August 17, 2021

WUEStandards@water.ca.gov

Water Use Efficiency Branch
Department of Water Resources
P.O. Box 942836
1416 9th St, Sacramento, CA 95814

Re: Provisional Outdoor Standard

Dear Water Use Efficiency Branch,

The Association of California Water Agencies (ACWA) and California Municipal Utilities Association (CMUA) appreciate the opportunity to provide comments to the California Department of Water Resources (DWR) on the *provisional outdoor standard presented at the June 30 Standards and Methodologies workshop*. ACWA represents over 460 public water agencies that deliver approximately 90 percent of the water used for residential, commercial and agricultural purposes in California. CMUA represents over 50 water agencies that deliver water to nearly 75 percent of Californians. The Water Code recognizes that our members, local urban retail water suppliers, have the responsibility of meeting the urban water use objective which is comprised of the standard-based water use targets. We additionally note that water agencies are at the forefront of preparing for and managing the impacts of climate change, including longer and more intense droughts. As many of California's regions enter a second consecutive dry year and drought, much has been learned and improved on following California's historic 2012 – 2016 drought.

We recognize that DWR, in coordination with the State Water Resources Control Board (State Water Board), has a statutory requirement to conduct necessary studies and investigations, and recommend no later than October 1, 2021, a standard for outdoor residential and dedicated irrigation meters. However, we have significant concerns regarding DWR's approach to develop a provisional outdoor standard. DWR's provisional standard proposes an ET factor (ETF) of 0.7 for Irrigated Irrigable landscapes. Water suppliers that do not meet their Water Use Objective can also include 20 percent of Irrigable Not Irrigated landscapes in their calculation, also using an ETF of 0.7. DWR's provisional standard assumes an Irrigation Efficiency of 0.8 and is back-calculated based on estimated applied outdoor water. We recognize the importance of developing feasible and implementable outdoor water efficiency standards to help meet the State's long term water use efficiency goals and, therefore, we offer the following comments on DWR's provisional outdoor standard.

ACWA recommends that the outdoor standard be developed based on the principles of MWELO to achieve efficient outdoor use, and not based on design standards that do not reflect actual performance. The outdoor standard should consider real-world performance of irrigation systems and existing landscapes to result in an efficiency standard that is feasible and implementable. Developing the

outdoor standard by back-calculating it using estimates of outdoor applied water (derived from estimates of residential indoor water use) does not reflect optimal irrigation for landscape health, and is subject to multiple sources of error. With these considerations in mind, ACWA recommends that the outdoor standard be established based on the horticultural and irrigation principles of MWELO as follows:

- ***1.0 ETF for Irrigable Irrigated (II):*** An ET Factor of 1.0 considers horticultural science and realistic irrigation efficiency and delivery systems for both new and existing landscapes, as shown in Table 1. This represents a balance between higher water use plants such as turf which are predominant in existing landscapes and lower water use or drought tolerant plants. It also assumes a reasonable balance between existing irrigation efficiency, balancing overhead spray and more efficient drip and high-efficiency rotary nozzles.

Table 1

ET Factors Under Different Lansdcape Factor and Irrigation Efficiency Scenarios

A	B	C		D D = avg(A X C)	E	F F = D X E
Plant Factor	**Plant Type Description**	**% of Area in Landscape**		**Overall Landscape Plant Factor**	**Irrigation Efficiency (IE)**	**ET Factor (based on IE)**
0.3	Low water use plants				0.45	**1.49**
0.5	Woody shrubs/trees	35%			0.55	**1.22**
0.6	Warm season grass		=	0.67	0.625	**1.07**
0.8	Cool season grass	60%			0.70	**0.95**
0.8	Annuals	5%			0.80	**0.84**

- ***0.55 ET Factor for 100% Irrigable Not Irrigated (INI):*** We propose a lower ET factor of 0.55 for INI since any newer plantings and irrigation systems would be expected to be more efficient than existing systems.
- ***1.2 ET Factor for Special Landscape Areas and Recycled Water for 100% of II and INI area:*** This reflects the additional water requirements for functional, special landscape areas, areas irrigated with recycled water, and actual irrigation system performance rather than a design standard.
- ***Remeasure and reevaluate in 5 years:*** There is significant uncertainty about INI areas, including how much irrigation water is required, and the rate of change from INI to II areas. To address this uncertainty, we recommend that the II and INI LAM be remeasured and the ET Factor for INI be reevaluated in 5 years.

Detailed explanations and the supporting data for these outdoor standard recommendations is provided in Attachment A.

We urge DWR to ensure that the final recommended outdoor standard meets the intent of the *Making Water Conservation a California Way of Life.* We have significant concern that the provisional recommendation of a 0.7 ET Factor for the outdoor standard is not a reasonable efficiency standard and will undermine the intent of *Making Water Conservation a California Way of Life*, which was to allow agencies to cost-effectively and flexibly implement water use efficiency. Furthermore, the provisional

recommendation would not allow for healthy landscapes and shade trees, which help mitigate climate change impacts like urban heat island effect that disproportionately impact disadvantaged communities.

We appreciate your consideration of these recommendations and are committed to collaborating with DWR and the State Water Board to successfully implement *Making Water Conservation a California Way of Life.* To discuss these comments, please contact Chelsea Haines at chelseah@acwa.com.

Sincerely,

Chelsea Haines
Regulatory Relations Manager
Association of California Water Agencies

Attachment A

1. **The outdoor standard should incorporate the principles of the Model Water Efficient Landscape Ordinance (MWELO), but it does not need to be based on MWELO irrigation system design standards.**

   While the enabling legislation calls for the outdoor standard to be based on the principles of the Model Water Efficiency Landscape Ordinance (MWELO), it does not require that the MWELO irrigation system design standards be used, or that the outdoor standard be capped based on current MWELO design requirements. Performance of existing irrigation systems cannot be expected to be the same as an irrigation design standard for new or renovated landscape. There are numerous reasons why in-ground irrigation system performance and applied water diverges from design standards, such as the growth of plant material that blocks irrigation over time. Installation not according to the design plan also results in degradation of the irrigation system from the original design that negatively affects actual performance.

   The legislation calls for the principles of MWELO to be incorporated. Principles that are based on horticultural and irrigation science, including ET Adjustment Factors (a product of Plant Factor and Irrigation System Efficiency) and reference evapotranspiration, should guide the development of the outdoor standard as they are most relevant to existing landscapes. In MWELO, landscape designers are required to calculate the Maximum Applied Water Allowance (MAWA), which is a theoretical/optimal volume of water that might be applied on a landscape, given a known area, plant factor and evapotranspiration rate.

   Thus, in developing the outdoor efficiency standard, the plant factor and irrigation system efficiency should not be back-calculated based on an estimated landscape area and estimated applied water; the underlying horticultural and irrigation science of existing landscapes should be used to develop the outdoor efficiency standard. Although the ET Adjustment Factor in MWELO is based on the parcel level, the science and principles can be expanded to multiple parcels or aggregated landscape area using assumptions of the mix of plant material in typical established landscape plant palettes and data on average irrigation efficiency from manufacturers and real-world distribution uniformity (DU) catch-can tests.

   We recommend that DWR use horticultural principles and irrigation system data to develop an appropriate and reasonable outdoor standard that considers both existing and new landscapes and actual performance of existing in-ground irrigation systems.

2. **80% of California's housing stock was built prior to the establishment of MWELO in 1993; these pre-existing residential landscapes were not conceived or built to perform to the design standards found in MWELO.**

   The legislation requires that the outdoor standard consider both new and existing landscapes. Based on housing data for California, from the 2010 US Census and 2019 CA Dept. of Finance, there were over 11 million housing units built before 1990 that were never subject to MWELO. Since 1990, just over 3 million additional housing units have been constructed. Only one in five houses built in California were potentially subject to MWELO design standards. Since 80% of California's housing

stock pre-dates MWELO, it is unreasonable to assume that MWELO's design standards are the operating conditions found in homes, landscapes, and irrigation systems built before 1990. The chart below summarizes the housing stock by decade during which MWELO has been in effect.

Year	1990 (pre-MWELO)	2000	2010	2019
Housing Units	11,182,513	12,214,550	13,680,081	14,235,201

Sources: US Census of Population and Housing for California (web link) and CA Department of Finance housing data from 2019 (web link)

Of the 20% of homes that have been built since MWELO has been in place, typically MWELO only applies to developer installed landscaping, which is usually the front yard, and often not applicable to back-yards. Further, the enforcement of MWELO is only as effective as the land-use regulating agency permitting new homes. Additionally, lack of enforcement of MWELO further weakens its effectiveness, even as a design standard in homes that are subject to it. The review and approval of MWELO landscapes has been non-existent for years and only recently have the approving agencies began to enforce MWELO, although it is still not widely enforced. In addition, the post installation inspection of these new landscapes is virtually non-existent, thus ensuring that these new MWELO landscapes are not installed as designed. Data from East Bay Municipal Utility District (East Bay MUD) data show that sites that were designed to meet MWELO 2010 and 2015 design standards perform above 150% of reference evapotranspiration.

3. **Use of a design standard of 0.8 for Irrigation System Efficiency does not reflect the reality of irrigation efficiency in existing landscapes or in how landscapes perform over time.**

Water Purveyors throughout the State have accumulated data on actual irrigation system performance through the various landscape programs implemented over ten plus years. The Municipal Water District of Orange County (MWDOC) has conducted distribution uniformity (DU) catch-can tests at 1,014 residential and 1,106 non-residential sites as part of its water use efficient landscape incentive programs. The average distribution uniformity for residential landscapes is 0.55 and for non-residential sites is 0.58. Data from Qualified Water Efficient Landscaper (QWEL) catch can audits conducted in the Bay Area between 2019-2020 by certified irrigation auditors show DUs ranging from 0.40 to 0.70, with an average DU of 0.50.

These field measurements of DU that are significantly lower than 0.80 are corroborated by recently completed field studies by UC Davis (Evapotranspiration Adjustment Factor Study (Agreement #4600008156). Certified irrigation specialists performed DU tests pre and post irrigation system improvements at existing mature turf landscapes throughout California and found average DU results of 0.55 pre-retrofit and 0.68 post-retrofit. While irrigation system performance improved after installing the most efficient rotating nozzles on the market, average DU was still below 0.70.

Additionally, DWR's proposed irrigation efficiency factor of 0.8 does not reflect the true operating ranges of irrigation efficiency that irrigation equipment manufacturers associate with their products.

The Irrigation Association (IA) provides the following ranges of expected DUs for rotary and spray sprinklers.

Sprinkler Type	Achievable	Target	Historical
Rotary Nozzles	0.75 – 0.85	0.65-0.75	0.55-0.65
Spray Sprinklers	0.65 – 0.75	0.55-0.65	0.45-0.55

The Irrigation Association notes the following important caveat regarding the expected range of DU's:

> "the shape of the area covered by the sprinkler system will influence the spacing and pattern of the sprinklers. This directly affects the ranges of DU that can be expected. The higher achievable values are obtained when the sprinklers have consistent spacing between them and the rows of sprinklers are also consistent. Many residential properties have smaller and curvilinear shapes that do not allow for consistent sprinkler patterns, so distribution uniformity is compromised even when the design, installation, and maintenance is the best that can be expected."

Manufacturers calculate irrigation efficiency in a highly controlled environment (e.g. perfect operating pressures, little to no wind, perfect head-to-head coverage, etc.) and assume that the system is installed "perfectly" according to their specifications. The reality is that once a system goes from design on paper to "in the ground" there is a natural and expected loss of efficiency. The "Achievable" and "Target" ranges are based on controlled, environments with optimal landscape design and installation. This is not the case, especially in the residential sector and the "Historical" ranges are actually representative of typical installed landscapes. This real-world data needs to be considered in establishing any assumed Irrigation Efficiency. Irrigation science and real-world data demonstrate that DWR's assumption of an Irrigation Efficiency of 0.8 is not achievable.

Although frequently used interchangeably, irrigation efficiency is influenced by distribution uniformity (DU). Efficient irrigation is when water is beneficially used compared to the amount of irrigation water applied. DU is a metric utilized to characterize the evenness of application of water to the planted area.

DU is often used as a proxy for irrigation efficiency since it is readily measurable. Catch-can measurements for DU are the recommended practice for quantifying system uniformity (Irrigation Association, 2013). When considering irrigation management that is less than 100% efficient, Irrigation Efficiency only decreases any given DU value. For example, a DU of 0.60 multiplied by an irrigation management efficiency of 80% results in an Irrigation Efficiency value of 48%. For this reason, assuming an Irrigation Efficiency of 80% requires an unrealistically high DU performance value. Existing landscapes do not perform to these unattainable standards, and even when retrofitted with more efficient irrigation equipment cannot achieve a DU of 80%.

To illustrate this, East Bay MUD conducted a program that retrofitted landscapes irrigated by spray nozzles with efficient rotating nozzles. The average DU of the landscapes at the 17 sites before the retrofit was 0.48. While the retrofit significantly improved the performance, the average DU of the all the sites post-retrofit was 0.69. The Coachella Valley Water District has conducted similar DU catch-can tests at residential sites in its service area and has found DU for spray heads and rotating nozzles to range from 0.58-0.60 and 0.62-0.65, respectively.

We recommend that the outdoor standard be based on an Irrigation Efficiency reflects actual irrigation performance that is measured in the field and supported by irrigation manufacturer specifications, which ranges from 0.55 to 0.65.

4. **DWR's provisional ET Factor of 0.7 is calculated from an unrealistic irrigation efficiency assumption (80% IE) that arbitrarily limits Plant (Landscape) Factors, such that it does not reflect existing landscapes.**

The proposed ET Factor of 0.7, when combined with an irrigation efficiency of 0.8, results in an average plant factor of 0.56. (ET Factor = Plant Factor/Irrigation Efficiency or 0.7 = 0.56/0.8). This does not consider the plant watering requirements for existing landscapes, many of which are predominantly turf grass. In fact, cool season grasses or annuals, with a plant factor of 0.8, and an irrigation efficiency of approximately 0.55, would require an ET factor of 1.45 to ensure maintenance of healthy landscape.

The table presented below is an exploration of what the ET Factor (column F) would be for a typical pre-MWELO suburban residential landscape using different Irrigation Efficiency (column E) assumptions. The yard is predominantly comprised of cool season grass and annuals, which both have a plant factor of 0.8 (65% of landscaped area, combined). The remaining 35% of landscaped area is woody shrubs and trees with a plant factor of 0.5. The composite landscape Plant Factor would be 0.67 (Column D). The resulting ET Factor ranges are all over the DWR provisional outdoor standard of 0.7, even with an unrealistically high IE assumption of 80%. In fact, the most likely ET Factor is over 1.0 given real world Irrigation Efficiency and performance of existing landscapes.

ET Factors Under Different Lansdcape Factor and Irrigation Efficiency Scenarios

A	B	C		D D = avg(A X C)	E	F F = D X E
Plant Factor	**Plant Type Description**	**% of Area in Landscape**		**Overall Landscape Plant Factor**	**Irrigation Efficiency (IE)**	**ET Factor (based on IE)**
0.3	Low water use plants				0.45	**1.49**
0.5	Woody shrubs/trees	35%			0.55	**1.22**
0.6	Warm season grass		=	0.67	0.625	**1.07**
0.8	Cool season grass	60%			0.70	**0.95**
0.8	Annuals	5%			0.80	**0.84**

We recommend that the outdoor standard be based on an Irrigation Efficiency of 0.625 that reflects in-field irrigation performance and based on a plant factor that takes into account typical plant palettes.

5. **Back-calculating an outdoor standard from estimated applied outdoor use embeds multiple sources of error and is not based on horticultural principles or irrigation science.**

Back-calculating an outdoor standard from estimates of indoor use, estimates of landscape area and estimates of applied outdoor water use incorporates multiple sources of error and is not based on horticultural science or the principles of MWELO. It embeds multiple sources of potential error and fails to consider on-site and in-field conditions, such as plant type and health, source water, and watering requirements.

The estimates of indoor use developed by DWR incorporate errors based on the fact that residential meters combine indoor and outdoor use. Assumptions of population and how much of the actual use is indoor versus outdoor includes levels of error. This is compounded by the fact that the eAR data used by DWR is based on water supplier billing data. Water suppliers billing data for residential account classifications do not align well with the parcel-based data used by DWR in developing residential landscape area measurements (LAM). As a result, the landscape area and billing data do not align and have sources of error. In particular, dedicated irrigation meters and mixed-use meters are frequently mis-categorized by DWR in the residential LAM data, resulting in overstated residential LAM. Consequently, any assessment of applied water, using a larger irrigated area than is actually the case, would result in DWR significantly under-estimating applied water on existing landscapes. In the case of Irvine Ranch Water District, DWR's estimate of residential LAM is overstated by 19%.

Another source of error in back-calculating an ET factor based on estimated applied water is that the approach does not consider the actual plant watering requirements. It assumes that applied water is the appropriate amount of water to maintain healthy landscapes, when many residential landscapes may be deficit irrigated, and therefore not maintained at an optimal level for plant health. The University of California has developed plant factors for many urban and ornamental landscapes, based on horticultural science. We recommend that DWR use WUCOLS data and estimates of existing plant palettes and typical ranges of irrigation efficiency to develop recommendations for the outdoor standard, rather than rely on estimates of applied water that are subject to multiple sources or error and is inconsistent with the principles of MWELO.

Another concern with DWR's approach is the data trimming of calculated ET Factors from the analysis to limit it to a range of 0.1 to 1.0, which does not reflect the reality of existing landscape use. An existing predominantly turf landscape, with an Irrigation Efficiency of 0.55, could be expected to have an ET factor of 1.45. The legislation requires that the standard consider existing as well as new landscapes.

DWR's data trimming approach fails to consider existing landscapes. While turf replacement and other outdoor programs can improve efficiency, the legislation clearly did not require existing landscapes to be replaced. The outdoor standard needs to be set so that both existing and new landscapes can be maintained in a healthy way. DWR's overall approach of back-calculating an ET Factor based on estimations of applied water is not appropriate and is not consistent with the principles of MWELO, and the problem is further compounded by data trimming landscape ET Factors that the legislation clearly states must be considered.

The ET Factor Matrix, below, highlights in light green all the ET Factors that DWR has omitted from considering by narrowly considering only an IE of 80% and a Plant (landscape) Factor of 0.56. Existing residential landscapes can have ET Factors of over 1.0, given many reasonable and expected operating conditions (e.g. an IE of 55% and Plant/Landscape Factor of 0.56 results in an ET Factor of

1.02). Special Landscape Areas and sites that use recycled water should be expected to have an ET Factor of 1.0 or greater (indicated by dark green cells), given the requirements to maintain such sites (e.g. sports fields) while being irrigated by overhead rotor irrigation. ACWA's recommendation for an ET Factor of 1.0 is still an aspirational target that better reflects existing real-world landscape and irrigation system performance than does DWR's proposal of a 0.7 ET Factor that is based on design standards and assumptions of Irrigation Efficiency that are not found in the field.

ET Factor Matrix		Plant/Landscape Factor							
		0.20	0.40	0.50	0.56	0.60	0.70	0.80	1.00
Irrigation Efficiency	45%	0.44	0.89	1.11	1.24	1.33	1.56	1.78	2.22
	50%	0.40	0.80	1.00	1.12	1.20	1.40	1.60	2.00
	55%	0.36	0.73	0.91	1.02	1.09	1.27	1.45	1.82
	60%	0.33	0.67	0.83	0.93	1.00	1.17	1.33	1.67
	62.5%	0.32	0.64	0.80	0.90	0.96	1.12	1.28	1.60
	70%	0.29	0.57	0.71	0.80	0.86	1.00	1.14	1.43
	75%	0.27	0.53	0.67	0.75	0.80	0.93	1.07	1.33
	80%	0.25	0.50	0.63	0.70	0.75	0.88	1.00	1.25
	85%	0.24	0.47	0.59	0.66	0.71	0.82	0.94	1.18
	90%	0.22	0.44	0.56	0.62	0.67	0.78	0.89	1.11
	95%	0.21	0.42	0.53	0.59	0.63	0.74	0.84	1.05

ET Factors Omitted by DWR
Existing landscapes
Special Lndsp Areas
ACWA Proposal
DWR Proposal

We recommend establishing the outdoor standard with an ET Factor of 1.0, based on an appropriate weighted plant factor based on horticultural principles and plant watering requirements, that considers existing, predominantly turf landscapes as well as newer landscapes, combined with a reasonable estimate of irrigation efficiency that reflects both existing and new landscapes. DWR's provisional ET Factor of 0.7 does not achieve this.

6. Special Landscape Areas and Recycled Water shall receive an ET Factor of 1.2.

The legislation (10609.9 (e)) recognized that certain landscapes require additional irrigation. Special landscape areas such as golf courses, parks, sports fields and other functional turf areas have higher watering requirements than areas that include a mix of plant material, and are typically irrigated with overhead spray or rotors. Landscapes irrigated with recycled water need additional water to flush salts down and out of the root zone. Expanding the use of recycled water is state policy and establishing an ET factor that is below the requirement would penalize both water suppliers and users that have invested in the expansion of recycled water systems and its use. DWR's provisional recommendation does not specifically account for the higher watering needs of these landscapes. MWELO principles recognize the need for a higher ET Adjustment Factor of 1.0 in the design of these landscapes. As previously noted, landscapes do not perform at the design level, and many landscapes were installed prior to MWELO being in effect.

We recommend that special landscape areas and areas irrigated with recycled water are given an ET factor of at least 1.2 to be consistent with the principles of MWELO, horticultural and irrigation science, State policy objectives, and expected performance of existing landscapes. Special landscape areas are functional and irrigated areas by definition. Recycled water systems are generally only installed in areas that will be irrigated, and therefore 100% of these areas should be assumed to be irrigated, without limitation.

7. **DWR's provisional recommendation of using only 20% of what is termed Irrigable Not Irrigated (INI) area and limiting that to only when a water supplier does not meet its Water Use Objective (WUO) is not consistent with the legislation.**

   The enabling legislation states that the "The standards shall apply to irrigable lands." (10609.6). It does not limit it to only a portion of the irrigable lands or limit its use to only if a supplier is not meeting its WUO. This provision reflects the fact that landscapes can change over time, and that areas not currently irrigated can become irrigated.

   To be consistent with the legislation, we recommend that the outdoor standard be based on one ET factor of 1.0 for irrigable irrigated (II) landscapes and a lower ET factor of 0.55 for all (100%) irrigable not irrigated (INI) areas irrigated with potable water, without limitation.