SLIDE: Simplified Landscape Irrigation Demand Estimation

The **SLIDE** (Simplified Landscape Irrigation Demand Estimation) approach to accurately and scientifically estimate the water demand of established landscapes was formulated by a small consortium of academic experts on landscape water needs. It is based on analysis and interpretation of published field research studies on landscape plant water requirements and on plant water-use physiology completed over the past several years. When established landscapes are irrigated, SLIDE provides and accurate simple method for estimating irrigation demand and calculating irrigation schedules. SLIDE is also effective for designing non-irrigated landscapes because it enables one to estimate accurately whether or not a particular landscape will perform acceptably with anticipated precipitation.

SLIDE is framed by the following four **SLIDE Rules** that integrate and apply the available science in plant environmental physiology and landscape plant water requirements:

- **SLIDE Rule #1.** *Reference evapotranspiration (ET_o) accurately estimates water demand of lawns and other uniform turf areas, but it marginally represents water demand of non-turf, non-uniform, physically and biologically diverse landscapes.*
- **SLIDE Rule #2**. *Plant Factors (PFs) alone accurately adjust ET_o to estimate landscape water demand, and they are assigned by general plant type categories, not by individual species (see Table 1 below).*
- **SLIDE Rule #3**. *A landscape area or zone controlled by one irrigation valve (hydrozone) is the smallest water management unit in a landscape; when plant types are mixed in a zone the water demand is governed by the plant type with the highest PF.*
- **SLIDE Rule #4**. *Water demand of dense plant cover (canopy covers ≥80%of the ground surface) comprised of mixed plant types is that of a single 'big leaf' governed by the plant type category in the mix with the highest PF; demand of sparse plant cover (canopy covers <80% of the ground surface) is that of individual plants and is governed by their leaf area and the PF of their plant type category.*

SLIDE offers several advantages over other approaches to estimating landscape water and irrigation requirements. SLIDE is

- *Scientifically defensible, conceptually sound, and logical.*
- *Simple to understand and use, and it replaces the need for a large database of plant factors.*
- *Applicable nationally.*
- *Able to provide accurate plant factors immediately for new plant introductions.*
- *Effective in enabling water conservation.*
- *Reliable in providing landscape water requirement data needed for:*
    - *complying with California's Model Water Efficient Landscape Ordinance.*
    - *designing landscapes that comply with water conservation ordinances and green building programs.*
    - *calculating landscape water budgets and irrigation schedules.*
    - *smart controller algorithms.*

Table 1. Plant Factors (PF) for established landscape plants, turf grasses, and garden crops to provide acceptable performance in California[1].

Plant Type	Plant Factor
Tree, Shrubs, Vines, Groundcovers (woody plants)	0.5
Herbaceous Perennials	0.7
Desert Adapted Plants	0.3
Annual Flowers & Bedding Plants	0.8
General Turfgrass Lawns, cool-season	0.6
General Turfgrass Lawns, warm-season	0.8
Home Fruit Crops, Deciduous	1.0
Home Fruit Crops, Evergreen	1.0

SLIDE Equation

The SLIDE equation uses only the Plant Factors from Table 1 to adjust reference ET and follows simple calculations to produce an estimate of the water required by a landscape area for a given period. The basic SLIDE equation is:

$$\textbf{Landscape Water Demand (gal.)} = ET_o \times PF \times LA \times 0.623 \quad \textit{(Eq. 1)}$$

where,

- ET_o is inches of historical average or real-time evapotranspiration for the period.
- PF is the Plant Factor from Table 1.
- LA is the landscape area, in square feet.
- 0.623 is the factor to convert inches of water to gallons; omit this factor if the estimated water demand is desired in inches.

The only ET_o adjustment needed for estimating the water requirements of a landscape area is a Plant Factor (PF) which accounts sensibly and accurately for the water demand characteristics of the plant types present. As noted in the SLIDE Rules, non-turf landscape areas are biologically and physically complex such that their water demand characteristics are marginally estimated by ET_o, so attempting to make precise adjustments to ET_o for each plant species would do little to improve an estimate of a landscape's water requirement. It is also ineffective to use a complicated equation with multiple ET_o adjustment factors for planting density, microclimate, and so on because, depending on the factor and planting, it may not meaningfully affect landscape water demand or it is impractical to determine a meaningful value to assign to it. Incorporating such factors provides a false sense of precision and unnecessarily complicates the calculations. More information on making sense of ET adjustment factors is discussed here.

Using the SLIDE Equation

The basic SLIDE Equation (Equation 1 above) can be used to estimate a complex landscape's water requirement and irrigation demand by adding sub-equations that calculate the water demand for each hydrozone or distinct planting area within the larger landscape (See Equations 2 and 3 below).

Following the SLIDE Rules, a landscape's estimated water requirement is the sum of the water required by the areas planted with various types of plants found in Table 1. The estimated water demand will need to be met by precipitation, irrigation, or a combination in order for plants to perform acceptably. Irrigated landscapes should be designed so that each irrigation station is composed of plants with similar water requirements in what is known as a hydrozone. When plants of different water requirement categories are mixed in the same irrigation station, the water demand of the entire zone is that of the plant category with the highest PF.

Procedures

To estimate the water demand for an established landscape, use the PF values for plant material categories provided in Table 1 with historic or real-time ET_o and precipitation data from or another reliable source.

The SLIDE algorithm below calculates estimated water requirements for the landscape area occupied by the plant categories present for any period of interest. It subtracts effective monthly rainfall to derive estimated monthly irrigation demand for each plant category (if desired), sums the water or irrigation demands, adds an allowance for distribution uniformity of irrigation application, and converts units to gallons of irrigation or water demand per year. The equations within the algorithm can be converted to a spreadsheet format to automate the individual calculations.

Note in Table 1 the category “Mixed Plantings”, which represents situations where plants from various categories are interplanted and, if irrigation is used, they are watered simultaneously. “Mixed Plantings” also applies where plant categories are grouped in discrete beds or zones according to PF but there are no data on the square footage devoted to each plant category represented in the overall landscape mix. In all of these circumstances, it is simplest and safest to assume the PF is that of the plant type in the mix with highest PF.

In situations where shade trees are planted within a turf area, there is no need to factor in the water requirement of the trees. Their demand will be accounted for in the water demand estimate for the turf, as would occur for trees in any other mixed planting where the PF meets or exceeds that for trees. When overall plant canopy (turf, trees, shrubs, etc.) shades at least 80% of the soil, water use is at its maximum and at the rate of the plant creating most of the canopy cover in the area or zone. Adding layers of canopy does not significantly increase the area's water use.

Importantly, the equations below can be used to develop a spreadsheet that automates the multiple calculations needed to derive estimated irrigation demand. An Excel spreadsheet using a layout with columns for each independent calculation step can work well. The basic calculations are:

1. Multiply ET_o for the period or year by the PF's for the plant categories in the landscape and for each month of the year. This is the estimated water requirement in inches of the plant category for the period. Multiplying this value by the specific square planted gives the gallons of water required (see Equation 1).
2. If precipitation is to be considered, calculate estimated effective precipitation by multiplying average monthly (or whatever period of interest) precipitation by 0.5 (i.e. 50% of precipitation) or other defensible percentage.
3. Subtract the effective precipitation from plant water requirement calculated in #1. Results that are negative values are recorded as zero. This is the estimated amount of irrigation (if available), in inches, each plant category will need in order to maintain acceptable landscape appearance and function.
4. For each plant category, multiply the inches of irrigation required by the square feet of each plant category. See #1 for guidance where plant-category specific square footage is not available.
5. If irrigation demand is needed, multiply the product from #4 by the inverse of the DU (1 ÷ DU).
6. Sum the products calculated in #4 or, if irrigation demand is needed, #5 and multiply it by 0.623; the result is the gallons of water required (see Equation 2).
7. When irrigation water quality is low due to soluble salt concentration, calculate a leaching requirement (LR) and use it to increase the irrigation water requirement as described in Equation 3. The result is the total irrigation demand when using water with elevated salinity.

http://ucanr.edu/sites/UrbanHort/Water_Use_of_Turfgrass_and_Landscape_Plant_Materials/