Appendix I.
Considering Climate Change Impacts

I.1 Legislative Language on Considering Climate Change in UWMPs

There are several sections in the revised California Water Code (Water Code) relevant to urban water management plans (UWMPs) that refer to climate change, many of which are new since the 2015 UWMP Guidebook. The Water Code does not specify the technical nor general methods for how to consider climate change in the UWMPs, but it does emphasize in several sections that climate change is appropriate to consider, including the projected future uses, water supply characterization projections, and reliability of supplies. The flexibility within the Water Code to conduct the analysis appropriately allows water suppliers (suppliers) to incorporate climate change as is relevant for their sources and water uses.

This guidance is not prescriptive but is written recognizing that some suppliers seek guidance on how to consider climate change in their UWMPs. As such, this appendix describes common approaches to incorporate climate change in planning and management, pulling from the California Department of Water Resources' (DWR's) experience, as well as experiences of water suppliers, local, state, and national governments, non-governmental organizations, and research scientists. The fields and practice of climate change science and climate adaptation have grown tremendously in the last decade, offering experiences and perspectives from which suppliers can use.

For quick reference the climate change sections of the UWMP-relevant Water Code are listed below:

> ***Water Code Section 10608***
>
> *The Legislature finds and declares all of the following: [...]*
>
> *(b) Growing population, climate change, and the need to protect and grow California's economy while protecting and restoring our fish and wildlife habitats make it essential that the state manage its water resources as efficiently as possible.*

Water Code Section 10609

(a) (c) It is the intent of the Legislature that the following principles apply to the development and implementation of long-term standards and urban water use objectives: …

(2) Long-term standards and urban water use objectives should advance the state's goals to mitigate and adapt to climate change.

Water Code Section 10610.2

(a) The Legislature finds and declares all of the following: […]

(3) A long-term, reliable supply of water is essential to protect the productivity of California's businesses and economic climate, and increasing long-term water conservation among Californians, improving water use efficiency within the state's communities and agricultural production, and strengthening local and regional drought planning are critical to California's resilience to drought and climate change.

Water Code Section 10630

It is the intention of the Legislature, in enacting this part, to permit levels of water management planning commensurate with the numbers of customers served and the volume of water supplied, while accounting for impacts from climate change.

Water Code Section 10631

A plan shall be adopted in accordance with this chapter that shall do all of the following […]

(b) Identify and quantify, to the extent practicable, the existing and planned sources of water available to the supplier over the same five-year increments described in subdivision (a) providing supporting and related information, including all of the following:

(1) A detailed discussion of anticipated supply availability under a normal water year, single dry year, and droughts lasting at least five years, as well as more frequent and severe periods of drought, as described in the drought risk assessment. For each source of water supply, consider any information pertinent to the reliability analysis conducted pursuant to Section 10635, including changes in supply due to climate change.

Water Code Section 10635

(a) Every urban water supplier shall include, as part of its urban water management plan, an assessment of the reliability of its water service to its customers during normal, dry, and multiple dry water years. This water supply and demand assessment shall compare the total water supply sources available to the water supplier with the long-term total projected water use over the next 20 years, in five-year increments, for a normal water year, a single dry water year, and a drought lasting five consecutive water years. The water service reliability assessment shall be based upon the information compiled pursuant to Section 10631, including available data from state, regional, or local agency population projections within the service area of the urban water supplier.

(b) Every urban water supplier shall include, as part of its urban water management plan, a drought risk assessment for its water service to its customers as part of information considered in developing the demand management measures and water supply projects and programs to be included in the urban water management plan. The urban water supplier may conduct an interim update or updates to this drought risk assessment within the five-year cycle of its urban water management plan update. The drought risk assessment shall include each of the following: [...]

(4) Considerations of the historical drought hydrology, plausible changes on projected supplies and demands under climate change conditions, anticipated regulatory changes, and other locally applicable criteria.

I.2 Background: Climate Change & Urban Water Management Planning

Water resource management in California has historically managed and planned for substantial climatic and seasonal variability. Projections of climate change in California indicate a further intensification of wet and dry extremes and shifting temperatures that can have affect both water uses and supplies. Extreme and higher temperatures can lead to increases in water use. A declining snowpack and earlier runoff patterns could result in changes in stream flows and reservoir operations. Projections of more frequent, severe, and prolonged droughts could lead to not only less surface water available, but also exacerbating ongoing stressors in groundwater basins across the state. Without implementing preparedness and other strategies to adapt to or mitigate these impacts, the changing climate jeopardize a supplier's reliability over near-term and long-term.

How an urban water supplier can best account and prepare for projected climate change differs across several variables including arrangements of infrastructure, water rights, water sources, demands, and a variety of tools are available to assist urban water planners assessing the potential impacts of climate change on their water supplies and reliability.

This appendix provides a discussion of the decision-making process helpful in determining which tools and analytical approach will work best for a given water supplier's particular needs. This process is determined by each supplier's needs and capacity, which range widely by geography, water sources, human and ecological demands, and infrastructural and organizational arrangements. This section lays out the factors that are appropriate for an urban water supplier to consider when selecting an analytical approach and tools. In Step 1, the planner can walk through a vulnerability checklist for each water supply source identified. The Step 1 exercise is set up to assist the planner self-identify areas where their water supply reliability may be at risk to the impacts of climate change. Planners can use the information gathering in Step 1 to an approach to analysis in Step 2.

Climate change studies, analysis and planning for your water supply sources may have already been completed by the regional groundwater sustainability agency (GSA), integrated regional water management (IRWM) group, or within agricultural water management planning or other local general planning or hazard mitigation documents. DWR encourages urban water managers to participate in these planning efforts and use existing resources whenever feasible and appropriate. Urban water management planning, groundwater sustainability planning, agricultural water management planning all have a similar planning horizon around 2040, which can help maintain regional planning alignment. DWR's *Climate Action Plan: Phase 2* (DWR 2018) and the *Climate Change Handbook for Regional Water Management* (DWR 2011) offer the framework presented here for climate change analysis in a way that maintains alignment within DWR programs. Note that regional climate change studies may have used different scenarios and approaches to analyze the impacts of climate change and could obtain varying results.

Analysis options vary greatly with respect to complexity and sophistication. The various methods described here are intended to give a representative overview of the most common options. But, it is not possible to include every method, as climate change science is frequently advancing.

I.3 Common Steps to Considering Climate Change

DWR recommends three main steps to conduct a climate change analysis, which is a common approach for adaptation. First is a screening process to determine what assets and other aspects of the supplier's system may be at risk to climate change. Assets and other aspects of the system to evaluate may include water supply source, demand and/or use projections, infrastructure, operations of the infrastructure, timing and volumes of supplies, customers and other users, existing preparations for extreme conditions and events and capacity to activate those more frequently, among others. The second step involves selecting and conducting the full analysis on those assets and other system aspects at risk, which tends to require more staff time and technical capacity. The third step involves developing strategies and actions to mitigate the impacts of climate change on the water uses, supplies, and overall water supply reliability of the supplier.

There are several places in the UWMP that are appropriate for consideration of climate change.

Several places of the UWMP warrant climate change analysis, including:

- System description (Chapter 3)
- Water use characterization (Chapter 4)
- Water supply characterization (Chapter 6)
- Water reliability evaluations (Chapter 7)

I.3.1 Step 1: Climate Change Risk Determination Screening

The first step in conducting a climate change analysis is assessing the supplier's risk to the changing climatic conditions. In the absence of quantifiable likelihoods and impacts (an absence of which is common in assessing a range of future conditions), risk is evaluated by combining how exposed a supplier is to climate change impacts and how vulnerable that supplier is to being exposed. Exposure refers to the degree to which the water system (including its demand) may be influenced by changes in climate. Vulnerability of a supplier to exposure commonly involves an assessment of its system, considering tolerance changes to factors such as temperature, precipitation, and other key processes. Not all water sources necessarily will be exposed to significant impacts of climate change. Even if risk is low, understanding the risk faced by each water supply source can contribute to better planning and reliability outcomes. Completing the "Climate Change Vulnerability Screening Form for Urban Water Management Planning" (see the Resources and References section at the end of this appendix) can help a supplier to gauge aspects of their water supply source that may be vulnerable to climate change impacts which can help guide the climate change analysis in Step 2.

In addition to this screening form exercise, a supplier may choose to conduct a stand-alone climate risk assessment. This can vary widely in terms of how in-depth the supplier pursues. In-depth assessments with scientific rigor can have multiple benefits for a supplier. The assessment provides information from which to increase understanding among policy makers for the supplier, other decision-makers, operators and customers. Updates of critical infrastructure or personnel training budgets over the long-term can then also include to mitigate some of the high impact climate risks. A rigorous assessment can also be valuable for justification to their Board or customers of expensive or otherwise controversial adaptation strategies. The Water Research Foundation (2020) offers several guidance materials on how to incorporate climate change information into the business functions. Materials include a web-based tool and several written case studies and step-by-step guidance.

I.3.2 Step 2: Selecting the Climate Change Analysis Approach

Extending from the screening risk assessment, the next common step in building resilience to climate change involves a more in-depth analysis on the assets and other supplier aspects of concern. Determining what is of concern may be a political process and should involve decision-makers and other stakeholders that hold an interest in the supplier’s long-term reliability and viability. There have been several cases demonstrating the inclusion of decision-makers and other stakeholders are part of the process (Moser and Ekstrom 2011; Brugger et al. 2015; Vogel et al. 2019) that should determine what existing climate change analysis may have already been completed on the water source in question, and if a new analysis needs to be completed, what are the most appropriate methods and tools to use in projecting the potential changes in supply and demand. The following information is provided only as a guide to assist in selecting a climate change analysis approach and does not make any prescriptive recommendations or requirements.

I.3.2.1 Existing Climate Change Analysis

Modelling how climate change is projected to impact a supplier’s water reliability can be a time- and resource-intensive exercise. For those supplier’s unable to pursue such an analysis, it is prudent to explore if an existing climate change analysis of their water supply sources has already been conducted. Using a climate change analysis conducted by the wholesaler, raw water supplier or research institution or consulting firm could save time and resources and, in cases where a supplier receives water from a wholesaler, using the wholesaler’s analysis can help ensure the supplier is planning under a consistent set of climate change projections.

I.3.2.2 Conducting a New Climate Change Analysis

There are multiple approaches for analyzing the impact of climate change, such as bottom up (starting with system characteristics and capabilities), top down (starting with characterizations of future climate), sensitivity analysis, and stress tests. The sensitivity analysis and stress tests can both be good options for utilities with less financial or technical capacity. Whatever approach is selected, it should adhere to the best available scientific guidance on climate change analysis.

Determining what type of climate change analysis is appropriate for a supplier depends on a number of considerations (Knutti et al. 2010). Many of these are listed below:

- Data Sources: The following factors should be considered in assessing the likely future climate change in a region: historical change, process change, global climate change projected by global climate models (GCMs), and downscaled projected change. This means that for any given region, the climate change analysis should incorporate information from historical observations, GCMs, downscaled GCM projections, and other relevant information about historical and projected changes.
- Purpose and Uncertainty: Climate change impact assessments are made for multiple reasons and employ different methodological approaches. Depending on the purpose, some impact studies explore the variations in models and in what is referred to as the “uncertainty space,” more thoroughly than others. Some studies may legitimately reach a specific conclusion by using a single global climate model or downscaled product. For policy-relevant impact studies, it is desirable to sample the uncertainty space by evaluating global and regional climate model ensembles and downscaling techniques.
- Other Forcings: It should be recognized that additional forcings and feedbacks, which may not be fully represented in global models, may be important for regional climate change (e.g., land use change, heat island effect, or the influence of atmospheric pollutants). Climate forcings refer to those physical factors outside the climate itself that affect the Earth’s climate. These include human-induced changes in greenhouse gas emissions, surface reflectivity, and atmospheric aerosols, the two latter of which can impact regional climate.
- Qualitative Information: When quantitative information is limited or missing, assessments may provide narratives of climate projections

(storylines, quantitative or qualitative descriptions of possible realizations of climate change) in addition to, or as an alternative to, maps, averages, ranges, scatter plots, or formal statistical frameworks for the representation of uncertainty.

- Communicate Uncertainties: Limits to the information content of climate model outputs for regional projections need to be communicated clearly. The relative importance of uncertainties typically increases for small scales and affects relevant quantities because of limitations in model resolution, local feedbacks and forcings, low signal-to-noise ratio of observed trends, and possibly other confounding factors relevant for local effects.
- Model Selection: For regional applications, some climate models may not be considered because of their poor performance for some regional metric or relevant process. That said, there are no simple rules or criteria to define this distinction. Whether a set of models should be considered is a different research-specific question in every case. Selection criteria for model assessment should be based, among other factors, on availability of specific parameters and the spatial and temporal resolution within the model.
- Downscaling: The usefulness and applicability of downscaling methods strongly depend on the purpose of the assessment (e.g., for the analysis of extreme events or assessments in complex terrain). If only a subsample of the uncertainty space of the available global climate model is used for the downscaling, this should be noted explicitly.
- Time Horizon and Emissions Scenarios: Many impact studies are affected by the relative similarity between different greenhouse gas emission scenarios in the near term. The length of time period considered in the assessment studies can significantly affect results.

Building upon the preceding scientific principles, this guide translates these principles into analytical considerations that planners can use to structure their decisional process for choosing an approach for the climate change analysis. The following analytical considerations can assist in determining the most appropriate approach:

1. Climate sensitive parameters.
2. Spatial scale/watershed area.

3. Infrastructure/systems and operational activities.
4. Legal and institutional issues.
5. Continuity with previous work/studies.

1. Climate-sensitive Parameters

Assessing the climate sensitivity of the water supply and water use can assist in determining the type and scope of the climate change analysis to use. Climate-sensitive parameters should indicate if the water supply or use type is sensitive to climactic events, how sensitive and in what ways. Analytical considerations may include climate-sensitive parameters, climate-driven parameters, and how definite the assessment of these parameters can be. Analytical considerations include:

- What are the key climate-sensitive parameters that effect performance of the supply or water use (e.g., average precipitation, summer high daily temperatures, extended heat waves, atmospheric river driven precipitation)?
- What are the key climate-driven parameters that affect vulnerability of the supply (e.g., average annual streamflow; September streamflow; 3-, 5-, 7-day streamflow; stream temperatures; minimum flows; wildfire; sea level rise)?
- Does adequate data exist to explore how climate change could affect the supply?
- Do extreme events (floods, droughts, heat waves, wildfires) significantly impact the performance of the water source or the water use?
- How skillfully do downscaled global climate models simulate historical observed climate parameters of interest? How will the observed historical record of climate parameters of interest be used? How will (downscaled) global climate model data for climate parameters of interest be used? Is low-frequency variability in the climate parameters of interest an important consideration?
- What is the optimal temporal scale to adequately analyze the climate conditions (e.g., hourly, 6-hourly, daily, weekly, monthly, annually, multi-year averages)?

Common climate-sensitive parameters include:

- Average monthly temperature and precipitation.
- Average monthly streamflow.
- Inter-annual and low frequency hydrologic variability in terms of how it could affect recurrence, length, and severity of droughts and wet periods.

GCMs and their downscaled results may not adequately simulate the variance and cyclical nature of California's observed hydrological variability. Because of this, hydrologic modeling of future conditions has often, though not always, used the historical precipitation or streamflow record as the basis for future conditions modeling, with the climate change trend data mapped onto that historical record in a way that allows comparisons of historical experience with potential future conditions. This type of analysis has strengths and weaknesses that planners should critically evaluate before deciding on an approach.

Flood-protection analyses within the context of UWMP focuses on flooding that could possibly disrupt the water supply, most likely through damage to infrastructure. When analyzing potential flood impacts daily and, in some cases, hourly temperature and precipitation will be the key climate-sensitive parameters of interest, while 1-, 3-, 5-, and 7-day peak streamflow and antecedent watershed conditions (such as snowpack and soil moisture) will be key climate-driven parameters of interest. GCMs are not designed to provide climate information at these temporal scales and do not have the spatial resolution to adequately simulate orographic precipitation patterns and other acute spatial characteristics. Downscaling approaches have been used in the past to address these issues, but concerns remain about the ability of downscaling methods to adequately translate important large-scale phenomena to smaller scale impacts. Again, planners should evaluate past efforts and the unique characteristics of the water supply source before deciding on an approach.

2. Spatial Scale / Watershed Area

In selecting the climate change analysis approach, suppliers will want to assess analytical considerations relevant to the spatial scale/watershed area. These issues may include the following:

- Is the analysis being conducted for a small, localized water source or broad statewide/regional scale water source?

- Is the analysis, whether localized or statewide, consistent with other previously used datasets and analysis?
- Is the analysis consistent with other plans or analyses conducted over the same, similar, or overlapping areas?
- Does the analysis require simulation of multiple systems in a consistent manner? For example, if the local water supply is fed by local streams, groundwater, and other inter-basin water, can all those sources be analyzed in a consistent manner?

Some analysis can be done at localized scales and are not influenced by conditions outside of the watershed in question; but, in many cases, conditions outside of the watershed will have important ramifications for the analysis.

3. Infrastructure, Systems and Operational Activities

Infrastructure, systems, and operational considerations include the following:

- Does the analysis consider multiple infrastructure or system changes? Or is the existing system (without changes) being analyzed under modified climate conditions?
- Is there an existing operations model (e.g., flood protection or water supply) that can be run with different climate conditions to simulate performance under differing climate conditions?
- What are the climate-sensitive inputs to the existing system model? What is the time step of the existing system model? Do these system model characteristics align with available climate datasets?
- Does the system model allow all important conditions to vary over time (land use, population, sea level, water demand, etc.)?

Often the models used to evaluate climate impacts, such as a water system operations model, are configured so that certain conditions remain fixed throughout the simulation. This constraint may have important ramifications for how the simulation is configured and the type of climate dataset and tools used. For example, California Water Resources Simulation Model (CalSim) is designed to run with land use, sea level, and water demand characteristics that remain static throughout the simulation. This configuration means that CalSim-II is often run in a “climate period” analysis mode, as opposed to a transient analysis mode.

Additionally, CalSim-II simulations historically have been run using the historical sequence of wet and dry years, and these simulations are then perturbed with monthly and annual climate change trends from climate change studies. This configuration has limited ability to simulate certain types of changes in climate and hydrology (e.g., changes in inter-annual variability, longer and more frequent droughts, etc.) that may be important for some impact evaluations.

4. Legal and Institutional Issues

Analytical considerations relevant to identifying the legal and institutional issues and constraints include the following:

- Is there a statute, regulation, or policy that requires a specific approach or the use of specific tools or datasets?
- Are there partnership agreements for the water supply that require or constrain the selection of approaches, tools, or data for climate change analysis?
- Who will be performing the analysis?

Developing new tools and datasets or deploying existing tools and datasets to be used for planning often involves additional considerations because of the range of technical capacities and data needs at local levels. For example, in 2016, DWR developed tools and data for climate change analysis to be used for the Water Storage Investment Program (WSIP). DWR provided applicants with all the tools, data, and guidance needed to facilitate successful completion of the analysis. An important consideration in WSIP was that the datasets and tools had to cover the entire state (because projects under the program could be located anywhere in the state) and provide temporally and spatially consistent information for temperature, precipitation, runoff, and State Water Project/Central Valley Project (SWP/CVP) water deliveries. Because of these considerations, a novel approach had to be developed specifically for the program. Some water supply sources may be similar in the sense that they have not yet been analyzed for impacts from climate change, and they are complicated by their source, topography, legal obligations, infrastructure, or stakeholder goals and objectives, as well as other challenges.

5. Continuity with Previous Work / Studies

The following considerations are useful to ensure continuity with previous analyses to the greatest ability possible:

- Does the analysis/plan need to be consistent with previously performed work? Does this analysis fit within an existing framework or larger/programmatic plan that was already analyzed using a specific approach and dataset?
- Does the analysis build upon or update previously completed analysis or planning work?
- Has a similar analysis been completed previously?

When a new analysis connected to previous work is being performed, additional considerations are useful to maintain alignment with the previous work. In these situations, it is important to maintain coherence and alignment between previous work and new work while also addressing the need to evolve and incorporate scientific, analytical, and management improvements. This stresses the importance of beginning this process with a thorough examination of existing climate change analysis at the local/regional level up to the watershed and statewide levels.

I.3.3 Step 3: Developing Adaptation Strategies, Planning and Implementation

The purpose of analyzing how a changing climate could impact the supplier's water reliability is to help reveal what needs to be mitigated for and otherwise planned or implemented to decrease the increasing risks. Often times the supplier's vulnerabilities to climate change impacts are also its vulnerabilities to existing extreme conditions. Climate change can create an added risk that raises some existing challenges to become higher priority. For example, if a supplier relies on groundwater in a basin that is already periodically affected by saltwater intrusion, it will likely need to take further actions to mitigate additional intrusion as sea level rises or seek new water sources.

The actions, infrastructure, and social processes of developing ways to mitigate climate change impacts is referred to as "climate adaptation." Adaptation strategies range widely depending on the needs of the supplier. They may include adding an additional water source as a back-up in case the existing sources are projected to decrease under climate change. This would involve both engineered infrastructure changes and also legal changes to account for necessary water rights. A supplier that identifies sea level rise as a threat to its coastal aquifer may decide to increase groundwater recharge in that area as a barrier to saltwater intrusion. In a case that a supplier identifies late summer increased risks of shortage, the supplier may also pursue behavior changes in its customers to reduce water usage in peak periods. How a supplier adapts to climate change varies widely and will depend on what types of projected impacts the supplier's supplies and uses are exposed to, as well as its existing capacity to cope or otherwise mitigate those impacts. The sociopolitical context also influences how a supplier adapts to climate change and what is considered successful adaptation.

Several cases of urban water suppliers in the United States planning for climate change are summarized by the Water Research Foundation (2020).

I.4 Resources

The list below includes a limited catalogue of existing resources and their potential uses for climate change analyses. This information is not meant to recommend any particular tool over another or represent an exhaustive list of available resources, but intends to offer a glimpse of the scope of what is available in California.

Climate Change Technical Advisory Group (CCTAG) — California Climate Change Projections

This document was developed in 2015 by a formal committee of outside experts working with DWR staff. The projections are drawn from the Coupled Model Intercomparison Project Phase 5 (CMIP5) archive and use a three-step culling procedure with a variety of metrics pertinent to water management in California to select the 10 global climate models that have the greatest ability in simulating California climate conditions.

- Total of 20 transient projections running from 1950–2099.
- Ten global climate models and two representative concentration pathways (4.5 and 8.5).
- Uses localized constructed analogs (LOCA) downscaling (6 kilometer [km] x 6 km grid spacing).
- Provides daily maximum and minimum temperature and precipitation.

- Hydrology model: Water evaluation and planning (WEAP).
- Hydrology model: Variable infiltration capacity (VIC).
- Water management model: WEAP.
- Operations model: CalSim-II.

Reference: Perspectives and Guidance for Climate Change Analysis.

Data Availability: LOCA downscaled projections data are available for exploration and download from the CalAdapt website and API.

Status as of 2020: The CCTAG scenarios are based on the newest available climate models and downscaling techniques. These scenarios provide a suite of future climate projections that generally cover the range of uncertainty expected in potential future climate conditions. The California Fourth Climate Change Assessment has recommended this suite of scenarios for all studies done for the upcoming assessment report. The Fourth Assessment team has also provided additional guidance on which of the 20 scenarios to use when using the full 20-model ensemble is infeasible.

Recommended Uses: These scenarios have wide applicability for many types of studies, but these scenarios cannot be run directly through CalSim-II. Additional preprocessing steps must be taken to prepare these climate projections for input into CalSim-II. The WSIP scenarios (below) provide an example of how those additional preprocessing steps have been performed by DWR for the Water Storage Investment Program.

SGMA / WSIP Scenarios

Developed in 2016 and 2017, these climate change scenarios were developed specifically for the WSIP and are being provided to groundwater sustainability agencies pursuant to the SGMA. They cover California in its entirety and provide a set of data products covering climate, hydrology, and water supply variables.

- Total of four climate period projections.
- One 96-year scenario run at 2030 conditions representing the consensus of the CCTAG ensemble of projections, three 96-year scenarios run at 2070 conditions representing the consensus of the CCTAG ensemble of projections plus a dry-extreme warming scenario

and a wet-moderate warming scenario.

- Uses LOCA downscaling (6 km x 6 km grid spacing).
- Quantile mapping methodology used to perturb historical observed record of temperature and precipitation with climate trends.
- Provides monthly maximum and minimum temperature, precipitation, potential evapotranspiration (two vegetation coverages), surface runoff, baseflow, soil moisture, Central Valley streamflows, SWP/CVP operations, SWP/CVP water deliveries.
- Hydrology model: VIC
- Operations Model: CalSim-II.

Reference: Guidance for Climate Change Data Use During Sustainability Plan Development.

Data Availability: Model products and data are available for download on the SGMA Data Viewer web mapping application under the "Water Budget" heading.

Status as of 2020: The WSIP/SGMA scenarios are based on the latest climate models and downscaling techniques. The scenarios provide a suite of future climate projections that provide consensus projections at two future time periods as well as "bounding scenarios" at 2070 conditions that provide users with extreme climate outcomes that help explore the range of uncertainty expected in potential future climate conditions.

Recommended Uses: These scenarios have wide applicability for many types of studies. They are specifically designed to work within a CalSim-II modeling environment (and CalSim-II outputs are already available). Accordingly, these scenarios are likely the most readily usable for studies involving project operations, Delta conditions, or those that require simulation of future SWP or CVP water deliveries. These scenarios are DWR's only currently available dataset that provides a complete and consistent set of statewide temperature, precipitation, evapotranspiration, runoff, and SWP/CVP operations and deliveries. As such, the WSIP scenarios are generally the most useful tool for planning that involve areas within and outside of the Central Valley, especially in cases where SWP and CVP water deliveries are an important consideration in the study.

CVFPP Scenarios

Developed throughout 2015, 2016, and 2017, these climate change scenarios were established specifically for the Central Valley Flood Protection Plan (CVFPP) 2017 Update. They cover the Central Valley and develop changes in flood volumes at various return periods to modify Central Valley Hydrology Study (CVHS) unregulated volume-frequency curves to incorporate future climate change for the flood risk analysis.

Six climate change scenarios, each scenario over a 96-year period, are included.

- Warming Only Scenarios (no precipitation changes):
  - Near-Term Warming: Projected warming of approximately +1 o C (+1.8 o F).
  - Mid Century Warming: Projected warming of approximately +2 o C (+3.6 o F).
  - Late Century Warming: Projected warming of approximately +3 o C (+5.4 o F).
- Combined Warming and Precipitation Change Scenarios based on CMIP5 Climate Model Simulations:
  - Near-Term: Projected precipitation and temperature changes.
  - Mid Century: Projected precipitation and temperature changes.
  - Late Century: Projected precipitation and temperature changes.
- Uses downscaled climate model data based on bias-correction spatial disaggregation downscaling method.
- Quantile mapping methodology used to perturb historical observed record of temperature and precipitation with climate trends.

- Hydrology model: VIC at 1/16-degree spatial resolution (6 km x 6 km grid spacing).
- Flood Frequency Analysis: Bulletin 17B method in the United States Geological Survey's PeakFQ software.
- Uses end-of-century climate change scenario considering combined changes in precipitation and temperature for CVFPP complete risk analysis.

Reference: 2017 CVFPP Update — Climate Change Analysis Technical Memorandum.

Data Availability: Data products can be requested via email.

Status as of 2020: The CVFPP climate change approach used climate model simulation data from the CMIP5, which was the basis of the most recently released Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5). Projected changes to historical unregulated flow volumes were derived through hydrologic modeling of the Central Valley watersheds. Unregulated flow volumes were estimated by applying climate scenarios (i.e., temperature and precipitation projections derived from CMIP5) to the historical variability in climate and simulating the hydrologic responses of the Central Valley watersheds using the VIC model. Although not applied to 2017 CVFPP Update flood risk analyses, additional analysis was undertaken to assess changes in the characteristics of future simulated hydrographs using 20 individual downscaled climate projections via the LOCA downscaling method.

Recommended Uses: These scenarios have applicability for flood planning studies. The CVFPP 2017 climate change scenarios were used to develop changes in flood volumes at various return periods for more than 150 locations throughout the Central Valley. The changes in flood volumes developed to support the CVFPP 2017 Update can be useful for other planning studies but require extra caution to use them for designing a flood project.

Decision Scaling Platform

Decision scaling is a platform for climate change analysis rather than a specific set of scenarios to be used for analysis. Decision scaling integrates vulnerability-based analysis with traditional risk-based assessment methods, allowing for the assessment of climate vulnerability across a wide range of potential future climate conditions and estimation of the probability of specific outcomes. This bottom-up approach enables planning for future changes that is informed by the best available science on climate change while not dependent on precise prediction of future values (i.e., does not rely on specific climate scenarios). Since 2016, DWR has collaborated with the University of Massachusetts Hydrosystems Research Group on the development of the decision scaling platform for the Central Valley watershed.

- Analysis platform evaluates system impacts and potential adaptation strategies across precipitation changes of +/- 30 percent and temperature changes of 0–4 degrees Celsius.
- Fifty-four hydrological sequences explore variations in inter-annual hydrologic variability observed in the 1,100-year reconstructed paleo record of streamflows in the Sacramento-San Joaquin watershed.
- Provides ability to explore hydrologic or system performance metrics across a range of climate changes.
- Hydrology model: Sacramento Soil Moisture Accounting hydrologic model (SAC-SMADS).
- Operations Model: CalLite 3.0.

Reference: California Climate Risk: Evaluation of Climate Risks for California Department of Water Resources.

Data Availability: Guidance on incorporating the decision scaling platform and related data products can be requested via email from the DWR Climate Change Program.

Status as of 2020: The decision scaling platform draws on cutting edge climate analysis research and techniques that have evolved out of a field known as “decision-making under deep uncertainty.” This platform allows DWR to analyze the Central Valley water system and potential changes to it across a wide range of climate changes and to assign conditional probability estimates to each outcome so that decision-makers have probabilistic information about expected outcomes as well as less likely outcomes.

Recommended Uses: This platform is recommended for higher-level strategic planning applications and has not yet been used for specific project-level evaluations. Additional future work will focus on integrating decision scaling and detailed project level analysis.

Cal-Adapt.org

Cal-Adapt provides a view of how climate change might affect California, including changes in temperature, precipitation, snowpack, sea level rise, and wildfire. It contains tools, data, and resources to conduct research, develop adaptation plans, and build applications. Data products currently available on Cal-Adapt include:

- LOCA downscaled projections.
- Historical observed daily temperature and precipitation gridded data.
- Sea-level-rise scenarios.
- Snowpack forced by LOCA and gridded observed data.
- Wildfire scenarios.
- Long drought scenarios (LOCA).
- Streamflow (routed and bias corrected by LOCA).
- Additional climate variables generated through use of the VIC model forced by LOCA, downscaled projections, and gridded observed data.

1.5 References and Other Resources

Several additional reports, studies, and other resources provide more guidance and information on conducting climate change analyses in California and beyond, and may be helpful for urban water planners.

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Drought-Related Science for Informing Management

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Sea-Level-Rise Guidance for California Local Planning

Befus KM, Barnard PL, Hoover DJ, Finzi Hart JA, Voss CI, 2020. Increasing threat of coastal groundwater hazards from sea level rise in California. Nature Climate Change, 16 pp., Available at: https://doi.org/10.1038/s41558-020-0874-1.

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California Ocean Protection Council (OPC): Updated Sea Level Rise Guidance, March 2018. Available at: http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf.
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1.6 Climate Change Vulnerability Screening Form for Urban Water Management Planning

This screening exercise is intended to guide urban water management planners in identifying climate change vulnerabilities in their water supply source. The information gathered here can help guide the climate change analysis.

I. Water Supply and Demand

Are the water supply diversions sensitive to climate change?

Both streamflows and water demands are likely to be affected by climate change. Any water supply source that involves long-term water diversions may be subject to conditions that differ from current or historical conditions. As average temperatures increase, water demands from agriculture, industrial, and municipal users may increase resulting in changes to water availability. Droughts are also expected to become more frequent and more severe in the future potentially leading to increased restrictions on water diversions.

Is the water supply source affected by urban or agricultural water demand that might be climate sensitive?

Would shifts in daily heat patterns, such as how long heat lingers before night-time cooling, potentially change cropping patterns, landscaping, or water demand in other ways?

Is groundwater a major supply source?

Climate change may affect natural recharge to aquifers. Droughts are expected to become more frequent and more severe in the future. In times of drought, California water users tend to rely more heavily on groundwater. These changing conditions would likely affect future groundwater conditions.

Does the water supply source rely on or could it be affected by snowmelt?

As climate warming occurs a greater percentage of precipitation falls as rain instead of snow resulting in smaller snowpack. Also, higher temperatures result in remaining snowpack melting earlier. (All water diverted from the Sacramento River, San Joaquin River, Colorado River, or the Delta would be affected by changes in snowmelt.)

Does the water supply source come from or could it be affected by coastal aquifers? Has saltwater intrusion been a problem in the past?

Coastal aquifers are susceptible to saltwater intrusion as sea levels rise and many have already observed salt intrusion as a result of groundwater overdraft.

Does the water supply source rely on or could it be affected by changes in stored water supplies?

Changes in hydrology and water demand are likely to have significant effects on the amount of water stored in reservoirs, particularly water storage for carryover from one year to the next. Droughts are expected to become more frequent and more severe in the future potentially leading to changes in stored water supplies.

II. Extreme Heat

Could extreme heat impact operations of the water supply project or diversions?

Climate change is altering seasonal patterns in California, making hot days hotter, and increasing the duration of heat waves. This change could drive up customer usage and evaporative-related water losses.

Does the supply source rely on equipment or infrastructure that could be impacted by extreme or prolonged heat?

Infrastructure impacts from extreme or prolonged heat can include things such as increased corrosion, wear from heat expansion, and difficulties operating cooling systems.

III. Water Quality

Could water quality issues, such as low dissolved oxygen, algal blooms, disinfectant biproducts affect the water supply source?

Warming temperatures result in lower dissolved oxygen levels in water bodies, which are conducive to algal blooms and eutrophication. Changes in streamflows may also alter pollutant concentrations in water bodies.

Could reduction in assimilative capacity of a receiving water body affect the water supply source?

In the future, low flow conditions are projected to be more extreme and last longer. This may result in higher pollutant concentrations where loadings increase or remain constant, including potentially in groundwater as observed in the 2012–2016 Drought. Disinfectant biproducts also can build up in reservoirs or distribution systems as supplier's implement conservation measures (reducing movement of supplies through the system) (Kimbrough 2019).

Could the water supply source be affected by water quality shifts during rainfall / runoff events?

Although it is unclear how average precipitation will change with temperature changes, it is generally agreed that storm severity likely will increase. Areas that already observe water quality responses to rainstorm intensity may be especially vulnerable.

IV. Sea Level Rise

Is any of the water supply source infrastructure located in area that could be exposed to rising tides?

While sea level rise of 10 feet would be a very extreme outcome by the end of the 21st century, more modest levels of sea level rise combined with higher storm surge, and coinciding with high tide could pose risks to areas below 10 feet.

IV. Flooding

Is the water supply source or any of its associated infrastructure located within the 200-year floodplain? Does the water supply source rely on flood protection infrastructure such as levees or dams?

DWR's best available floodplain maps are available for download.

Although it is unclear how average precipitation will change, it is generally agreed that storm severity will increase. More intense, severe storms may lead to higher peak flows and more severe floods.

V. Wildfire

Is the water supply source located in an area that is expected to experience an increase in wildfire activity or severity? Would a wildfire result in damage to the water supply source infrastructure or interruption of its ability to perform as designed? Could the water supply source be affected by an increase in wildfire activity or severity in an upstream watershed or other adjacent area?

Wildfires alter the landscape and soil conditions, increasing the risk of flooding within the burn and downstream areas. Some areas are expected to become more vulnerable to wildfires over time.

VI. Sea Level Rise

Could coastal erosion affect the water supply source?

Higher sea levels and more severe storms in the future are expected to result in higher rates of coastal erosion.

Is the water supply source dependent on coastal structures, such as levees or breakwaters, for protection from flooding?

Coastal structures designed for a specific mean sea level may be impacted by sea level rise.

Appendix J.
Industrial Process Water Exclusion from Gross Water Calculations

J.1 Title 23. Waters

Division 2. Department of Water Resources

Chapter 5.1. Water Conservation Act of 2009

Article 1. Industrial Process of Water Exclusion in the Calculation of Gross Water Use

J.2 California Water Code Regulation Section 596. Process Water.

(a) An urban retail water supplier that has a substantial percentage of industrial water use in its service area is eligible to exclude the process water use of existing industrial water customers from the calculation of its gross water use to avoid a disproportionate burden on another customer sector.

(b) The Department of Water Resources will review and assess the implementation of this article and may amend its provisions upon considering the recommendations of the Commercial, Industrial and Institutional task force convened pursuant to section 10608.43 of the Water Code.

(c) This regulation supplements “Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use for Consistent Implementation of the Water Conservation Act of 2009” February 2011, and the “Provisional Method 4 for Determining Water Use Targets” February 2011, hereby incorporated by reference.

J.3 California Water Code Regulation Section 596.1. Applicability and Definitions.

(a) Sections 596.2 through 596.5 describe criteria and methods whereby an urban retail water supplier may deduct process water use when calculating their gross water use in developing their urban water use targets.

(b) The terms used in this article are defined in this subdivision.

(1) “commercial water user” means a water user that provides or distributes a product or service. Examples include commercial businesses and retail stores, office buildings, restaurants, hotels and motels, laundries, food stores, and car washes.

(2) “disadvantaged community” means a community with an annual median household income that is less than 80 percent of the statewide annual median household income.

(3) “distribution system” means a water conveyance system that delivers water to a residential, commercial, or industrial customer and for public uses such as fire safety where the source of water is either raw or potable water.

(4) “drought emergency” means a water shortage emergency condition that exists when there would be insufficient water for human consumption, sanitation and fire protection, as set forth in California Water Code Section 350–359 and Government Code Section 8550–8551.

(5) “gross water use” means the total volume of water, whether treated or untreated, entering the distribution system of an urban retail water supplier, excluding all of the following:

(A) Recycled water that is delivered within the service area of an urban retail water supplier or its urban wholesale water supplier.

(B) The net volume of water that the urban retail water supplier places into long-term storage.

(C) The volume of water the urban retail water supplier conveys for use by another urban water supplier.

(D) The volume of water delivered for agricultural use, except as otherwise provided in subdivision (f) of Section 10608.24 of the Water Code.

(6) “incidental water use” means water that is used by industry for purposes not related to producing a

product or product content or research and development. This includes incidental cooling, air conditioning, heating, landscape irrigation, sanitation, bathrooms, cleaning, food preparation, kitchens, or other water uses not related to the manufacturing of a product or research and development.

(7) "industrial water user" means 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. An industrial water user is primarily involved in product manufacturing and processing activities and research and development of products, such as those related to chemicals, food, beverage bottling, paper and allied products, steel, electronics and computers, metal finishing, petroleum refining, and transportation equipment. Data centers dedicated to research and development are considered an industrial water user.

(8) "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.

(9) "local agency" means any municipality, such as a city or county government or public water agency.

(10) "non-industrial water use" means gross water use minus industrial water use.

(11) "process water" means water used by industrial water users for producing a product or product content, or water used for research and development. Process water includes, but is not limited to; the continuous manufacturing processes, water used for testing, cleaning and maintaining equipment. Water used to cool machinery or buildings used in the manufacturing process or necessary to maintain product quality or chemical characteristics for product manufacturing or control rooms, data centers, laboratories, clean rooms and other

industrial facility units that are integral to the manufacturing or research and development process shall be considered process water. Water used in the manufacturing process that is necessary for complying with local, State and federal health and safety laws, and is not incidental water, shall be considered process water. Process water does not include incidental, commercial or institutional water uses.

(12) “recycled water” means water that is used to offset potable demand, including recycled water supplied for direct use and indirect potable reuse that meets the following requirements, where applicable:

(A) For groundwater recharge, including recharge through spreading basins, water supplies that are all of the following:

(i) Metered.

(ii) Developed through planned investment by the urban water supplier or a wastewater treatment agency.

(iii) Treated to a minimum tertiary level.

(iv) Delivered within the service area of an urban retail water supplier or its urban wholesale water supplier that helps an urban retail water supplier meet its urban water use target.

(B) For reservoir augmentation, water supplies that meet the criteria of subdivision (A) and are conveyed through a distribution system constructed specifically for recycled water.

(13) “urban retail water supplier” means a water supplier, either publicly or privately owned, that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre-feet of potable water annually at retail for municipal purposes.

(14) “Urban Water Management Plan” means a plan prepared pursuant to California Water Code Division 6 Part 2.6. A plan shall describe and evaluate sources of supply, reasonable and practical efficient

> uses, reclamation and demand management activities. The components of the plan may vary according to an individual community or area's characteristics and its capabilities to efficiently use and conserve water. The plan shall address measures for residential, commercial, governmental, and industrial water demand management as set forth in Article 2 (commencing with Section 10630) of Chapter 3. In addition, a strategy and time schedule for implementation shall be included in the plan.

J.4 California Water Code Regulation Section 596.2. Criteria for Excluding Industrial Process Water Use from Gross Water Use Calculation.

When calculating its gross water use, an urban retail water supplier may elect to exclude up to 100 percent of process water use from its gross water use if any one of the following criteria is met in its service area:

(a) Total industrial water use is equal to or greater than 12 percent of gross water use, or

(b) Total industrial water use is equal to or greater than 15 gallons per capita per day, or

(c) Non-industrial water use is equal to or less than 120 gallons per capita per day if the water supplier has self-certified the sufficiency of its water conservation program with the Department of Water Resources under the provisions of section 10631.5 of the Water Code, or

(d) The population as a whole within the supplier's service area meets the criteria for a disadvantaged community.

J.5 California Water Code Regulation Section 596.3. Quantification and Verification of Total Industrial Process and Industrial Incidental Water.

The volumes of water uses in Section 596.2 shall be for the same period as urban water suppliers calculate their baseline daily per capita water use and reported in their Urban Water Management Plans.

(a) The volume of process water use shall be verified and separated from incidental water use.

(1) To establish a baseline for determining process water use, urban retail water suppliers shall calculate the process water use over a continuous ten year period ending no earlier than December 31, 2004, and no later than December 31, 2010.

(2) Verification of process water volumes can be accomplished by metering, sub- metering or other means determined suitable and verifiable by the urban retail water supplier and reported in their Urban Water Management Plans and reviewed by the Department of Water Resources.

(b) In cases where the urban retail water supplier provides only a portion of an industrial water user's water supply, the urban retail water supplier shall prorate the volume of process water use excluded from gross water use by considering the average share of the industrial water use that it supplied over a continuous ten year period ending no earlier than December 31, 2004, and no later than December 31, 2010.

The verification of the proportion of industrial water use supplied shall be accomplished through metering, sub-metering, or other means determined suitable and verifiable by the urban water supplier such as audits, historic manufacturing output or suppliers' billing records and as reported in their Urban Water Management Plans.

Example. If an urban water supplier delivered only 60 percent of the average annual water used by an industrial water user, the urban supplier can only use that 60 percent of industrial water in determining if it is eligible to exclude process water from its gross water use; and if it is eligible, it can exclude only 60 percent of the volume of process water used by such industrial water user.

J.6 California Water Code Regulation 596.4. Existing Industrial Customers.

When implementing this article, urban retail water suppliers shall meet the following provisions:

(a) Any ordinance or resolution adopted by an urban retail water supplier after November 10, 2009, shall not require industrial water customers existing as of November 10, 2009, to undertake changes in product formulation, operations, or equipment that would reduce process water use.

(b) An urban retail water supplier may encourage existing industrial customers to utilize water efficiency technologies, methodologies, or practices through the use of financial and technical assistance.

(c) This section shall not limit an ordinance or resolution adopted pursuant to a declaration of drought emergency by an urban retail water supplier.

J.7 California Water Code Regulation 596.5. New and Retrofitted Industries.

Local agencies and water suppliers shall encourage newly established and retrofitted industries to adopt industry-specific water conservation practices and technologies where such technologies exist.

Appendix K. Estimating Future Water Savings from Adopted Codes, Standards, Ordinances, or Transportation and Land-Use Plans

K.1. Introduction and Background

Pursuant to California Water Code (Water Code) Section 10610 et seq., referred to as the Urban Water Management Planning Act (Act), an urban water supplier "*shall be required to develop water management plans to actively pursue the efficient use of available supplies*" (California Water Code 10610.4(c)). One challenge from this directive is reflecting how the pursuit of efficient use is best represented in the projected future water uses that are the cornerstone of good planning. As required by the Act, the water uses from both existing customers and those that may be added during each five-year increment for at least a 20-year planning horizon should be reflected in projections of future water demands.

This document provides urban water suppliers guidance for projecting future water uses for both existing customers and future, new customers based on recent trends, new codes and ordinances, land-use changes and other water-use impacting factors and it allows Suppliers to calculate anticipated conservation savings for its existing customers, as well as predict the demands for new customers.

Further, this suggested methodology can be used to reflect the outcome of required coordination with local or regional land-use authorities by allowing unique land-use classifications to be separately considered, as appropriate, to reflect varied water-use factors (e.g., residential lot density, anticipated occupancy, etc.) and be consistent with potential varied designations used by land-use authorities.

K.1.1 Background

In September 2014, two legislative bills amending sections of the Act were approved and chaptered: Assembly Bill (AB) 2067 and Senate Bill (SB) 1420. Key among the changes to existing statutes was the addition of Water Code Section 10631(d)(4). This specific addition provides the option for urban water suppliers to reflect its and its customer's efficiency efforts as part of its future demand projection. Water Code Section 10631(d) already requires an urban water supplier to comply to the following:

> (1) For an urban retail water supplier, quantify, to the extent records are available, past and current water use, over the same five-year increments described in subdivision (a), and projected water use, based upon information developed pursuant to subdivision (a), identifying the uses among water use sectors, including, but not necessarily limited to, all of the following:
>
> (A) Single-family residential.
>
> (B) Multifamily.
>
> (C) Commercial.
>
> (D) Industrial.
>
> (E) Institutional and governmental.
>
> (F) Landscape.
>
> (G) Sales to other agencies.
>
> (H) Saline water intrusion barriers, groundwater recharge, or conjunctive use, or any combination thereof.
>
> (I) Agricultural.
>
> (J) Distribution system water loss.

The new statutes added a new section (subsection 4)to Water Code Section 10631(d). The new section can be incorporated by either or both retail and wholesale urban water suppliers. When a wholesale water supplier is accounting for factors on behalf of its retail suppliers, it must closely coordinate with the retail supplier to assure consistency in how factors are represented by both parties. When multiple retail agencies coordinate on a regional plan, the methods to account for these factors should be consistently applied for each retailer's service area. The new text (subsection 4) added to Water Code Section 10631(d) is as follows.

> Water Code Section 10631(d)
>
> (4) (A): Water use projections, where available, shall display and account for the water savings estimated to result from adopted codes, standards, ordinances, or transportation and land use plans identified by the urban water supplier, as applicable to the service area.
>
> (B) To the extent that an urban water supplier reports the information described in subparagraph (A), an urban water supplier shall do both of the following:
>
> (i) Provide citations of the various codes, standards, ordinances, or transportation and land use plans utilized in making the projections.
>
> (ii) Indicate the extent that the water use projections consider savings from codes, standards, ordinances, or transportation and land use plans. Water use projections that do not account for these water savings shall be noted of that fact.

The last statement should not be overlooked, as it explicitly requires a water supply to identify when water-use projections do not account for these water savings. As part of standard review processes, DWR will be checking for this notation as appropriate.

K.1.2 Why is this Important?

An urban water management plan (UWMP) should be viewed as more than a document prepared to simply meet requirements of the Act. It should serve as an opportunity for a water supplier to continually evaluate water supply and water-use conditions to assure the most reliable, economically viable water services to its municipal and industrial customers. UWMPs provide an opportunity to (a) manage compliance with State mandates (e.g., per-capita targets), (b) understand and evaluate effects of its own water-use ordinances, expected impacts of growth, and benefits of existing customer water conservation actions, (c) support infrastructure planning, capital improvement plans, and rate setting, and (d) support land-use planning such as community general plans, or project-specific development plans. The California Department of Water Resources (DWR) encourages water suppliers to really understand current and future water uses to enable useful and practical planning.

Because UWMPs are updated on a five-year cycle, water suppliers should feel comfortable making assumptions using recent data, modifying previous assumptions based upon new facts (with appropriate notations of the basis for such modifications), and testing effects of various conservation strategies, as these can and should be revisited at the next UWMP cycle.

At the same time, DWR recognizes that the variable nature of codes, standards, and ordinances will translate to varying interpretations and representations of such in a supplier's UWMP. DWR recognizes that an UWMP is a supplier's plan — not DWR's — and will defer to each supplier's discretion for reflecting the quantitative benefits of applicable codes, standards, and ordinances, assuming reasonable citations and basis are provided, as required by Water Code 10631(d)(4)(B).

K.1.3 Document Organization

This document is organized to help suppliers understand how to best organize water-use forecasts to account for savings from adopted codes, standards, ordinances or transportation and land-use plans. The following sections are included:

- Section 1 – Introduction and Background
- Section 2 – Using a Land-use Basis for Unit Water Demand Estimates

- Section 3 – Implementation Examples
- Section 4 – Additional Useful Information
- Section 5 – Conclusions

K.2. Using a Land-use Basis for Unit Water Demand Estimates

As noted earlier, Water Code Section 10631(d)(1) requires water suppliers to separate water use into several categories, ranging from “single-family residential” to “institutional and government.” Though this subdivision is helpful, it still limits a water supplier’s opportunity to reflect the impact of conservation measures or land uses because the differences between the unit water demand of existing customers and future customers must be blended into one representative unit water demand factor. For example, if a water supplier currently serves 15,000 residential customers, but anticipates adding another 5,000 customers over the next 10 years — approximately a 3 percent growth rate — the unit water demand factors for existing housing versus that of future housing cannot be differentiated and is generally reflected as one blended value.

To improve on this, DWR recommends but does not require, at a minimum, a water supplier separate each of the six customer categories described in Water Code Section 10631(d)(1) into “existing” and “future” customers (see Figure K-1). This allows the water supplier to assign different unit demand factors to each customer category, allowing adjustments to reflect important water-using drivers — such as existing versus future housing density, and new building standards versus those in place 10 or 20 years ago. As shown in Figure K-1, through this simple separation, a supplier can readily recognize the potential decreasing unit water demand over each five-year planning increment for existing homes (as may result from natural replacements of appliances or from the water supplier’s conservation actions), but can also recognize the different starting point for a home built today that must meet new landscape and building standards, and be equipped with water-efficient appliances. (“Natural replacement” is the term for adopting water conservation ethics and replacing fixtures and appliances with more efficient models.)

Figure K-1 Sample Table with "Existing" and "Future" Customer Separation

		No. of Units over 5-yr increments	Land-use Specific Demand Factors	Projected Demand over 5-yr increments
Land use type A	**Existing**	(stable or fewer)	(may decrease over time)	(Unique value for each class and over time)
	Future	(increasing)	(likely stable over time)	
Land use type B	**Existing**			
	Future			
Land use type C	**Existing**			
	Future			
			Total Demand	(sum of parts)

Further expanding the land-use categories allows even more discrete application of codes, ordinances and land-use plans to be applied to existing and future customers. For instance, growth in many communities reflects a trend to smaller lots with larger homes than the existing customer base. This subtle change just to residential housing products can significantly reduce the available space for outdoor landscaping, and lower the outdoor demand of future housing without considering any other factors. By expanding the land-use categories beyond the simple "existing" and "future" to also include varying residential lots sizes, a water supplier has the ability to further refine demand estimates. This can be expanded again to reflect indoor versus outdoor demands for each land-use category. The greater the number of categories, the more unique water-use factors can be reflected to best correspond to actual and predicted conditions. Figure K-2 presents a more detailed table showing how data can be separated to focus the effects of codes, ordinances, and land-use plans to each applicable land-use category.

Figure K-2 Sample Detailed Demand Table

	Unit Count or Acreage						Demand Factor	Demand (af/yr)					
Category	Current	2020	2025	2030	2035	2040	(af/du or af/ac)	Current	2020	2025	2030	2035	2040
Residential													
Type A							(indoor)						
(existing)							(outdoor)						
Type B							(indoor)						
(new)							(outdoor)						
Type C							(indoor)						
(existing							(outdoor)						
DU Total													
							Indoor Subtotal						
							Outdoor Subtotal						
Commercial													
Type A													
Type B													
Type C													
Type D													
							Subtotal						
Public													
Type A													
Type B													
							Subtotal						
Park													
Streetscape													
Open Space													
							Outdoor Subtotal						
							Indoor Total						
							Outdoor Total						
							Total						
						Outdoor Non-revenue water	10%						
						Indoor Non-revenue water	10%						
							Total Indoor						
							Total Outdoor						
							Total Proposed Project Demand						

Note: Ideally the “Demand Factor” column would be expanded to allow for a unique factor for each corresponding five-year increment. This would allow “existing” factors to be lowered over time to show benefits of conservation.

K.2.1 Using Land-use instead of Population to Estimate Water Demand

As part of the 2010 and 2015 UWMPs, all retail suppliers were required to determine baseline per-capita water use and set targets for reduced per-capita use by 2020, established as gallons per capita per day (GPCD). Many water suppliers used these 2020 GPCD targets to determine future demands in their 2010 and 2015 UWMPs. This is an easy calculation because it requires multiplying a future estimated population by the GPCD. While simple, this method did not provide a water supplier with the opportunity to assess the effect of codes, ordinances, and land-use plans on future water demand. Consequently, it potentially misrepresents actual trends and reduces the opportunity for the supplier to assess success toward achieving its 2020 target. For example, a water supplier that forecasts future demands by simply applying GPCD targets to population projections did not have the ability to differentiate the effect of new landscape ordinances on new construction from the effect of conservation mandates on existing customers.

For 2020 UWMPs, the supplier should consider a more robust approach than GPCD x population not only to better estimate its future water-use needs, but also to compare its projections with pending urban water-use objective that will be established prior to the 2025 UWMP period, as described in California Water Code Section 10609.25.

DWR strongly encourages water suppliers to shift to land-use-based water demand factors to have a more thorough understanding of how demand may change over time, as influenced by the composition of its existing and future customers, and help position the supplier to address future water-use objective requirements.

K.2.2 Using Meter Data to Develop Unit Demand Factors

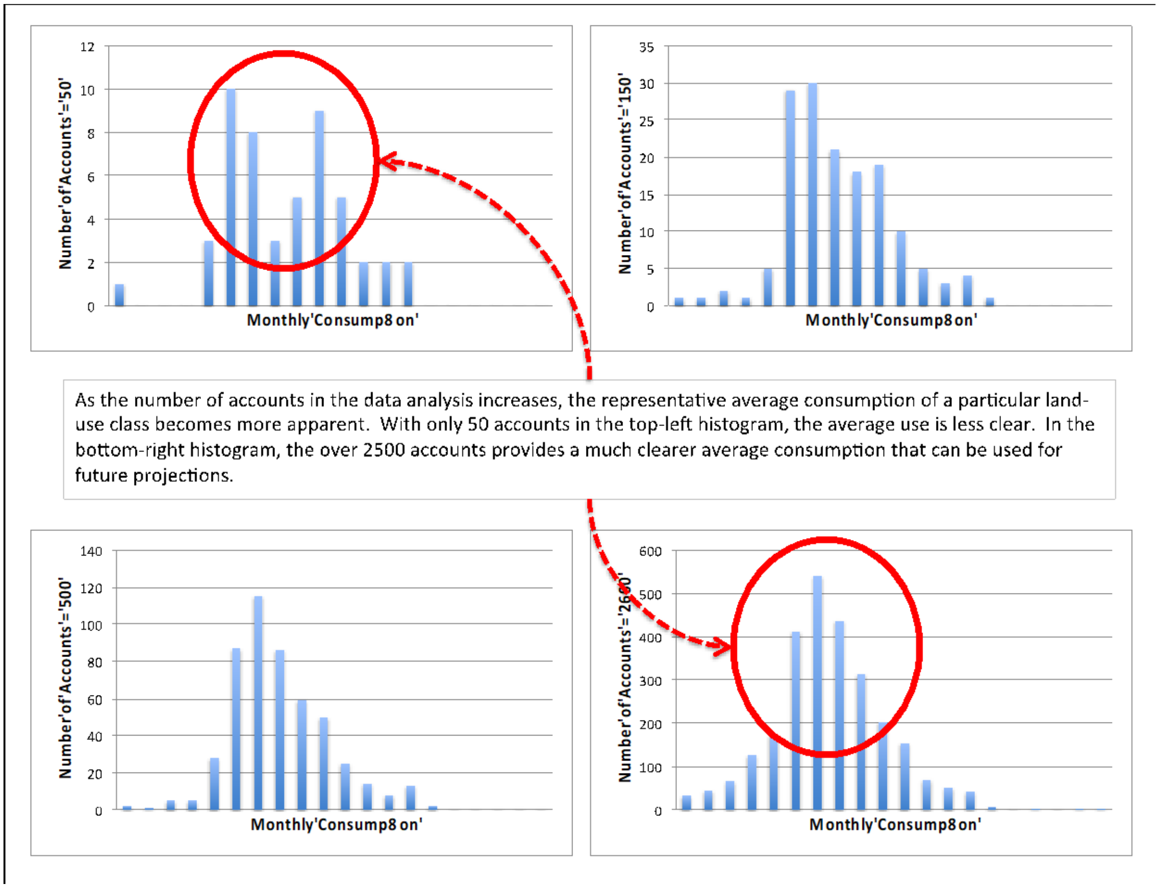
The most accurate way to analyze existing demands for differing land-use classifications is to review historic meter records obtained from the water system itself, especially for residential customers that often constitute the majority of an urban supplier’s water use. The following steps outline a simple meter analysis for residential data, though each water supplier likely has unique circumstances that may require more specialized assessments to assure the data is usable for demand forecasting purposes. Non-residential meter data can also be analyzed using similar steps.

- Create land-use categories. In this step, the lot sizes, housing types, neighborhood types, and relative ages of structures are used to develop appropriate land-use categories in relation to expected differences in water use. Existing residential developments typically can be grouped by age and size into a manageable number of dwelling unit categories. Some typical characteristics that can be used for dwelling unit classification include lot size, housing square footage, and general development age. As outdoor demands are generally the largest component of residential water use, net landscape area provides a good basis for creating land-use categories. Generally, large developments are built grouping similar-sized homes into their own neighborhoods. One method for defining a lot type is to review satellite photos of a few houses in a neighborhood and identify the general lot size, house size, and net landscape area. Geographic information system (GIS) tools, if available to water suppliers, can also offer methods to help establish categories. Indoor demands can vary significantly in older neighborhoods where there is a mixture of newer and older appliances and fixtures compared to newer homes that may have been built or remodeled subject to more recent plumbing code requirements. These differences can create another basis for category distinction. Note that typical neighborhoods built after the initial plumbing codes in the early 1990's (e.g., 1.6-gallon-per-flush toilets) will see normalized indoor demands. Homes built after the latest efficiency codes (e.g., 1.28-gallon-per-flush toilets) see even lower indoor demands.

- Download meter data. For each land-use classification, obtain a few years (minimum) of monthly customer meter data from at least one representative neighborhood. (Note: This step requires staff or consultant access to query the billing database or other source of records). Typically, meter data will be available in database form where a spreadsheet can be generated through a query designed to reflect the categories developed in Step 1. This is the most primitive type of data pull and is easily achieved by locating a few streets in neighborhoods with identified housing types. At least 50 customer meter records in a given dwelling unit classification should be analyzed, but 150 records would allow for more confidence in the data. The more data used, the more errors or anomalies that can be normalized. Although it can be valuable to assess all residential customer data, often-representative samplings provide a solid basis for developing the unique unit water demand factors. If the meter data database is accessible through a GIS system, then data queries can be defined by geographical area and can encompass entire tracts easily. There are a number of GIS-based tools emerging that may be used to simplify the meter data analysis process.

- Sort data. This step allows the data to be scrubbed so that it appears reflective of the general water demand characteristics of the selected land-use category. Assuming a typical inclined rate structure, the resulting total annual demands should graph into an offset bell curve when plotted as a histogram. This curve will smooth with more meters, but 150 is typically enough to define the shape. The more data available for a land-use class, the more representative the average consumption data will be (see Figure K-3). As indicated by the data set used to create the figure, the rate structure results only in a minor offset in water use. This is more noticeable in the data set using 150 or more customer meters and is absent in the data set with only 50 customer meters. From this curve the erroneous or outlier meter sets can be eliminated. Meters with exceptionally high and exceptionally low use can be eliminated so as to not inappropriately skew the analysis of "typical" water-use characteristics for the specific land-use class. Specific thresholds are not defined in this guide, but typically eliminating the top and bottom 10 percent of records (in relation to annual quantity of use) will improve the relevance of the curve. Monthly data should be reviewed in chart format and errors removed. Some basic criteria for removal include months with zero use, incomplete meter records, months with default minimum use, lack of seasonality in meter use, and fixed annual use. The goal is to eliminate records from vacant homes, seasonally used homes, and the like. This step is subjective, requiring reasonable judgment.

Figure K-3 Histogram Shape of Monthly Consumption Exemplifying how it Can Change with More Accounts Included



- Analyze data. Using the sorted data for each land-use category, monthly averages can be developed, indoor and outdoor use characteristics can be ascertained, and use between categories can be compared. This step may result in some consolidation of the original land-use categories (see step 1) or may verify that enough variance exists to maintain separate categories. Finally, an annual water demand per unit can be developed (e.g., acre-feet per year or average gallons per day per house type A). This value represents the “current” demand of the “existing” customer categories. From this existing set of demand factors, the water supplier can begin applying reductions to account for the effects of codes and ordinances and other water conservation-related factors applicable to existing customer types.

> These existing demand factors can also act as a baseline factors for future land-use categories. For instance, a medium density neighborhood built in the early 2000s has a determined set of demand factors that can indicate indoor use. New medium-density homes should have an indoor factor that is less by some percentage to reflect plumbing code and building standard changes since the existing homes were constructed (e.g., CalGreen Building Standards or California Energy Commission Title 20 appliance standards for toilets, urinals, faucets, and showerheads).

Another example of the use of meter data may be found in how many water suppliers are assessing monthly water-use data to satisfy mandated State Water Resources Control Board (SWRCB) reporting. In the SWRCB monthly reporting, suppliers have the opportunity to separate residential from non-residential use on a monthly basis. Throughout the year, the determination of percentage of residential versus non-residential should vary. For example, a hot inland area would see a residential use as a higher percentage of overall water demand. This results from more extensive outdoor residential water demand in the summer months because of landscaping needs. In winter months, the percentage of residential use compared to non-residential would lower reflecting only minimal residential outdoor watering. The supplier that is already reporting this likely has the data readily available to also take the steps above to develop land-use based demand factors.

K.2.2.1 Commercial Water-Use Sector Considerations

The commercial water sector is a very broad category that may include a wide range of non-residential water users, from large regional shopping centers, to neighborhood retail centers, to high-rise office buildings, hotels, and medical centers. If the commercial class is a significant portion of water demands or a number of unique water users exist, then suppliers are encouraged to create appropriate subcategories to enable appropriate analysis for future water needs. Because of the wide variety of customer types in this class and the large variability of water use and lot size, suppliers are encouraged to use a demand per-acre value to account for varied businesses within one metered water service account. For example, a neighborhood retail center may have a mix of very low and very high water users, such as a laundromat or restaurant. Individually, the use varies significantly; but for the entire commercial parcel, including parking areas, ornamental landscaping and other features, the entire water use can be averaged per acre of the commercial space. However, a neighborhood retail center may vary from a high-rise office complex, which may cause the supplier to create a separate category under the "commercial" sector for each. The important consideration is to create unique categories as most appropriate to facilitate future water-use projections as those may vary by each subcategory.

K.2.2.2 Industrial Sector Considerations

The industrial water-use sector is another category with a wide range of actual or potential water use and an even greater range of land development intensity, making forecasts challenging. For example, a new major industrial facility may be opening soon or may expect to significantly expand. Conversations with the local land-use authority are extremely important to understand likely new industrial water users otherwise unknown to the supplier.

For this classification, suppliers are encouraged to closely review the water-use history of its industrial customers and potentially group into "high-water using" or other categories that can facilitate forecasts for future water needs. In some instances, conversations with the high-water users may be useful for projecting whether demands may change over the next five-year period. Overall, this category requires close analysis to assure future demands reflect anticipated conditions.

K.2.2.3 Institutional and Governmental Sector Considerations

This water-use sector likely has obvious subclasses for water-use analysis, such as parks, schools, fire stations, or other explicit uses. Often these can be significant water users with only a limited number of water-service accounts, allowing easy separation into unique categories. The class may also capture some unique land-use classes, such as large airports, which should be separated from the general use in the class.

K.2.2.4 Representing Unique Water-Use Sectors and Land-Use Classification

Several water suppliers in the state have unique land uses, or variation of uses, that fall outside of the six categories described in Water Code Section 10631(d)(1) (see page K-2). Some examples include vacation homes, dual-plumbed homes, and “rural residential” or “country estate” type larger (multi-acre) parcels with active agricultural demands. In each of these cases, the most appropriate method to develop unit demand factors is to obtain representative meter data either from existing similar projects already served by the supplier or through coordination with another supplier with similar circumstances. For example, estimating the future demand from new vacation homes would require some analysis of similar vacation homes in the region (whether served by the supplier or not). It is important to remember that this is representative data to assist the supplier in performing demand forecasts, so absolute certainty is not required. If data is not available, subjective-based adjustments could be made to existing uses, such as multiplying outdoor use per square foot for a standard residential development, then applying the value to the larger lots.

Many factors can affect water use in unique land classifications. Generally, if existing data is not available for similar uses, the unique use is likely a small contributor to the overall demand of the supplier. For example, in a vacation community, the supplier should have ample access to data to establish usable demand factors. In a community with a new vacation development, the new demand likely represents a small portion of existing demand, so it can be assessed using professional judgment extrapolating existing land-use factors.

Other unique water-use classes which a worth analyzing as their own subclass may include universities, resorts, large hospitals, large office and research parks, and large hotels. In addition to the unique examples in previous sections, each of these categories can represent a significant water use and impact the larger trends on the supplier as a whole.

K.2.4 Converting Per-capita to Land-use Based Demand Factors

Per-capita demand factors can easily be calculated from land-use-based demand factors. Unfortunately, a simple method to convert per-capita demand factors into land-use demand factors is not viable. Because the use characteristics between land-use classes can vary significantly, trying to convert a supplier's average of 120 GPCD (example only) is meaningless without looking at actual water-use characteristics for each land-use class. DWR encourages suppliers using a per-capita basis for forecasting demands switch to the more refined land-use-based approach, then convert back to GPCD to understand overall trending toward per-capita targets or other supplier-specific objectives.

Care should be taken when converting back to GPCD that the appropriate population estimate is used that best reflects the land-use forecasts. As an example, a water supplier's land-use-based forecast may assume that 1,000 medium-density, single-family and 500 multi-family homes are constructed over the next 10 years. Based on available census data, the water supplier may determine that the average single-family residence has 3.1 people and the multi-family housing averages 1.8 people. These numbers would generate a forecasted population (all other aspects remaining the same) of 4,000 people. In contrast, the California Department of Finance may project a 10-year population growth of 4,500 people, based upon birth, death and migration statistics. These two different methods will result in different projected GPCD values. DWR strongly recommends that the population basis used to convert back to GPCD values match that used to determine the baseline GPCD values, as first documented in a water supplier's 2010 and 2015 UWMPs.

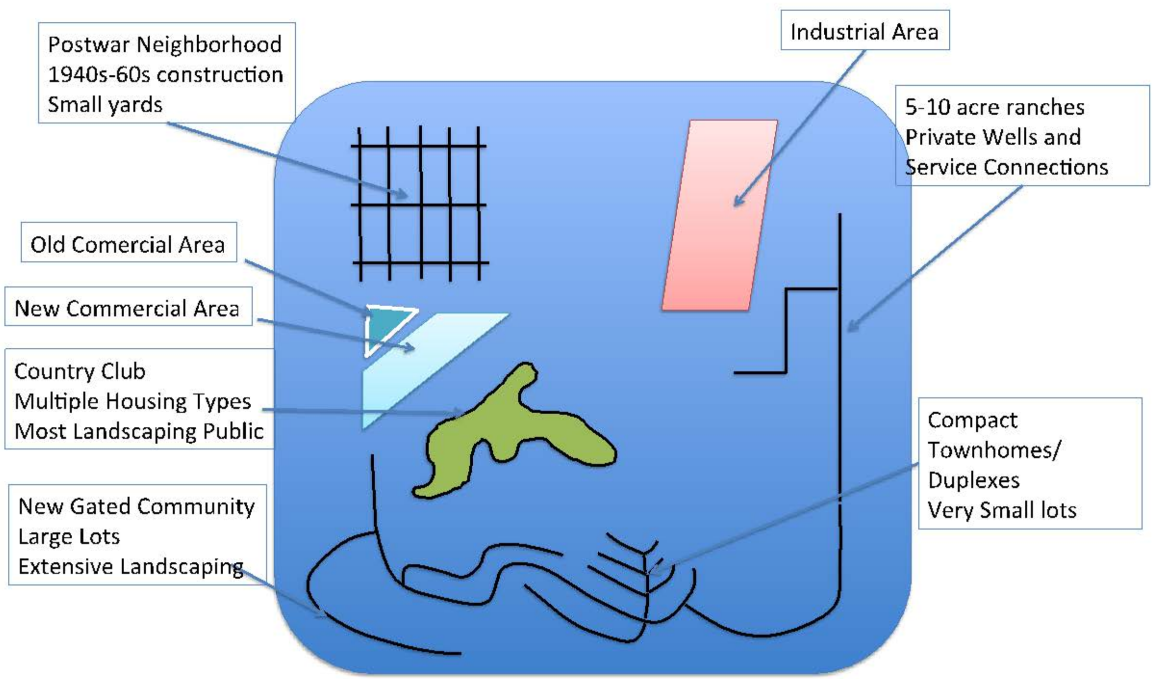
K.3. Implementation Examples

This section provides a few examples to illustrate the benefits of creating multiple land-use categories and unit demand factors.

K.3.1 Example "Water Supplier A"

Water Supplier A is located on the outskirts of a major metropolitan area. The community has existed for many years and benefitted from growth in neighboring industries resulting in significant population increases in the last couple decades. Figure K-4 depicts the key water demand sectors.

Figure K-4 Water Supplier A's Water-Demand Sectors



Water Supplier A serves a mix of residential housing types, an industrial area, historic downtown commercial, new big-box commercial establishments, and a private golf course and country club with housing. In this example, the residential demands comprise 80 percent of the annual water demands and are, accordingly, assessed in more detail. As shown in Figure K-4, this example includes distinct residential classifications, including older postwar housing, ranches, townhomes, large estates, typical low-density new developments, medium-density new developments, high-density new developments, and a country club with distinct housing types. Figure K-5 displays a sample table that subdivides each unique residential land-use classification.

Note that, generally, the detailed analysis of any land-use classification (whether residential, industrial, commercial, or agriculture) is justified when that classification uses more than 20 percent of water delivered by the water supplier. Detailed analysis is also justified in small subsectors if a significant change in that sector is anticipated (e.g., planned redevelopment of older section of town).

Figure K-5 Water Supplier A's Residential Classification Table (example only)

Unit Type	Unit Count						Demand Factors						Demands					
	Current	2020	2025	2030	2035	2040	Current	2020	2025	2030	2035	2040	Current	2020	2025	2030	2035	2040
Ranches 2-10ac																		
Estates .5-2ac																		
Low Density .25-.5ac																		
Medium Density .1-.25ac																		
Old Housing Development																		
Townhomes																		
High Density																		
Large Country Club Housing Type A																		
Large Country Club Housing Type B																		
Large Country Club Housing Type C																		

Note that one important addition in Figure K-5 that is not shown in the sample table above is the inclusion of multiple columns to record unit demand factors. This allows demand factors for an existing land-use category to be modified over time to reflect anticipated effects of conservation measures, codes, ordinances, etc. For example, assume the water supplier has a toilet rebate program targeting older homes. The unit demand factors for the “Old Housing Development” could be lowered over the next 5 to 10 years from the “current” value (as determined through meter analysis) to reflect saturation of new toilets and other targeted conservation efforts – possibly reducing the demand factor by 10 percent or more. Note also that Figure K-5 includes multiple columns to adjust demand factors, it does not include the separation between existing and future customers in each class that is represented in Figure K-2. Ideally, the multiple demand factor columns allow existing customer use to be modified, while separating existing customers from future customers allows for a completely different demand factor for new customers (e.g., new homes likely use less than existing homes).

Some key features of this table to note are (1) categorizing by residential type, (2) tracking the number of dwelling unit changes over each time increment, (3) the inclusion of demand factors, and (4) the tracking of demand factors by year.

- Categorizing by residential type allows the total demand to be subdivided so that no single residential type masks important demand characteristics of other types (e.g., the older homes demand factors are not inadvertently higher as a result of influence of the country club housing, which may have greater per-unit use). Lot size is typically the driver of water use as landscaping is the largest annual household demand for single-family homes. Another example illustrating the value of subcategories is the ability to account for varying population or homeowners association controlled landscaping. For example, consider that "Housing Type A" in the country club is the same size as the typical "low-density" new developments. But if the country club is an age-restricted community and has front yard landscaping controlled by a homeowners association (HOA), water demands per unit may be measurably lower than other similar size residences – as a result of few people per house and more consistent irrigation management by the HOA.
- Especially in-service areas experiencing growth, the number of dwelling units added during each 5-year increment within each residential type becomes a critical component of understanding future demand, especially near-term future demand. By understanding which residential types may be added over time — by integrating information from land-use plans — the supplier can more closely anticipate and evaluate water supply circumstances. Because the UWMP will be updated again in 5 years, the emphasis should be on the near-term growth, while using mid-term growth to help plan infrastructure needs and supply augmentation (if necessary). Further, by separating the "existing" residential units, the water supplier can apply unique demand factors for new homes (likely much lower than existing homes), while separately applying the effect of conservation measures to the existing units whose count generally does not change.
- Demand factors are derived from the result of meter analysis, as used directly for existing homes, and used as a baseline from which to adjust for new homes. As discussed previously, the ability to uniquely characterize the demand for separated residential types provides the water supplier a more accurate

forecast of demands into the future, helping track GPCD objectives and adjust where conservation efforts are targeted.

- Tracking of demand factors over time allows for the effect of conservation measures to be recognized. An example of this might be in an older part of town. If the water supplier has yet to complete meter installation on the legacy housing, demand factors could reasonably be dropped by 20 percent (or appropriate expected value) in 2025 to account for full meter implementation in the next 10 years. For example, the existing unit demand factor could be 0.5 acre-feet per house per year (af/du/yr), which is listed under "current" in the table. The supplier anticipates a 20 percent reduction in total use after meters are fully installed. Under the 2025 column, the demand factor for this land-use category would show 0.4 af/du/yr. The reduction in future demand would automatically be reflected for 2025.

For purposes of example, assume Water Supplier A has adopted an ordinance that applies the new Model Water Efficient Landscape Ordinance (MWELO) provisions, but not more. Note that while a water supplier can adopt ordinances to mimic or expand the MWELO to which they can assure compliance, the local land-use agency has authority to enforce compliance with the MWELO. The MWELO provisions will require the new planned gated community with large lots (see Figure K-4) to significantly restrict the installation of turf. As a result, each new dwelling unit will have a much smaller water demand than the same size unit in the existing country club area. As a result, the demand factor for these new large-lot residences would be lower than the demand factor for the existing large lots within the country club. Further, assume that Water Supplier A has offered a cash-for-grass program throughout its service area. Participation is strong within the housing development and is expected to reduce the average demand for housing in this category. Water Supplier A can reflect these changes by adjusting the 2025–2045 demand factors as appropriate for each category, resulting in a more accurate projection of future demands.

To understand the potential rate of growth for the new large-lot development, Water Supplier A looks to the local land-use planning agency's adopted documents (such as a development specific plan, or simply a general plan) and can directly incorporate or adjust growth rates and housing absorption schedules. Further, Water Supplier A may already have prepared a Water Supply Assessment (per Water Code Section 10910 et seq.) that identifies the anticipated phasing of the new development. The water supplier should evaluate the date and assumptions of land planning documents to understand whether they reflect older trends, whether build-out rates or lot sizes, which may reasonably be updated. For instance, a general plan completed in the early 2000s likely reflected a trend toward large-lot, single-family homes and rapid growth (as was being experienced at the time). Current development projects, while again seeing growth trends, are trending toward more dense single-family housing and slower growth rates than may have been assumed a decade ago.

By separating the residential types, Water Supplier A can better understand the effects of various codes, ordinances, and applicable land-use plans on its available supplies and make adjustments as necessary to assure compliance with its 2020 GPCD targets.

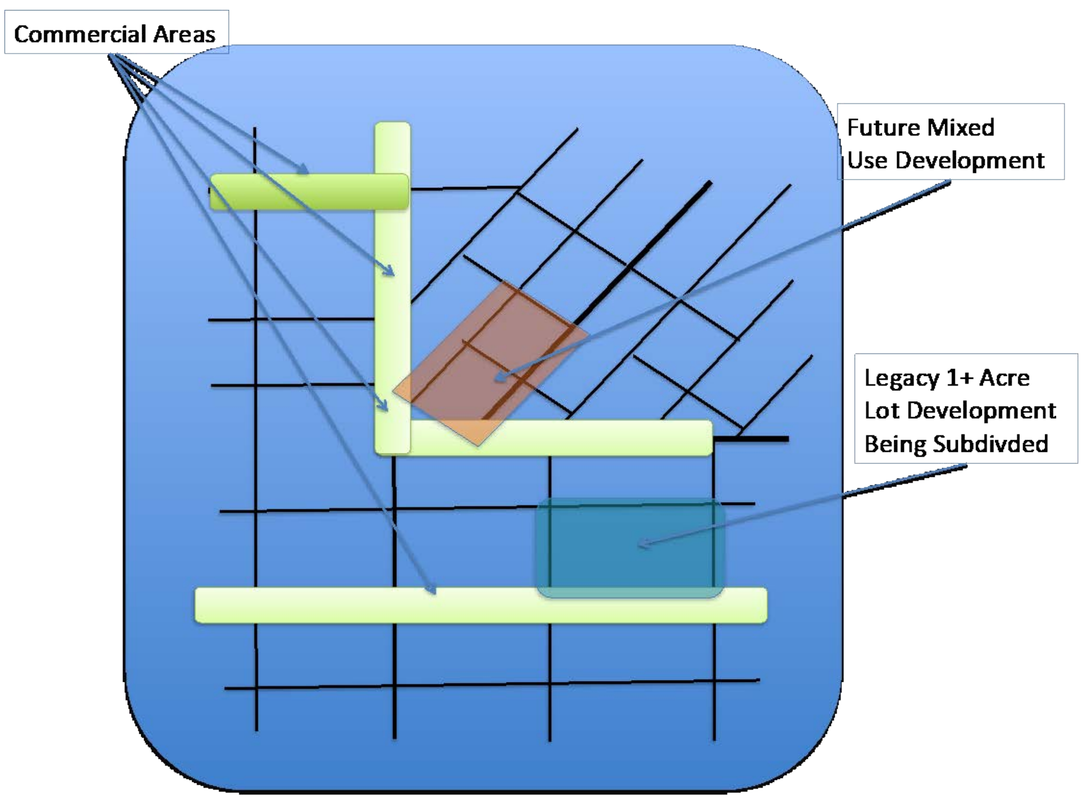
K.3.2 Example "Water Supplier B"

Water Supplier B is located in a major metropolitan area, and though once only a suburb, it is now considered a borough with urban area completely surrounding it. The community has existed for many years in its current state and population has remained steady in the last couple of decades with growth focused on redevelopment of existing areas. Similar to Water Supplier A, water demand is driven significantly by residential demands. Figure K-6 depicts Water Supplier B's key water demand sectors.

Much like Water Supplier A, subdividing the residential types provides more useful information in terms of planning. Key changes coming in Water Supplier B's service area include a new commercial redevelopment that will turn an area of single-story strip malls into multi-story mixed-use units with condos/townhomes above and pedestrian-friendly ground-floor commercial and courtyards. Another change will focus on subdividing a legacy development, shifting from generally small homes with nominal landscaping on 1-acre or greater lots to half-acre estate housing with extensive landscaping and large homes.

Through the use of the expanded table, it is noted that both redevelopments will increase population numbers. The 2015 UWMP prepared by Water Supplier B accounted for this growth and estimated the increased population to drive GPCD down as a result of applying the 2020 target GPCD to all the population. By undertaking an analysis for its 2020 UWMP using unique demand factors for each residential type, Water Supplier B discovered total water use was higher than previously projected. This was driven mainly by higher than anticipated use at the new estate housing. When translated to GPCD, Water Supplier B realized it may have missed its 2020 target GPCD.

Figure K-6 Water Supplier B's Water-Demand Sectors



As a result of this analysis, Water Supplier B must consider significantly increasing its water conservation programs — targeting the existing customers — and consider placing additional landscaping restrictions on the new estate housing that exceed the State's MWELO provisions. Water Supplier B believes these actions will help position them for the pending urban water-use objectives that will be forthcoming under Water Code Section 10609.25.

K.4 – Additional Useful Information

As discussed in previous sections, developing unit water demand factors for various land-use classifications is essential to understanding current customer use characteristics and to forecast future water demands. The Water Code requires that a supplier shall reflect codes, standards, ordinances, or transportation and land-use plans in its forecasted water demands, where such information is available. Incorporating these into future unit demand factors (to include in tables such as sampled in Figure K-2 and Figure K-5) requires a supplier to make adjustments to baseline demand factors determined through the assessment of meter data. There is no standard formula to accomplish this task. Rather, a supplier is encouraged to use professional judgment, a discretionary action that will be supported by DWR during review of UWMPs. This section provides guidance.

K.4.1 Applicable State Codes and Ordinances

At the State level, various codes and ordinances are adopted and put into law, which increases efficiency statewide. Overall, a water supplier retains discretion to reflect these conservation savings as deemed appropriate for its circumstances. If baseline unit demand factors for existing land uses are used as a basis, these State codes and ordinances will, at a minimum, cause a reduction from the baseline. Experimenting with the sensitivity of overall forecast demands by modifying the effect of all these factors can help a supplier assess likely 2025 GPCD conditions, the value of existing conservation efforts, and the need to potentially make adjustments prior to the next UMWP update. A brief description follows of several statewide codes and ordinances that should affect future water needs.

K.4.1.1 Model Water Efficient Landscaping Ordinance

The Water Conservation in Landscaping Act was enacted in 2006 and has since been revised and expanded multiple times by DWR resulting in the current MWELO (Government Code sections 65591-65599). In response to Governor Brown's executive order dated April 1, 2015, (EO B-29-15), DWR updated MWELO and the California Water Commission approved the adoption and incorporation of the updated State standards for MWELO on July 15, 2015. MWELO requires a retail water supplier or a county to adopt MWELO provisions or to enact its own provisions equal to or more restrictive than the MWELO provisions. The changes included a reduction from 70 percent to 55 percent of the reference evapotranspiration (ETo) for the maximum amount of water that may be applied to a landscape for residential projects, and non-residential projects to 45 percent, which effectively reduces the landscape area that can be planted with high-water-use plants, such a turf. For residential projects, the allowable maximum coverage of high-water-use plants is reduced to 25 percent of the landscaped area (down from 33 percent). The updated MWELO also now applies to new construction with a landscape area greater than 500 square feet (the prior MWELO only applied to landscapes greater than 2,500 square feet, per Cal. Code Reg. Tit. 23, Div. 2, Ch. 27, Sec. 490.1.).

K.4.1.2 California Energy Commission Title 20

First developed in 1977, the California Energy Commission (CEC) introduced appliance energy-efficiency standards. Since then, these standards have been expanded to include a number of household items related to water and energy use including dishwashers, clothes washers, sprinklers, showerheads, faucets, toilets, and urinals. These standards are applied in addition to national standards. In many cases, within a few years, national standards are modeled on and adopted from California's standards. Following approval of a new standard, the CEC ensures that only items that can pass new testing procedures are legally allowed to be sold in California.

K.4.1.3 Cal-Green Building Code

Beginning in January 2010, the California Building Standards Commission adopted the statewide mandatory Green Building Standards Code (CALGreen Code) requiring the installation of water-efficient indoor and outdoor infrastructure for all new projects after January 1, 2011. The CALGreen Code was incorporated as Part 11 into Title 24 of the California Code of Regulations and was revised in 2016 to address changes to MWELO adopted during the 2012–2016 statewide drought. Revisions to CALGreen Code in 2019 modified sections to direct users to MWELO regulations.

The 2016 Triennial Code Adoption Cycle consisted primarily of the MWELO updates adopted in response to the drought. Indoor infrastructure changes were limited to some minor non-residential fixture changes and changes to the voluntary Tier 1 and Tier 2 requirements. Additionally, the Code was updated to match the new Title 20 Appliance Efficiency Regulations. The 2019 updated sections to direct CALGreen code users to Title 23 of the California Code of Regulations to allow Title 23 to be the sole location of MWELO requirements.

The CALGreen Code applies to the planning, design, operation, construction, use, and occupancy of every newly constructed or remodeled building or structure. All new residential and non-residential customers added to the District's demands must meet the CALGreen Code as well as the outdoor requirements described by MWELO. Generally, remodels and new construction will satisfy these indoor requirements through the use of appliances and fixtures such as high-efficiency toilets, faucet aerators, on-demand water heaters, or other fixtures, as well as Energy Star and California Energy Commission-approved appliances.

K.4.1.4 Water Conservation Objectives and Legislative Actions

In 2009, Governor Arnold Schwarzenegger signed Senate Bill No. 7 (SBX7-7), which established a statewide goal of achieving a 20 percent reduction in urban per capita water use by 2020 for urban retail water suppliers (Water Code Section 10608.20). The efforts undertaken by urban retail suppliers to comply with this statute affects existing customer purchases of replacement appliances and fixtures, has caused landscapes to alter, and has generally created a continuing water conservation ethic.

In response to multi-year drought conditions, Governor Brown issued Executive Order B-37-16, "Making Water Conservation a California Way of Life," in May 2016. In May 2018, Governor Brown signed into law SB 606 and AB 1668, both of which imposed additional statutory requirements above and beyond the 20 percent by 2020 target and resulted in continued efforts to increase water-use efficiency and ultimately to reduce water demands of existing customers.

In 1991, SB 229 passed which created Water Code Section 525 and required water suppliers to install meters on all new service connections after January 1, 1992. Water Code Section 527, modified in 2004 by AB 2572, required water suppliers to charge for water based upon the actual volume of water delivered if a meter has been installed, and more importantly, to install water meters on all customers by January 1, 2025. Customers that are metered and billed in part based upon volume have consistently shown a lower use when compared to flat rate non-metered customers.

K.4.2 Examples of Applying Local Ordinances and Conservation Programs

Standard rules do not exist for reflecting the benefits of local ordinances on future demand factors. However, through assessments of selected meter data, use of readily available studies and reports, sound professional judgments can be made. Overall, the anticipated reduction in unit water demand factors for specific land-use classes needs to consider the existing circumstances (e.g., age of home, cost of water to customer, and local demographics). Although recent extreme efforts to manage demand during the 2015 drought crisis indicate reductions in excess of 30 percent, the actual long-term savings for existing residential users may be much less. Without a more thorough assessment, a water supplier may conservatively assume existing residential customers reduce unit demands by 5 to 10 percent over the forecast timeframe. More sophisticated analysis to support reductions can be undertaken using available guidance from existing reports. Consider these examples:

- Turf replacement — With several water suppliers throughout the state implementing these programs over the past several years, data to guide anticipated savings is readily available. As noted in a 2015 study by the California Water Efficiency Partnership (California Water Efficiency Partnership/California Urban Water Conservation Council 2015), not all programs achieve success, with savings dependent on the design of the program. Before and after meter data can be helpful in providing guidance as to expected long-term benefits to unit demand factors.
- Fixture and appliance rebates — To an even greater extent than turf replacement, fixture and appliance rebates have been ongoing for many years with varied success. The supplier will

need to anticipate participation rates and ultimate reductions in the various unit water demand factors.

- Natural Replacement — Even without targeted conservation programs, existing water users will generally experience a reduction in unit water demands over time as fixtures and appliances are replaced and water conservation ethics continue to be embodied. This is considered “natural replacement.” For instance, even without a rebate incentive, residential customers will purchase new washing machines over time, likely replacing an inefficient appliance with one meeting the current State appliance standards. Care must be taken to ensure the acceleration of replacement intended through rebate programs is not double counted with natural replacement.

In addition to specific conservation programs, the water supplier or land-use agency may have other specific ordinances that will affect unit demand factors. Most of the time, these factors will need to be reflected in unit demands for future land-uses (e.g., the anticipated homes and commercial establishments occurring in the next 5- or 10-year increment). Examples of local ordinances include expansions beyond the State’s MWELO, adding turf percentage limits, turf square footage limits, native area landscaping or open space requirements, more strict irrigation limits, stricter water budgets, and native only or xeriscaping requirements.

The California Water Efficiency Partnership, the Alliance for Water Efficiency, and other conservation-oriented advocacy groups offer many tools to assist water suppliers. Examples of tools are available online at California Water Efficiency Partnership and Alliance for Water Efficiency websites. (Membership may be required to access some tools and references.)

K.4.3 Using Standardized Values

DWR prefers the use of actual supplier-specific meter data as the best source for baseline demand factors. However, some future land-uses, especially those predicted in the 20th year may not have detailed information beyond a general zoning designation of “residential” or “commercial.” These land-uses may include large tracts of land designated in an adopted zoning map or may be nearer-term projects not currently part of a supplier's customer base (e.g., a hotel or particular industry). For these instances, water-use data from a recently completed specific plan or possible water supply assessment, may provide a standard value. Lacking any other data, a standard American Water Works Association-approved value or other common standard in the industry may be used as available.

Caution should be used when applying typical engineering standards to develop annual residential demands. These standards often represent a daily demand in gallons per unit for purpose of sizing infrastructure. Expanding to an annual value (multiplying by 365 days) could be misleading. But daily values can be useful for estimating commercial and industrial uses (e.g., office buildings, retail centers, shipping warehouses), as these uses tend to be stable throughout most of the year.

K.4.4 Recognizing Trends in Land-Use Planning

As noted earlier, when using land-use or transportation planning documents to help define future land-use classes, the time-relevance of those documents needs to be considered. For instance, a general plan completed prior to 2005 likely reflected the trend toward larger lots and rapid build-out, matching the conditions of the late 1990s. But today, land-use agencies are promoting trends to more dense residential developments, mixed uses, and slower growth, although they may not have updated their general plans or other relevant land-use documents. Developers are responding with combinations of compressed densities but also with large homes on smaller lots. The effect of this latter trend is significant reductions in outdoor landscaped square footage, as the house and hardscapes cover most of the lot. This translates to lower unit demand factors when compared to what might have been otherwise reflected under existing land-use documents, even if the result is more dwelling units, as the indoor demands are typically less than the previously projected outdoor demands for the larger lots.

Ideally, incorporating land-use and transportation planning documents provides an opportunity for the water supplier and local land-use agency(ies) to coordinate on trends, applications of ordinances (e.g., the State or local MWELO), and anticipated growth rates. Improved coordination also allows the 2020 UWMP to be a useful resource to land planning agencies that may be updating general plans or evaluating specific development proposals.

Suppliers are encouraged to work with local land-use authorities to understand growth plans and incorporate these into more realistic and aligned water demand projections.

K.4.5 Including Citations

As required in the statute, a water supplier must "Provide citations of the various codes, standards, ordinances, or transportation and land-use plans utilized in making the projections" or otherwise note the absence of estimated savings from its water-use projections. Citations can easily be included by simple reference to an ordinance or basis of a calculation, or the source of land-use information (e.g., from 2005 General Plan for City A). Appropriately citing sources and methods will allow a water supplier to easily revisit approaches and assumptions made in the 2020 UWMP when it is undertaken the 2025 UWMP. Internal trends published in an annual report, such as submitted by suppliers to the State's Division of Drinking Water also serve as a useful and reliable citation for preparing State document.

K.5 Conclusions

To enable the most reasonable representation of codes, standards, ordinances, or transportation and land-use plans within 2020 UWMPs, water suppliers are strongly encouraged to transition to land-use-based demand projections. Further, land-use-based demands should separate existing customer demands from future customers anticipated to be added in each of the five-year forecast increments.

Water suppliers should view the 2020 UWMP as an opportunity to garner a better understanding of where its overall use may be relevant to pending urban water-use objectives (see Water Code Section 10609.25). And, if there is a perceived risk of not achieving the to-be-determined objectives, identify where to focus near-term conservation efforts to achieve success. Working with only per-capita and population-based values, including basing forecasts on assumed successfully reaching the GPCD target, can mislead a water supplier into a false sense of success.

Importantly, a water supplier must indicate in its 2020 UWMP when its forecasts do not reflect any representation of water savings from codes, standards, ordinances or transportation and land-use plans, as required by Water Code section 10631(d)(4)(B)(ii).

Finally, the concept of disaggregating demand and associating it with land-use classes is understandably a highly technical process. But as has been acknowledged by others, the degree of disaggregation and associated effort may only add incrementally to the understanding of demand characteristics or to the accuracy of demand forecasts. Even simply taking the first step to create separate demand factors for existing land uses from those for new land uses will provide significant planning utility to a water supplier.

References

California Water Efficiency Partnership/California Urban Water Conservation Council. 2015. *Turf Removal and Replacement: Lessons Learned*. Author: Briana Seapy. 29 pp. Viewed online at: http://toolbox.calwep.org/w/images/9/98/Turf_Removal_%26_Replacement_-_Lessons_Learned.pdf. Accessed: August 10, 2020.

Appendix L. Water Loss Audit Regulations

Drought and other water-shortage issues highlight the need to manage water loss in water distribution systems in California. Water loss can result from water theft or from seepage, leaks, and pipe failures caused by aging infrastructure or errors in data. Water utilities can increase water supplies and recover revenue by identifying the scale and cost of these losses. The benefits above can improve relations with the public — both ratepayers and members of the financial community, such as rating agencies. A water audit and the management of water losses can facilitate a broader adoption of more goal-oriented, metric-driven, financially sensible, and publicly accountable decisions.

To improve water loss reporting in California, Senate Bill (SB) 1420 was passed in 2014 requiring water suppliers to submit water loss audits as part of urban water management plans prepared once every five years. SB 555 (passed in 2015) builds on SB 1420 and, beginning in 2017, requires the submittal of annual water loss reports to the California Department of Water Resources (DWR) that are then validated for data accuracy.

Appendix L of the 2015 Urban Water Management Plan Guidebook summarized water loss auditing and is still available as an archive, but is not provided here because regulations have since specified how to conduct the audits. The archived version of the 2015 summarized guidance is available for download on the California Natural Resources Agency website. Caution is advised when using this summarized and simplified version because it is not an officially approved methodology and is not updated for any subsequent changes in methods used.

Since publication of the 2015 Urban Water Management Plan Guidebook, DWR has adopted the regulations for specifying how to monitor and report water loss.

In summary, these regulations require water suppliers to submit a water loss audit report annually to DWR. The audit must be conducted using the methods from American Water Works Association's (AWWA's) most recent

Manual of Water Supply Practices and free water audit software. The current manual (as of publication of this UWMP Guidebook) is the M36 Fourth Edition. Each water loss audit report must be validated following the specifications in the California Code of Regulations (below), which then must be submitted to and approved by DWR.

Text below was accessed from the official California Code of Regulations website on July 31, 2020, and is considered current as of July 17, 2020.

California Code of Regulations, Title 23, Section 638.1
Section 638.1. Definitions.

As used in this Chapter, the following terms mean:

(a) "Apparent losses" means losses due to unauthorized consumption and/or nonphysical (paper) losses attributed to inaccuracies associated with customer metering, or systematic handling errors.

(b) "Authorized consumption" means the volume of water taken by registered customers, the water supplier, and others who are implicitly or explicitly authorized to do so. Authorized consumption may be billed or unbilled, metered or unmetered.

(c) "AWWA" means the American Water Works Association.

(d) "CA-NV AWWA" means the California-Nevada Section of the American Water Works Association.

(e) "Data grading values" means specific grade scores (on a scale from 1 to 10) applied to each input component in the AWWA Free Water Audit Software spreadsheet.

(f) "Data Validity Score (DVS)" means a measure of the overall trustworthiness of the data entered in the AWWA Free Water Audit Software. The DVS represents the validity of the water audit data and is a reflection of the level of best practices employed by the water supplier associated with the water supply system subject to the audit.

(g) "Department" means the Department of Water Resources.

(h) “General manager” means a person who holds an executive position with the urban retail water supplier with overall responsibility for managing operations, revenue, and costs. Such a position may also be described as a water department director, city manager, utilities manager, or the director of public works.

(i) “Level 1 validation” means a review of the water loss audit that includes an examination of the data sources used for each input and an evaluation of the DVS selected for each input of the audit, as described in Section 700.3.

(j) “Non-revenue water” means the portion of water consumption that is not billed and does not produce revenue. It equals the unbilled authorized consumption plus apparent and real losses.

(k) “Real losses” means the physical water losses from the pressurized potable water system and the utility’s potable water storage tanks, up to the point of customer consumption.

(l) “Report” means the water loss audit report of a potable water supply required to be submitted to the Department as specified in Section 700.5.

(m) “Standardized water loss audit” means a water loss audit conducted in accordance with the method specified in Section 700.2.

(n) “Urban retail water supplier” means a water supplier, either publicly or privately owned, that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre-feet of potable water annually at retail for municipal purposes.

(o) “Validating” means a process whereby an urban retail water supplier uses a water audit validator to confirm the basis of data entries in the Reports and to characterize the quality of the reported data. All references herein to “validating” or “validation” refer to “Level 1 validation.”

(p) “Water audit validation” refers to the process of examining water loss audit inputs to consider the water audit’s accuracy and document the sources of uncertainty.

(q) “Water audit validator” means a person who meets the requirements of Section 700.4 to perform the validation of a water loss audit.

Note: Authority cited: Section 10608.34, Water Code. Reference: Sections 10608.12 and 10608.34, Water Code.

California Code of Regulations, Title 23, Section 638.2
Section 638.2. Audit Standards and Frequency.

Urban retail water suppliers shall, on an annual basis, conduct water loss audits of their potable water systems in accordance with the methods in AWWA’s Manual of Water Supply Practices - M36, “Water Audits and Loss Control Programs” (4th ed. 2016) and Free Water Audit Software, pursuant to section 10608.34 of the Water Code.

Note: Authority cited: Section 10608.34, Water Code. Reference: Section 10608.34, Water Code.

California Code of Regulations, Title 23, Section 638.3
Section 638.3. Standardized Conduct for Validation of Water Loss Audits.

(a) All water loss audits shall receive a Level 1 validation.

(b) A Level 1 validation shall include:

(1) An interview between the water audit validator and the person or persons who prepared the water loss audit, and any member of the utility staff with information that the water audit validator believes is necessary to complete the Level 1 audit validation.

(2) A review and evaluation of the following documentation:

(A) The completed AWWA Free Water Audit spreadsheet.

(B) The reported water volume from its own sources, as documented by the supply meter(s) or other means, as applicable.

(C) The reported volume of water imported and exported each month by connection.

(D) The documentation of the customer meter and supply meter accuracy testing and calibration.

(E) The reported volume of authorized consumption each month broken down by water rate, if different rates are applied to water users.

(3) A review and evaluation of the accuracy of performance indicators included in the AWWA Free Audit Software.

(4) A review of audit inputs and data grading values to confirm a correct application of methodology, and follow-up reviews (if indicated).

(5) A summary of the validation, including:

(A) Name and contact information of the water audit validator.

(B) A summary of the Level 1 validation utility staff interview, including the basis for the input derivations and the DVS selections.

(C) Any recommended changes to the water audit inputs by the water audit validator that were not accepted by the urban retail water supplier, and the rationale for not accepting the recommendations.

(D) A summary of any follow-up performance indicator reviews.

(E) Overall impressions, including the consistency of performance indicators with system conditions and water loss management practices.

(F) Any recommendations for further validation or water loss audit improvements.

Note: Authority cited: Section 10608.34, Water Code. Reference: Section 10608.34, Water Code.

California Code of Regulations, Title 23, Section 638.4
Section 638.4. Technical Qualifications for a Water Audit Validator.

(a) For purposes of Reports submitted on or before June 30, 2019, a water audit validator means:

(1) A contractor working in the CA-NV AWWA Water Loss Technical Assistance Program ("Water Loss TAP") performing water loss audit training and conducting audit validations,

(2) An individual who can demonstrate having conducted water loss audits in accordance with the method specified in Section 700.2, and having conducted a minimum of 10 Level 1 audit validations in accordance with the Water Research Foundation Level 1 Water Audit Validation: Guidance Manual 4639A (Water Audit Validation), or

(3) An individual certified by the CA-NV AWWA as a water audit validator.

(b) For purposes of Reports submitted on or after July 1, 2019, a water audit validator means an individual certified by the CA-NV AWWA as a water audit validator.

(c) An urban retail water supplier may conduct a water loss audit validation for its own water loss audit, provided that the individual performing the validation meets the requirements of this Section.

(d) A water audit validator may not conduct a water loss audit validation if he or she participated in compiling the water loss audit.

Note: Authority cited: Section 10608.34, Water Code. Reference: Section 10608.34, Water Code.

California Code of Regulations, Title 23, Section 638.5
Section 638.5. Audit Reporting Requirements.

(a) Not later than October 1, 2017, and by October 1 of every year thereafter, urban retail water suppliers shall submit a Level 1 validated Report to the Department. The Report shall include data spanning 12 consecutive months, as follows:

(1) For utilities that prefer to provide Reports on a calendar year basis the reporting period shall be for calendar year 2016 and annually thereafter.

(2) For utilities that prefer to provide Reports on a fiscal year basis that is not on the calendar year, the first reporting period shall be for their 2016-2017 fiscal year and annually thereafter.

(b) Reports under subsection (a) shall be submitted in two separate files. One file shall be in a complete and fully operational water loss audit spreadsheet format generated from the AWWA Free Water Audit Software and contain the water audit information specified in subsection (1) below. The second file shall be in PDF format and contain the information specified in subsections (2)-(4) below:

(1) System-specific data entered into each field in the water loss audit spreadsheet worksheets of the AWWA Free Water Audit Software, with a DVS.

(2) In 2017, information identifying steps taken by the urban retail water supplier in the previous year to increase the validity of data entered into the final audit, reduce the volume of apparent losses, and reduce the volume of real losses, as informed by the annual validated water audit.

(3) Beginning in 2018, information identifying steps taken by the urban retail water supplier in the preceding 3 years to increase the validity of data entered into the final audit, reduce the volume of apparent losses, and reduce the volume of real losses, as informed by the annual validated water audit.

(4) A statement confirming the Level 1 validation of the submitted water loss audit, including the validation findings, and documenting the following:

(A) Identification of the water audit validator.

(B) Qualification of the water audit validator.

(C) Date of the Level 1 validation review.

(5) The following Water Loss Audit Certification Statement, signed by the chief financial officer, the chief engineer or the general manager of an urban retail water supplier:

"This water loss audit report meets the requirements of California Code of Regulations Title 23, Division 2, Chapter 7 and California Water Code Section 10608.34 and has been prepared in accordance with the methods prescribed therein."

(c) In the case of urban retail water suppliers with two or more separate public potable water systems, the urban retail water supplier shall submit a separate AWWA Free Water Audit Software spreadsheet worksheet meeting the requirements in subsection (b)(1) for each potable water system.

(d) Reports required under subsection (a) shall be submitted using the Department's Water Use Efficiency Data online submittal tool at https://wuedata.water.ca.gov/secure/login_auth.asp.

Note: Authority cited: Section 10608.34, Water Code. Reference: Section 10608.34, Water Code.

California Code of Regulations, Title 23, Section 638.6
Section 638.6. Validated Water Loss Audit Acceptance Criteria.

(a) The Department shall evaluate Reports submitted under Section 700.5. A Report shall be accepted if it contains the elements required under Section 700.5, subsection (b), and meets the following criteria:

(1) The Report was properly validated by an individual with the qualifications specified in Section 700.4.

(2) The data and data grading values in the audit sheet indicate that the system is operating in a manner that is congruent with known characteristics of potable water system operations. To evaluate congruency, the Department may consider the presence and significance of any of the following conditions:

(A) The real losses are less than 0.0.

(B) The cost of the non-revenue water is greater than 100% of operating costs.

(b) If the Department does not accept a Report as described in subsection (a), the Department shall return the Report to the urban retail water supplier. The urban retail water supplier shall resubmit a completed Report within 90 days of a Report being returned.

Note: Authority cited: Section 10608.34, Water Code. Reference: Section 10608.34, Water Code.

Appendix M. Recycled Water

This appendix describes the various aspects of municipal recycled water to support completion of the urban water management plan (UWMP) recycled water section and tables discussed in Chapter 5. The appendix provides clarification on how to define and document recycled water in the 2020 UWMPs, as well as additional background information that may be helpful for understanding recycled water and, in turn, completing the wastewater and recycled water requirements in the 2020 UWMPs.

The topics covered in Appendix M are as follows:

- Status of Recycled Water in California
- Recycled Water Definition
- Title 22
- Levels of Treatment
- Disposal vs Recycling
- Direct vs Indirect Use
- Planned vs Unplanned Beneficial Uses
- Potable vs Non-potable Reuse
- Direct Potable and Indirect Potable Reuse
- Supplemental Water
- Quantifying Recycled Water Production and Use within the Area Considered by the UWMP
- Estimating vs Metering
- Involved Agencies
- Wholesaler vs Retailer
- Internal Reuse
- Coordination of UWMP and the 2015 Recycled Water Survey Data
- Beneficial Uses

- Recycled Water Use and Urban Per Capita Water Use Targets
- Fit for Purpose
- Tables
- Figures

M.1 Status of Recycled Water in California

Recycled water as a water supply potentially can provide additional locally available and locally controlled water resources. It has been safely reused in California for more than 100 years and the state, as of 2015, is annually reusing over 714,000 acre-feet (AF) to meet water supply needs (Municipal Wastewater Recycling Survey 2015). Although this is a significant amount of water, there is potential to increase this amount and provide greater local water supply reliability.

M.2 Recycled Water Definition

Municipal recycled water is wastewater that has been treated to a specified quality to enable it to be used again. As defined in Water Code Section 13050(n), recycled water means "water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource." Although the legal definition does not specify the source of water, in common use, "recycled water" refers to water originating as municipal wastewater, and it is the reuse of that wastewater that is tracked in UWMPs.

There are two requirements that treated municipal water must meet to be classified as recycled water in UWMPs. It must be reused:

- Beneficially, in a manner consistent with recycled water criteria in Title 22 of the California Code of Regulations.
- In accordance with a Regional Water Quality Control Board (RWQCB) permit, such as National Pollutant Discharge Elimination System, waste discharge requirements, or water recycling requirements.

The terms "recycled water" and "reclaimed water" have the same meaning and can be used interchangeably. But, recycled water is used more commonly and implies a municipal wastewater source. The process by which a facility (industrial or otherwise) uses process water multiple times is usually referred to as internal reuse to distinguish it from municipal recycled water.

The quality of most water discharged from a wastewater facility in California is suitable to be recycled for some beneficial use. Recycled water encompasses a range of water qualities, depending on the level of treatment provided at the wastewater facility. The distinction between discharged or disposed wastewater effluent and recycled water is the act of the planned beneficial reuse that makes the treated effluent “recycled water”. The term “recycled water” indicates a beneficial use after wastewater treatment. It does not mean or imply a certain level of treatment, such as “tertiary-treatment.”

Municipal wastewater originates primarily from domestic (household) sources, but it can include commercial, industrial, and institutional wastewater discharged to a sanitary sewer. Industrial water is considered municipal recycled water when it is comingled with other municipal wastewater or treated by a municipal wastewater treatment facility. Industrial wastewater that is separately treated and reused is not categorized as municipal recycled water.

M.3 Title 22

Title 22 (California Code of Regulations, Division 4, Chapter 3, Section 60301 et seq.) is the regulation overseeing reuse or “recycling” of municipal wastewater to protect public health. Level of treatment and bacteriological water quality standards are used in Title 22 to define what uses are legally allowed, based on the probability of public contact to protect public health. Title 22 identifies uses for a range of wastewater treatment levels, from undisinfected secondary treatment through water that has undergone advanced treatment. Title 22 regulations also specify monitoring and reporting requirements and onsite use area requirements.

The State Water Resource Control Board’s (SWRCB’s) Division of Drinking Water administers the adoption of Title 22 regulations and oversees their application. The applicable provisions of Title 22 are incorporated into permits issued by RWQCB or statewide general permits issued by SWRCB. These permits are the mechanism for enforcement of Title 22 regulations.

M.4 Levels of Treatment

Municipal wastewater that can be beneficially reused is classified by its level of treatment in accordance with Title 22. Primary-treated water, that which has removed 70 to 85 percent of the organic and inorganic solids through either settling or floating, is not able to be recycled in California. When reporting level of treatment in Tables 6-3 and 6-4, one of the five treatment categories specified in Title 22 must be used. The specific requirements for each level of treatment are included in Title 22, but are briefly summarized, as follows:

- Secondary, Undisinfected (California Code of Regulations [CCR] Section 60301.900) — Oxidized wastewater.
- Secondary, Disinfected-23 (CCR Section 60301.225) — Oxidized and disinfected wastewater.
- Secondary, Disinfected-2.2 (CCR Section 60301.220) — Oxidized and disinfected to a higher level than Secondary, Disinfected-23.
- Tertiary (CCR Section 60301.230) — Oxidized, filtered, and disinfected wastewater to achieve both bacterial and virus removal.
- Advanced (CCR Section 60320.201) — Treatment technologies beyond conventional coagulation, filtration and disinfection, including reverse osmosis, micro- or nanofiltration, ozonation, or advanced oxidation. Refer to the CCR for specific requirements.

Tables at the end of this appendix summarize uses allowed for levels of municipal recycled water treatment specified in Title 22. Although Title 22 lists specific allowed uses, other uses are permitted and approved on a case-by-case evaluation by the SWRCB’s Division of Drinking Water (DDW). Examples of other specific allowed non-potable recycled water applications are geothermal power production and carpet dying. In general, the linkage between level of recycled water treatment and potential uses specified in Title 22 is strongly influenced by the potential for direct human contact and ingestion, with higher levels of treatment (tertiary or advanced) required for open public access and worker contact conditions.

A key component of incorporating municipal recycled water into water supply is aligning potential uses to the availability of various levels of treated municipal recycled water. Determining municipal recycled water availability requires coordination with both the local water and wastewater agencies, because each jurisdiction has its own roles, authorities, and service areas with respect to municipal recycled water generation and distribution.

M.5 Disposal vs Recycling

There are three situations where misconceptions may occur about the distinction between wastewater disposal and recycled water:

- Release of treated municipal wastewater into a receiving water body.
- Land application of treated municipal wastewater onto a field for the primary purpose of disposal.
- Treated wastewater percolation ponds.

Once the treatment process is complete and the effluent is released into a receiving water body, the effluent becomes part of the receiving water body and is considered disposal unless there is a contractual arrangement to use the river to convey the treated water from the discharger to a downstream user. If a downstream user extracts water from the water body without a contractual relationship with the upstream discharger, the reuse of the treated effluent would be considered an incidental use (see below for further discussion of incidental use).

If a wastewater treatment plant uses land application to dispose of its treated effluent, how the irrigated field is subsequently used distinguishes whether the disposal can also be considered as water recycling. If the field has a planned use for pastureland or crop cultivation, then the effluent would be classified as recycling for agricultural irrigation. If there is no use of the field, then the effluent discharge is considered disposal without recycling.

Percolation disposal ponds may be adding water to a usable aquifer, but that incidental recharge is not a planned purpose of such ponds and these ponds are not regulated as a water supply source. Thus, percolation from disposal ponds is not counted as groundwater recharge or recycled water use.

M.6 Direct vs Indirect Use

Direct beneficial use is defined in the CCR Section 60301.200 as the use of recycled water that has been transported from the point of treatment or production to the point of use without an intervening discharge to waters of the State. Direct reuse involves a conveyance structure, such as a pipe or canal, to take treated wastewater from the point of treatment to the point of use. Typically, treated wastewater is discharged into rivers and streams as part of permitted disposal practices. Discharged water then commingles with the stream or river that may be a water source for downstream communities or agricultural users. These downstream uses are considered indirect reuse. Groundwater recharge and surface water augmentation with recycled water are two forms of planned indirect reuse for potable use; these are discussed below.

M.7 Planned vs Unplanned Beneficial Uses

Treated municipal wastewater is integrated into California's water supply through both planned and unplanned applications. A planned reuse is an intentional use of recycled water without relinquishing control. Planned reuses are generally identified in planning studies and permit applications. They also generally involve agreement between the recycled water supplier and the recycled water user.

An unplanned reuse occurs when water is discharged and subsequently reused by an entity that is not the discharger without a continuity of custody of the water. Indirect reuse is often also unplanned reuse, with the major exception of indirect potable reuse, which is discussed below. Non-potable indirect reuse may also be planned if treated wastewater is discharged — usually into a surface water body — and there is prearranged agreement or intention between the producer and user that treated wastewater discharge will be maintained in specified quantities and times for use by downstream diverters. Discharged treated wastewater supplements river flow and can be a downstream benefit for wetland or aquatic habitat, or withdrawn by a downstream river water user. In the case of the latter, the wastewater discharge is regulated to protect the all beneficial uses of the receiving water (Recycled Water Task Force 2003). The instream benefits of treated wastewater discharge and indirect reuse by downstream diversions are both important components of managing California's water resources, but they are distinguished from planned reuse.

M.8 Potable vs Non-potable Reuse

Non-potable recycling includes any application not involving drinking water for human consumption, such as landscape or agricultural irrigation, commercial applications such as car washes or dual-plumbed office buildings, or industrial process such as oil refineries or cooling towers. Examples of non-potable uses are given in the Beneficial Uses section below. Potable reuse results in augmentation to drinking water supplies. Potable reuse can be either direct reuse or indirect reuse.

M.9 Direct Potable and Indirect Potable Reuse

Direct potable reuse is the planned introduction of recycled water either directly into a public water system, as defined in Section 116275 of the California Health and Safety Code, or into a raw water supply immediately upstream of a water treatment plant. Direct potable reuse is a practice which is not currently occurring in California.

Indirect potable reuse occurs when tertiary or advanced treated wastewater augments drinking water resources. The two types of indirect potable reuse are as follows:

- Indirect potable reuse for groundwater recharge, where recycled water recharges a groundwater basin and groundwater is later extracted from the basin.
- Surface water augmentation, where recycled water is added into a surface water reservoir used as a source of domestic drinking water supply.

Potable use does not actually occur until the water is subsequently pumped from the ground or withdrawn from the reservoir, treated, and added to the drinking water distribution system.

Because seawater intrusion barriers typically result in groundwater recharge, they may be considered a form of indirect potable reuse.

Indirect potable reuse through groundwater recharge has occurred in California since 1962. Title 22, Division 4, Chapter 3, Article 5.1 (CCR Section 60320 et seq.) describes the permitting and monitoring process required to obtain a RWQCB permit for groundwater recharge.

Water Code Section 13558 requires SWRCB to adopt regulations for onsite treatment and reuse of non-potable water in multifamily residential, commercial, and mixed-use buildings on or before December 1, 2022.

M.10 Supplemental Water

Supplemental water is water added to a recycled water system to meet peak demands when the supply of recycled water cannot meet demands. Supplemental water may also be added to recycled water systems during interruptions in the recycled water supply or to a groundwater recharge project as a required blend with tertiary-treated water.

Supplemental water can be potable or non-potable. If a supplier adds supplemental water to its recycled water system, the volume of supplemental water is not to be included in the volumes of recycled water provided by UWMP preparers in Tables 6-4 and 6-5 but is to be included as a separate line in Table 6-4.

M. 11 Quantifying Recycled Water Production and Use within the Area Considered by the UWMP

The focus of the discussion of recycled water in an UWMP is to be the volume of wastewater generated and treated and the amount of recycled water beneficially reused within the service area. This can be a straight-forward assessment when there is one utility that provides both water and water services within a service area. It can get very complicated in larger urban areas where cities are adjacent to each other and independent water suppliers (suppliers) provide regional services. For example, wastewater generated within a service area is not always treated within the service area or recycled water used in a service area may have been generated in another service area.

Guidance on collection and treatment scenarios and how an UWMP preparer should approach completing Tables 6-2 and 6-3 is provided at the end of this section.

M.12 Estimating vs Metering

Table 6-2 summarizes wastewater volumes collected within the service area. Because wastewater volumes frequently are not metered, it may be necessary to estimate values. For this table, indicate in the appropriate column whether the values provided are from estimated or metered data. It is assumed that the volumes in the remaining tables summarizing wastewater and recycling will be metered data with the exception of Table 6-6 (methods to increase recycled water use).

M.13 Involved Suppliers

The guidebook requests a summary list of suppliers or organizations involved in the collection, treatment, or discharge of wastewater. This list should also include recycled water agencies and may consider organizations involved but not directly participating in the treatment process, such as groups operating a wetland or participants in memoranda of understanding. It could also include contracted operations as well as joint-venture participants. It is likely that many of these organizations would be part of the overall UWMP outreach effort.

M.14 Wholesaler vs Retailer

A recycled water wholesaler is an organization that distributes recycled water to another organization that is not an end user. A wholesaler obtains the recycled water fully treated from another agency, may provide additional treatment to partially treated wastewater, or may provide all treatment of wastewater. A recycled water retailer distributes recycled water to end users. An agency may also be both a wholesaler and a retailer if it has direct customers that use recycled water and it provides recycled water to another organization that distributes it to end users in that service area.

M.15 Internal Reuse

Wastewater facilities frequently internally reuse partially or fully treated, non-potable water within their facilities for equipment cleaning or minor landscaping. This is a similar practice to industrial internal reuse. Although this internal reuse is a beneficial use, internal industrial or wastewater treatment reuse should not be included with other recycled uses in Tables 6-3, 6-4, or 6-5.

If a wastewater plant uses treated effluent for on-site landscape irrigation at a treatment plant where public access is not restricted, that volume should be entered in Table 6-4 as landscape irrigation. The table should also include treated wastewater used offsite for sewer system maintenance, such as sewer line flushing (included in the "Other" category).

M.16 Beneficial Uses

The term "beneficial uses" applies to almost every aspect of water use in California. Water Code section 13050(f) specifies: "Beneficial uses" of the waters of the state that may be protected against quality degradation include, but are not limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.

For the purposes of recycled water, Water Code 10633(d) specifies that a UWMP must contain a description and quantification of the potential uses of recycled water, including, agricultural irrigation, landscape irrigation, wildlife habitat enhancement, wetlands, industrial reuse, groundwater recharge, indirect potable reuse, and other appropriate uses, and a determination with regard to the technical and economic feasibility of serving those uses. UWMP preparers are requested to review the descriptions, provided below, of the recycled water beneficial uses to be quantified and apply them to completing the tables summarizing recycled water use for their service area. Recycled water does not have to offset potable demand to be considered beneficially reused.

The quantified data provided for the beneficial uses by the recycled water provider must be for uses authorized by a permit issued by a RWQCB or SWRCB for waste discharge or water recycling. Volumes indicated in Tables 6-4 and 6-5 should be consistent with that permit.

An “Other” category is included in Tables 6-4 and 6-5. But, it is intended that the category be used only if there is no other appropriate category. A category of water use, institutional water use, is used in water use accounting but is not used in recycled water use accounting. An institutional water user is a water user dedicated to public service, such as higher education institutions, schools, courts, churches, prisons, hospitals, government facilities, and non-profit institutions. Recycled water used by institutional water users is to be included with the type of use and will generally be landscape irrigation, golf course irrigation, agricultural irrigation, or “Other” categories.

The following provides specific definitions of each beneficial use classification.

Agricultural Irrigation

Irrigation of food, fiber, and fodder crops, and pastureland. This also includes Christmas tree production, pasture for farm animals, and wholesale plant nurseries.

Landscape Irrigation (excluding Golf Courses)

Irrigation of parks, schools, cemeteries, churches, residential, streetscapes, slope protection, or public facilities. Golf course irrigation is not included. Water to maintain aesthetic impoundments within landscaped areas is included with landscape irrigation. Fill stations primarily used for public use should be classified as landscape irrigation.

Golf Course Irrigation

Irrigation of golf courses, whether publicly or privately held. Water used to maintain aesthetic impoundments within golf courses is also included with golf course irrigation.

Commercial Use

Uses by commercial water users, except landscape irrigation. A commercial water user is a water user that provides or distributes a product or service. Examples of commercial water use are: commercial building use (toilets, HVAC, etc.), car washes, laundries, and retail nurseries.

Landscape irrigation of commercial building areas is to be classified as landscape irrigation if it is separately metered or if landscape is the dominant use of mixed uses served by a single meter. Fill stations, if they are primarily used for commercial use, should be classified as commercial use. Landscape irrigation on golf courses should be reported as golf course irrigation. Fill stations primarily used for public use should be classified as landscape irrigation.

Industrial Use

Uses by industrial water users, except landscape irrigation and geothermal energy production. An industrial user is a water user that is primarily a manufacturer or processor of materials.

Examples of industrial water uses are cooling towers, oil refining, process water, and mining. Landscape irrigation of industrial building areas is to be classified as landscape irrigation if it is separately metered or if landscape is the dominant use of mixed uses served by a single meter.

Geothermal and Other Energy Production
Water used to augment geothermal zones or used in the energy industry, excluding refineries. Refinery use is classified as industrial.

Seawater Intrusion Barrier
Injected water in coastline setting designed to reduce seawater intrusion into a coastal aquifer with a seawater interface.

Recreational Impoundment
Addition of water to maintain water levels in a lake for recreation or other non-potable uses. Lakes for wildlife habitat are included in the natural systems/restoration category. Small impoundments that are features in parks or golf courses are included as part of landscape irrigation or golf course irrigation.

Natural Systems/Restoration
Any water provided to a designated wildlife area, whether included as part of a wastewater facilities treatment process or an independent area. The area must be designated as a wetland or wildlife area and so does NOT include water that a wastewater facility must discharge to maintain habitat in the creek to which it is discharging. This category also includes recycled water used at wetlands, wildlife habitats and refuges, and duck clubs.

Groundwater Recharge (IPR)
Addition of water to augment groundwater aquifers for future use. Only groundwater recharge projects that are permitted by the state or regional water boards for the purpose of groundwater recharge is accounted for in this category. A water agency cannot claim as planned groundwater recharge treated wastewater incidentally recharging groundwater as a result of leakage from evaporation/percolation ponds.

When recycled water is blended with other water sources within the recharge system, only the amount of recycled water is to be reported in Tables 6-4 and 6-5.

Surface Water Augmentation (IPR)

Surface water augmentation is defined in the Water Code as “the planned placement of recycled water into a surface water reservoir used as a source of domestic drinking water supply” (Water Code Section 13561). Surface water augmentation is not allowed in California at this time; so, 2015 recycled water use cannot be classified as surface water augmentation. But, regulations for its implementation are being prepared by the SWRCB’s DDW, so projects may be permitted and implemented by 2020. In Table 6-4, surface water augmentation may be considered a future beneficial use in 2020 and thereafter.

Direct Potable Reuse

Direct potable reuse is defined in the CWC as “the planned introduction of recycled water either directly into a public water system or into a raw water supply immediately upstream of a water treatment plant” (Water Code Section 13561). This use is currently not permitted in the State of California, but its feasibility is being assessed by an expert panel supported by the SWRCB’s DDW. A time frame for permitting and implementing direct potable reuse projects is uncertain at this time, but a supplier may be considering and planning for its enactment. In Table 6-4, direct potable reuse may be considered a future beneficial use in 2020 or thereafter, but it is not certain that regulations allowing implementation will be in place.

Other

If a recycled water use cannot be classified into one of the categories identified above, a supplier may use this category. Sewer system flushing and firefighting are two possible uses that could be classified as “Other.” Fill stations should not be classified as “Other.” If the fill station was primarily used by commercial users for dust control or other purposes, fill station use should be classified as “Commercial use.” If the majority was used by landscapers or residential customers, then the use should be classified as “Landscape irrigation.”

M.17 Recycled Water Use and Urban Per Capita Water Use Targets

Urban water suppliers may exclude recycled water use for the purpose of setting and meeting per capita water use targets. The amounts of recycled water excluded must be calculated in accordance with the methodologies in Chapter 5, and these amounts may not coincide with the amounts of recycled water reported in Tables 6-4 and 6-5.

M.18 Fit for Purpose

A concept that organizations may find useful for increasing recycled water use within the UWMP area is a concept referred to as “fit for purpose” (U.S. Environmental Protection Agency 2012).

The basis of this concept is that the level of wastewater treatment should be commensurate with the uses of recycled water to ensure adequate treatment to meet the needs of users or protect public health while avoiding excessive treatment and associated costs. More rigorous treatment (and more energy-intensive processes) is reserved for uses with higher human or food production contact to minimize pathogen or harmful chemical contact. Conversely, less-treated wastewater has been safely used for decades in many agricultural reuse applications, which is the largest category of recycled water use in California. Greater reuse of secondary-treated wastewater in agriculture and environmental settings, where additional “natural treatment” through exposure to sunlight and soil contact can augment wastewater plant treatment, may provide additional opportunities for expanding recycled water use. Finally, suppliers may determine that having available multiple levels of treated wastewater may support increased integration of recycled water use into their water supply portfolio. For example, West Basin Municipal Water District is successfully providing multiple water quality levels of recycled water to its customers to meet specific needs of its diverse customer base.

M.19 Tables

Each UWMP will have three to five tables addressing wastewater and recycled: Tables 6-2, 6-3, and 6-6. Tables 6-4 and 6-5 are included in the UWMP if recycled water is being used in an UWMP area or is planned to be during the planning horizon of the UWMP (required to be 20 years, but may be 25 years at the discretion of the supplier). suppliers complete Table 6-6 to show actions they have considered to begin or increase use of recycled water. Additional guidance for completing each table is included below.

Submittal Table 6-2 Retail: Wastewater Collected Within Service Area in 2020

Submittal Table 6-2 Retail: Wastewater Collected Within Service Area in 2020						
☐	There is no wastewater collection system. The supplier will not complete the table below.					
	Percentage of 2020 service area covered by wastewater collection system *(optional)*					
	Percentage of 2020 service area population covered by wastewater collection system *(optional)*					
Wastewater Collection			**Recipient of Collected Wastewater**			
Name of Wastewater Collection Agency	Wastewater Volume Metered or Estimated? *Drop Down List*	Volume of Wastewater Collected from UWMP Service Area 2020	Name of Wastewater Treatment Agency Receiving Collected Wastewater	Treatment Plant Name	Is WWTP Located Within UWMP Area? *Drop Down List*	Is WWTP Operation Contracted to a Third Party? *(optional)* *Drop Down List*
Add additional rows as needed						
Total Wastewater Collected from Service Area in 2020:		0				
NOTES:						

Each retail supplier completes this table for all wastewater **collected** within the UWMP service area. Instructions for completing the table are as follows:

- If there is not a centralized wastewater collection system (the UWMP area is 100 percent septic), then check this box and do not complete the remainder of the table. Continue completing the table if there is a wastewater collection system.
- Percentage of 2020 service area covered by wastewater collection system (optional): Using the 2020 size of the UWMP area, identify what percentage (to the nearest whole number) of the service area is covered by sewer service.
- Percentage of 2020 service area covered by wastewater collection system (optional): Using the 2020 population determined for the gallons per capita per day calculations (Section 5), identify what percentage (to the nearest whole number) of the population is covered by sewer service.
- Enter wastewater collection agency information and the wastewater treatment plants within the service area. Enter the requested

information for each column.

Starting in Row 8, enter the name of the wastewater collection agency. In the next column of the same row, enter the volume of wastewater **collected** within the UWMP area and treated at the wastewater facility identified in the row. In the next column, enter the names (one per row) of each agency receiving collected wastewater and then treating it. In the next column, enter the names of the wastewater facility (one per row) treating the wastewater produced within the UWMP area. In the next column, select whether or not the wastewater treatment plant (WWTP) is located within the service area of the UWMP (or service areas of the suppliers covered under the UWMP). And then in the final column, enter the names of the wastewater facility (one per row) treating the wastewater produced within the UWMP area.

Submittal Table 6-3 Retail: Wastewater Treatment and Discharge Within Service Area in 2020

Submittal Table 6-3 Retail: Wastewater Treatment and Discharge Within Service Area in 2020											
☐	No wastewater is treated or disposed of within the UWMP service area. The Supplier will not complete the table below.										
							2020 volumes				
Wastewater Treatment Plant Name	Discharge Location Name or Identifier	Discharge Location Description	Wastewater Discharge ID Number *(optional)*	Method of Disposal *Drop down list*	Does This Plant Treat Wastewater Generated Outside the Service Area?	Treatment Level *Drop down list*	Wastewater Treated	Discharged Treated Wastewater	Recycled Within Service Area	Recycled Outside of Service Area	Instream Flow Permit Requirement
Add additional rows as needed											
						Total	0	0	0	0	0
NOTES:											

This table is to be completed for all wastewater TREATED OR DISPOSED within the UWMP area. If neither occur, the table does not have to be completed. Instructions for completing the table are as follows:

- If wastewater is neither treated nor disposed, then check the box and do not complete the rest of the table. If wastewater is treated or disposed within the service area, including use of recycled water, then the supplier continues to fill out the table.
- Enter the WWTP name, as indicated. Use as many rows as needed. Multiple rows can be used for one treatment plant, if different quality waters are produced, or if there are multiple discharge locations or

wastewater discharge IDs. For each WWTP and non-recycled wastewater discharged within the UWMP service area, provide the requested information.

- For the columns marked “2020 volumes,” enter the total amount of wastewater generated in 2020 within the UWMP service area. The value in the outlined cells are what should be reported in Tables 6-4 and 6-5.

In the columns to the right of the WWTP Name, enter the following information (listed by column):

- Discharge Location Name or Identifier
- Discharge Location Description
- Wastewater Discharge ID Number (optional)
- Method of Disposal
- Does This Plant Treat Wastewater Generated Outside the Service Area?
- Treatment Level
- Then enter volumes from 2020 for each of the following:
    - Wastewater Treated: Enter the total volume of water treated at the wastewater facility associated with the discharge location. If more than one row is used to fully account for different levels of wastewater treatment and/or discharge.
    - Discharged treated wastewater in 2020: Enter the volume to treated wastewater that was not recycled and was discharged to the environment at the discharge location.
    - Recycled within Service Area: Enter the volume of recycled water used within the service area. If more than one treatment level of recycled water is used, use more than one row. If recycled water is provided outside the service area directly to customers that are not included in another UWMP, this recycled water is to be included in this column. In the notes (Row 4), indicate the amount of recycled water directly supplied outside the service area. This directly supplied recycled water is to be included in subsequent tables with the outlined cell (Tables 6-4, 6-5, and 6-6).

- Recycled Outside of Service Area: Enter the volume of recycled water produced within the service area but transported for use to another area that is included in the UWMP of a different supplier.

- Instream Flow Permit Requirement: Enter the volume of instream flow required by permit.

Submittal Table 6-3 Wholesale: Wastewater Treatment and Discharge within Service Area in 2020

Submittal Table 6-3 Wholesale: Wastewater Treatment and Discharge Within Service Area in 2020										
☐	Wholesale Supplier neither distributes nor provides supplemental treatment to recycled water. The Supplier will not complete the table below.									
							2020 volumes			
Wastewater Treatment Plant Name	Discharge Location Name or Identifier	Discharge Location Description	Wastewater Discharge ID Number *(optional)*	Method of Disposal *Drop down list*	Does This Plant Treat Wastewater Generated Outside the Service Area?	Treatment Level *Drop down list*	Wastewater Treated	Discharged Treated Wastewater	Recycled Within Service Area	Recycled Outside of Service Area
Add additional rows as needed										
						Total	0	0	0	0
NOTES:										

This table is to be completed by a wholesale supplier it provides supplemental treatment to recycled water it distributes. Instructions for completing the table are as follows:

If the wholesale supplier does not distribute nor provide supplemental treatment to recycled water, please select the checkbox and go on to the next applicable table of the UWMP. If the supplier provides supplemental treatment to recycled water it distributes, the following further describes the information to enter for each column for each WWTP and non-recycled wastewater discharged within the UWMP service area (list each WWTP separately as its own row):

- Discharge Location Name or Identifier
- Discharge Location Description
- Wastewater Discharge ID Number (optional)
- Method of Disposal

- Does This Plant Treat Wastewater Generated Outside the Service Area?
- Treatment Level
- Then enter volumes from 2020 for each of the following:
  - Wastewater Treated: Enter the total volume of water treated at the wastewater facility associated with the discharge location. If more than one row is used to fully account for different levels of wastewater treatment and/or discharge.
  - Discharged treated wastewater in 2020: Enter the volume to treated wastewater that was not recycled and was discharged to the environment at the discharge location.
  - Recycled within Service Area: Enter the volume of recycled water used within the service area. If more than one treatment level of recycled water is used, use more than one row. If recycled water is provided outside the service area directly to customers that are not included in another UWMP, this recycled water is to be included in this column. In the notes (Row 4) indicate the amount of recycled water directly supplied outside the service area. This directly supplied recycled water is to be included in subsequent tables with the outlined cell (Tables 6-4, 6-5, and 6-6).
  - Recycled Outside of Service Area: Enter the volume of recycled water produced within the service area but transported for use to another area that is included in the UWMP of a different supplier.

Submittal Table 6-4 Retail: Current and Projected Recycled Water Direct Beneficial Uses within Service Area

Submittal Table 6-4 Retail: Current and Projected Recycled Water Direct Beneficial Uses Within Service Area										
☐	Recycled water is not used and is not planned for use within the service area of the supplier. The supplier will not complete the table below.									
Name of Supplier Producing (Treating) the Recycled Water:										
Name of Supplier Operating the Recycled Water Distribution System:										
Supplemental Water Added in 2020 (volume) *Include units*										
Source of 2020 Supplemental Water										
Beneficial Use Type	*Projected:* Potential Beneficial Uses of Recycled Water (Describe)	*Projected:* Amount of Potential Uses of Recycled Water (Quantity) *Include volume units*	General Description of 2020 Uses	Level of Treatment *Drop down list*	2020	2025	2030	2035	2040	2045 (opt)
Agricultural irrigation										
Landscape irrigation (excludes golf courses)										
Golf course irrigation										
Commercial use										
Industrial use										
Geothermal and other energy production										
Seawater intrusion barrier										
Recreational impoundment										
Wetlands or wildlife habitat										
Groundwater recharge (IPR)*										
Surface water augmentation (IPR)*										
Direct potable reuse										
Other *(Provide General Description)*										
				Total:	0	0	0	0	0	0
Internal Reuse (*not counted towards Statewide Recycled Water volume*).										
**IPR - Indirect Potable Reuse*										
NOTES:										

The purpose of Table 6-4 is to record the current and projected recycled water for current and projected beneficial uses. A supplier completes Table 6-4 Retail if there is any recycled water used or projected in its service area. If recycled water is not currently nor planned to be used, the table does not have to be completed (check the box at the top and do not complete the table).

For those completing this table, please note that if recycled water within the supplier's service area is supplied by more than one entity operating separate systems, the supplier creates multiple versions of this table so that each system is reported in its own table. If recycled water is obtained from multiple suppliers but operated within a single system, please provide the total amount of recycled water obtained in 2020 from each provider in Row 1, but report the use numbers in a single table.

The top portion of the table includes space for the supplier to enter the name of the supplier treating the recycled water, and the name of the organization that operates the recycled water distribution system. If more than one entity supplies recycled water into a single distribution system, indicate each supplier's 2020 total. For example, Supplier A (250 AF) and Supplier B (125 AF). If any supplemental water was added in 2020, list the addition volume, and the name or description of the source of the supplemental water. Record the volume of water added to the recycled water system in 2020 that was **not** municipal recycled water.

The remainder of the table is structured for the supplier to enter information about potential or actual beneficial uses of recycled water and to document the volumes used in 2020 and projected into 20–25 years by five-year increments.

The supplier will enter either a potential beneficial use **or** an existing beneficial use from 2020 in each row. List as many as are relevant, one per row. List all the potential uses under the appropriate header, followed by its expected volume (with units). List all existing beneficial uses from 2020 in new rows under the appropriate header, followed by its actual volume use in 2020 and then projected for every five years up to 2040 or 2045.

Each row should have either a projected use listed or a 2020 use (recorded in different columns), but not both. Suppliers can add as many extra rows as are needed. For each use recorded, provide the actual and projected uses for the identified uses of recycled water. For “surface water augmentation” and “direct potable reuse,” entry of 2020 use is not allowed because these uses are currently not permitted.

The “other” category is to be used for uses not classified by any of the provided use types. “Other” use types may include firefighting, fill stations, and dust control. If a supplier has multiple “other” uses, additional lines can be inserted.

Submittal Table 6-4 Wholesale: Current and Projected Retailers

Provided Recycled Water Within Service Area

Submittal Table 6-4 Wholesale: Current and Projected Retailers Provided Recycled Water Within Service Area							
☐	Recycled water is not directly treated or distributed by the Supplier. The Supplier will not complete the table below.						
Name of Receiving Supplier or Direct Use by Wholesaler	Level of Treatment *Drop down list*	2020	2025	2030	2035	2040	2045 *(opt)*
Add additional rows as needed							
	Total	0	0	0	0	0	0
NOTES:							

Submittal Table 6-4 Wholesale is to be completed by a wholesale supplier for any recycled water it directly treats or distributes to retail suppliers. Enter the name of each supplier to which recycled water was provided and used in the service area.

For each supplier entered, the supplier enters the total amount of recycled water used or planned for use for each of the corresponding years within the service area. The total for the Year 2020 should equal the value of the sum of the corresponding totals in Tables 6-3 and 6-5.

Submittal Table 6-5 Retail: 2015 UWMP Use Projection Compared to

2020 Actual

Submittal Table 6-5 Retail: 2015 UWMP Recycled Water Use Projection Compared to 2020 Actual			
☐	Recycled water was not used in 2015 nor projected for use in 2020. The Supplier will not complete the table below.		
Use Type		**2015 Projection for 2020**	**2020 Actual Use**
Agricultural irrigation			
Landscape irrigation (excludes golf courses)			
Golf course irrigation			
Commercial use			
Industrial use			
Geothermal and other energy production			
Seawater intrusion barrier			
Recreational impoundment			
Wetlands or wildlife habitat			
Groundwater recharge (IPR)			
Surface water augmentation (IPR)			
Direct potable reuse			
Other	*Type of Use*		
	Total	0	0
NOTES:			

If recycled water was not used in 2015 or 2020 (and the supplier did not project for recycled water to be used in 2020), the table does not have to be completed. A supplier completes Submittal Table 6-5 Retail if recycled water was used in 2015 or 2020, or if it was projected to be used for 2020.

For each use type listed, enter the 2015 UWMP's projected 2020 volume of recycled water used. In the next column, enter the volume of recycled water actually used in 2020.

Submittal Table 6-5 Wholesale: 2015 UWMP Use Projection Compared to 2020 Actual

Submittal Table 6-5 Wholesale: 2015 UWMP Recycled Water Use Projection Compared to 2020 Actual		
☐	Recycled water was not used or distributed by the supplier in 2015, nor projected for use or distribution in 2020. The wholesale supplier will not complete the table below.	
Name of Receiving Supplier or Direct Use by Wholesaler	2015 Projection for 2020	2020 Actual Use
Add additional rows as needed		
Total	0	0
NOTES:		

If recycled water was not used in 2015 or 2020, the table does not have to be completed. Wholesale suppliers complete this table if they distributed recycled water in 2015 or 2020.

For those suppliers that complete the table, enter the actual and projected volumes of recycled water provided to retail or wholesale customers in 2020. The sum of the 2020 Actual Use should equal the sum of the corresponding cells in Table 6-3 and 6-4. If they are not equal, please explain in the UWMP text and the Notes section at the bottom of this table.

Submittal Table 6-6 Retail: Methods to Expand Future Recycled Water Use

Submittal Table 6-6 Retail: Methods to Expand Future Recycled Water Use			
☐	Supplier does not plan to expand recycled water use in the future. Supplier will not complete the table below but will provide narrative explanation.		
	Provide page location of narrative in UWMP		
Name of Action	Description	Planned Implementation Year	Expected Increase in Recycled Water Use
Add additional rows as needed			
		Total	0
NOTES:			

If the supplier does not plan to expand recycled water use in the future, the supplier selects the relevant box, describe the limitations for implementing or expanding recycled water use in the narrative of its UWMP with page number and not complete the rest of the table.

For those suppliers with plans to expand recycled water use in the future, enter the name of the action, meaning specific actions planned to be taken to increase the use of recycled water within the UWMP area. These may include specific programs such as onsite retrofit support, price reduction per unit volume of recycled water, increased discussion with potential users of recycled water, changes in the permitting to expand user or use area, or development of joint projects with regional partners.

Following listing the approximate year for the listed action (Planned Implementation Year), suppliers enter the volume of expected increase in recycled water use for that action.

Summary of Most Recycled Water Uses Approved Under Title 22

Uses for recycled water are becoming increasingly common among urban water suppliers in California. The more advanced the treatment typically requires more energy demand and increased capital, operational and maintenance costs. The following tables offer examples of beneficial uses by water use type for five levels of water treatment.

Undisinfected Secondary Treatment Beneficial Use Examples

Water Use Type	Beneficial Uses
Agricultural Irrigation	Fodder and fiber crops.
Agricultural Irrigation	Seed crops not eaten by humans.
Agricultural Irrigation	Non-food-bearing trees.
Agricultural Irrigation	Nurseries and sod farms, with limitations.
Agricultural Irrigation	Food crops processed before human consumption.
Agricultural Irrigation	Orchards or vineyards with no contact between edible portion and recycled water.
Other Urban Uses	Sanitary sewer flushing.

Disinfected Tertiary Treatment Beneficial Use Examples

Water Use Type	Beneficial Uses
Urban Irrigation	Residential landscaping.
Urban Irrigation	Golf courses.
Urban Irrigation	Parks and playgrounds.
Urban Irrigation	School yards.
Urban Irrigation	Any other irrigation not specific in Title 22 and not prohibited by other California laws and regulations.
Other Urban Uses	Decorative fountains.
Other Urban Uses	Toilet/Urinal flushing.
Other Urban Uses	Structural firefighting.
Commercial and Industrial	Laundries.
Commercial and Industrial	Cooling or air conditioning.

Water Use Type	Beneficial Uses
Commercial and Industrial	Artificial snowmaking.
Commercial and Industrial	Process water that may contact workers.
Commercial and Industrial	Car washes.
Impoundments	Recreational impoundments.
Indirect Potable Reuse	Groundwater recharge or salinity barrier injection allowed with permits by RWQCBs.

Disinfected Secondary 23 Treatment Beneficial Use Examples

Water Use Type	Beneficial Uses
Agricultural Irrigation	Pastures for dairy animals with human consumption.
Agricultural Irrigation	Non-edible vegetation with access control.
Agricultural Irrigation	Nurseries and sod farms with unrestricted access.
Urban Irrigation	Cemeteries.
Urban Irrigation	Freeway landscaping.
Urban Irrigation	Golf courses with restricted access.
Other Urban Uses	Dust control.
Other Urban Uses	Road cleaning.
Other Urban Uses	Non-structural firefighting.
Commercial and Industrial	Boiler feedwater.
Commercial and Industrial	Mixing concrete.
Commercial and Industrial	Some types of cooling or air conditioning.
Commercial and Industrial	Soil compaction.
Commercial and Industrial	Process water not in contact with workers.
Impoundments	Landscape impoundments.

Disinfected Secondary 2.2 Treatment Beneficial Use Examples

Water Use Type	Beneficial Uses
Agricultural Irrigation	Food crops with surface irrigation with food portion above-ground and not in contact with recycled water.
Impoundments	Restricted recreational impoundment.
Impoundments	Publicly accessible fish hatcheries.

Advanced Treatment Beneficial Use Examples

Water Use Type	Beneficial Uses
Indirect Potable Reuse	Advanced treated recycled water is now defined in the June 18, 2014, revision of Title 22 and is used for groundwater recharge, including groundwater injection for salinity barriers. Advanced treatment also will be considered as part of the surface reservoir augmentation and direct potable reuse efforts to be completed as part of Senate Bill 918 and Senate Bill 322.

M.21 Collection and Treatment Scenarios for Completing Table 6-2

The following offers six plausible scenarios of wastewater treatment responsibility in the service area of the UWMP's supplier. Each scenario offers steps to follow for how to complete Submittal Table 6-2.

Scenario 1: The supplier is responsible for collecting, treating, and disposing of the wastewater generated within its service area.

Steps to follow:

- Complete Tables 6-3.

Scenario 2: The supplier does not treat or dispose of the wastewater generated within its service area. Wastewater is treated and disposed by an organization that does not prepare an UWMP.

Steps to follow:

- Provide narrative description on wastewater disposal (treatment level and location).

Scenario 3: The supplier does not treat or dispose of the wastewater generated within its service area. Wastewater is conveyed for treatment to another entity that also prepares an UWMP.

Steps to follow:

- Provide narrative description on wastewater disposal and the name of the UWMP that applies to the plant receiving the effluent.

Scenario 4: A portion of the wastewater collected in supplier's area is conveyed for treatment to another entity which also prepares an UWMP.

Steps to follow:

- Complete Table 6-3 for the wastewater treated within the service area.
- Provide narrative description on wastewater disposal and the name of the UWMP that applies to the plant receiving the effluent.

Scenario 5: Multiple wastewater facilities may occur within the supplier's area. Untreated wastewater may be received from another agency.

Steps to follow:

- Complete Table 6-3 for the wastewater treated within the service area.
- Summarize volumes reported in Table 6-3 by each separate facility.

M.22 References

DWR and SWRCB. 2015 Municipal Wastewater Recycling Survey 2015. Available online at: https://www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/munirec.shtml (Accessed August 25, 2020).