Comments on Draft Water Resources Program Guidance – Determining Irrigation Efficiency and Consumptive Use Public Review Draft, October 2026, Publication 26-11-017

Provided by RH2 Engineering, Inc.

1. Page 2. Definition of Crop Irrigation Requirement (CIR)
    a. Can you confirm that the CIR (and Net Irrigation Required as defined in the Effective Water Use model) includes the water required for leaching, frost-protection, and cooling (highlighted in blue below), for every station and every crop in the Effective Water Use model, or is this an incorrect statement? Page 11, states, "ET Models do not account for situational miscellaneous crop requirements such as leaching, frost-protection, and cooling…"
    b. Page 2. Definition of Crop Irrigation Requirement (CIR), last sentence. Should the term "inefficient" (highlighted in yellow below) be deleted? The losses described are not necessarily due to an inefficient irrigation system, but instead are part of all irrigation systems. Recommend deleting "inefficient".
    c. CIR should also include additional water retained by/for plant growth.

Crop Irrigation Requirement (CIR) – Water that needs to be supplied by irrigation to satisfy evapotranspiration that is not provided by water stored in the soil and precipitation. This includes water required for miscellaneous crop requirements such as leaching, frost-protection, and cooling. It does not include water losses from inefficient irrigation systems such as deep percolation, runoff, or wind drift and evaporation.

2. Page 4 – Footnote 4. How is the potential for shallow groundwater supposed to be handled by Ecology staff or applicants/consultants? This presents a lot of uncertainty with the calculations presented later since a lot of agricultural areas are coincident with shallow groundwater, such as on the floodplains of rivers.

[4] Shallow groundwater is not often present, and when it is then it is typically a small portion of the water used by a crop and therefore isn't considered here (Hopmans et al, 2002) (USDA, 1997). If Ecology staff are aware of the presence of shallow groundwater when evaluating irrigation water use then they should discuss water table management plans with the applicant, and evaluations of irrigation water needs with senior Ecology staff or irrigation experts.

3. Page 6 – I believe the last sentence in the paragraph below, is incorrect. Based on review of Pe data for various locations, even during summer months, the effective precipitation will always be less than the total precipitation for that month. Recommend deleting that sentence.

The contributions of Pe to the crop ET can vary in significance depending on factors such as the amount, intensity, and frequency of precipitation, the temperature and wind speed, topography, crop growth stage, depth of the root zone, and soil properties. If Pe satisfies all the crop's water needs (ET), then no irrigation is required (Pe≥ET, CIR=0); any excess precipitation will not be effective. When no ET occurs, then Pe=0. Under some conditions, such as during hot and otherwise dry periods, all precipitation can be reasonably considered effective (Pe=Pt).

4. Page 6 – Recommend placing parentheses around (Pt^0.82416) within the Pe equation. This will help avoid confusion and make it clear that the Pt^0.82416 calculation needs to occur, and then be multiplied by 0.70917, before 0.11556 is subtracted from the product.

Pe = SF x (0.70917 x Pt^0.82416-0.11556) x 10^(0.02426 x ETc)

5. Page 6 – Recommend adding the equation for soil water storage factor (SF), since it is used in the effective precipitation equation and referenced in footer 7.

SF = 0.531747+0.295164x(D)-0.057697x(D^2)+0.003804x(D^3)

6. Page 6 – Recommend adding definition for variable D occurring in the SF equation. "D = usable soil water storage (inches)"

7. Page 10, Table 1. It doesn't seem logical that any of the irrigation methods would have their average evaporated (% Evap) equal to 0, except for maybe subsurface drip. It also doesn't seem logical that surface drip would have higher return flow than subsurface, as there will be some evaporation associated with any application exposed to the air.
    a. Why isn't Travelling Boom included in Table 1 as an irrigation method, since it appears on WSU's Effective Water Use model, and has become more popular as a more efficient replacement for traveling big gun irrigation?
    b. How can the range for solid set sprinklers be 70-85% but the average 67%?
    c. Why are the average irrigation efficiencies in Table 1 different than the average irrigation efficiencies contained in WSU's Effective Water Use model website that is the recommended tool for calculating the total irrigation requirement? This leads to additional calculation steps that have to be made and double-checked as opposed to being able to use the model output directly. It can be done, but decreases efficiency and increases the likelihood of errors being introduced.

Irrigation Method	Table 1 Average Irrigation Efficiency	Effective Water Use calculator average irrigation efficiency
Pivot/linear - Mid-elevation spray application (MESA)	79	80
Pivot/linear - Low-energy precision application (LEPA)	91	97
Pivot/linear - Low-elevation spray application (LESA)	92	96
Pivot/linear (top of pipe)	56	60
Hand Move	68	68
Wheel Line	68	68
Microsprinkler	75	80
Undertree Orchard	77	70
Sold Set Sprinklers	67	75
Big Gun – Traveler	59	60
Furrow	62	Variable based on soil type
Graded Furrow	73	Not provided
Furrow w/surge	75	Not provided
Furrow w/tailwater reuse	80	Not provided
Basin	75	70
Border	65	Variable based on soil type
Contour Border	73	Not Provided
Corrugation	50	Not Provided
Wild Flood	35	30
Subsurface Drip	92	100
Surface Drip	89	97
Mobile Drip Irrigation	97	99

8. Page 12. I believe the use of power energy consumption data needs to be approved by Ecology in writing prior to it being used in lieu of water metering, if water metering is required. However, I don't believe permission is needed to use this equation as another source of data to estimate water use. Recommend deleting the highlighted sentence.

Power (energy) consumption data, where the electrical power meter is dedicated solely to a diversion pump, can be used to estimate the volume of water diverted. An equation to convert power meter data to water volume is described in WAC 173-173-160, using estimated pump and motor efficiencies, the vertical lift of system while pumping, and the number of kilowatt hours measured at the electric meter. Use of the method must be approved in writing by Ecology (WAC 173-173-160(1)(a)).

9. Page 13 – I appreciate that Ecology has acknowledged that the data provided by the web-based models changes more than would be anticipated. If data is downloaded and the raw data file saved, will Ecology accept that data as satisfactory, or will it require recalculation if it has changed by the time Ecology is reviewing a report of examination that contains these calculations?
10. Page 14 – On the east slope of the Cascades where the precipitation gradient is the steepest, sometimes the geographically "closest" weather is not necessarily the closest in terms of climate data, some discussion, nuance, or leeway as to this discrepancy should be noted.

Basic information is needed to develop a consumptive use estimate using the reference ET method:

- Crop type: from applicant or, if needed, historical records such as sale records, historical property records, the Washington Department of Agriculture Crop Survey[16], etc.
- Irrigated area: from applicant or, if needed, aerial imagery, parcel data, historical records, satellite data,[17] etc.
- Location: choose the closest weather station with adequate data available for the model of choice.[18]
- Irrigation system type: from applicant or, if needed, aerial imagery, observations, etc.

11. Page 14 – Using the closest specific station info can be misleading in areas prone to thunderstorms. Take 2026 data from the Wenatchee and Malaga stations, they are only approximately 6 miles apart, effectively in the same part of the rain shadow/rain gradient, and yet there is a 27% difference in precipitation YTD due in large part to a thunderstorm that passed over the Wenatchee station on 8/14 dropping 0.47" but not over the Malaga station. Trying to determine whether or not a specific storm impacted a specific site, and/or to what degree, is impossible, yet the implications for consumptive water use are substantial. This is a clear example of more precision not necessarily equating to better accuracy over using larger dataset like those used in the older WIG. Would it be acceptable to use aggregated ET/CIR data from multiple stations, in leu of a single source, or allowing the practitioner to select a station based on other factors besides proximity?

12. Page 14- How many years of data are considered sufficient? When is it justifiable to use a further station with a larger/longer data set?

    [18] Some weather stations should be used with caution or may not have a sufficient period of record or collect sufficient weather data for reference ET models.

13. Page 18, Appendix A – When using metering records, it appears to suggest that the crop being grown is irrelevant since only the metering data and irrigation method, along with the average consumptive use, is used to calculate the consumptive use. How is this accurate?

14. Page 20 – The metering data is multiplied by the average consumptive use (93%) to calculate the consumptive use. Then, later in the example, the crop irrigation requirement is compared to the total irrigation requirement to calculate an irrigation efficiency of 78.5%. Since this is different than the average irrigation efficiency of 59%, it leads to the percent evaporated being 19.5% (assuming irrigation efficiency plus evaporated percent = consumptive use percent) to make the math work out, which is different than the average evaporated percentage of 34% from Table 1.

    a. How are staff/consultants supposed to perform calculations when the percent irrigation efficiency, % Evap, %RF, and/or % CU are not the average values contained in Table 1? In the older guidance it stated that, "Typically, systems that are more efficient than the average will first reduce return flow and then reduce consumptive use." There is no direction for staff/consultants on how to make non-average irrigation calculations in this document.

15. Page 20 – The last paragraph on that page calculates that the irrigation efficiency of the traveling big gun sprinkler, based on comparison of the metering data and Effective Water Use model is 78.5%.

    a. The calculated 78.5% is higher than the range of 50-70% provided in Table 1. How are irrigation efficiency results outside of the provided range to be considered?

16. Page 20 – In the last paragraph, a conclusion is made that states that, "The irrigation efficiency is therefore considered reasonable and non-wasteful." At what point would the calculated irrigation efficiency be considered unreasonable and wasteful in this example?
    a. When it is less than the average irrigation efficiency percentage of 59%?
    b. When it is less than the low end of the range provided in Table 1, of 50%?

c. Other?

The irrigation efficiency as a percentage is therefore 78.5%, which is more efficient than the average irrigation efficiency of 59% for traveling big gun sprinklers. The irrigation efficiency is therefore considered reasonable and non-wasteful.

17. General – This guidance lacks what is supposed to happen when water right limits are less than the total irrigation requirement numbers calculated using this guidance.

    a. How should it be treated if the water right period of use is shorter than the period when water is used under the Effective Water Use model?
        i. If the water right allows for use June through August, but the Effective Water Use model shows irrigation need also occurs in May and September. Is the need in May and September not included, or is it assumed that the additional water can be applied during the period of June through August to make up for it?

    b. How should it be treated if the water right annual volume is less than the total irrigation requirement calculated using the Effective Water Use model?
        i. With respect to which application efficiency should be used.
        ii. With respect to the consumptive use calculation.

    c. How should the consumptive use be calculated if the metering data divided by the water right limit suggests an irrigation efficiency that is higher than the range provided in Table 1, and a site visit suggests that the crops appear healthy?

    d. How should it be treated if the water right instantaneous rate is not physically high enough to provide the total irrigation requirement for the peak month (assuming 24/7 pumping at the instantaneous rate), or more, during the summer?

    e. What if the water right water duty (as an example 10 inches) is less than the crop irrigation requirement, (as an example 12 inches). Would the entire water use be considered consumptive?

18. Effective Water Use model – The “Additional Information:” contained at the bottom of the Effective Water Use model results identifies that the estimates are plus or

minus about 10% to 15%. How should Ecology staff and consultants account for this uncertainty when using this model?

These methods are not perfect. Every year the weather, and thus crop water use, is different. My best guestimate of the accuracy of the ETr estimates, based on weather stations that were near each other that should have been equivalent, but were not, is that these estimates are plus or minus about 10 to 15%. There is a lot of variability and uncertainty in crop coefficients as well.