

# Reduced Water Budgets and Implications for Landscape Irrigation

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## Introduction

The California Legislature is considering lowering the ET adjustment factor used in the California landscape irrigation model ordinance from 0.8 to 0.7. This value is used to determine water allocations for irrigated landscape areas. A smaller number corresponds to a lowering of the water budget per unit area. The purpose of this paper is to highlight the impact and potential solutions of such a proposed change.

This review is focused primarily on the impact to irrigation uniformity. In order to effectively measure this change, we have “fixed” the other two components of the ET adjustment factor calculation. Specifically, the crop factor is maintained at 0.5, and the irrigation management efficiency is estimated to be 90%. Thus, reducing the ET adjustment factor from 0.8 to 0.7 is met by improving application uniformity.

This analysis does not take into consideration the current 25% allocation for effective rainfall as defined in the model ordinance, nor does it address additional water that may be available for recreation areas. It is based in part, however, on the assumption that the ET adjustment factor will be used to establish water budgets for commercial, multi-family, and other similarly landscaped areas.

## Background

The current definition of ET adjustment factor is determined as:

$Kc/IE = \text{ET adjustment factor (currently set at 0.8)}$

Where:

$Kc$  (Crop Factor) = is a statewide average crop factor recognizing a plant material mix approximating 1/3 high, 1/3 medium, and 1/3 low water use plants. For the purpose of calculating the ET adjustment factor an average  $Kc$  of 0.5 is used. The use of 0.5 as a crop factor suggests medium water use plant material, on average in the irrigated landscape area. High water use plant material can be used when demand is off-set by proportional medium or low water use plant material in the landscape.

$IE$  (Irrigation Efficiency) = is the product of multiplying the irrigation uniformity or distribution uniformity ( $DU$ ) by the irrigation management efficiency. In order to achieve the targeted ET adjustment factor of 0.8, the minimum allowed  $DU$  must measure 69% or higher and represents the average application uniformity in the entire irrigated landscape area. The irrigation management efficiency for the purpose of this example is estimated at 90% (e.g. 9 inches of water required and 10 inches applied ~ 9/10). The product of irrigation uniformity multiplied by the irrigation management efficiency using these two values cited above is 0.625 (.694 x .90). An irrigation management efficiency of 0.90 would indicate approximately 10%

more water applied than required. It is expected that SMART irrigation controllers should be able to consistently meet or exceed this level of water management.

Thus the calculation would be done as follows:

$$\frac{0.5}{(0.69 \times 0.90)} = \text{ET landscape factor of } 0.8$$

Where the Kc used in the numerator is 0.5. The irrigation uniformity required in the denominator is 69% and is multiplied by the irrigation management efficiency of 90%. The resulting quotient is 0.8.

For irrigated landscape that is 100 percent watered by overhead methods (spray heads and/or rotors), the average of the entire irrigated area must meet or exceed 69% distribution uniformity. Using the IA’s recommended “minimal operational uniformity” values as shown in Table 1, we can make the following observations.

**Table 1. Minimum Operational Uniformity Taken from the Irrigation Association’s Practice Guidelines**

<b>Type of zone</b>	<b>Type of uniformity</b>	<b>Minimum uniformity</b>
Spray	Lower Quarter DU	55%
Rotor	Lower Quarter DU	70%
Drip/micro	Emission Uniformity	80%

If one-third of the landscape area is irrigated using the drip method (80% EU), then the other two-thirds must have an average DU of 65%. Spray heads achieving a DU of 65% represents the extreme upper end of expected performance from existing technology. The combined or universal uniformity is represented by the following calculation (assuming each method represents approximately one-third each of the irrigated area):  $(0.80+0.65+0.65/3)=0.7$  or 70%. We must achieve at least a uniformity of 69% in the denominator of the ET adjustment factor formula to meet the required 0.8.

The current ET adjustment factor of 0.8 would not allow for 100% irrigation by the spray head method. Spray heads do not routinely meet the standard of 69% distribution uniformity. However, the mix of irrigation methods shown in the example above is consistent with many landscape designs. Approximately 1/3 of the area would be in turf grass and irrigated via spray heads. Another 1/3 of the landscape area would be planted to groundcover and also irrigated via the spray head method. The remaining 1/3 irrigated area would be planted to either trees or shrubs and irrigated via the drip method.

**Proposed Change**

If California were to lower the ET adjustment factor to 0.7 (or less), then the following implications should be considered:

In review, the current definition of ET adjustment factor is determined as:

$Kc/IE = \text{ET adjustment factor (proposed reduction to 0.7)}$

Where:

Kc (Crop Factor) = is a statewide average crop factor recognizing a plant material mix of 1/3 high, 1/3 medium, and 1/3 low water use plants. For the purpose of calculating the ET adjustment factor an average Kc of 0.5 is used. In many applications this includes turf grass (high Kc) and a corresponding use of medium and/or low Kc plant material.

IE (Irrigation Efficiency) = is the product of multiplying the irrigation uniformity or distribution uniformity (DU) by the irrigation management efficiency. In order to achieve the targeted ET adjustment factor of 0.7, the minimum allowed DU is now raised to 79% and represents the average application uniformity in the entire irrigated landscape area. The irrigation management efficiency is still estimated at 90% (e.g. 9 inches of water required and 10 inches applied ~ 9/10). The product of irrigation uniformity (79%) multiplied by the irrigation management efficiency (90%) using these two values cited above is 0.71 (.79 x .90).

Thus the calculation for the ET landscape factor would be done as follows:

$$\frac{0.5}{(0.79 \times 0.90)} = \text{ET landscape factor of 0.7}$$

Where the Kc used in the numerator is 0.5. The irrigation uniformity in the denominator is 79% and is multiplied by the irrigation management efficiency of 90%. The resulting quotient is 0.7.

For landscape that is 100 percent irrigated by overhead irrigation (spray heads and/or rotors), the average uniformity must meet or exceed 79% uniformity. Using the IA's recommended "minimal operational uniformity" values as shown in Table 1, we could not irrigate any of the landscape with spray heads because they fail to achieve the required 79% under most conditions.

The landscape contractors are heavily dependent on the spray head irrigation method to provide irrigation water to landscapes. Eliminating this product in its current configuration will cause irrigation contractors to rethink their options. Those options include:

1. Reducing the average plant Kc used in the landscape area. This could include a reduction or elimination of turf grass, which may not be desirable.
2. Use significantly more drip irrigation in the landscape area. While drip irrigation is a widely proven technology, it lacks familiarity with many contractors and requires a different set of design and maintenance skills to be successful.
3. Adopt new overhead irrigation technology which can meet or exceed the requirement of an average 79% distribution uniformity.

Adopting Option 1 above could effectively eliminate ALL turf grass from the landscape area irrigated via the overhead irrigation method (spray heads) in order to meet the reduced ET adjustment factor of 0.7. This is due primarily to the inability of spray heads to provide high distribution uniformity.

While it is true Option 2 would allow for improved uniformity to meet the requirements of a reduced water budget, the total elimination of overhead irrigation does not appear to be completely desirable either. There are many applications where drip irrigation is not a clear substitute for overhead irrigation. Examples include the irrigation of large turf grass areas, providing cooling or frost protection, and the periodic washing of foliage.

Selecting Option 3 appears to be the best practical answer for reduced water budgets. There are new overhead sprinklers which are reported to meet or exceed the 79% uniformity requirement. Mixing high efficiency overhead irrigation with water efficient drip irrigation should allow us to maximize landscape water uniformity. This also requires contractors to re-examine their irrigation product selection. Those tried and true products of the past may not meet today's higher performance standards. If this holds true, then contractors will need to educate themselves on proper design, maintenance, and operation of these new products.

### **Conclusions**

In general, it is desirable to maintain a broad palate of plant materials for individual landscapes. To achieve this goal it will be necessary to significantly improve distribution uniformity from overhead irrigation methods. It appears that some, new overhead irrigation products hold the promise of meeting this goal. In order to accelerate the adoption of improved distribution uniformity, the following actions should be considered.

1. Product testing to determine those products that meet minimum distribution uniformity.
2. Labeling and promotion of products that meet performance requirements at point-of-purchase.
3. Training and certification of irrigation professionals to effectively use these products.
4. Periodic field audits to demonstrate that high distribution uniformity can be maintained by overhead and drip irrigation methods.