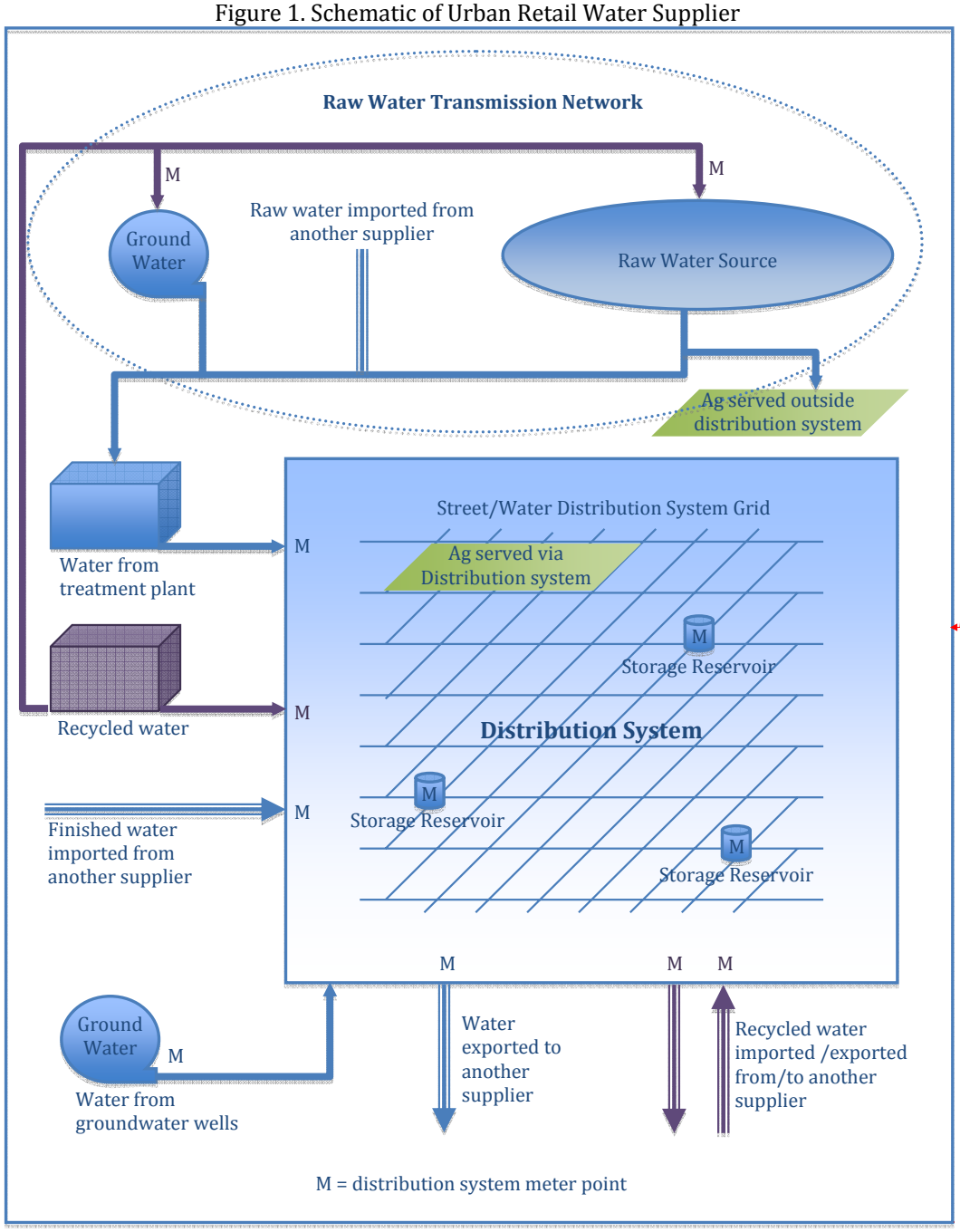
The estimated annual volume of process water use should be based on facility records of each industrial water user with process water uses. In cases where the urban retail water supplier provides only a portion of an industrial water user's water supply, the average share of facility water use supplied by urban retail water supplier for the previous 5 years should be used to prorate the volume of process water use deducted from Gross Water Use. For example, if over the previous 5 years the industrial water user's own sources of supply

[12] Per subdivision (l) of Section 10608.12 of SBx7-7.

accounted, on average, for 40% of its annual use and supply from the urban retail water supplier accounted for the other 60%, only 60% of the industrial water user's process water use should be deducted from Gross Water Use. Table 3 provides an example calculation of prorated process water use.

*Step 12: Calculate Gross Water Use After Optional Deductions*. This equals the volume of water determined in Step 9 less the volume of water determined in Steps 10 and 11. Table 1 provides an example calculation of Gross Water Use After Optional Deductions.

Figure 1. Schematic of Urban Retail Water Supplier

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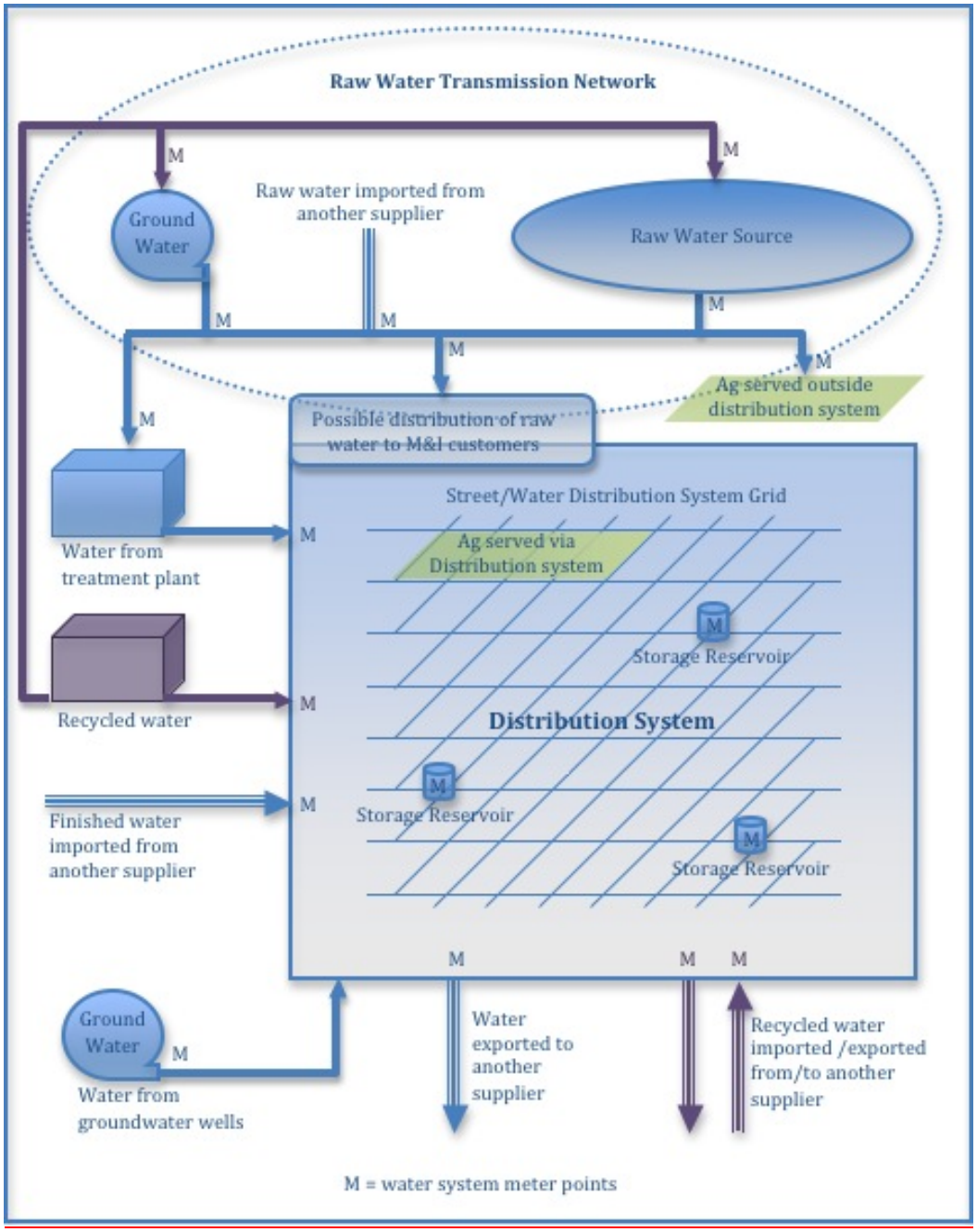
Raw Water Transmission Network
M
M
Ground Water
Raw water imported from another supplier
Raw Water Source
M
M
M
M
M
M
Ag served outside distribution system
Possible distribution of raw water to M&I customers
Street/Water Distribution System Grid
Water from treatment plant
M
Ag served via Distribution system
M
Storage Reservoir
Recycled water
M
Distribution System
Finished water imported from another supplier
M
M
Storage Reservoir
M
Storage Reservoir
M
M
M
Ground Water
M
Water from groundwater wells
Water exported to another supplier
Recycled water imported /exported from/to another supplier
M = water system meter points

Table 1. Example Gross Water Use Calculation

| **GROSS WATER USE CALCULATION** | Utility Name: | Example Urban Retail Water Supplier | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12-month period from: | 1-Jan | | | to: | 31-Dec | | | | | |
| | Volume Units: | Mil. Gal. | | | | | | | | | |
| | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** | **Year 8** | **Year 9** | **Year 10** |
| 1 Volume from Own Sources (raw data) | 3,480.80 | | | | | | | | | |
| Meter error adjustment (+/-) | 136.9 | | | | | | | | | |
| *Subtotal: Corrected Volume from Own Sources* | 3,617.70 | | | | | | | | | |
| 2 Volume from Imported Sources (raw data) | 1,005.00 | | | | | | | | | |
| Meter error adjustment (+/-) | 39.5 | | | | | | | | | |
| *Subtotal: Corrected Volume from Imported Sources* | 1,044.50 | | | | | | | | | |
| ***3 Total Volume Into Dist. System = Line 1 + Line 2*** | ***4,662.20*** | | | | | | | | | |
| 4 Volume Exported to Other Utilities (raw data) | 432 | | | | | | | | | |
| Meter error adjustment (+/-) | 17.3 | | | | | | | | | |
| *Subtotal: Corrected Volume Exported to Other Utilities* | 449.3 | | | | | | | | | |
| 5 Change in Dist. System Storage (+/-) | -8.6 | | | | | | | | | |
| ***6 Gross Water Use Before Indirect Recycled Water Use Deductions = Line 3 - Line 4 - Line 5*** | ***4,221.50*** | | | | | | | | | |
| 7 Indirect Recycled Water Use Deduction | 304.3 | | | | | | | | | |
| ***8 Gross Water Use After Indirect Recycled Water Use Deductions = Line 6 - Line 7*** | ***3,917.2*** | | | | | | | | | |
| 9 *Water Delivered for Ag. Use (optional deduction)* | 0 | | | | | | | | | |
| 10 *Process Water Use (optional deduction)* | 278.8 | | | | | | | | | |
| **11 Gross Water Use After Optional Deductions = Line 8 - Line 9 - Line 10** | **3,638.4** | | | | | | | | | |

Table 2. Example Calculation of Deductable Volume of Indirect Recycled Water Entering Distribution System

| **Surface Reservoir Augmentation** | | | Volume Discharged from Reservoir for Distribution System Delivery (Mil. Gal.) | Recycled Water Blend % | Recycled Water Delivered to Treatment Plant (Mil. Gal.) | Transmission/ Treatment Loss % | Transmission/Treatment Losses (Mil. Gal.) | Volume Entering Distribution System (Mil. Gal.) |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | | | | | (4) x (5) | | (6) x (7) | (6) - (8) |
| Source 1 | | | 1000 | 5% | 50 | 3% | 1.5 | 48.5 |
| Source 2 | | | 500 | 10% | 50 | 3% | 1.5 | 48.5 |
| | | | | | | | *Subtotal Reservoir Augmentation:* | *97.0* |
| **Groundwater Recharge** | 5-Year Annual Average Recharge (Mil. Gal.) | Recharge Recovery Factor | Recycled Water Pumped from Basin (Mil. Gal.) | Utility Pumping as % of Basin Total | Recycled Water Pumped by Utility (Mil. Gal.) | Transmission/ Treatment Loss % | Transmission/Treatment Losses (Mil. Gal.) | Volume Entering Distribution System (Mil. Gal.) |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | | | (2) x (3) | | (4) x (5) | | (6) x (7) | (6) - (8) |
| Basin 1 | 500 | 90% | 450 | 25% | 113 | 3% | 3.4 | 109.1 |
| Basin 2 | 750 | 90% | 675 | 15% | 101 | 3% | 3.0 | 98.2 |
| | | | | | | | *Subtotal Groundwater Recharge:* | *207.3* |
| | | | | | | | | |
| | | | | | | | **Deductable Volume of Indirect Recycled Water Entering Distribution System:** | **304.3** |

Table 3. Example Prorated Process Water Use Calculation

| **Industrial Facility** | **Annual Process Water Use (Mil. Gal.)** | **% Facility Water Use Supplied During Prior 5 Years By** | | **Deductable Process Water Use (Mil. Gal.)** |
|---|---|---|---|---|
| | | Retail Urban Water Supplier | Self Supplied or Other Source | |
| (1) | (2) | (3) | (4) | (2) x (3) |
| Facility #1 | 150.7 | 100% | 0% | 150.7 |
| Facility #2 | 95.5 | 65% | 35% | 62.1 |
| Facility #3 | 13.0 | 35% | 65% | 4.6 |
| Facility #4 | 76.9 | 80% | 20% | 61.5 |
| Facility #5 | 22.6 | 0% | 100% | 0.0 |
| **Total** | **358.7** | | | **278.8** |

**Methodology 2: Service Area Population**
Draft Methodology
May 14, 2010

## Defining the Service Area Population

Subdivision (f), Section 10608.20 of SBx7 7 states:

> "*When calculating per capita values for the purposes of this chapter, an urban retail water supplier shall determine population using federal, state, and local population reports and projections.*

Beyond this, however, the legislation is not specific. It gives the Department authority to develop consistent methodologies and criteria for determining service area population.

To obtain an accurate estimate of GPCD, water suppliers must estimate population of the areas that they actually serve, which may or may not coincide with either their district boundary or with the boundary of a city. Customers may exist within the distribution area with a wholly private supply during the baseline and compliance years, and new areas may be annexed into an water supplier's distribution system over time.

Figure 1 illustrates the many different situations that may arise, with the background grid indicating the census blocks that overlap with the district's boundary. Examples include the following.

- The actual distribution area may only cover a portion of the area within the water supplier's boundary.

- Within the distribution area, large water users may exist that depend wholly or partially upon a private groundwater supply (e.g., a college campus, a military installation, or a correctional facility). If such a user is wholly dependent on private supply, its residents should be excluded. If it is partially dependent but it uses the water supplier's potable supply for indoor use (for example if it uses groundwater for irrigation only), its residents should be included. Compliance testing may become an issue if such customers switch their irrigation to a municipal source between the baseline and compliance years; those situations are dealt with in the compliance testing methodology.

- New customers outside the present distribution area may connect to the water supplier's distribution system in the future for various reasons.

- The water supplier's distribution system can geographically expand over time as a result of economic and population growth.

Although a water supplier may consult any or all federal, state, and local data sources to estimate population, these estimates must account for the above-mentioned complexities.

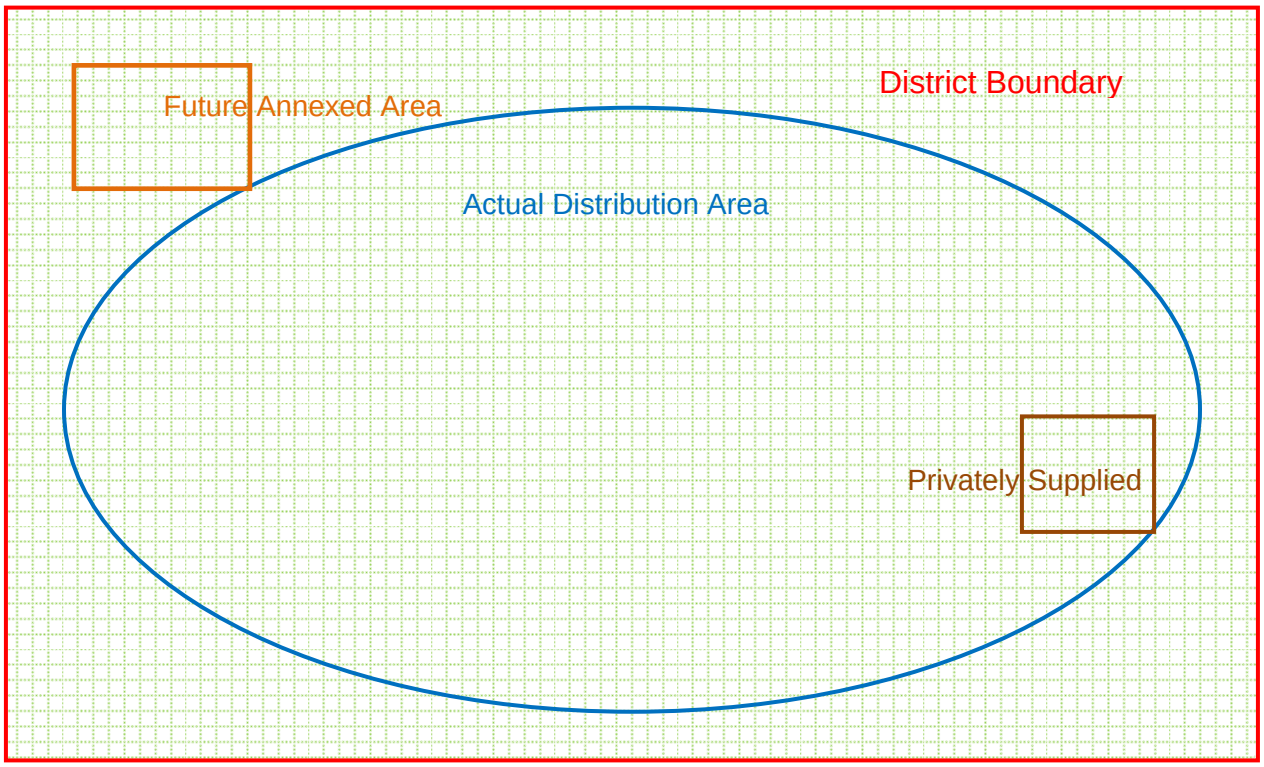


Figure 1 Defining area for population calculation

**Estimating the Service Area Population**

Urban retail water suppliers will generally fall into one of the following three categories:

1. Water suppliers whose *actual distribution area* overlaps substantially (≥95%) with city boundaries (may be a single city or a group of cities) during both baseline and compliance years.
2. Water suppliers not falling in category (1) with an electronic GIS map of their distribution area.
3. Water suppliers not falling in category (1) without an electronic GIS map of their distribution area.

Category 1 water suppliers: These water suppliers are encouraged to use population data published by the California Department of Finance's demography unit. However, population data may also be available through a water wholesaler, a local government agency, or through an association of local governments. A list of associations of local governments is available through the California Association of Councils of Government

(www.calcog.org). Many of these associations serve as census-data repositories, and also have GIS capabilities.

Category 1 water suppliers may use any of these estimates as long as they clearly cite their data source, use the same source for both the baseline and compliance years, and correct these estimates for privately supplied customers that may exist within their actual distribution area (on developing these corrections, see sections below).

Category 2 water suppliers: These water suppliers have two options. If they are already members of an association of local governments (or a water wholesaler) that develops population estimates for its members using GIS maps of actual distribution areas, they should use these data for both the baseline and compliance years. The water supplier should coordinate with the local government association or wholesaler to complete the task of identifying and removing institutions with wholly private systems within their distribution area.

If not, these water suppliers need to develop population estimates by anchoring their year 2000 residential connections (individual and master-metered) to the year 2000 census population estimate, and then scale this estimate backward and forward using data on active residential connections. The procedure for deriving population from connections first requires identifying the census blocks that lie within a water supplier's (year 2000) distribution area. The availability of a GIS distribution area map for the year 2000 makes this first step relatively easy. The subsequent steps that should be followed are described below.

Category 3 water suppliers: These water suppliers have the same two options as category 2 water suppliers. The only difference is that if no data are available to indicate the population residing in the distribution area, the matching of census blocks to a water supplier's distribution area map would need to be performed manually. The Census Bureau's county/tract/block maps should serve as the primary tool for this matching exercise (http://ftp2.census.gov/geo/maps/blk2000/st06_California/County/). After selecting county, the first file labeled "CBC06xxx_001.pdf" provides the detailed map numbering scheme for the entire county. The relevant maps from this list can then be used online, or printed, to locate the appropriate census blocks.

It is also possible to take a paper map of the (year 2000) distribution area, scan it, digitize and geo-reference the boundary (and internal areas that need to be excluded), and overlay it electronically on a census map to identify which census blocks lay within the distribution area in 2000. Category 3 water suppliers may be able to access these capabilities through their local association of governments.

*Finalizing census blocks falling within the 2000 distribution area*

It is possible that a few census blocks may straddle the year 2000 distribution area boundary line. In such cases, if half or more of the block's area appears to lie within the boundary, the water supplier should include it; otherwise, they should exclude it.

What is a census block? It is the smallest geographical unit used by the Census Bureau. Census blocks are areas bounded on all sides by visible features, such as streets, roads, streams, and railroad tracks, and by invisible boundaries, such as city, town, township, and county limits, property lines, and short, imaginary extensions of streets and roads. Generally, census blocks are small in area; for example, a block bounded by city streets. However, census blocks in sparsely settled areas may contain many square miles of territory.

Census blocks are grouped into block groups. Blocks that identify places such as college campuses, military installations, correctional institutions, and so on, are organized into a single block group that taken together overlaps completely with the boundary of such a place. Census blocks associated with large customers within the distribution area having wholly private sources of supply can thus be cleanly removed from the distribution area, hence also from the population estimation.

What is a census block group?A block group (BG) is a cluster of census blocks having the same first digit of their four-digit identifying numbers within a census tract. For example, block group 3 (BG 3) within a census tract includes all blocks numbered from 3000 to 3999. BGs generally contain between 600 and 3,000 people, with an optimum size of 1,500 people. BGs on American Indian reservations, off-reservation trust lands, and "special places" must contain a minimum of 300 people. (Special places include correctional institutions, military installations, college campuses, worker's dormitories, hospitals, nursing homes, and group homes.)

Block groups aggregate up to the next level of geography, which is called a census tract. Blocks have a unique identification number only within a tract, not across tracts. While identifying blocks that lie within the distribution area, it is important to also note the tract identification codes, because both are needed to correctly link up the selected blocks with their corresponding population data.

*Scale population information from census blocks to distribution area*

Once the census blocks lying within the year 2000 distribution area are identified, each block's (year 2000) population can be obtained from the census website. This requires the following steps:

1. Go to www.census.gov
2. Click on the "American FactFinder" tab in left column

3. Click on the "Download Center" tab in left column
4. Select the "Census 2000 Summary File 1 (SF-1) 100-Percent Data" link
5. Under geographic summary level, select "All Blocks in a County (101)"
6. Under download method, select "Select Detailed Tables"
7. Click "Go"
8. Follow the prompts to select state and county
9. When prompted with table choices, select at a minimum "P1. Total Population" and "P37. Group Quarters Population by Group Quarter Type."
10. Click "Next"
11. Click "Start Download"

A file will be created for the user in a delimited text format containing total population and any additional information you select by block (the character "|" will be the delimiter, which the user must specify while importing the text file into Excel for further manipulation). From this list, select out the blocks that were identified as falling within the water supplier's year 2000 actual distribution area in step 2.3.1 and obtain the aggregate population for the water supplier's service area.

Each person included in the census is counted at his or her usual place of residence, which is the place where he or she lives and sleeps most of the time. If a person has no usual residence, the person is counted where he or she was staying on Census Day (April 1). People temporarily away from their usual residence, such as on a vacation or business trip, are counted at their usual place of residence. People who moved around Census Day are counted at the place they consider to be their usual residence. A person's usual place of residence is not necessarily the same as legal residence or voting residence. A detailed set of enumeration rules guide how the Census Bureau counts individuals. An attempt is made to count all individuals, whether they reside in housing units or in group quarters.

"P1. Total Population" includes population residing in housing units as well as in group quarters. Housing units include structures such as single-family homes, multi-family homes, mobile homes, boats, RVs and vans. Group quarters include institutions such as correctional facilities, nursing homes, hospital wards and hospices, psychiatric hospitals, juvenile institutions, college dormitories, military quarters, agriculture worker's dormitories, logging camps, and so on. The full list of what is included in group quarters is long and is intended to capture a whole variety of residency scenarios to make the population tally as complete as possible. This list can be obtained from the Census Bureau's website.

For the most part, additional editing of total year 2000 population should not be required beyond this point. Census blocks associated with privately supplied customers would already have been removed from the distribution area definition. However, if additional privately supplied customers need to be removed from the population count, the group quarter population estimates may be further used to identify the population associated with such customers and the relevant block level group quarter population estimates subtracted from total population.

"P37. Group Quarters Population by Group Quarter Type" breaks out the group quarter population into the following categories: correctional institutions; nursing homes; other institutionalized populations; college dormitories including college quarters off campus; military quarters; other non-institutional group quarters.

*Obtain population by structure type*

To estimate population per connection, water suppliers are advised to develop at least two separate ratios: one for population per individually metered residential connection, and another for population per master-metered residential connection, including apartment complexes and other types of group quarters. This information can also be obtained from the census website.

1. Go to www.census.gov
2. Click on the "American FactFinder" tab in left column
3. Click on the "Download Center" tab in left column
4. Select the "Census 2000 Summary File 3 (SF-3) Sample Data" link
5. Under geographic summary level, select "All Block Groups in a County (101)"
6. Under download method, select "Select Detailed Tables"
7. Click "Go"
8. Follow the prompts to select state and county
9. When prompted with table choices, select at a minimum "P1. Total Population" and "H33. Total Population in Occupied Housing Units By Tenure By Units in Structure"
10. Click "Next"
11. Click "Start Download"

A file will be created for the user in a delimited text format containing total population split across many categories (the character "|" will be the delimiter, which the user must specify while importing the text file into Excel for further manipulation). These data are for block groups, not blocks. The first letter in a block's identifier indicates the block group it belongs to. Total population in a block group obtained from Summary File 3 may not exactly match block group population were it to be estimated from Summary File 1 for the purpose of comparison. This is because the former is created from a sample, and the latter from the 100-percent count data. Sample weights ensure that the two estimates of total

population converge for higher levels of aggregation, such as at the level of a county, but they may not exactly match at the block-group level.

H33. Total Population in Occupied Housing Units By Tenure By Units in Structure" breaks out population by the following types of structures:

- Owner occupied, 1 detached unit in structure
- Owner occupied, 1 attached unit in structure
- Owner occupied, 2 units in structure
- Owner occupied, 3-4 units in structure
- Owner occupied, 5-9 units in structure
- Owner occupied, 10-19 units in structure
- Owner occupied, 20-49 units in structure
- Owner occupied, 50 or more units in structure
- Owner occupied, mobile home
- Owner occupied, boat, RV, van, etc.
- …..repeated for renters……

Group quarters are not included in the definition of housing units. Therefore, total population residing in occupied housing units does not capture the group quarter population. It is for this reason that total population must also be obtained from Summary File 3.

*Obtain data about active connections*

Water suppliers vary in their approach to metering certain structure types. For example, in some water suppliers the preponderant pattern may be individual metering of single-family attached structures; in other water suppliers, the preponderant pattern may be master-metering. Water suppliers must first decide, based upon local knowledge and level of detail available in the billing system, how different structure types will be allocated to either the individual or master-metered bucket.

For each baseline year, and the year 2000 if it happens to be excluded from the baseline, tabulate total individually metered residential connections and total master-metered residential connections. Remove connections that were inactive during the year from these counts.

For each block group, aggregate population for the individually metered structure types including renters and owners. Subtract this estimate from total block group population obtained from Summary File 3. This becomes the best estimate of population residing in master-metered structures, including group quarters.

Develop a ratio for each block group indicating how its total population splits between the individually and master-metered structures. Then, for each block within the distribution area, apply its corresponding block-group ratio to split the block-level total population

(from Summary File 1) into the individual and master-metered categories. Aggregate these block-specific splits to obtain total population residing in individually metered and master-metered structures in the entire distribution area.

*Develop population estimates for non-census years*

For the census year 2000, obtain the number of persons per individually metered residential connection and per master-metered residential connection. Apply these ratios to active connections data for the non-census years to estimate non-census year population. Figure 2 illustrates the approach outlined above.

Exceptions

1. Water suppliers with reliable data are permitted to split their master-metered accounts into additional buckets (e.g., by dividing the multi-family sector into additional buckets based upon units in the structure if such information is reliably recorded in their billing system) and developing persons-per-connection for each of these buckets, as long as they follow the same methodology over time.

2. Water suppliers that cannot identify master-metered residential connections at present should use a single ratio (total population per individually metered residential connection) to obtain population for the non-census years, but we recommend that these water suppliers start to improve their data systems so that 2015 and 2020 compliance is not subject to data errors. The new data reporting form under development (required per the SBx7-7 legislation) will likely require that water retailers identify their mastered-metered residential accounts separately from their CII accounts.

*Further improvements to these estimates*

Water suppliers that derive population using the per-connection method described above are free to improve these estimates by including auxiliary information from other sources such as the California Department of Finance, Current Population Survey, the American Housing Survey, building permits data, and so on, as long as they maintain consistency between the baseline and compliance years, document the methodology, and provide details about the magnitude of the corrections made to the basic methodology (outlined in steps 2.3.1 through 2.3.6) because of these additional improvements.

**Adjustment to population estimates**

1. Population increase due to organic growth or high-density infill redevelopment will be captured to a great extent through the persons-per-connection ratios applied to increasing counts of active connections over time. These ratios, however, should be reexamined in 2012 when data from the 2010 census will likely become available. Population estimates for baseline years between 2000 and 2010 may be adjusted as necessary in light of updated census information.

2. Service area boundaries may also expand due to annexation of previously developed areas that may have been dependent upon groundwater at one point but, for any number of reasons, have subsequently become part of a municipal system.
    i. If an area was annexed prior to the first baseline year, or the annexation involves a merger with another urban retail water supplier, no data issues arise. In the latter case, population and connections data would be available for each water supplier separately.
    ii. If the area was annexed between the first baseline year and 2000, population estimates should be developed for the annexed area using the same census block and person-per-connection method outlined above. Water suppliers wishing to test compliance separately for the annexed area must also report population separately for the annexed areas. These issues are described in greater detail in the compliance testing methodology.
    iii. If the area was annexed after 2000, the water supplier will only know the connection count in the year of the annexation, not in 2000 corresponding to the population estimate. Water suppliers may apply person-per-connection ratios developed for their pre-annexation distribution area to estimate population in the annexed area, or use other defensible techniques. For example, they could obtain county assessor data to back-cast what connection counts would have been in the annexed area in the year 2000, which would permit scaling of census population estimates for the annexed areas to the post-annexation years. These estimates can be further improved after 2012 once data from the 2010 census become available. Once again, water suppliers wishing to test compliance separately for the annexed area must also report population separately for the annexed areas.

3. Water suppliers in other unique situations (for example, experiencing a significant change in their seasonal workforce or their seasonal resident population between the baseline and compliance years) may adjust the per-connection-based population estimates using methodologically rigorous and documented techniques.

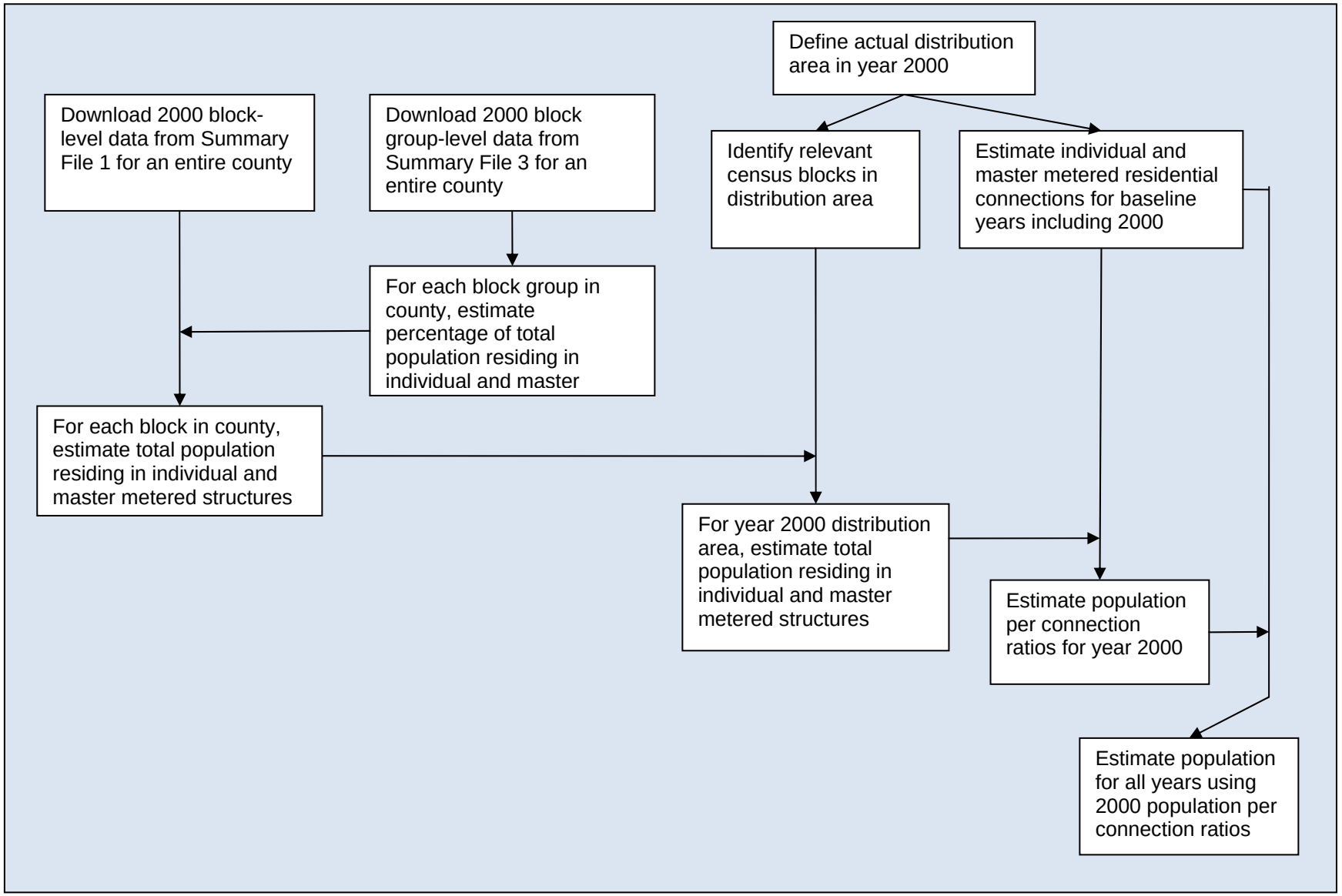


**Figure 2. Population per residential connection method**

**Methodology 3: Base Daily Per Capita Water Use**
Draft Methodology
May 14, 2010

## Definition of Base Daily Per Capita Water Use

Subdivision (b) of Section 10608.12 of SBx7-7 defines Base Daily Per Capita Water Use as the average Gross Water Use, reported in gallons per capita per day (GPCD), for a continuous base period. Different base periods apply to different sections of SBx7-7, as follows:

*For Purposes of Section 10608.20* – The base period depends on whether an urban retail water supplier meets at least 10 percent of its measured 2008 retail water delivery with recycled water.

a. If it does not, the base period is a continuous 10-year period ending no earlier than December 31, 2004, and no later than December 31, 2010.
b. If it does, the base period is a continuous 10 to 15-year period ending no earlier than December 31, 2004, and no later than December 31, 2010.

*For Purposes of Section 10608.22* – The base period is a continuous 5-year period ending no earlier than December 31, 2007, and no later than December 31, 2010.

Figure 1 is a flow diagram for determining which base period calculations are required.

## Calculation of Base Daily Per Capita Water Use

Calculating Base Daily Per Capita Water Use entails five basic steps, as follows:

*Step 1: Determine the base period for which Base Daily Per Capita Water Use is to be calculated.* The base period will depend on whether Base Daily Per Capita Water Use is being calculated for purposes of Section 10608.20 or Section 10608.22 of SBx7-7, as described previously. If the retail urban water supplier's population and/or water use data do not extend over the full period and there is no reasonable and reliable way in which the necessary data can be estimated or inferred, use the longest period possible that is consistent with the base period for which Base Daily Per Capita Water Use is being calculated.[1]

*Step 2: Estimate Service Area Population for each year in the base period*. Use the Service Area Population methodology to estimate the Service Area Population for each year in the base period.

[1] Note that the retail urban water supplier cannot select a period shorter than the specified base period if population and water use data are available to calculate per capita water use over the full period. For example, if the base period is 10 years, ending no earlier than December 31, 2004, and no later than December 31, 2010, and the water supplier has population and water use data from 1998 forward, the water supplier cannot select a base period ending earlier than 2007, since doing so would result in Base Daily Per Capita Water Use being calculated with less than 10 full years of data.

*Step 3: Calculate Gross Water Use for each year in the base period*. Use the Gross Water Use methodology to calculate the service area Gross Water Use for each year in the base period. Express Gross Water Use in gallons per day.[2]

*Step 4: Calculate Daily Per Capita Water Use for each year in the base period*. Divide Gross Water Use determined in Step 3 by Service Area Population determined in Step 2.

*Step 5: Calculate Base Daily Per Capita Water Use*. Calculate the average of the values calculated in Step 4.[3] The result is Base Daily Per Capita Water Use for the base period determined in Step 1.

Tables 1 and 2 can be used to organize the data needed for calculating Base Daily Per Capita Water Use.

[2] If Gross Water Use is expressed in million gallons per year, multiply by 1,000,000 and then divide the result by 365. If Gross Water Use is expressed in acre-feet, multiply by 325,851 and then divide the result by 365.
[3] To calculate the average, sum the daily per capita water use values calculated in Step 4 and divide the result by the number of years in the base period.

**Figure 1. Flow Diagram for Base Daily Per Capita Water Use Calculations**

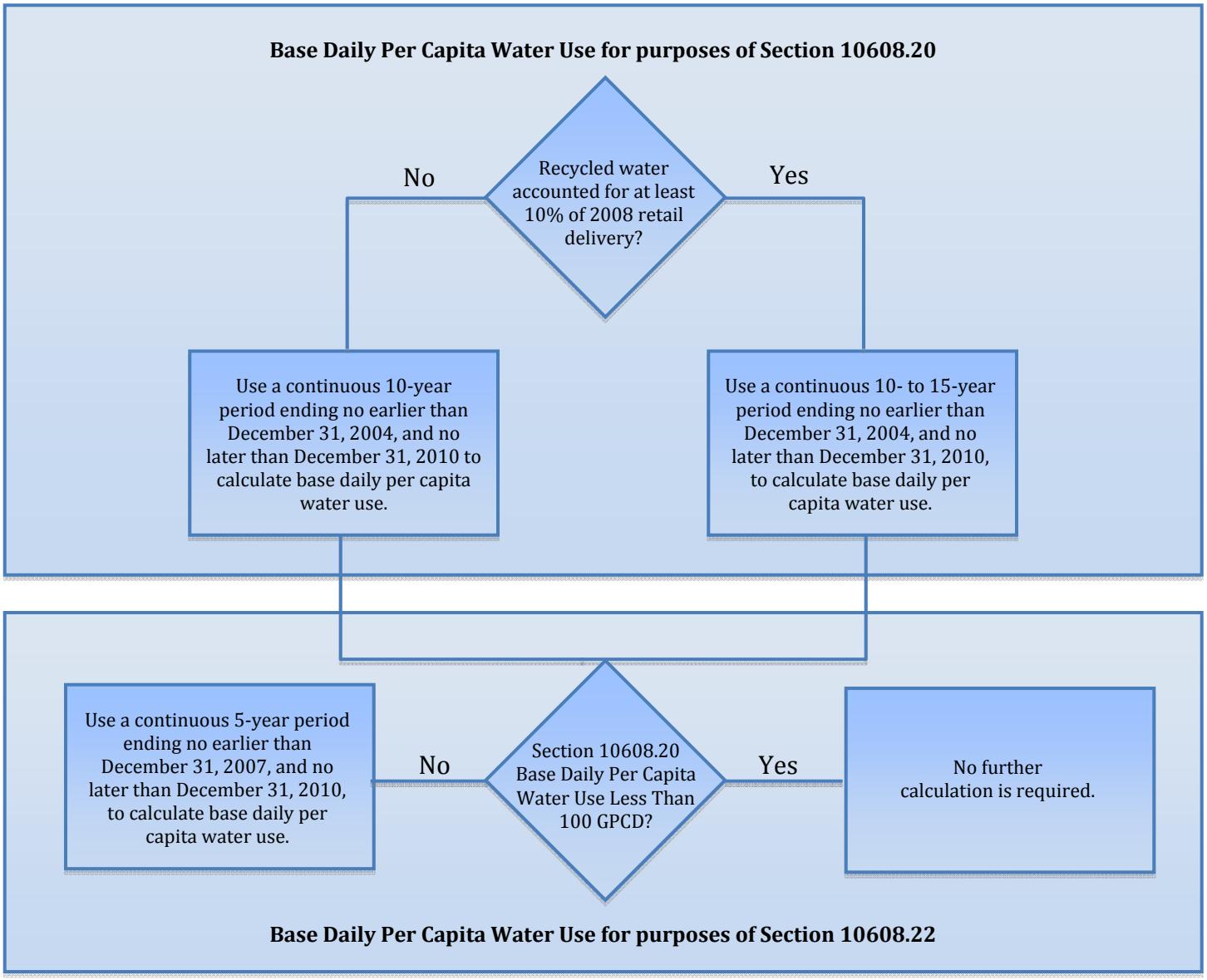

**Table 1. Base Daily Per Capita Water Use Calculation for Section 10608.22 of SBx7-7**

Utility Name: _____

12-month Period: _____ to _____

| (1) | (2) | (3) | (4) |
|---|---|---|---|
| Base Years | Service Area Population | Gross Water Use (gal. per day) | Daily Per Capita Water Use (3) ÷ (2) |
| Year 1 | | | |
| Year 2 | | | |
| Year 3 | | | |
| Year 4 | | | |
| Year 5 | | | |
| | | Total of Column (4): | |
| | | Divide Total by 5: | |

Most recent year in base period must end no earlier than December 31, 2007 and no later than December 31, 2010.

**Table 2. Base Daily Per Capita Water Use Calculation for Section 10608.20 of SBx7-7**

Utility Name: _____

12-month Period: _____ to _____

| (1) | (2) | (3) | (4) |
|---|---|---|---|
| Base Years | Service Area Population | Gross Water Use (gal. per day) | Daily Per Capita Water Use (3) ÷ (2) |
| Year 1 | | | |
| Year 2 | | | |
| Year 3 | | | |
| Year 4 | | | |
| Year 5 | | | |
| Year 6 | | | |
| Year 7 | | | |
| Year 8 | | | |
| Year 9 | | | |
| Year 10 | | | |
| *Year 11* | | | |
| *Year 12* | | | |
| *Year 13* | | | |
| *Year 14* | | | |
| *Year 15* | | | |
| | | Total of Column (4): | |
| | | Divide Total by Number of Base Years: | |

Most recent year in base period must end no earlier than December 31, 2004 and no later than December 31, 2010. *Base period cannot exceed 10 years unless at least 10 percent of 2008 retail deliveries were met with recycled water.*

# Methodology 4: Compliance Daily Per Capita Water Use

Draft Methodology
May 14, 2010

The following methodology addresses estimation of compliance daily per capita water use (in GPCD) in the years 2015 and 2020.

## Definition of Compliance Daily Per Capita Water Use

Subdivision (e), Section 10608.12 of SBx7-7 states:

> *(e) "Compliance daily per capita water use" means the gross water use during the final year of the reporting period, reported in gallons per capita per day.*

## Estimation of Compliance Year GPCD

The Gross Water Use Methodology and the Service Area Population Methodology show how to develop the two basic components for estimating compliance year GPCD. This section discusses methodological issues (and how to handle them) that may arise due to changes in distribution area caused by mergers, annexation, and other scenarios.

Adjusting compliance year GPCD for factors described in Section 10608.24 of the SBx7-7 legislation are discussed in the Criteria for Compliance Year Adjustment Methodology.

*When Distribution Area Expands Due to Mergers*

1. If two or more urban retail water suppliers merged wholly, or one water supplier acquired a portion of another's service area, during a year that falls within the baseline period of the merged entity, the water suppliers should derive their baseline GPCD as if they were a single entity for the entire baseline period to stay consistent with the targets and compliance GPCDs, which would obviously represent the merged entity.
2. If municipal systems merge, or if one water supplier acquires a portion of another's service area, between the baseline period and the compliance year, water suppliers can select one of two options:
    a. Test compliance separately for each entity.
    b. Take a (compliance year) population weighted average of each system's target and test for compliance as a single entity against this weighted average.

*When Distribution Area Contracts on Account of Service Area Rationalization*

1. If during the baseline years a previously served portion exits a water supplier's service area, the baseline GPCD may be corrected to reflect only that portion of the service area that remained consistently supplied during the baseline and compliance years.

2. If a previously supplied portion exits the distribution area during the baseline and compliance years, water suppliers can recomputed their baseline GPCD after eliminating the exited portion for all the baseline years.

*When Distribution Area Expands Due to Annexation of Areas Not Previously Connected to a Municipal Source*

1. For areas annexed during the baseline years, water suppliers can select one of two choices:
    a. Include these areas for baseline GPCD estimation and test compliance for the combined entity.
    b. Track baseline and compliance GPCDs for the annexed areas separately.
2. For areas annexed between the baseline and compliance years, water suppliers can select one of two choices:
    a. Annexed areas should be assigned a prorated target based upon the year they are annexed. For example, if a water supplier declares that it is aiming for a 20% reduction by 2020, and it annexes an area in 2017, this annexed area should show a 6% reduction in GPCD by 2020 relative to its 2017 GPCD.
    b. Compliance may be tested separately or against a (compliance year) population weighted average target of the annexed and existing service area.

*When Existing Large Partial Customers Become Whole Customers*

Large customers that draw groundwater for irrigation (depending upon their municipal source only for indoor use) may decide to switch their irrigation to the municipal source, throwing the time comparison off. If the switch occurs during the baseline years, the end use should be included in the compliance year gross water calculation. If the switch occurs between the baseline and compliance years, the water associated with such end-use switches, properly documented and subjected to the requirements of the Model Landscape Ordinance, may be excluded from the calculation of compliance year gross water use.

*Water suppliers that become subject to UWMP Reporting Requirements between 2010 and 2020*

(to be completed)

**Methodology 5: Residential Indoor Use**
Draft Methodology
May 14, 2010

## Definition of Residential Indoor Use

Subdivision (b) (2), Section 10608.20 of SBx7-7 states:

> *(A) For indoor residential water use, 55 gallons per capita daily water use as a provisional standard. Upon completion of the department's 2016 report to the Legislature pursuant to Section 10608.42, this standard may be adjusted by the Legislature by statute.*

Section 10608.42 of SBx7-7 states:

> *The department shall review the 2015 urban water management plans and report to the Legislature by December 31, 2016, on progress towards achieving a 20-percent reduction in urban water use by December 31, 2020. The report shall include recommendations on changes to water efficiency standards or urban water use targets in order to achieve the 20-percent reduction and to reflect updated efficiency information and technology changes.*

The SBx7-7 legislation sets a provisional standard for efficient indoor use (55 GPCD) that urban retail water suppliers using Method 2 must use to set their 2020 target. However, they are not required to demonstrate that this indoor residential target has actually been met—only that the overall target, which includes additional components for landscaped area water use and CII water use, has been met.

The legislation asks the Department to submit a report in 2016 assessing whether achieving the provisional indoor standard of 55 GPCD by 2020 is a reasonable expectation, and to make additional recommendations on water use efficiency standards if warranted.

Based on the report DWR is to submit in 2016, the legislature might change residential indoor standards which would affect water suppliers that adopt Method 2. Apart from this possible change, calculation of indoor usage by water supplier is not required for the implementation of the SBx7-7 legislation.

## Estimation of Efficient Residential Indoor Use

The Department expects to follow a dual-track strategy for addressing this question. It will ask water suppliers to report certain basic data about their service area to enable selection of useful case study sites for detailed subsequent evaluation. Once these case study sites are selected, the Department will commission a study, resources permitting, to examine

whether achieving the provisional indoor standard of 55 GPCD by 2020 is a reasonable expectation. This study also will undertake a literature review about best practices used elsewhere with respect to indoor conservation, including results from new end-use studies and evaluations that may become available or may be commissioned by the Department.

**Methodology 6: Landscaped Area Water Use**
Draft Methodology
May 14, 2010

The calculation of landscaped area water use requires a measurement (or estimate) of both landscaped area and of the landscape water use per unit area (based on reference evapotranspiration). Like other urban water use measures, SBx7-7 defines landscaped area water use as a per capita rate of use. Service area population estimation is the subject of a separate methodology.

## Definition of Landscaped Area Water Use

For the landscaped area water use component of target Method 2, subdivision10608.20 (b) (2) (B) states:

> *For landscape irrigated through dedicated or residential meters or connections, water efficiency equivalent to the standards of the Model Water Efficient Landscape Ordinance set forth in Chapter 2.7 (commencing with Section 490) of Division 2 of Title 23 of the California Code of Regulations, as in effect the later of the year of the landscape's installation or 1992. An urban retail water supplier using the approach specified in this subparagraph shall use satellite imagery, site visits, or other best available technology to develop an accurate estimate of landscaped areas.*

Definitions and calculations contained in the Model Water Efficient Landscape Ordinance are provided in the next section. These calculations give the landscaped area water use as a function of landscaped area and reference evapotranspiration. Whereas the Model Water Efficient Landscape Ordinance defines landscaped area in terms of developed planted area and water features, the provision quoted above clearly intends the calculation to be applied only to irrigated landscape for purposes of setting the target water use for Method 2 under SBx7-7.

Landscaped area for purposes of calculating the Method 2 target shall mean the water supplier's estimate or measurement of 2020 landscaped areas.

## Calculation of Landscaped Area Water Use

Landscaped area water use for each parcel shall be calculated using Maximum Applied Water Allowance (MAWA) computation from the applicable Model Water Efficient Landscape Ordinance. For landscaped areas that are installed on or after January 1, 2010, the MAWA equation from the 2010 version of the ordinance shall be used:

> *Maximum Applied Water Allowance (MAWA) = (ETo) (0.62) [(0.7 x LA) + (0.3 x SLA)]*
>
> *Maximum Applied Water Allowance (MAWA) is in gallons per year*
>
> *ETo = Reference Evapotranspiration (inches per year), which is" a standard measurement of environmental parameters which affect the water use of plants. . . . Reference evapotranspiration is used as the basis of determining the Maximum Applied Water Allowance so that regional*

*differences in climate can be accommodated." Reference Evapotranspiration values for each location can be found in Appendix A of the 2010 Model Water Efficient Landscape Ordinance.*

*0.62 = Conversion Factor (from inches/year to gallons/sqft/year)*

*0.7 = ET Adjustment Factor (ETAF). When applied to reference evapotranspiration, the ETAF "adjusts for plant factors and irrigation efficiency, two major influences upon the amount of water that needs to be applied to the landscape."*

*LA = Landscaped Area including SLA (square feet), which includes " all the planting areas, turf areas, and water features in a landscape design plan subject to the Maximum Applied Water Allowance calculation. The landscape area does not include footprints of buildings or structures, sidewalks, driveways, parking lots, decks, patios, gravel or stone walks, other pervious or non-pervious hardscapes, and other non-irrigated areas designated for non-development (e.g., open spaces and existing native vegetation)." (For SBx7-7 compliance, only irrigated landscaped area should be included.)*

*0.3 = Additional Water Allowance for Special Landscape Area (SLA), resulting in an effective ETAF for SLA of 1.0.*

*SLA = Special Landscaped Area (square feet), which is defined as "an area of the landscape dedicated solely to edible plants, areas irrigated with recycled water, water features using recycled water and areas dedicated to active play such as parks, sports fields, golf courses, and where turf provides a playing surface."*

For landscaped areas that are installed before January 1, 2010, the MAWA equation from the 1992 version of the ordinance shall be used:

*Maximum Applied Water Allowance (MAWA) = (ETo) (0.62) (0.8 x LA)*

*Maximum Applied Water Allowance (MAWA) is in gallons per year*

*ETo = Reference Evapotranspiration (inches per year), which is" a standard measurement of environmental parameters which affect the water use of plants. . . . Reference evapotranspiration is used as the basis of determining the Maximum Applied Water Allowance so that regional differences in climate can be accommodated." Reference Evapotranspiration values for each location can be found on page 38.10 of the Model Water Efficient Landscape Ordinance.*

*0.62 = Conversion Factor (from inches/year to gallons/sqft/year)*

*0.8 = ET Adjustment Factor (ETAF). When applied to reference evapotranspiration, the ETAF "adjusts for plant factors and irrigation efficiency, two major influences upon the amount of water that needs to be applied to the landscape."*

*LA = Landscaped Area including SLA (square feet), which includes " all the planting areas, turf areas, and water features in a landscape design plan subject to the Maximum Applied Water Allowance calculation. The landscape area does not include footprints of buildings or structures, sidewalks, driveways, parking lots, decks, patios, gravel or stone walks, other pervious or non-pervious hardscapes, and other non-irrigated areas designated for non-development (e.g., open spaces and existing native vegetation)." (For SBx7-7 compliance, only irrigated landscaped area should be included.)*

The above calculations will yield water use estimates in gallons per year. The total landscaped area water use for the water supplier will equal the total landscaped area water

use of all parcels in the supplier's service area. Because SBx7-7 defines landscaped area water use in units of GPCD, the result of the calculation above must be divided by service area population and then converted from annual to daily use.

**Methodology for Computation of Landscaped Area**

The water supplier shall select a technique for estimating landscaped area that satisfies the following criteria:

- The landscaped area must be measured or estimated for each parcel served by a residential or dedicated landscape water meter or connection within the water supplier's service area.
- Only irrigated landscaped area served by residential or dedicated landscape water meter or connection shall be included in the calculation of landscaped area water use. Landscape served by CII connections and non-irrigated landscape shall be excluded.

The following sections describe techniques that may be used to estimate landscaped area.

1. *Field-Based Measurement of Landscaped Area*

Field-based measurement of each parcel's landscaped area may be performed through physical measurement using a total station, measuring wheel and compass, Global Positioning System (GPS), or other measuring devices having similar accuracy to these.

2. *Estimate Landscaped Area Using Remote Sensing*

The landscaped area may be estimated by using remote sensing (aerial or satellite imaging) to identify the landscaped areas in conjunction with a GIS representation of the parcels within the water supplier's service area. A variety of remote sensing techniques are currently available, and additional ones may become available between now and 2020. The Department will allow the water supplier to select the remote sensing technique that it prefers. However, the following conditions shall be met:

- The remote sensing information must be overlaid onto a GIS representation of each parcel's boundaries to estimate the irrigated landscaped area within each parcel.
- The remote sensing imagery must have a resolution of 1 meter or less per pixel.
- The remote sensing technique must be verified for accuracy by comparing its results to the results of field-based measurement for a subset of parcels selected using random sampling. The water supplier should report the resulting percent error between the estimates of landscaped area produced by the remote sensing technique and those produced by field-based measurements for the sampled parcels.
- The Department has not set its own standards for remote sensing verification and sampling design. The water supplier shall provide a description of its remote sensing technique, including imagery, data processing, and verification, when it reports its landscaped area for purposes of complying with provisions of SBx7-7. Congalton and Green (1999) and Stein et al. (2002) are examples of references that describe professional standards for remote sensing.

*3. Estimate Landscaped Area as a Percentage of Total Land Use*

The landscaped area for smaller-sized parcels may be estimated by measuring the percentage of total parcel area that is landscaped in a group of similar parcels and applying that percentage to the remaining parcels. This technique may only be used for parcels with a total land area of 24,000 square feet or less. The parcels for which this technique is used shall be divided into groups based on parcel size, in increments of 4,000 square feet or less. Field-based measurement or remote sensing should be used to estimate the landscaped area for a subset of parcels sampled at random within each parcel size group (see Sampling below). The percentage of landscaped area to total land area for the sampled parcels in each group can then be used to estimate the landscaped area for all other parcels within the group. Parcels greater than 24,000 square feet shall be measured directly.

*4. Other Techniques to Estimate Landscaped Area*

The water supplier may select another technique to estimate landscaped area for each parcel other than the ones described above if one becomes available in the future. However, the selected technique must meet similar conditions to those described above for remote sensing:

- The landscaped area information must be overlaid onto a GIS representation of each parcel's boundaries to estimate the landscaped area within each parcel.
- The technique must be tested for accuracy by comparing its results to the results of field-based measurement for a subset of parcels. Field-based measurement should be performed for a subset of parcels selected at random (see Sampling below) from those for which the technique has been used. The water supplier should report the percent error between the estimates of landscaped area produced by the technique and those produced by field-based measurements for the sampled parcels.

**Using Sampling to Estimate Landscaped Area**

Statistical sampling is a means to provide adequate information at reasonable cost. If implemented carefully, sampling allows the water supplier to develop accurate estimates of landscaped area for all relevant parcels from a subset of parcels. It is fundamental to technique 3 above, but may also be incorporated into remote sensing or other techniques. For example, statistically valid samples of landscaped area identified on aerial photographs may be used to estimate total landscaped area.[1] Sampling shall not be used to estimate landscaped area for parcels larger than 24,000 square feet.

Stratified sampling (random sampling within identified sub-groups of parcels) should be used to estimate the proportion of landscaped area within different parcel size classes. Other characteristics of parcels may be used as a basis for selecting the strata in addition to parcel size.

The Department has not developed specific standards for sampling design. Urban water suppliers should follow standards of professional practice sufficient to demonstrate

[1] Note that this is different from sampling required to validate remotely sensed estimates using field measurement.

unbiased estimates of landscaped area. For example, Cochrane (1977) and Lohr (2010) provide guidance for sound sampling design.

**Estimating Irrigated Landscaped Area from Total Landscaped Area**

Irrigated landscaped area is defined as landscaped area served by a landscape irrigation system supplied by a dedicated or residential meter or connection.

- For field-based measurement, the irrigated portion of landscaped area may be measured for each parcel.
- For remote sensing, irrigated landscaped area may be estimated as part of the imagery interpretation and processing, but must be verified for accuracy using field-based measurement.
- For all techniques, random sampling is an acceptable approach to estimate the fraction of landscaped area that is irrigated. The sampling design should follow standards of professional practice sufficient to demonstrate unbiased estimates of irrigated fraction.

**References**

General sampling design and statistical analysis


- Cochrane, William G. *Sampling Techniques*. Wiley; 3rd edition. NY, NY. 1977.
- Lohr, Sharon. *Sampling: Design and Analysis*. Brooks/Cole Cengage, Boston, MA. 2nd edition. 2010.


Statistical techniques for remote sensing.


- Stein, A.; van der Meer, F.; and Gorte, B., Editors. *Spatial statistics for remote sensing.* Kluwer Academic Publishers, Netherlands. 2002.
- Congalton, R. G., and Green, K. *Assessing the Accuracy of Remotely Sensed Data: Principles and Practices*. CRC Press, Boca Raton, FL. 1999.

**Methodology 7: Baseline Commercial, Industrial, and Institutional (CII) Water Use**

Draft Methodology
May 14, 2010

The following methodology addresses the calculation of baseline commercial, industrial, and institutional (CII) water use. Baseline CII use is needed for urban water use target Method 2 (along with the indoor residential and landscape uses). It also affects the adjustment factors that agencies may consider at the time of testing compliance in 2015 and 2020 by allowing them to make adjustments based on "substantial changes" in CII relative to base CII use. The definition of "substantial change" and adjustments are discussed in the companion Methodology on on Criteria for Compliance Year Adjustments.

## Definition of Baseline CII Water Use

According to section 10608.12, baseline CII water use and related concepts are defined as:

> *(c) "Baseline commercial, industrial, and institutional water use" means an urban retail water supplier's base daily per capita water use for commercial, industrial, and institutional users.*
> *(d) "Commercial water user" means a water user that provides or distributes a product or service.*
> *(h) "Industrial water user" means a water user that is primarily a manufacturer or processor of materials as defined by the North American Industry Classification System code sectors 31 to 33, inclusive, or an entity that is a water user primarily engaged in research and development.*
> *(i) "Institutional water user" means a water user dedicated to public service. This type of user includes, among other users, higher education institutions, schools, courts, churches, hospitals, government facilities, and nonprofit research institutions.*

## Use of Baseline CII Water Use

Urban retail water suppliers are given several methods for calculating water use targets. Method 2 allows them to calculate a target by using three components: indoor residential use, landscape water use, and CII. Section 10608.20 (b)(2) specifies that the CII portion of the target is to be calculated as follows:

> *(C) For commercial, industrial, and institutional uses, a 10-percent reduction in water use from the baseline commercial, industrial, and institutional water use by 2020.*

## Calculation of Baseline CII Water Use

Baseline periods that a retail water supplier may use to determine baseline CII use shall follow the same direction that SBx7-7 provides for base daily per capita water use under Section 10608.12.(b):

> *"Base daily per capita water use" means any of the following:*
> *(1) The urban retail water supplier's estimate of its average gross water use, reported in gallons per capita per day and calculated over a continuous 10-year period ending no earlier than December 31, 2004, and no later than December 31, 2010.*
> *(2) For an urban retail water supplier that meets at least 10 percent of its 2008 measured retail water demand through recycled water that is delivered within the service area of an urban retail water supplier or its urban wholesale water supplier, the urban retail water supplier may extend the calculation described in paragraph (1) up to an additional five years to a maximum of a continuous 15-year period ending no earlier than December 31, 2004, and no later than December 31, 2010.*

A retail water supplier must have CII data for the entire baseline period used in the supplier's calculation of base daily per capita use. If the CII data does not exist, the retail water supplier should use another water use target method.

For each year in the baseline period, the quantity of baseline CII water use shall be divided by the Service Area Population, and the average of those calculations, converted to a daily rate, is the baseline CII for purposes of calculating the Method 2 target. Service Area Population methods are described in a separate methodology. The procedure for averaging the annual per capita CII use is the same as for calculating base daily per capita water use, and is described in that paper.

The CII component of the 2020 target for Method 2 shall be the baseline CII water use (in GPCD) multiplied by 0.9.

### Process Water Exclusion

A retail water supplier may elect to exclude process water from its calculation, consistent with SBx7 7 direction in Section 10608.24:

> *(e) When developing the urban water use target pursuant to Section 10608.20, an urban retail water supplier that has a substantial percentage of industrial water use in its service area, may exclude process water from the calculation of gross water use to avoid a disproportionate burden on another customer sector.*

The methodology for Gross Water Use defines "substantial percentage."

### Adjustments if Multifamily Residential Connections are Included in a Supplier's CII

To be completed.

**Methodology 8: Criteria for Compliance Year Adjustments**
Draft Methodology
May 14, 2010

## Definition of Adjustments to Compliance Daily Per Capita Water Use

Sub-division (d), Section 10608.24 of SBx7-7 states:

*(d) (1) When determining compliance daily per capita water use, an urban retail water supplier may consider the following factors:*

*(A) Differences in evapotranspiration and rainfall in the baseline period compared to the compliance reporting period.*

*(B) Substantial changes to commercial or industrial water use resulting from increased business output and economic development that have occurred during the reporting period.*

*(C) Substantial changes to institutional water use resulting from fire suppression services or other extraordinary events, or from new or expanded operations, that have occurred during the reporting period.*

*(2) If the urban retail water supplier elects to adjust its estimate of compliance daily per capita water use due to one or more of the factors described in paragraph (1), it shall provide the basis for, and data supporting, the adjustment in the report required by Section 10608.40.*

## Calculation of Adjustments to Compliance GPCD

The SBx7-7 legislation allows water suppliers to take several factors into account while determining compliance with their GPCD targets. These include weather; substantial changes to commercial, institutional, or industrial water use; and substantial changes resulting from extraordinary events.

*Evapotranspiration and Rainfall*

The Department will adopt a standard weather-normalization method that accounts for differences between base period and compliance year evapotranspiration and rainfall. One such method is being developed and tested under the auspices of the California Urban Water Conservation Council. DWR will evaluate the Council's method and adopt it if it meets the legislation's requirements.

Weather normalization is only as accurate as the weather data that is used to perform this exercise. DWR Land and Water Use Section is working on developing a model that can deliver historical rainfall and evaporation data for as early as 1990 for any part of California down to a 4 km-by-4 km square. This data capability will allow water suppliers to drill down to microclimate zones if desired. Once this tool is operational, the Council's weather normalization model will be recalibrated using weather data from this model.

The evapotranspiration and rainfall adjustments will be developed to be used by all water suppliers regardless of which method they choose to set their target. Water suppliers choosing Method 2 to set their water use target can test compliance by comparing actual usage in the compliance years to targets based upon the reference evapotranspiration (ETo) in the compliance years (see the landscaped area water use methodology).

*Substantial Increase in Business Output and Economic Development*
If GPCD still exceeds the target by a substantial amount (>3%) after being adjusting for evapotranspiration and rainfall compliance, water suppliers can examine whether the discrepancy is being caused by substantial growth in business output by using one of the following two methods:

1. Per-capita connection method
    a. First, water suppliers must demonstrate that commercial and institutional connections per capita was higher in the compliance year relative to the baseline, and that the difference was substantial (that is, it was greater than the year-over-year variation observed in these two ratios during the baseline period).
    b. Second, water suppliers should calculate average use per commercial connection and per institutional connection in the compliance year, and estimate total commercial plus institutional use assuming baseline connections per capita prevailed during the compliance year for these two sectors. Because industrial process water can be exempted from the calculation of gross water use, no additional correction is required for unusually strong business growth that may influence industrial uses.
2. Examination of economic indicators and statistical adjustment
    a. Water suppliers may examine a variety of indicators related to commercial and institutional water use to make the case that these indicators had changed substantially between the baseline and compliance periods. Examples of economic indicators that may be used include, but are not limited to, hotel occupancy rates, commuter population size, and other such indicators that aim to capture increases in an area's non-resident population that may not be adequately captured by the service area population estimates. A statistical adjustment of commercial and institutional water use may be attempted using defensible and documented techniques.

*Extraordinary events*
Water suppliers must document the estimated amount of gross water use attributable to extraordinary events, the nature of these extraordinary events, and how the estimates were derived.