

Updating the Washington Irrigation Guide

In 2008, the Department of Ecology (Ecology), Washington State University (WSU), and the United States Department of Agriculture's Natural Resource Conservation Service (NRCS) funded a project to update the Washington Irrigation Guide (WIG). This publication is the standard in Washington State for estimating crop water needs.

Q: Has the WIG ever been updated before?

A: Yes. The current WIG was published in 1985, with supplemental data added in 1992. Prior to the current WIG, similar publications were developed in 1982 (*Irrigation Requirements for Washington—Estimates and Methodology, or "Bulletin XB0925"*) and 1969 (*Circular 512*).

Q: Why update the WIG now?

A: There are 3 reasons that Ecology, WSU and NRCS decided to collaborate on an update to the WIG. First, it is an important guidance document used today by farmers, irrigation design professionals, and state agencies in their daily work. Having the most accurate and up-to-date information is important to those that use the WIG. Second, several decades worth of new climate data are available. The WIG uses climate data to estimate crop water needs. And third, better scientific formulas are now available to estimate crop water needs.

Q: Are there different methods to estimate crop water needs?

A: Yes. There are over 50 scientific formulae to estimate evapotranspiration (ET). ET is a term used to describe the sum of evaporation and plant transpiration from the Earth's land surface to atmosphere. ET, combined with how much water is available from rainfall, determines how much irrigation water is needed to grow a crop. *Circular 512* (1969) used the modified Blaney-Criddle method to estimate ET, while *Bulletin XB0925* relied on the Doorenbos and Pruitt Blaney-Criddle method. The WIG (1985/1992) relied on both the FAO 24 Modified Blaney-Criddle and SCS Modified Blaney-Criddle methods. The current method for the new WIG will rely on the ASCE Standardized Penman-Monteith method.

FOR MORE INFORMATION

Information on this topic can be accessed through Ecology's website. The address is:

<http://www.ecy.wa.gov/programs/wr/wig/wig.html>

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The Penman-Monteith method predicts ET based on actual data and assumptions about local area temperatures, wind speed, solar radiation, and precipitation.

Q: How does the method of estimating ET affect how much water the crop needs?

A: Depending on what method is used, the estimate of crop water need can vary by $\pm 25\%$. For this reason, the American Society of Civil Engineers did a study of the most appropriate ET method to use when estimating crop water needs and determined that the Penman-Monteith method was preferable.

Q: How does the data in the Penman-Monteith equation affect crop water needs?

A: The current WIG (1985/1992) is based on average climate conditions from 1951 to 1980 over a limited number of weather stations. We now have access to many more stations around the state, and more recent data on rainfall, temperature, wind, relative humidity, solar radiation and other data. By updating the WIG to include newer data, the crop water needs will be more accurately predicted. WSU & NRCS applied standardized data cleaning methods to ensure that the data being used in the new WIG were based on best available science.

Q: How are peak water needs estimated?

A: The current WIG (1985/1992) included a method to translate average daily use to peak daily use to help in sizing irrigation infrastructure. However, the peak day estimate was still based on average rainfall and temperature conditions (as opposed to a drought year). *Bulletin XB0925* provided tables that showed the variation between average years and drought conditions on a 1:5, 1:10, and 1:20 year frequency. The new WIG will incorporate both of these tools allowing the user to specify the data set that best meets their need.

Q: Are peak water needs due to drought significantly different than average water needs?

A: Crops require more water in droughts because temperatures are hotter and rainfall is lower. Crops cannot always get the water they need during drought because water may not be physically available from the source, or legally available under the water right. If water is available, then crops may consume on the order of 10 to 15% more water depending on the severity of the drought. For example, *Bulletin XB0925* published crop water needs for average and drought years. Pasture in Ellensburg in an average year requires 32 inches, while in a 20-year drought it would need 36 inches. A particular water user's reaction to drought varies, from diverting more water if available, to diverting the same amount of water and becoming 10% more efficient that year, to diverting the same amount of water and deficit irrigating the crop that year which reduces crop yield.

Q: How well documented was the old WIG?

A: Unfortunately, much of our understanding of how the old WIG was developed has been lost to time. We know the method of calculation and the data set used to develop the tables estimating crop water use. However, over the last 25 years, much of the actual data have been lost and the institutional memory of how it was developed is no longer available from the original authors. For example, the actual data sets and computations are not available, a bibliography of sources that provided the data are not available, data cleaning methods were not described, and sources of crop coefficients used to translate reference ET (e.g. grass) to a specific crop (e.g. apples) cannot be replicated. So while the WIG remains the standard ET guidance in Washington today, the underlying data are not well-documented. By contrast, all of the data in the new WIG will be documented, peer-reviewed and available, with both a written-published document and a web application.

**Q: What is different in the results between the old WIG and the new WIG?**

A: There are many differences that will be interesting to users of the WIG:

- The number of stations for which results are available increased from 90 to 232.
- The number of crops for which results are available increased from 40 to 76.
- Depending on specific locations, some crop irrigation requirements increase and some decrease.

Q: Does Ecology use the WIG when evaluating water rights?

A: Yes. Ecology routinely uses the current WIG when evaluating applications for new water right permits and applications for water right changes and transfers. In some cases this is required by statute because some water right transfer applications trigger a “consumptive use analysis,” which requires Ecology to determine how much water is lost to ET from an irrigation water right. The WIG is the best source of information available to Ecology to comply with this statutory requirement. In other cases, Ecology uses information from the WIG, along with aerial photographs, to estimate historical water use when metered water or power data are not available to ascertain the extent that water was put to beneficial use in the past. When Ecology tentatively determines the extent and validity of a water right for the purpose of evaluating a water right transfer application, it tries to use multiple data sources to come up with the most accurate answer possible.

Q: Until the new WIG is completed, what data will Ecology use when evaluating water rights?

A: Until the new WIG has been peer-reviewed and gone through a robust public review process, Ecology will continue using the old WIG. Ecology wants to make sure it and the public have confidence in the new numbers before adopting them and training staff in their use.

Q: Once the new WIG is finalized, will Ecology allow applicants to use the old WIG or an ET estimate other than the Penman-Monteith method?

A: Not unless there is a compelling scientific basis to do so. The new WIG is based on the best method available for estimating ET in Washington State, the most comprehensive data set available, and a peer-reviewed work product. Other methods and data sets may yield higher (or lower) numbers, but they won't necessarily be more accurate. Ecology will consider such requests on a case-by-case basis.

Q: What data set will Ecology use when evaluating water rights?

A: It depends on the type of analysis Ecology is required to do by statute. Generally, Ecology will try and match the data set to the statutory test prescribed.

- For extent and validity determinations, Ecology will use the WIG long-term average which is based on the most recent 30 year data set from 1980 to 2010. WSU and NRCS considered whether longer data sets would affect results, and generally the correlation was within an inch, so a standardized 30 year data set was selected for all of the stations.
- For new water right application, Ecology will use the WIG long-term average as a starting point for a reasonable water duty. However, it will also consider drought frequency in the local area and the ability of the proposed irrigation system to adapt to changing crop water demands. Ultimately, a certificate will only issue for the quantity of water put to beneficial use.
- For annual consumptive quantity (ACQ) evaluations triggered when someone seeks to add acres or purposes of use to a water right, or for trust water donations, Ecology will use the most recent 5-year period of water use directed in the statute.
- For impairment evaluations based on a consumptive use evaluation, Ecology will consider the highest consumptive use over the life history of the water right.
- For drought transfers, Ecology will consider using the climate data that best correspond to the frequency of the drought being experienced.

Q: What if I recently got a water right transfer approved under the old WIG and the new WIG would have given me a higher number?

A: Because Ecology typically uses multiple data sources to estimate historical beneficial use, it does not expect that the WIG update will dramatically affect recent decisions. However, Ecology's change authorizations are permissive and its extent and validity determinations are tentative in nature. An applicant may cancel a change authorization which remains in a valid development schedule, and may re-file a change application and seek a new tentative determination. Ecology will consider such applications on a case-by-case basis. In addition to the new WIG data, Ecology may require corroborating evidence

such as power or meter records, irrigation scheduling, or production records to confirm historical water use under the water right.

Q: What if the old WIG numbers were used in adjudicating my water right?

A: An adjudication court's determination of the extent and validity of a water right is final. If the court relied on the old WIG as part of the evidence of the total annual quantity confirmed, then changes in the new WIG cannot change the total annual quantity authorized (unlike for changes where Ecology's decisions are only tentative). However, adjudication courts typically do not assign a consumptive use value as an express limit of an adjudicated water right. Therefore, future transfers on adjudicated water rights can rely on the new WIG as one of several data sources in evaluating historical beneficial use.

Q: Will the WIG be updated in the future?

A: Yes. This is the fourth time the State has updated this guidance document and updates will occur in the future. It is likely that future updates will occur more often (e.g. every 5 years) rather than 25+ years apart since the last update to the WIG.