NET GROUNDWATER CONSUMPTION WITHIN A DAIRY FACILITY AREA

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OVERVIEW OF NET GROUNDWATER CONSUMPTION WITHIN A DAIRY FACILITY

I. Introduction

Dairy Operations are a vital component of the overall agriculture economy within the San Joaquin Valley of California, and efficient water management is a key element of successful dairy operations.

The recent implementation activities of the Sustainable Groundwater Management Act (SGMA) require an accurate accounting for the net groundwater *consumed* within dairy operations. Therefore, all dairy facility water imports and exports must be accurately measured and reported. Compliance with SGMA requires that the net groundwater *consumed* by a dairy facility cannot exceed the "Sustainable Yield" per acre limit for groundwater consumption as defined by the dairy facility's Groundwater Sustainability Agency (GSA).

Dairy facilities *use* a significant amount of water as an integral component of the dairy's milk and beef production process. However, as the analysis in this document shows, dairy facilities *consume* very little water. Almost all the water *used* within a dairy facility is recycled to be *consumed* on the farm for growing crops (crop ET).

II. Explanation of the SGMA Water Accounting Requirements

The Sustainable Groundwater Management Act (SGMA) is enforced by the rules and regulations of a Groundwater Sustainability Agency (GSA) formed to represent landowners in a designated area. Although there is variation in GSA implementations of the SGMA requirements, a common thread is the creation of GSA-managed water accounts for landowners. These water accounts allow landowners to manage their GSA water allocations in the same way they would manage a bank account.

Here's how it works: The GSA deposits water credits (in units of acre-feet) into each landowner's GSA water account every year. The number of water credits deposited is determined solely by the number of acres owned by the landowner and on local hydrology

and surface water availability. Water credits are withdrawn from the landowner's water account based on water consumed by crops grown on the landowner's property. If the landowner requires more water credits for the landowners' crops than allocated by the GSA, the landowner may purchase additional water credits from the GSA and deposit these into his water account. But the GSA limits how many additional water credits the landowner can purchase. The landowner is prohibited from using more water credits than are deposited in the GSA water account and may be penalized if water credit withdrawals exceed deposits.

How is crop water consumption measured? There are two ways. The first method is to meter the groundwater-pumped irrigation water applied to the crop. Then measurements and additional calculations are required to determine how much of the applied irrigation water was returned to the groundwater source. The difference is the *net* water consumed by the crop, and it is called evapotranspiration (ET). The second (and simpler) method is to allow the GSA to measure the ET water consumption of crops directly using satellite data.

How is dairy facility water consumption measured? Satellite data cannot be used solely to measure the net water consumption of dairy facilities. However, dairy records (meter readings that measure water use, feed deliveries, milk shipments, beef shipments) can be used to calculate net dairy facility *groundwater* consumption. These calculations, supported by dairy records, can be used to show compliance with SGMA regulatory requirements. In general, this is how industries and communities that recycle water compute net water consumption to show regulatory compliance.

The computation of a dairy facility's net *groundwater* consumption requires a separate boundary to be drawn around the perimeter of the dairy facility. All water imports that cross this boundary (which includes all pumped groundwater) are metered, measured, recorded, or otherwise counted. Similarly, all water exports that cross this boundary are also counted.

The difference between the water imports and exports are the net water consumed by the dairy facility. However, SGMA requires that the computations show the net *groundwater* consumption at a dairy facility. Therefore, water imports and exports are divided into two categories; those whose source is groundwater, and those whose source is not groundwater.

Then, the net *groundwater* consumption for a dairy facility is computed by subtracting the groundwater exports from the various water imports.

The remaining sections of this report explain in detail the quantity and sources of water imported to the dairy facility, and the quantity and destinations of water exported from the dairy facility. From these water sources, the net *groundwater* water consumption is computed for a typical Dairy Production Facility in the Central Valley of California.

III. Efficient Water Usage on Dairy Facilities

At dairy production facilities, utilizing water efficiently to prevent unnecessary groundwater pumping and losses to evaporation is important for SGMA compliance. Following is a general, not exclusive, list of practices and equipment often used by dairies to improve the efficient use of water and to keep groundwater pumping and evaporation losses to a minimum.

- Air Cooling for Refrigerator Compressors: Water-based refrigeration compressors are replaced with air cooling fans. This reduces groundwater pumping.
- Solenoid Valve for Stage 1 Plate Cooler: An open/close valve that cycles with the milk pump is added to the stage 1 plate cooler water source to reduce water usage. This reduces the amount of water flowing through the plate cooler to match the flow of milk rather than running water continuously through the plate cooler. This reduces groundwater pumping.
- Barn Flush Timer / Automation: A timer is added to minimize the number of barn flushes during each milking. This prevents workers from flushing more often than necessary. Flush water is water collected and recycled from the plate cooler

after the water is used to cool the milk. Therefore, preventing the amount of water used for flushing from exceeding plate cooler water usage reduces groundwater pumping.

- Sensors on Soakers: Add sensors to soakers to only operate when a cow is standing next to the soaker. This reduces groundwater pumping.

IV. Summary of Dairy Production Facility Water Imports

Water must be imported to the dairy facility for dairy animals to drink, maintain body fluids, metabolize nutrients, and produce milk. Water is also used on dairy facilities for cleaning equipment, flushing concrete surfaces, cooling milk equipment, cooling the milk cows, and washing the milk cows.

However, the water imports to a dairy facility are efficiently used. For example, the water imported for cooling the milk is captured and then reused for washing the cows and cleaning equipment. This same water is then recaptured and reused again for flushing concrete surfaces. This is important to keep in mind when counting water usage on a dairy facility. Much of the imported water is used two or three times before the residual water is exported to the farm.

Therefore, care must be taken to avoid double-counting dairy facility water usage. As mentioned previously, double counting the various internal uses of dairy facility water is avoided when a separate boundary is drawn around the perimeter of the dairy facility. Only water that crosses this boundary is counted as an import or export for the purpose of computing net dairy facility consumption.

Dairy Facility Water Import Sources:

1. **Pumped Groundwater:** Groundwater is pumped to a pressure tank that is the source for all water used on the dairy facility. Excess water is drained to wastewater storage pond(s).
2. **Precipitation:** Dairy facilities are designed (and regulated) to divert all rainfall runoff into the wastewater storage pond(s).

3. **Feed Imports:** All feed consumed by the animals is imported from sources outside the dairy facility. All imported feed is tested for water content, which generally ranges from 10% to 80%. Some feed is sourced from forages grown on the lands adjacent or near to the dairy (e.g., corn silage, wheat silage, alfalfa). The remaining feed consists of grains purchased from the Midwest, alfalfa which is often purchased from other states, and many by-products purchased from local agricultural crops (e.g., Cottonseed, Almond Hulls, Citrus, Grape Pomace, Whey). The water imported through the feed is consumed by the cattle. A portion of this water is excreted by the cow and diverted to the wastewater storage pond(s).

V. Summary of Dairy Production Facility Water Exports

As previously mentioned, most of the water imported to a dairy facility is not consumed. It is used and then exported. The exported water destinations are listed below.

Dairy Facility Water Export Destinations:

1. **Farm Ground for Crop Irrigation:** The wastewater collected in the wastewater holding pond is exported to adjacent or nearby farm ground for crop irrigation through pipelines or utilizing tanker trucks. The wastewater application replaces groundwater pumping because the wastewater application to crops offsets water that would otherwise be pumped from groundwater. However, it is important to understand that the dairy's wastewater is consumed by the crops and not recharged. Wastewater application is regulated by the California Regional Water Quality Control Board (CRWQCB) and wastewater application rates are reported annually to the CRWQCB under the dairy's Nutrient Management Plan.
2. **Evaporation:** As water is used on the dairy facility for various purposes (cow washing, lane flushing, etc.), evaporation occurs. This evaporation is counted as a destination for water exported from the dairy facility.
3. **Milk Shipments:** Each day, the milk produced on a dairy facility is picked up by truck and hauled to a processing plant. Shipped liquid milk, which is primarily water, is counted as a destination for water exported from the dairy facility.

4. **Beef Shipments:** When dairy animals get old, sick, injured, or die, these animals are hauled offsite to beef or rendering plants. The water content within these animals is counted as a water export from the dairy facility.
5. **ET Consumption from Vegetative Growth.** Dairies usually have little water-consuming vegetation growth (landscaping) within the production facility. Therefore, the water exported to this destination is assumed to be negligible.
6. **Domestic Water Use:** The majority of the domestic water use is diverted to septic systems and leach lines, thus recycled back into the groundwater system. However, the water exported to this destination is assumed to be negligible.

VI. Computation of Dairy Facility Net Groundwater Consumption

The computation of the net groundwater consumed per acre for a dairy facility is illustrated in the example below. The example assumes a dairy facility housing 1,000 Animal Equivalents on 30 acres (e.g., Freestall dairies house milk cows different than an open lot and housing type will vary the area of the facility). The water imports and exports are for a period of one year. Typical dairy volumes for groundwater pumping, other water imports, and water exports are assumed. The example of the dairy in the chart below shows that the net groundwater consumption for a typical dairy is likely to be negligible.

Dairy Water Calculator - Production Facility Net Consumption

Assumption:	1,000	Animal Equivalents (AE)
Production Facility:	30	acres

WATER IMPORTS TO DAIRY FACILITY

Water Pumped from Groundwater:	**per Animal Equivalent (gal/day)**	**per Animal Equivalent (gal/yr)**	**Total Pumped Groundwater (gal/yr)**	**Total Pumped Groundwater (ac-ft/yr)**
	100	36,500	36,500,000	**112.01**
Water from Feed Imports:	**Usage (tons/yr)**	**Moisture Content (%)**	**Equivalent Water (gal)**	**Equivalent Water (ac-ft/yr)**
Silage (Wheat/Corn)	12,000	65%	1,747,200	5.36
Hay	1,000	10%	22,400	0.07
Supplemental Ingredients	7,500	35%	588,000	1.80
				7.24

Water from Precipitation:	8	inches (average)
	20.00	**ac-ft/yr**
TOTAL WATER IMPORTS:	**139.25**	**ac-ft/yr**

WATER EXPORTS FROM DAIRY FACILITY

Wastewater Pumped to Crops:	**98.36**	**ac-ft/yr**
Water Lost to Evaporation/Transpiration (ET):		
ET (estimated from LandSAT):	12	inches/yr
(includes storage pond evaporation, feed, flush)	**30.00**	**ac-ft/yr**
Water Shipped as Milk Production:		
Volume of Milk	80	lbs/Cow/Day
	3,499,401	Gallons per year
	10.74	**Ac-ft/yr**
Water Shipped as Beef:		
Cull Rate	42%	
Number per year	420	
Average Weight	1,000	lbs
	120	gallons/animal
	0.154	**Ac-ft/yr**
TOTAL WATER EXPORTS:	**139.25**	**ac-ft/yr**

SUMMARY

Total Water Inports from Groundwater:	**112.01**	**ac-ft/yr**
Total Water Exports to Crops:	**98.36**	**ac-ft/yr**
Net Groundwater Consumption	**13.66**	**ac-ft/yr**
	0.46	**ac-ft/yr/acre**

VII. Summary

Dairy production facilities don't consume much groundwater. This is despite the fact that dairies use a significant amount of water during the milk and beef production process. However, when all water imports to the dairy facility are considered, and when the fact that dairy wastewater exports reduce groundwater pumping for growing crops is considered, the conclusion is the net water used in the dairy facility is minimal.

On a net basis, dairy production facilities consume little (if any) groundwater. Based on this analysis, the recommendation is to apply 6" of Consumed Water to a Dairy Production Facility.

This conclusion is surprising but verifiable. Meters can be installed to measure groundwater pumped into the dairy, and to measure wastewater exported from the dairy. Milk volume shipped from the dairy can be verified with creamery records, and beef weights verified with purchase receipts. The water content of feed ingredients imported to the dairy can be verified with nutritionist laboratory test reports, and the tonnage verified with sales invoices. Precipitation data totals are widely available, and weather data to confirm evaporation rates are published daily.

The dairy milk and beef production process uses groundwater, adds nutrients to it, then (in effect) returns the water in lieu to offset the need to pump additional groundwater for crop irrigation.

VIII. Study for Validation

To validate the conclusion of this analysis, a **study is currently underway to confirm the results**, with data to be collected on a quarterly basis and reported annually. For the various dairies selected for the study, meters are installed on the pumped groundwater import source and on the dairy's wastewater export destination. Dairy records will be collected to confirm other water sources and destinations. Over the next several years, as data is collected, the analysis within this report can be refined to better predict dairy

facility net water consumption and understand variations between different dairy operations.