QUICK GUIDE

Wisconsin Irrigation Scheduling Spreadsheet (WISS) NRCS

Version 2.10.21

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For the
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The Wisconsin Irrigation Scheduling Spreadsheet (WISS) NRCS applies the checkbook method to track soil moisture daily within a user defined managed root zone depth. Soil moisture losses through evapotranspiration (soil evaporation and plant transpiration) and deep drainage (water passing through the managed root zone) are considered along with moisture inputs that include daily rainfall and irrigation. A time series chart plots root zone soil moisture and deep percolation resulting from applied irrigation. Colored fonts also indicate when excess water input results in deep drainage or when additional water input is needed to prevent plant stress. The WISS program supports decisions on soil moisture management and should be used in combination with other information such as soil moisture monitoring and field observations when making irrigation decisions.

The concept behind the WISS NRCS is described in University of Wisconsin Extension Publication A3600-01, revision November 2019. This version of WISS NRCS has been updated with technical assistance from the United States Natural Resources Conservation Service (NRCS) – Madison, Wisconsin state office.

The non-input cells in WISS NRCS have been protected to reduce accidental deletion or overwriting, but they are **not** password protected. When setting up the scheduler for growers, NRCS staff will password protect the worksheet to protect the setup data. If additional days (rows) are needed, simply unprotect the sheet by selecting *Tools – Unprotect Sheet* and copy the columns down. The model is designed for scheduling one irrigated field, but for multiple years. Each tab of the spreadsheet is for a specific year, thus becoming an irrigation history of the field over time. Soils data are inputted into the Soils Data Input Sheet (Tab 1). Daily ET data (from the UWEX Ag. Weather Data site), rainfall amounts, irrigation amounts, and percent of ground covered by the crop canopy or Plant Canopy Cover (%) must be entered into each sheet individually. The percent of ground covered by the crop canopy or Plant Canopy Cover (%) is also entered or estimated daily.

Model Inputs

Parameter	Comments / Explanation
Soils Data Input Tab	
Field Name:	Enter the irrigated field name. One spreadsheet file should be assigned to one irrigated field name. Subsequent pages will automatically be populated with the field name.
Web Soil Survey Data Input Table:	Enter the field capacity (Fc) and permanent wilt point (PWP) values for your soils from the USDA Web Soil Survey into the soils data input table for every depth provided. This need only be done once during setup. Soils data for all

subsequent sheets are automatically copied from the soils data input table to all subsequent sheets and are referenced based on the managed root zone depth for the crop selected. The Soils Data Input Tab data can be overwritten as previously explained.

The WEB Soil Survey (WSS) is the recommended method to obtain soils data. The steps to use the WSS are as follows:

1. Start the WSS using the hyperlink on the soils input screen.

2. Locate your fields using the methods available in the WSS (address, state and county, map, etc.).

3. Select VIEW each time to retrieve the requested data.

4. Zoom into your location using the magnifying glass with the + symbol.

5. Use the Area of Interest (AOI) tool to delineate the specific field of interest.

6. Select the SOIL DATA EXPLORER tab and the soil series identifications will appear.

7. Select the SOIL PROPERTIES AND QUALITIES tab and under that the SOIL PHYSICAL PROPERTIES sub-menu.

8. One at a time select WATER CONTENT, 15 BAR (PWP) and WATER CONTENT, One-Third bar (Fc) as shown on the WSS input screen.

9. Under Aggregation Method be sure to select WEIGHTED AVERGE, select the correct depth units and enter your managed root zone depth (inches).

10. The WSS will provide a depth weighted summary of Fc and PWP along with the area and % area of each within the AOI. At this point you can select the number of individual soil groups you want to use for your field. If Fc and PWP values are within 10% of each other, you may choose to average values and lump spoil groups.

Note that WISS NRCS data are a starting point for the Fc values. Site specific monitored soil moisture data should be used when available. Field capacity (Fc) is the stable soil moisture level after sufficient water has been applied and held in the soil against gravity. This can be observed as the stable soil moisture level several hours after a large rain fall event.

Soil Mapping Unit:	Enter in the mapping unit name for the soil type being managed. This is for archival purposes. Use the soil type making up > 10% of the field unless the landowner specifies otherwise.
Field Coordinates Latitude & Longitude:	Enter in GPS latitude and longitude coordinates for archival purposes. This information will be helpful for receiving Potential ET values from the AGWX climate web site.

All Other Tabs

Start date:	Use the crop emergence date for perennials or the date when annual crops are planted. When the start date is entered, WISS NRCS will add the next 162 successive days into the lower portion of the sheet. If needed, additional days can be added to the end of the list as previously discussed.
Select Field Crop:	Select a field crop for the field that is irrigated that year. Crops are selected from a drawn down menu. If another crop is desired, select "other" and insert the crop name. The user will then have to enter in the Managed Root Zone Depth and Management Allowed Depletion (MAD) for the crop in the applicable override buttons.
Managed Root Zone Depth (in):	This is the crop root depth assuming no obstructing soil layer. See attached Table 1 for typical root zone depths and the recommended installation depths for soil moisture sensors. Root zone depth is impacted by many things (i.e. local soil conditions, crop type, plant hybrid type), therefore the root zone depth is best determined in the field by exposing the roots at full canopy and measuring the depth. The spreadsheet will automatically assign a managed root zone depth based on a crop selection. This value may be overridden by entering a new value in the adjacent override cell to the right.
MAD value:	The **M**anagement **A**llowable **D**epletion (MAD) is the fraction of the total available water (TAW) that is plant extractable without limiting growth via plant stress. MAD values are provided based on the crop selected. Default MAD values may be overridden by inserting a new value in the cell above the MAD value. A maximum value of 0.50 is recommended for all crops. A smaller value could be used for crops that are more susceptible to water stress; however it is recommended that this input not be changed because of increased risk for plant stress.

AGWX Potential ET (in/day): The AGWX Potential ET is the site-specific (Lat. & Long.) potential evapotranspiration (ET). The UW Extension Ag. Weather URL is: https://agweather.cals.wisc.edu/subscribers The potential ET can be retrieved directly from this site or you can have it emailed to you during the growing season (April 1st – November 1st). To set up the ET email service, CTRL left click on the link above, then on the link in the text above the map and follow the instructions. Daily crop ET (Column H) is either the Potential ET if crop canopy cover is equal to or exceeds 80 percent or potential ET multiplied by a crop coefficient. The spreadsheet will make this calculation for you.

Daily Rainfall (in/day): Rainfall volume should be measured daily and entered into the model. Rainfall data should be collected from a location as close to the irrigated field as practical. The average of multiple gage readings is preferred. If the rainfall event is greater than a day in length the total rainfall volume for each day should be used otherwise divided the total volume by number of days and enter it daily.

Daily Irrigation (in/day): The irrigation volume should be measured daily or, if known, entered into the model.

Plant Canopy Cover %: An estimate of the percent a crop covers the bare ground. Entries from zero to eighty percent will result in a daily ET value calculated by multiplying the Potential ET with a crop coefficient. Values greater than eighty percent will use the Potential ET value as daily ET. Percent Canopy Cover is estimated by dividing the canopy width of one of the rows by the crop row spacing. The *Canopeo* smart phone app can also be used to estimate canopy cover. It is available free of charge for both the Android and iphone app stores.

Observed Soil Moisture (%): The root zone soil moisture should be measured on a regular basis (i.e. weekly) using a soil moisture sensor(s) and entered. The model will automatically readjust its predicted soil moisture content to the observed value and use that value in subsequent calculations. CELLS WITHOUT DATA MUST REMAIN BLANK. USE THE **DELETE KEY** TO REMOVE UNWANTED VALUES FROM THIS COLUMN.

Model Outputs

Parameter	Comments / Explanation
Daily Crop ET (in/day):	Estimated crop evapotranspiration (ET) for that day.
Storage Change (in/day):	The daily change in soil moisture is displayed in column I and is calculated as Rainfall + Irrigation – ET.
Readily Available Water (in/day):	The plant available water balance for a given day is calculated as the balance from the previous day plus or minus any change in storage. All fields are assumed to start the growing season with the root zone at the soil water holding capacity (field capacity). The initial monitored soil moisture should be entered if it is available. The predicted plant available water should be monitored closely and used to determine when irrigation is necessary. A negative value indicates depletion of readily available water (RAW) and the onset of plant stress. A **BLUE** font alerts the user to this condition. The larger the negative value, the greater the stress. The negative value can never be less than the Total Available Water (TAW) minus the RAW.
Deep drainage volume (in/day):	Deep drainage occurs when water is added to soils at field capacity thus, forcing water already in the soil deeper into the soil profile. This condition should be avoided or minimized to the greatest extent practical. Deep drainage transports nutrients and pesticides deeper into the soil profile away from plant roots, where it has a greater potential to enter groundwater or tile drains, if present. In addition, saturated soils create conditions favorable for disease and limits aeration, both of which can adversely impact crop health and yields. A **RED** font alerts the user to this condition.
Water Reservoir Graph:	Each tab provides a soil moisture time series graph for each spreadsheet. Included are the upper and lower limits of the Readily Available Water (RAW) and the cumulative deep drainage or deep percolation resulting from applied irrigation.

Proper tracking of root zone soil moisture can help to optimize crop health and yield, while minimizing adverse environmental impacts of production agriculture. In addition, it may be possible to eliminate one or two irrigations during the growing season resulting in energy cost savings. Irrigation scheduling is an important component of natural resource stewardship for irrigated crop production and should be done whenever possible.

Table 1. Root zone / irrigation management range and recommended sensor placement depths by crop type.

Crop Type	Irrigation Mgmt. Depth (in)	WISS NRCS Default Depth (in)	Shallow Sensor Depth (in) @ 25%	Deep Sensor Depth (in) @ 75%
Broccoli & Cauliflower	12 -18	-	3 - 4	9 - 13
Blueberry & Strawberry	12 -18	18	3 - 4	9 - 13
Potato *	16	16	4	12
Tomato & Cantaloupe	12 - 24	-	3 - 6	9 -18
Dry, Snap and Green Bean	18 - 24	18	4 - 6	13 - 18
Soy Bean	30 - 36	30	7 - 9	22 - 27
Small Grains	30 - 36	30	7 - 9	22 - 27
Sweet Corn & Asparagus	24 - 30	24	6 - 7	18 - 22
Field Corn	30 - 36	30	7 - 9	22 - 27
Est. Alfalfa	36 - 48	36	9 - 12	27 - 36

***** Measured from the top of the hill.