Lagoon Management through the Water Year

Doug Hamilton
Waste Management Specialist
Oklahoma Cooperative Extension Service

Lagoons are used for storage and treatment on most Oklahoma hog farms because they provide effective treatment and are simple to operate. The five keys to proper management are:

1. Don't overload the lagoon – flush or pull plugs every day.
2. Draw effluent down to the maximum drawdown level by the first of October.
3. Irrigate effluent in mid May or early June to use nitrogen as fertilizer.
4. Irrigate again in September if you need to bring effluent down to the maximum drawdown level.
5. Irrigate whenever liquid level exceeds the maximum operating level.

The Maximum Drawdown and Operating Levels are set when the lagoon was designed; they should be clearly marked on your gauge pole. Knowing a little about the water year will help you keep the liquid level between the two marks.

The water year is different than the calendar year; the water year starts at the point in the year when area lakes and streams (and manure treatment lagoons) begin to fill with water. The start of the water year varies from place to place. Let's look at the situation in Broken Bow, Oklahoma.

Figure 1 gives the monthly average rainfall and lake evaporation in Broken Bow. Rainfall exceeds evaporation in Broken Bow from October to May. Evaporation exceeds rainfall from June through September. Figure 2 shows the average water gain (the rainfall minus evaporation) for each month. According to Figure 2, if we set a bucket on the ground at the end of September, the volume of water sitting in the bucket would increase through February. The rising water level would slow down in April and May, and during the summer months, the bucket would start losing water. The water year in Broken Bow runs from October to October.

How does the water year affect lagoons?

Let's use a 130 sow farrow-to-finish farm in Broken Bow. The surface area of a lagoon treating manure from this farm would be about ¾ acre at maximum drawdown. Figure 3 shows how the liquid level in the Broken Bow lagoon (Blue Line) would rise and fall through the water year if the only materials entering the lagoon were manure and rain falling on the lagoon. Liquid level rises in the lagoon through May and begins to decline during the summer. By the end of September, there is slightly more than 1 Acre-ft of effluent stored in the lagoon. This is enough effluent to irrigate 1 inch of effluent over 14 acres. Irrigating 1 Acre-ft of effluent would also bring the liquid level down to the maximum drawdown – it wouldn't matter when you removed the effluent – you could irrigate 1 Acre-ft in May or September, the liquid level would still be at the maximum drawdown by October.

This pattern is exactly how we expect lagoons to operate: by recycling effluent to flush manure from the buildings, you can store effluent over an entire year, and irrigate once or twice in the spring to fertilizer pasture or cropland. The engineers who developed the lagoon-sprayfield system for swine manure treatment had the water year pattern of the Carolinas in mind when they came up with concept. The rainfall and evaporation pattern in Broken Bow, way down in the southeast corner of the Oklahoma, is pretty much the same as it is in Raleigh, North Carolina.

The climate in Broken Bow is much wetter than most everywhere else in Oklahoma. In fact, annual lake evaporation exceeds rainfall in most parts of Oklahoma. Let's look what would happen if we moved the identical farm and lagoon to Stillwater (the green line in Figure 3). The effluent level still rises through the winter (though not as much as it did in Broken Bow) and reaches a maximum in March. Evaporation causes the liquid level to drop below the maximum drawdown during the summer. Even without irrigating any effluent, the lagoon in Stillwater lost volume. The situation in Guymon (Figure 3, Red line) is even more extreme.

This brings up two three points:

The first one is pretty obvious: **you need to add extra water to lagoons in most of parts of Oklahoma in order to have enough effluent to recycle nutrients through irrigation**. In Stillwater, you need to add roughly one-and-a quarter times as much water as manure for the lagoon to operate the same as it does in Broken Bow. In Guymon, you would have to add two-and-a-half times the manure volume for the liquid level to act as it does in Broken Bow.

The second point is not so obvious. Lagoons are designed based on average rainfall and evaporation. **Average water years do not exist**. Around one hundred and twenty years worth of monthly values were used to estimate the rainfall and evaporation data for Stillwater. Actual monthly rainfall values deviate greatly from the averages, and most of our rain (and dry spells) occur over extended periods when weather patterns stall in the middle of the continent. For instance, last year we had a very wet August in Stillwater. We had to irrigate in September to bring effluent down to the maximum drawdown by October 1. This year, we had lots of rain in spring and early summer, so we cut down on outside water going into the lagoon in April and May and still had sufficient irrigation water.

The third point is: Rain causes the lagoon to rise quickly; whereas, evaporation slowly lowers the water level. The liquid level rises after each rain event and approaches the maximum operating level much quicker than it appears to do in Figure 3. **It is best to keep track of the water levels in your lagoon on a weekly basis, using the general pattern of the water year -- and your best judgment -- to determine when to irrigate or add water**.

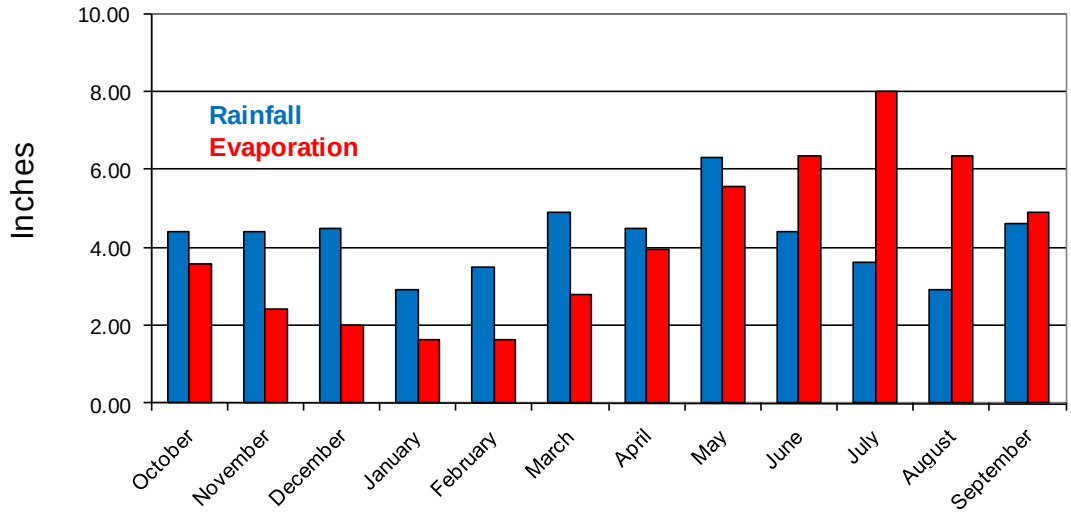

Figure 1. Average Monthly Rainfall and Lake Evaporation in Broken Bow, Oklahoma.

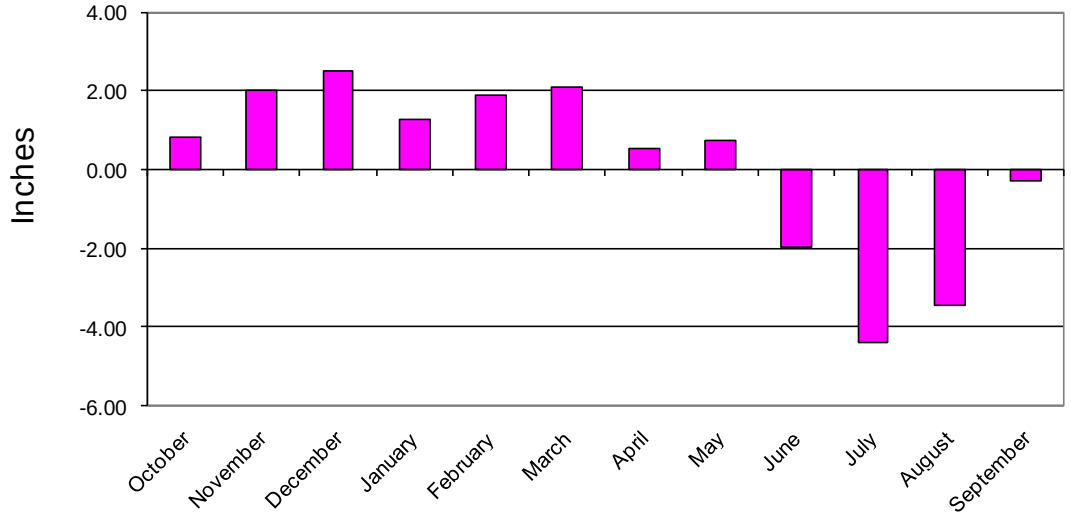

Figure 2. Average Monthly Water Gain (Rainfall Minus Lake Evaporation) in Broken Bow, Oklahoma

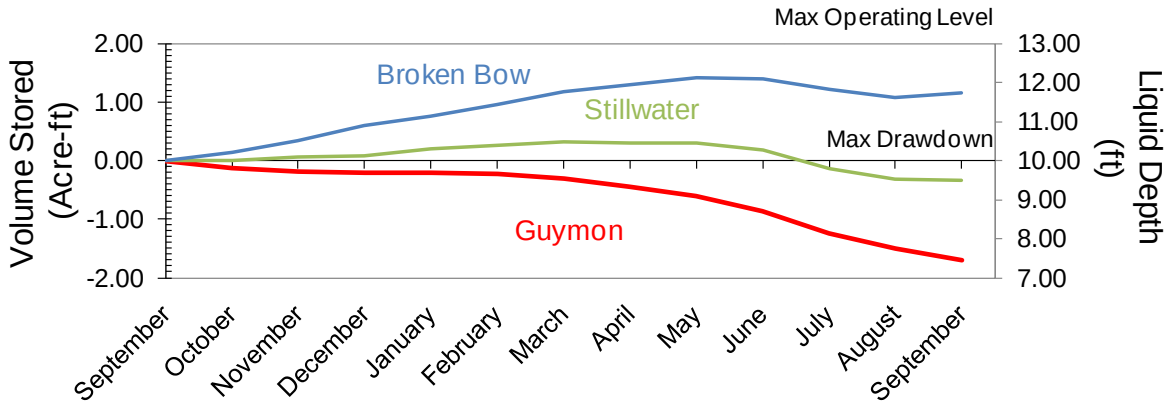

Figure 3. Effluent Stored and Lagoon Liquid Level at the End of Each Month for a ¾ Acre Lagoon Treating Manure Produced by a 130 Sow Farrow-to-Finish Farm. Complete Recycle of Effluent for Flushwater.