

ADJUDICATION MEMO #36

TO: Adjudication Staff
FROM: Marci Sterling
RE: Water Use for Dairies
DATE: May 12, 1992

The need has arisen for quantification of the diversion rate and volume for dairy claims and the consumptive use volume for those exceeding the 13,000 gallon per day domestic and stock limitation. Some information has been collected to assist in making a determination and those ideas will be presented here.

A LOTUS 123 spreadsheet has been developed which, provided with the necessary information, will analyze the inputted values and supply the user with approximations of several elements of the water right. The spreadsheet will calculate the stockwater diversion rate, diversion volume, and consumptive use volume, along with the commercial diversion volume and consumptive use volume. These values are merely estimates and should be used only if no method of measurement is available. The spreadsheet may be found on Node 1.

DIVERSION RATE

Stockwater diversion rate estimates given on the spreadsheet for both milking and nonmilking cattle were taken directly from the administrative memo, Application Processing Memo #3. Commercial diversion rates must be determined by some other method.

The horsepower equation, which has been supplied on the spreadsheet, may be useful for determining the diversion rate of the commercial portion of the right(s). The information necessary for the equation must be supplied by the user. The maximum flow rate which can be expected for the existing system, assuming the pumping plant is 70% efficient, will then be calculated. The maximum diversion volume based upon that flow rate will be computed also, presuming the pump is allowed to run continuously all year. Caution should be used when applying this equation. A good understanding of the system is necessary to ensure that the equation is being used properly. Small holding tanks are often used along with booster pumps to supply the necessary water to systems. The booster pump is not the correct pump to be analyzing with the horsepower equation. In cases where multiple pumps are being used and each serves a specific, identifiable purpose, the spreadsheet allows the equation to be used to analyze each individual pump.

DIVERSION VOLUME

The water used to wash tanks, floors, and cattle prior to milking is all taken into account when the commercial diversion volume is calculated. The cattle washing may be done using one of three techniques: manual, automatic, or sprinklers in the holding pen, which also serve to flush the holding pen. The source of the information for approximating these volumes is Bulletin No. 694 by the University of Idaho Cooperative Extension Service, "Dairy Waste Management: System Planning - Estimating Storage" by Dean E. Falk and Robert M. Ohlensehlen. Some information was also obtained through phone conversations with Dean Falk. Stockwater diversion volume estimates were taken from the same administrative memo as the stockwater diversion rates.

In the spreadsheet, the number of cattle is multiplied by a factor, resulting in a total diversion volume or rate. In addition, a line was added which will round the number of cattle up so that the volumes and rates calculated will match those given in the table from the administrative memo. This was done so that consistency can be maintained between the spreadsheet and licensing procedures in the past.

CONSUMPTIVE USE

Consumptive use is a factor that must be dealt with in the operation of dairies. If a dairy is claiming only a stockwater use with a limiting volume of 13,000 gallons per day, consumptive use may be assumed to be de minimus. For larger dairies, the consumptive use must be determined.

The water contained in the milk that leaves the dairy is consumptively used, so it must be accounted for in the consumptive use volume. Using information supplied by the University of Idaho Cooperative Extension Service for the average annual milk production per dairy cow in 1989 and their estimate that a cow's milk is 87% water, a consumptive use of 0.0058 ac-ft/yr per dairy cow was calculated. This means that approximately 172 dairy cattle would consumptively use 1 ac-ft/yr of their drinking water for milk production. Estimates of the amount of water which is consumptively used by a particular number of dairy cows for the production of milk may be found in the attached table or in the LOTUS spreadsheet. For example, if a dairy farm in Jerome has 550 dairy cattle, the consumptive use from the milk production would be 3.50 ac-ft/yr.

A little water is lost through evaporation from the wastewater lagoons for dairies. These evaporation losses must be considered in estimating consumptive use volumes for the wastewater systems. Ideally, the amount lost due to evaporation could be defined by the number of head of dairy cattle contained on the property. However, because individual waste handling systems are designed differently, that amount may vary somewhat for dairies of equal size.

Certain types of lagoons lose very little of the water stored in them to evaporation, no matter what their size. There are two major types of waste lagoons: aerobic and anaerobic.

Aerobic lagoons depend on interaction with air to provide the oxygen necessary to support the bacteria which digest the waste material. Because of the need for oxygen, they are designed to be shallow (between 3 and 5 feet) and to have a large surface area. Anaerobic lagoons do not use oxygen in the chemical process to break down the organic matter. Because of this, they can be deeper (from 12 to 20 feet) and can have smaller surface areas. They also characteristically form a crust on the surface which prevents reactions with the air, including evaporation. Evaporation from a lagoon only becomes significant if the lagoon has a surface area of at least half an acre. If you encounter one which is at least that size, you should attempt to determine whether it is aerobic or anaerobic from these brief descriptions and consider evaporation for aerobic lagoons only.

The use of lagoons and manure stacks is the most common method of waste disposal. The amount of evaporation from a manure stack would be fairly small and very difficult to determine, so it will not be considered here. If a lagoon is half an acre or larger, the portion of the consumptive use volume due to evaporation will be about equal to the evapotranspiration (ET) value for alfalfa (or about 80% of the reference ET) for that area multiplied by the number of acres of surface area. This conclusion was made using information found in the report, Monthly Shallow Pond Evaporation in Idaho, by Myron Molnau and Kojo C.S. Kporde, and using evapotranspiration data from the 1983 report, Estimating Consumptive Irrigation Requirements For Crops In Idaho, by R.G. Allen and C.E. Brockway.

To simplify the determination of the consumptive use due to evaporation, a map supplying the necessary information has been provided with this memo. The state has been divided into different climatological regions and each has been given a particular per acre consumptive use value. Those figures were determined using the reference evapotranspirations given in the Allen & Brockway report. For each of the 98 stations in the state, the reference ET was multiplied by 0.80 and the result was transferred to the map. All those within a particular region were averaged and rounded up to the nearest 0.5 acre-feet per acre. The boundaries between regions are the same as those from the Department's 1991 Consumptive Irrigation Requirement, Field Headgate Requirement, & Season of Use map. Once you determine the region in which a dairy is located, the figure found on the map for that region may be multiplied by the surface area of the sewage lagoon. The result would be the total annual consumptive use volume due to evaporation. The spreadsheet will also provide that information. If the dairy farm described above has a sewage lagoon with a surface area of 3/4 acre, the annual consumptive use due to evaporation would be: $(0.75 \text{ ac}) \times (4.0 \text{ ac-ft/ac-yr}) = 3.0 \text{ ac-ft/yr}$.

There is some inconsistency in the way water use for dairies has been claimed in the adjudication. The manner in which the consumptive use should be recommended will not

be as variable. Below are the possible scenarios and how to handle the consumptive use for each:

1. For stockwater claims under 13,000 gpd, no consumptive use volume is required.
2. If both stockwater and commercial uses have been claimed on a single claim, the consumptive use volume for each portion should be determined using the information supplied here and the total consumptive use volume should be assigned to the claim.
3. If the stockwater and commercial uses for a dairy have been claimed on separate claims, the consumptive use for each component should be determined separately. The consumptive use volume due to the milk production should be assigned to the stockwater claim, and the consumptive use volume caused by the lagoon evaporation should be assigned to the commercial claim.
4. If only a commercial use has been claimed and that claim is known to include the stockwater use also, the facility should still be analyzed as if both stockwater and commercial uses have been claimed and the consumptive use for each component should be determined. When the right is recommended, a stockwater component should be added to the right, along with its respective consumptive use. An amendment to the claim and an additional fee will not be necessary.

To summarize, there are two main consumptive uses of water for dairies. They consist of the portion of the drinking water which is contained in the milk and the water lost due to evaporation from sewage lagoons. The amount of water which is consumptively used for the production of milk can be found in the attached table. The consumptive use volume for evaporation from any aerobic lagoons may be obtained using the attached map and the method described above. Both volumes may also be found using the spreadsheet described above. If the lagoon is large enough to be considered, its consumptive use volume should be added to the amount used for milk production. The total annual consumptive use for the dairy farm in the example would be 6.50 ac-ft/yr.

RECOMMENDED CONSUMPTIVE USE FOR MILK PRODUCTION DAIRIES

Number Consumptive of head Use (afa)

0-10 0.1

11-25 0.1

26-50 0.3

51-100 0.6

101-200 1.2

201-300 1.7

301-400 2.3

401-500 2.9

501-600 3.5

601-700 4.1

701-800 4.6

801-900 5.2

901-1000 5.8

If there are more than 1000 head of stock, round the number of head to the next highest 100 and multiply by 0.0058.

NOTE:

* If applicable, determine the consumptive use volume due to evaporation losses in the wastewater lagoon(s), then add those figures to the appropriate ones above.