# How Total Farm Water Pressure and Volume Affect Commercial Poultry Production

This publication provides additional information as follow-up to an earlier presentation on behalf of Mississippi Farm Bureau on the difference between **water pressure** and **water volume** that should prove useful to commercial poultry producers. Everyone raising chickens knows that an adequate supply of water is necessary to be successful. However, not everyone understands the importance that both water pressure and water volume play in providing an adequate supply. Pressure and volume are two different things, and both are critical to chicken production. Water **pressure** refers to the *force* that allows water to flow through pipes, fittings, filters, and distribution lines, overcome elevation, and still reach the drinkers and cool cell pads. The *amount* of water coming out of the pipe or hose is the **volume**. A deficiency in either pressure or volume will cause serious water-restriction issues.

Perhaps the simplest way to understand the difference is this: **Pressure is how much force is needed for water to overcome resistance or drag; volume is how much water to supply to meet drinker and cool cell demands**. It is possible to have excellent water pressure but only a small amount of water coming out of the pipe. It is also possible to have a pipe full of water coming out of the line but almost no pressure behind it. Both of these situations are bad when it comes to commercial chicken houses. You must have proper water pressure *and* volume to be successful. Let's take a closer look at the importance of each.

## Pressure versus Volume

An adequate water supply must be available on every commercial poultry farm and should be verified before the houses are constructed. This supply is often either multiple wells or perhaps a well (or multiple wells) and a municipal supply. Multiple wells should be connected so water can still go to all houses in case you have a problem with a well. The water supply should be tested for mineral content and absence of bacterial contamination to ensure the water is safe for poultry to drink. Once you know the water is safe, you must also determine if the supply is adequate to meet demands of both the chickens and the evaporative cooling system. Well-drillers can usually tell you how strong your well is by pumping it for approximately 24 hours and telling you how many gallons per minute it was capable of pumping. **Your poultry company will have guidelines** on how many gallons of water per minute your water supply sources must be able to deliver. (Remember, it is better to oversize the system than install a system that does not meet your needs. Also, a larger system will allow you to expand in the future.)

If it is determined that you have an adequate amount of water in your wells, you still aren't out of the woods. You now have to deliver that water to the chicken houses with enough pressure at sufficient flow rates to meet demands of the birds for both drinking and cooling. There are multiple ways to make mistakes between the well and the chicken houses. Installing a **pump that is unable to meet the demand** of the chicken houses is a common

mistake. If you install a pump capable of pumping 50 gallons per minute but the total water supply demanded by all your chicken houses is 70 gallons per minute, you are going to have serious water-restriction problems, especially in those houses farthest from the well. Having an adequate supply of water in the well is useless if you can't get it pumped to the houses in a timely manner.

Another common mistake is installing a supply line from the well to the chicken houses that is **too small to carry the volume of water needed**. If the water demand on your farm is 60 gallons per minute and you have a 2-inch supply line from the well to the chicken houses, you cannot supply 60 gallons per minute! A 2-inch pipe will only supply about 48–50 gallons per minute. You may have plenty of water in the well, and you may have a pump that can pump 75 gallons per minute, but if you want to pump 60 gallons per minute out the end of the pipe, you will need a 2.5-inch supply line. If you want to pump 75 gallons per minute, you will need a 3-inch supply line. **Pressure and volume must work together**. If one is less than adequate, regardless of which one, you will not be able to provide your chickens with an adequate water supply.

## Adequate Water Supply

**Adding additional houses to a farm without increasing the size of the supply line** is another common mistake. Your four-house farm may be just fine with a 2-inch supply line. However, if you build two additional houses and do not upgrade to a 3-inch supply line or add an additional water source, you are likely going to have water-restriction issues. You must have properly sized and installed pumps, supply lines, and other equipment to get enough water to the chicken houses. For the past few years, conventional thinking has been that a typical 40-by-500-foot broiler house requires about 2 gallons per minute (gpm) for drinking and about 8 gpm for the cool cell pads (for a total of about 10 gpm per house; naturally, bigger houses will require even more water). However, **chicken genetics change every year**. Chickens today eat and drink more than they did just a few years ago. Conservatively, it might be better today to consider 3 gpm for drinking and 9 gpm for the cool cells. **PVC pipe is inexpensive** compared to what it will cost if you make a mistake and undersize your supply line and cannot provide adequate water to your farm.

Another common mistake is switching from growing small birds (4.5 pounds or less) to large birds (9 pounds or more) without upgrading the supply line. Growing larger birds requires more water for both drinking and cooling purposes. Improved cooling is typically achieved by adding an additional 20 feet or more of cool cell space to each side of your house and an additional one or two tunnel fans, which will require a lot more water. If you have an older farm with a ¾- or 1-inch supply line (**Figure 1**) that worked fine for smaller birds, that line likely cannot adequately handle the drinking and cooling water demands of larger birds during the later stages of the growout. You may need to increase the size of the well pump and the supply line in order to meet water demands of larger birds.

Figure 1. Three-quarter-inch supply line may restrict water supply to drinkers and cool cells.

You must size your equipment to meet **peak demand in summer with big chickens** on the farm. You may only reach peak demand once or twice a year, but you must have the ability to meet that demand. Otherwise, drinking and/or cooling water will be limited, which could prove disastrous with large birds in hot weather. To improve your water supply management, you should be able to answer the following common questions related to poultry house water supply:

- How much water does a poultry house use?
- How much water do all my poultry houses use?
- What size should my main supply line be from the well to the houses?
- How can I tell if I am short on water?
- Do I need water storage tanks?
- What are my options (bigger pump, larger supply line, stronger well, etc.)?
- If I was short on water last summer, what steps should I take now?

To answer these questions, there are a number of things you need to know:

- Tunnel fan capacity: How many fans and how big? How many cubic feet per minute (cfm) of air can be moved?
- Type and thickness of pad (cool cell or fogger pad; 2, 4, 6 inches)
- Number of birds per house and bird size
- Drinking water needs
- Cooling water needs
- Main supply line and meter size (¾, 1, 2 inches, etc.)
- Farm layout: Is water pushed uphill from the well?
- Location: house distance from well or municipal water supply

The following tables will provide information to help you make informed decisions concerning water demands on your farm and how best to meet those demands. **Table 1** lists various total tunnel fan air-moving capacity based on cubic feet per minute (cfm) and the maximum amount of water usage (gals/min) associated with either a 6-inch cool cell pad or a 2-inch fogger pad at the various cfm capacities. While 2-inch fogger pads are becoming less common, there are still some older houses growing smaller birds that continue to use them. Interior fogging nozzles are a common sight in many poultry houses today. However, some growers have moved away from using them as they can increase humidity in the house to high levels, which can make it more difficult for the birds to cool themselves. The amount of water used by fogging nozzles is listed in **Table 2**.

**Table 3** lists peak drinking water use in gallons per minute per 1,000 birds for birds at various days of age. Knowing the number of birds in your house, you can use these figures to calculate the gallons per minute per house, gallons drunk or consumed per hour, and total gallons consumed in 24 hours per house. As mentioned previously, chicken genetics improve each year, and each round of genetic improvements results in an increase in water and feed intake. **Table 4** lists the estimated per-house water consumption in gallons per minute at various bird numbers per house. **Table 5** lists various house sizes and fan capacities (cfm), along with the estimated peak water demand for a 6-inch cool cell pad system (calculated using an outside air temperature of 90°F and an outside relative humidity of 20 percent) and estimated peak drinking demand. **Table 6** lists various house sizes and fan capacities (cfm), along with the water demand for the pad system and the birds, a specified number of houses on the farm, and the estimated total farm water demand in gallons per minute. This total farm water demand in gallons per minute is what your well pump and supply line must be able to provide at the time of peak water use. A **bottleneck anywhere in the system will limit** the ability of the system to provide adequate water flow rates. A pump that is not sized to deliver the flow rate needed at the required pressure or a too-small supply line that leads to pressure loss will mean a restriction in water

availability. **Water is the most important nutrient** that a chicken consumes. Therefore, restricting water availability will affect feed intake, growth rate, bird performance, and, if severe enough, mortality rates.

**Table 7** lists estimated farm supply line pipe size based on estimated farm water demand, house size, and fan capacity. Note that bigger houses require bigger supply lines to adequately deliver the flow rates of water needed. Bigger houses will hold more birds and will have additional cool cell area to keep those birds cool during summer, which will place heavier demands on the water supply and delivery system. Make sure your supply line can furnish what your farm needs (**Figure 2**). **Table 8** lists PVC pipe sizes required to meet various flow rates in gallons per minute. Most new house construction today and many retrofits require in excess of 30 gallons per minute. This means **anything less than a 2-inch supply line** will likely not be adequate to meet demands of a modern chicken house.

Figure 2. Four-inch supply line from well (upright pipe) with 1-inch drinker lines (brood and off end) and cool cell line (above) coming off of it.

## Potential Problems

Water filters can further restrict flow and create additional problems. Water pressure will decrease approximately 5 pounds per square inch (psi) for each in-line water filter that the water passes through. In addition, **pushing water uphill results in a significant pressure loss**. Water pressure loss due to rise in elevation can be calculated by the following equation:

Feet rise in elevation x 0.433 = pressure loss

Therefore, a 50-foot rise in elevation would result in a pressure loss of 21.7 psi (50 x 0.433 = 21.7).

Most chicken house controllers today are capable of monitoring daily water use by the drinkers. You should **know what your peak 24-hour water demand is**. This peak is likely in summer (July or August) with big chickens on the farm. Watch for changes in water consumption (it should always be increasing each day). Water and feed intake should increase each day to support the growth rate. If consumption tends to plateau for several days toward the end of the flock, this could be an indication that there is a water restriction somewhere in the system. If your controller can record hourly data (or smaller increments), watch for plateaus of a couple of hours during the hottest part of the day when demand is greatest. It could be the pump, supply, supply line, or perhaps a combination of all three. Water lines for the drinkers should come off the supply line first before the line(s) supplying the cool cells and possibly foggers. Cool cell water should not come off first because, if there is a restriction, it will be the drinking water that suffers the most. If there is not a water meter on your cool cell line, you might consider adding one to track cool cell water being used. On hot days with big chickens, **cool cells can use as much or more water than the drinkers**.

Some growers have water storage tanks on their farms to help meet water demands during peak usage. How much water storage is enough? You most likely will never have too much water, but a quick rule of thumb is 100 gallons per 1,000 birds. However, this could quickly become a huge amount of water on a 6- to 10-house farm. With 25,000 birds per house, this would mean 2,500 gallons of storage per house (25,000/1,000 = 25 x 100 = 2,500 gallons). Therefore, a 6-house farm would require 15,000 gallons of storage, while a 10-house farm would require 25,000 gallons.

There are a variety of problems that can threaten both the pressure and the volume of the water supply at your chicken houses. Several common problems include:

- Poor planning
- Undersized main line
- Undersized water meters
- Distance between farm and well or municipal line
- Changes in elevation
- No municipal supply available
- Insufficient well capacity
- Failure to maintain drinker system
- Not checking water availability before building
- Too many houses for the amount of water availability
- Adding additional houses that overload water availability
- Retrofitting beyond water supply capability
- Failure to regularly test water supply
- No backup plan in place should something happen

A quick and easy estimation of how much water you can deliver is the 5-gallon bucket test. Fill a 5-gallon bucket with water from the control room and time how long it takes for the bucket to fill. It will likely make a difference whether you have birds in the house and what age they are, so it is best to conduct this test when birds are not present. (The bucket will fill more slowly with birds in the house.) Here is a quick estimation:

5 gallons in 10 seconds = 30 gallons per minute
5 gallons in 15 seconds = 20 gallons per minute
5 gallons in 30 seconds = 10 gallons per minute

| Table 1. Fan capacity and pad system water use.[1] | | |
|---|---|---|
| | Pad system | |
| Tunnel fan capacity ($ft^3$/min) | Maximum water usage (gal/min) | |
| | 6-inch pad | 2-inch fogging pad |
| 160,000 | 7.6 | 5 |
| 180,000 | 8.5 | 5.6 |
| 200,000 | 9.5 | 6.3 |
| 220,000 | 10.4 | 6.9 |
| 240,000 | 11.3 | 7.5 |
| 260,000 | 12.3 | 8.1 |
| 280,000 | 13.2 | 8.8 |
| 300,000 | 14.2 | 9.4 |
| 320,000 | 15.1 | 10 |
| 450,000 | 21.3 | – |
| [1]Adapted from Czarick, 2007. | | |

| Table 2. Fogging nozzle water use.[1] | |
|---|---|
| Fogging nozzles (1.5 gal/hr/nozzle) | |
| Maximum water use (gal/min) | |
| number of nozzles | water use |
| 50 | 1.3 |
| 100 | 2.5 |
| 150 | 3.8 |
| 200 | 5 |
| [1]Adapted from Czarick, 2007. | |

| Table 3. Peak water use at day of age.[1] | |
|---|---|
| Bird age (days) | Peak water use (gal/min/1000 birds) |
| 35 | 0.08 |
| 42 | 0.095 |
| 49 | 0.1 |
| 56 | 0.1 |
| [1]Adapted from Czarick, 2007. | |

| Table 4. Gallons per minute water use at various bird numbers at 49 days. | |
|---|---|
| Number of birds per house | Estimated per-house maximum (gpm) |
| 15,000 | 1.5 |
| 20,000 | 2 |
| 25,000 | 2.5 |
| 30,000 | 3 |
| 35,000 | 3.5 |
| 40,000 | 4 |
| 45,000 | 4.5 |
| 50,000 | 5 |

| Table 5. House size, fan capacity, and house water demand. | | |
|---|---|---|
| House size and fan capacity (cfm) | Estimated peak demand for 6-inch pad system (gpm) | Estimated peak drinking demand for birds @ 0.70 density (gpm) |
| 40'x500' @ 228,000 | 10.8 | 2.9 |
| 50'x500' @ 285,000 | 13.5 | 3.6 |
| 60'x500' @ 342,000 | 16.2 | 4.3 |
| 66'x600' @ 450,000 | 21.3 | 5.7 |

| Table 6. Estimated total farm water demand. | | | |
|---|---|---|---|
| House size and fan capacity (cfm) | Water demand for pads and birds per house (gpm) | # of houses on farm | Estimated total farm water demand (gpm) |
| 40'x500' @ 228,000 | 13.7 | 4 | 55 |
| 50'x500' @ 285,000 | 17.1 | 4 | 68 |
| 60'x500' @ 342,000 | 20.5 | 4 | 82 |
| 66'x600' @ 450,000 | 27 | 4 | 108 |

| Table 7. Estimated farm water demand and supply line pipe size required. | | |
|---|---|---|
| House size and fan capacity (cfm) | Estimated total farm water demand (gpm) | Farm supply line required pipe size (inches) |
| 40'x500' @ 228,000 | 55 | 2.5 |
| 50'x500' @ 285,000 | 68 | 2.5 |
| 60'x500' @ 342,000 | 72 | 3 |
| 66'x600' @ 450,000 | 108 | 4 |

| Table 8. PVC pipe size to meet flow rate requirements.[1] | |
|---|---|
| Required flow rate (gals/min) | Pipe size (inches) |
| 0–10 | 1 |
| 10–20 | 1.25 |
| 20–30 | 1.5 |
| 30–50 | 2 |
| 50–70 | 2.5 |
| 70–100 | 3 |
| [1]Adapted from Donald et al., 2000. | |

## Summary

Both water pressure and water volume are critical to commercial poultry production. Having enough of one without the other will limit your ability to be successful. **Water pressure is how *fast* water is flowing, while water volume is how *much* water is flowing**. You must have enough of each to supply your chicken houses with the drinking and cooling water they need for the birds to perform at their best. Pump size must be adequate to supply the amount of water recommended by your integrator. Supply line size must also be large enough to deliver the amount of water the well pump can pump. A bottleneck on either pump or supply line size will restrict the amount of water reaching your chicken houses and likely limit the ability of the chickens to reach their full potential. Becoming familiar with the tables in this publication will help you better understand how much water your chicken houses need and how you can better meet those needs. Knowing common problems associated with providing an adequate water supply to your chicken houses can help you avoid making mistakes when initially building houses, adding additional houses, or retrofitting older houses. For more information on poultry water well placement and sizing, please see MSU Extension Publication 2953 *Private Water Well Placement and Sizing for Poultry Production* at ***http://extension.msstate.edu/publications/publications/private-water-well-placement-and-sizing-for-poultry-production***.

## References

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