APPLICATION RATE CALCULATOR
Verison 2.0

Purpose of Calculator

The calculator is designed to help meet the regulatory requirements for permitting effluent irrigation systems in Texas. It determines if a proposed wastewater application rate will fail or not. The calculator was developed in consultation with the Texas Commission on Environmental Quality and is designed to meet the requirements of Texas regulations: 30 TAC 222.83 and TAC 309.20.

INSTALLATION - IMPORTANT NOTICE

The software is comprised of two files: "apprate" (MS ACCESS file format) and the program "Apprate." Both files must be in the same folder or the program will not run.

Data in "apprate" can be changed as long as the file structure (columns of data) remains the same. Additional cities can be added as long as this is done for all four tables: *City, Crop, ETo, Rain*. The *Soil* table list the typical water holding capacity of soils.

Copyright and Acknowledgments

This software was developed by the Irrigation Technology Center and Texas AgriLife Extension Service. This material is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture under Agreement No. 2005-45049-03209.

The software is copyrighted and cannot be sold or distributed without permission.

GENERAL INSTRUCTIONS AND INFORMATION

All units are in terms of volume (inches per month or year) and percentage.

The calculator using the average monthly ETo (PET) and rainfall data for 21 cities in Texas. This data was updated in August 2005 using total climate record available for each city listed. This data is also posted at http://texaset.tamu.edu

The plant material is assumed to be warm season grass over-seeded with cool season. The crop coefficients used for these grasses are Kc = 0.6 for warm season and Kc = 0.8 for cool season. Higher coefficients can be used such as Kc = 0.8 and 1.0 for warm and cool season grasses by modifying these values in the apprate file.

Effective rainfall percent (ER%) and initial soil moisture content are entered as percent (not as decimals).

All other parameters (Application Rate, Leaching Volume, and ET) are in units of inches per month or total inches per year.

ER% (effective rainfall percent) is the portion of rainfall/precipitation (inches) that infiltrates into the soil. Land forming practices, slope, ground cover and amount of depressionary storage all affect ER%. ER% = 0.67 is normally used for agricultural and landscape irrigation water budgeting when using long-term historic averages.

Leaching may be included, and requires the user enter the EC concentrations of the water and the maximum level in the soil.

Seepage is not allowed under Texas effluent irrigation regulations and are not included in this calculator.

MONTHLY APPLICATION RATE CALCULATOR

The Monthly calculator computes the <u>Application Rate</u> for the selected month using the following equation:

$$AR = ET - RAINe + LEACH \qquad \text{(Equation 1)}$$

where: $ET = ETo \times Kc$
                       $RAINe = RAIN \times EF\%$

AR   = application rate (inches)
ET   = actual water requirement of grass (inches)
ETo   = potential evapotranspiration (inches)
Kc   = crop coefficient (decimal)
RAINe = effective rainfall (inches)
LEACH = leaching volume (inches)
EF%   = effective rainfall percentage
LF   = leaching fraction (percent)

Soil moisture storage is not considered.

Leaching volume is optional and is calculated as discussed below.

LEACHING VOLUME

The total <u>leaching volume</u> (inches per month) is automatically calculated using the inputted EC (electric conductivity) of the applied water and targeted soil salinity level. For details, see Texas AgriLife Extension publication B-1667, Irrigation Water Quality Standards and Salinity Management Strategies (http://AgriLifebookstore.org)

The calculation of leaching volumes are based on the procedures specified in Texas regulations: TAC 309.20(b)(3)(A). The underlying assumption is that the application volume is limited and based on the Net Water Demand.

$$NWD = ET - RAINe \qquad \text{(Equation 2)}$$

$$LEACH = NWD \times Ce/(Cl-Ce) \qquad \text{(Equation 3)}$$

where:

NWD = net water demand
Ce = EC of the water
Cl = EC to maintain in the soil

YEARLY APPLICATION RATE CALCULATOR

The Yearly calculator tests to see if the selected Application Rate fails. Failure occurs when the root zone becomes saturated with water and runoff of the applied water becomes likely. A monthly water balance is computed which includes soil moisture storage. Any available soil moisture is carried over to the next month. Failure happens when the total water application (rainfall and irrigation) exceeds available soil moisture storage and ET, as well as leaching if used.

Note: the Yearly calculator is designed to be used for a single year only. Using the calculator to do multiple yearly runs (where a year's ending values are used as input for the next simulated year) violate the underlying assumptions used in the design of the calculator.

A modified form of equation 1 is used as follows:

$$SMa = ET - RAINe + LEACH - AR \qquad \text{(Equation 4)}$$

where: SMa - change in available soil moisture

SMa is calculated from the soil depth and soil water holding capacity. Soil water holding capacity is defined as the volume of water (inches) held in the soil between field capacity and permanent wilting point.

LEACH cannot exceed the AR in any one month.

Instructions

1.   Select month to begin calculations (first month).

2.   Enter the Initial Soil Moisture content (percent) at the beginning of the first month.

3. Enter the Application Rate (inches per month) to be tested.

4. Enter Soil Depth (inches) and select Soil Type and nearest City from drop down menus.

5. Enter the Seepage rate (inches per month) and leaching volume (inches per month) if desired.

6. To include Leaching, check the box, enter the Ce and Cl values, and a pop-up window will show the total annual Leaching Volume for that location. The calculator automatically partitions the leaching into the months of Dec. - Feb. Leaching can be distributed over as many months as is desired, but the calculator will not let you exceed the maximum annual leaching volume or the application rate during a particular month. When finished, click on "*Set Leaching Rate*" to return to the Calculator.

CONTACTS

For technical support:

    David Flahive, System Analyst
    flahive@tamu.edu

For other information:
    Dr. Guy Fipps, Professor and Extension Agricultural Engineer
    979-845-7454; g-fipps@tamu.edu