(Click the highlighted text and see the top of the page for guidance)

Irrigation Scheduling Field Discussion Points

Producer: _____ Date: _____ Planner: _____

Irrigation Scheduling Principle	Score
1. What is the crop(s) and irrigation method(s)?	
2. Considering the source(s) of water, describe the producer's flexibility in controlling the 1) date and time of water application, 2) flow rates delivered and 3) the ability to turn the water off when they'd like to.	
3. How does the producer currently decide when to irrigate? o When plants appear dry/stressed (1) o When indicated by the calendar or schedule of required field operations AND the amount applied or run time is usually not changed much from one irrigation to the next (1) o When indicated by the calendar or schedule of required field operations AND the amount applied or run time is calculated based on current soil water depletion (5) o When water is available (0) o Soil surface, or near surface appearance or feel, and general current climate observations (1) o By checking current published CIMIS ET data or soil moisture monitoring devices once in a while (2) o When a target "dryness" value (i.e. estimated inches depleted, relative palm wetting, etc.) from systematic soil moisture monitoring by feel and appearance to the depth of the root zone (5) o When a target "dryness" value (i.e. inches depleted, centibars of tension, % remaining, etc.) from soil moisture monitoring devices is reached (5) o When a target water use value (i.e. inches of ET since last irrigation) from rootzone water budget and current weather data (CIMIS) is reached (5) o When a target measured plant stress level (i.e. pressure bomb, canopy temperature, etc.) is reached (5) o Other _____	5 max
4. How does the producer currently decide when an irrigation set is done? o Observe when about the right amount of time has passed and the furrows or border checks appear to be adequately wet (1) o Run times based on what's worked in the past and the current schedule of required field operations (2) o Sets/blocks changed when the target number of inches for all crops or gals/tree or vine is applied. May be calculated from run time and flow rate. (5) o Other _____	5 max

(Click the highlighted text and see the top of the page for guidance)

5. Does the producer apply extra water for salt leaching? If so, how does he/she determine the amount of extra water needed? o No extra water added for leaching (Assign 5 points to indicate leaching is not an issue we need to address) o Just run the system a little longer (0) o Additional amount or runtime based on general local recommendations (3) o Amount calculated based on supply water EC and crop tolerance values (5)	5 max
6. Describe irrigation records that the producer currently keeps. o No records kept (0) o Record irrigation dates (2) o Record irrigation dates and amounts applied (5)	5 max
7. Does the producer know how much water they apply to each crop (i.e. inches or gal per tree or vine)? o No (0) o Yes, by irrigation district record/report/bill (2) o Yes, by flow measuring device (5) o Yes, by knowing the system application rate and runtime (3) o Yes, by a pump test flow rate and run time (2) o Yes, other _____	5 max
8. Does the producer know how much water (inches or gallons) the crop removes from the soil? o No (0) o Yes, by using current (real time) climate based measurements (i.e. CIMIS) (5) o Yes, by using historic (typical year) data (i.e., CIMIS, Cooperative Extension publications, etc.) (3) o Yes, by tracking root zone soil moisture changes with electronic probes or other devices and correlating readings with water volumes (5) o Yes, other _____	5 max
9. If the producer knows or can estimate their water supply flow rate, complete the appropriate Scheduling Check sheet for one or two fields *(Select: Micro, Sprinkler, Furrow, Border, Center Pivot)*. Compare amount applied to the estimated ET for the irrigation cycle. Conclusions:	

Expected benefit from including IWM 449 in a plan or contract: Total _____

25-30 Low
16-24 Medium
0-15 High

Micro Scheduling Check *(Alt ← to return)*

Producer _____ Field _____ Date _____

Timing and Amount of Applications
(Evaluate management on one field or part of field)

Amount of water typically applied each irrigation during the peak of the season:

$$\text{Inches} = \frac{96.3^{1} \text{ X Q (gpm) X set time (hrs)}}{\text{Area (ft}^2\text{)}}$$

Q=gpm to block

Area= block length (ft) X block width (ft)

$$\text{Inches} = \frac{_____\text{(gpm) X } _____\text{(hrs) X 96.3}}{_____\text{(ft}^2\text{)}} = **_____ \text{ (in.)}$$

OR

Inches = application rate (in/hr) X set time (hrs)

= _____ (in/hr) X _____ (hrs) = **_____ (in.)

Estimate of crop water use between irrigations during the peak of the season:

Crop _____ Planting date _____

*Normal daily crop water use for this irrigation period _____
*(*use NRCS CA Consumptive Use Tool or equivalent)*

No. days between irrigations _____

Estimated Period crop water use: _____ X _____ = **_____ (in.)

**Compare

[1] A unitless conversion to convert gpm, ft^2 and hrs. to inches

Furrow Scheduling Check *(Alt ← to return)*

Producer _____ Field _____ Date _____

Timing and Amount of Applications
(Evaluate management on one field or part of field)

Amount of water typically applied each irrigation during the peak of the season:

$$\text{Inches} = \frac{96.3^{1} \text{ X Q (gpm) X set time (hrs)}}{\text{Area (ft}^2\text{)}}$$

Area = furrow spacing (ft) X furrow length (ft) X No. of furrows per set

$$\text{Inches} = \frac{_____\text{(gpm) X } _____\text{(hrs) X 96.3}}{_____ \text{ (ft}^2\text{)}} = **_____ \text{ (in.)}$$

Target maximum amount of water to refill rootzone:

= Root zone depth (in.) X *available water capacity (in./in.) X 0.5[2]
*(*see soil survey for dominant soil)*

= _____ X _____ X 0.5 = **_____ (in.)

Estimate of crop water use between irrigations during the peak of the season:

Crop _____ Planting date _____

*Normal daily crop water use for this irrigation period _____
*(*use NRCS CA Consumptive Use Tool or equivalent)*

No. days between irrigations _____

Estimated Period crop water use: _____ X _____ = **_____ (in.)
**Compare

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[1] A unitless conversion to convert gpm, ft^2 and hrs. to inches
[2] Typical allowable depletion between irrigation events (50%)

Border Scheduling Check *(Alt ← to return)*

Producer _____ Field _____ Date _____

Timing and Amount of Applications
(Evaluate Management on one field or part of field)

Amount of water typically applied each irrigation during the peak of the season:

$$\text{Inches} = \frac{96.3^{1} \text{ X Q (gpm) X set time (hrs)}}{\text{Area (ft}^2\text{)}}$$

Area = border width (ft) X border length (ft) X No. of borders per set

$$\text{Inches} = \frac{_____\text{(gpm) X } _____\text{(hrs) X 96.3}}{_____ \text{ (ft}^2\text{)}} = **_____ \text{ (in.)}$$

Target maximum amount of water to refill rootzone:

= Root zone depth (in.) X *available water capacity (in./in.) X 0.5[2]
*(*see soil survey for dominant soil)*

= _____ X _____ X 0.5 = **_____ (in.)

Estimate of crop water use between irrigations during the peak of the season:

Crop _____ Planting date _____

*Normal daily crop water use for this irrigation period _____
*(*use NRCS CA Consumptive Use Tool or equivalent)*

No. days between irrigations _____

Estimated Period crop water use: _____ X _____ = **_____ (in.)
**Compare

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[1] A unitless conversion to convert gpm, ft^2 and hrs. to inches
[2] Typical allowable depletion between irrigation events (50%)

Sprinkler Scheduling Check *(Alt ← to return)*

Producer _____ Field _____ Date _____

Timing and Amount of Applications
(Evaluate management on one field or part of field)

Amount of water typically applied each irrigation during the peak of the season:

$$\text{Inches} = \frac{96.3^{1} \text{ X Q (gpm) X set time (hrs)}}{\text{Area (ft}^2\text{)}}$$

Area= set length down the line (ft) X set width or move distance laterally (ft)

$$\text{Inches} = \frac{_____\text{(gpm) X } _____\text{(hrs) X 96.3}}{_____\text{(ft}^2\text{)}} = **_____ \text{ (in.)}$$

OR

Inches = application rate (in/hr) X set time (hrs)

= _____ (in/hr) X _____ (hrs) = **_____ (in.)

Target maximum amount of water to refill rootzone:

= Root zone depth (in.) X *available water capacity (in./in.) X 0.5[2]
*(*see soil survey for dominant soil)*

= _____ X _____ X 0.5 = **_____ (in.)

Estimate of crop water use between irrigations during the peak of the season:

Crop _____ Planting date _____

*Normal daily crop water use for this irrigation period _____
*(*use NRCS CA Consumptive Use Tool or equivalent)*

No. days between irrigations _____
Estimated Period crop water use: _____ X _____ = **_____ (in.)
**Compare

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[1] A unitless conversion to convert gpm, ft^2 and hrs. to inches
[2] Typical allowable depletion between irrigation events (50%)

Center Pivot Scheduling Check *(Alt ← to return)*

Producer _____ Field _____ Date _____

Timing and Amount of Applications
(Evaluate management on one field or part of field)

Amount of water typically applied each irrigation during the peak of the season:

$$\text{Inches} = \frac{96.3^{1} \text{ X Q (gpm) X rotation time (hrs)}}{\text{Area (ft}^2\text{)}}$$

Area= area of the pivot circle (ft^2)

Rotation time = time to complete one rotation (hrs)

$$\text{Inches} = \frac{_____\text{(gpm) X } _____\text{(hrs) X 96.3}}{_____\text{(ft}^2\text{)}} = **_____ \text{ (in.)}$$

OR

Inches = application amount (in) in each rotation = **_____ (in.)

Estimate of crop water use between irrigations during the peak of the season:

Crop _____ Planting date _____

*Normal daily crop water use for this irrigation period _____
*(*use NRCS CA Consumptive Use Tool or equivalent)*

No. days between start of one rotation and the start of the next rotation _____

Estimated Period crop water use: _____ X _____ = **_____ (in.)

**Compare

[1] A unitless conversion to convert gpm, ft^2 and hrs. to inches

Guidance Supporting the Discussion Questions and Typical Responses

Introduction to the Irrigation Scheduling Assessment

a. These nine multiple choice questions are intended to help planners initiate the IWM irrigation scheduling discussion with producers. It can also serve to document conversations, to begin to inform the planner and producer about specific water management improvement opportunities, to identify and describe specific NRCS water management objectives and to help focus NRCS assistance. Use these questions truly as a discussion (not a quiz) where the producer teaches the planner something about how producers make irrigation decisions and the planner offers methodologies and tools that we believe may help the farm operation.

   A point system has been added so the tool can provide a quantitative assessment for planning purposes and financial assistance program ranking. Point values appear at the end of each statement with a "5" indicating they can't be doing much better. The planner should check all answers that apply but note that the maximum score is 5 points for each question. Lower point totals suggests there is greater need for IWM 449 assistance. **(Alt ← to return)**

What is the crop(s) and irrigation method(s)?

b. *Crop(s)* - The crop has a large impact on the producer's interest to schedule irrigations with high precision. Wine grape growers, for example, are particularly interested in managing plant stress (through managing soil moisture) to achieve crop quality objectives. On the other hand, cattle ranchers who occasionally "wild flood" range/pasture land may be less interested in getting the most out of the irrigation water they apply. It's important to have an understanding of the value the producer puts on the outcome of their crop so we can offer/promote IWM accordingly. **(Alt ← to return)**

c. *Irrigation Method* - Probably the greatest influence over the use of precise irrigation scheduling is the method of irrigation. Drip/micro systems, center pivot sprinklers, solid set sprinkler and to some extent hand moved sprinklers, lend themselves to precise scheduling because the producer can turn the system on and off with a valve. It's much more challenging for producers who irrigate with sloping furrow and border check systems due to water delivery schedules and the fact that the soil (intake rates and flow conditions) tends to dictate run times (not the producer). For surface irrigators we can focus on the "when to irrigate" question and work with them on system operation techniques to put more of the "how much" control back in their hands. **(Alt ← to return)**

Considering the source(s) of water, describe the producer's flexibility in controlling the 1) date and time of water application, 2) flow rates delivered and 3) the ability to turn the water off when they'd like to.

d. It's important that we understand the constraints producers work under when we discuss potential improvements in irrigation scheduling practices. They can control their irrigation dates and set times only to the extent that they have control

over when they get the water, how long they get it and at what flow rate. If they're on a well or pump directly out of a reservoir or stream/river they are usually only limited by flow rate, in other words, lots of flexibility. On the other hand, a few irrigation districts still deliver water on a "rotation" and fixed duration basis providing the producer with very little flexibility for making optimum irrigation scheduling decisions. If the producer has a relatively inflexible water supply NRCS will need to adjust our expectations and technical and financial assistance delivery accordingly. This should also serve as a reminder to work with water suppliers and other partners in improving water delivery flexibility. **(Alt ← to return)**

How does the producer currently decide when to irrigate?

e. Producers may choose to irrigate on a fixed frequency or when they believe the crop/soil is dry enough. They must consider such things as flexibility of water delivery, crop cultural practices, labor schedules and the desire to take advantage of power company "time of use" (for pumping) programs when making their decision. If they irrigate too frequently with a fixed amount that they typically apply then excessive deep percolation will result. It they irrigate too late with a fixed amount then crops may be water stressed and performance may suffer. Most producers use a combination of factors when deciding when to irrigate. **(Alt ← to return)**

f. *When plants appear dry/stressed* -Waiting until the plants show signs stress or wilt certainly indicates that it's dry enough to irrigate but may be too late for many crops to recover causing yield and/or quality reduction. **(Alt ← to return)**

g. *When indicated by the calendar or schedule of required field operations AND the amount applied or run time is usually not changed much from one irrigation to the next* - It's common for producers to irrigate on the same frequency that they believe has worked for them in the past regardless of current conditions. It's also common for irrigation timing decisions to be based on the need to shift labor, equipment and water to the next field in order to meet the needs of the entire farm. Either of these could result in over or under irrigation if the amount of water applied is not adjusted considering current soil moisture depletion (water use) conditions. **(Alt ← to return)**

h. *When indicated by the calendar or schedule of required field operations AND the amount applied or run time is calculated based on current soil water depletion* – Irrigating on a fixed frequency can be efficient as long as the AMOUNT applied is adjusted based on current soil moisture depletion as measured by feel, sensors or estimated using CIMIS data. **(Alt ← to return)**

i. *When water is available* - A producer's decision on when to irrigate may be dictated by when they can get the water. This is a common problem for producers who get their water from an irrigation district that makes deliveries on a fixed rotation basis (for example, they get water every Thursday). **(Alt ← to return)**

j. *Soil surface, or near surface appearance or feel, and general current climate observations* - Many producers will use visual observations of soil dryness (i.e. surface cracking) and current general climate conditions (temperature, wind, humidity) when making irrigation timing decisions. This is actually good to do but doesn't allow them to quantify the current soil moisture status to confirm that a target amount of water has been removed. **(Alt ← to return)**

k. *By checking current published CIMIS ET data or soil moisture monitoring devices once in a while* - Some producers passively observe current published CIMIS data or passively observe soil moisture monitoring device readings without actually setting and using target "dryness" values. **(Alt ← to return)**

l. *When a target "dryness" value (i.e. estimated inches depleted, relative palm wetting, etc.) from systematic soil moisture monitoring by feel and appearance to the depth of the root zone* – One measure of our success is when producers 1) quantify current soil moisture status, and 2) set and use target values for how dry the soil is allowed to get or how much water has been removed to trigger irrigation events. Different types of soil moisture monitoring devices or methods can provide readings in centibars of tension, percent moisture, relative wetness scales or inches depleted. These methods can, and should, be complemented by climate based methods such as CIMIS, on-site weather stations and atmometers, which can provide an acceptable estimate of the inches of water the crop has removed from the soil. **(Alt ← to return)**

m. *"Other"* – There will be times when the producers do something different than any of the options offered. When using this assessment tool for ranking purposes the planner should use judgment and assign their own ranking values. **(Alt ← to return)**

How does the producer currently decide when an irrigation set is done?

n. Irrigating too long and consequently applying too much water will cause excessive deep percolation and perhaps other losses. This question addresses how producers decide HOW MUCH to apply each irrigation event or set. We approach the question indirectly by asking them how they decide when to change irrigation sets. **(Alt ← to return)**

o. *Observe when about the right amount of time has passed and the furrows or border checks appear to be adequately wet* - One of the challenges we have with surface irrigation on sloping land is that it's difficult to select and apply a target amount of water because the soil/furrow/border check is going to "take" as much water as it takes while it flows to the end of the field. Therefore producers who furrow or border-irrigate don't typically think in terms of inches of water to apply. Their set times are usually based on "what's worked for them in the past", how long it takes to get the water "out" at the end of the field, and how well the beds between furrows have "wetted up". **(Alt ← to return)**

p. *Run times based on what's worked in the past and the current schedule of required field operations* - The need to move water, labor, or equipment someplace else may be a factor in the producer's decision on when to turn the

water off. Many times in farm operations, labor (the irrigator) is limited on when they can get back to the irrigation to make a change. Minimizing over application may be a secondary interest. **(Alt ← to return)**

q. *Sets/blocks changed when the target number of inches for all crops or gals/tree or vine is applied. May be calculated from run time and flow rate* - This is our goal, assisting the producer in applying a target, predetermined amount of water to each set. This is practical on pressurized systems where pipelines are used to distribute the water and valves control flows. It may also be practical on dead level basins (primarily orchards) where basins are "filled" with a target depth of water and there is no runoff. In contrast, applying a target amount of water to sloping furrows or border checks is difficult due to the challenges of handling runoff. **(Alt ← to return)**

Does the producer apply extra water for salt leaching? If so, how do they determine the amount of extra water needed?

r. Adding extra water explicitly to prevent the accumulation of salts in the rootzone is something that is practiced when the producer's water supply is relatively high in salts. Applying excessive amounts of leaching water results in unnecessary deep percolation. Applying too little may lead to salinizing the soil. Our goal is to have the producer calculate the correct amount based on measured water salinity and a specific crop salt tolerance value. **(Alt ← to return)**

Describe irrigation records that the producer currently keeps.

s. NRCS encourages producers to keep irrigation records so they have something to refer back to to quantitatively compare the effects of past decisions with outcomes before they make future irrigation decisions. Our goal is that they record (or have records of) all irrigation dates, amounts applied and crop water use data. Producers may prefer to keep records in hardcopy or electronically. **(Alt ← to return)**

Does the producer know how much water they apply to each crop (i.e. inches or gal per tree or vine)?

t. If NRCS achieves nothing more with the producer than to enable them to accurately compare the amount of water they've applied to the amount actually used by the crop then we've just about done our job. With this comparison they will see quantitatively how they are doing and will then draw their own conclusions on if they want or need to change their system and/or irrigation scheduling practices. **(Alt ← to return)**

u. *Yes, by irrigation district record/report/bill* - The producer may respond that they know how much they apply from their irrigation district records. Although some districts are beginning to use accurate flow measuring devices and may even include flow rates/volumes with associated clock times so the producer can target specific fields, most should be considered only estimates of what the farmer actually applies to any particular field. If the planner concludes that the data is

probably pretty accurate then higher point values should be assigned if needed for ranking purposes. **(Alt ← to return)**

v. *Yes, by knowing the system application rate and runtime* - When a sprinkler or micro irrigation system is first designed the designer calculates the average system application rate. Producers can then use this information to calculate how much water has been applied based on set time. For example, the producer says he knows the sprinkler system application rate (inches/hour) and multiplies this by the hours of operation (set time) to determine the inches of water applied. This is important for the producer to do for making routine set length decisions. However, the average system application rates change over time due to wear and changes in operating conditions reducing the accuracy of the calculation. Average application rates should be regularly checked and re-established with a flow meter. **(Alt ← to return)**

w. *Yes, by a pump test flow rate and run time* - A pump test flow rate method will get them in the ball park but is not accurate enough to confirm amounts actually applied. If it's been a while since the test (pump wear) and the depth to water table has changed the measured flow rate will change. **(Alt ← to return)**

Does the producer know how much water (inches or gallons) the crop removes from the soil?

x. *Yes, by using current (real time) climate based measurements (i.e. CIMIS)* - Using real time climate (CIMIS) data means data is regularly collected and processed with appropriate crop coefficients (Kc) and accumulated to arrive at the crop water use estimate. **(Alt ← to return)**

y. *Yes, by tracking root zone soil moisture changes with electronic probes or other devices and correlating readings with water volumes* - Few producers should be able to answer yes here. If they are using sensors most use them to track trends and relative soil moisture change. A "yes" (our goal here) is to move technology and producers to determine volumetric water use by crops so they can compare it to amounts of water they apply. **(Alt ← to return)**

If the producer knows or can estimate their water supply flow rate, complete the appropriate Simple Scheduling Check sheet for one or two fields

z. If the producer has some idea about what their water supply flow rate is or how many inches they apply each irrigation then a quick calculation comparing amount applied to accumulated CIMIS ET should be informative. You are assessing the producer's decision making process so it doesn't matter which field or part of the field you use to do the math. It's important to note that this is a "ball park" level of comparison. Its purpose is to simply raise red flags to encourage further investigation. It also demonstrates the basic math producers should occasionally perform on their own. The planner should choose the worksheet that's appropriate for the producer's irrigation method being assessed. **(Alt ← to return)**