The *Alabama Poultry Engineering and Economics*

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Feature article

Key Water Factors for Broiler Production

Providing adequate, good-quality water is critical for top broiler performance. The following is a “basics” outline of the most important water factors in poultry production. This information is essential in planning a new house or complex. We also urge growers to evaluate their existing facilities in light of this information, since water-related problems that may not be obvious to the grower may be limiting production or bird performance. The key water requirements for broiler production fall under three headings:

1. An adequate water supply, typically from a well or wells.
2. Good quality water, suitable for birds to drink and/or for use in evaporative cooling.
3. Properly sized and installed pumps, pipes and other equipment to get the water to the houses and birds.

Ensuring an Adequate Water Supply

Adequacy of a water supply is evaluated in terms of how many gallons per minute (gpm) it can deliver on a sustained basis. A typical 500-foot broiler house requires about 2 gpm for drinking water, so a 10-house complex would require a 20-gpm water supply, just for drinking water for the birds. For comparison, a well for a single-family residence is usually judged to be adequate if it can deliver around 4-5 gpm.

Modern broiler houses typically need a water supply delivering about 10 gpm

Evaporative cooling systems, using either foggers or pads, typically require about 8 gpm per house, which will up the total water requirement per house to about 10 gpm. Recirculating pad systems are more efficient in water use than non-recirculating types, in that water not evaporated is “recycled” and not lost. However, with either type system, almost all the water will be evaporated into the air going into the house during peak hot weather demand times, so the design gpm requirement will be the same no matter which type evaporative cooling system is used.

Water is so important that many companies require two independent supply sources, in case one fails

Ensuring an adequate and reliable water supply is so important that many poultry companies require that two independent supply sources be available, in case one fails. Water adequacy is especially important for modern broiler houses because peak water usage times come during hot weather. If the supply is not adequate, the cooling will be poor and/or the birds will not get enough drinking water – either of which can be disastrous. For much of the year, when cooling is not needed, the water demand will be lower – but the water supply for the house or houses must be capable of supplying adequate water to meet the hot-weather demand. Growers should consult system manufacturers and a design engineer to get more accurate information for planning purposes.

Almost all poultry farms draw water from wells. Surface water resources such as lakes and streams are not used because they require much more elaborate filtering and other treatment to ensure adequate water quality. They also tend to be more variable, and at lower levels during hot-weather peak demand time.

Well yields vary tremendously from one area to another, within the same county, or even on the same farmstead

The amount of water that can be pumped from wells varies tremendously from one area to another, and even within the same county. In Alabama, an usually water-rich state, wells in the northern part of the state cannot be expected to yield more than 10 gpm. In large areas of South Alabama, on the other hand, wells can be expected to yield 150 gpm and above. However, since geologic water-bearing formations can vary even from farm to farm or on the same farm, growers planning a new complex should consult the state geologic survey, local well drillers, and a consulting engineer.

Ensuring Adequate Water Quality

When water looks clear and tastes okay, water quality is easy to take for granted. However, growers must be aware that water quality is impossible to judge adequately except with laboratory testing. Field tests have conclusively shown that unobservable differences in water quality, from farm to farm and even from one well to another within a complex, can result in significant differences in bird performance. On one farm, for example, when one of two adjacent houses was switched to a newly drilled well, the succeeding flocks grown in that house did not perform as expected. When the house was reconnected to the old well, flock performance went back to normal. Testing showed that water from the new well had higher concentrations of sodium and sulfate. The water quality factors to be aware of include:

Water may look and taste okay, but quality is impossible to judge adequately except with laboratory testing

1. Bacteria, especially coliform bacteria
2. Dissolved solids (can be organic or inorganic, such as metals, usually invisible to the eye, and can be toxic)
3. Suspended solids (called "turbidity;" organic or inorganic materials in suspension, not dissolved, and causing the water to be cloudy or colored).

In addition to bacterial (microbial) contamination, elements that are particularly detrimental to poultry include nutrients (nitrate and nitrite); high concentrations of sodium, chloride, hydrogen sulfide ("sulfur water"), iron and manganese, and toxic elements such as lead, selenium and arsenic. Industrial chemicals and toxins such as are used in or occur as by-products of agricultural pesticides can also be a problem, and should be tested for. Table 1 on the facing page lists the commonly accepted drinking water quality standards for poultry.

Excess iron, bacteria, and agricultural pesticides or their by-products are often encountered in farm well water

A common water quality problem in Alabama and the Southeast U.S. is excess iron, along with bacteria that feed on the iron and form a reddish brown slime that clogs filters, drinkers and fogger nozzles. Mild iron bacteria problems can often be dealt with by "shock chlorination," which involves a one-time treatment between flocks, injecting a strong chlorine solution into the well and circulating and flushing it through all pipes in the system.

Chlorination, either between flocks or continuously, may be needed to cope with iron or coliform bacteria contamination

For more severe iron bacteria problems, continuous chlorination is called for, installing a "chlorinator" to continuously inject chlorine into the water system. Chlorine not only kills bacteria but is an oxidizing agent, meaning it causes minerals such as iron and manganese to combine with oxygen, in the process coming out of solution and forming a solid precipitant. Because of this reaction, a sand media filter must be installed downstream from the chlorinator to remove the mineral solids from the water. Chlorination also prevents other kinds of bacterial contamination, and may be needed even if iron and iron bacteria are not present in the water supply.

Ensuring an Adequate Water Delivery System

Proper well siting and construction are critical. Any new well must be located a safe distance from any present or future pollutants. Unfortunately, many existing farm wells have been polluted with nitrates, bacteria and other contaminants. New wells should be located at least 100 feet from septic tanks and field lines, pesticide, fertilizer or petroleum storage or handling facilities, and animal or fowl enclosures; and 150 feet from waste lagoons and dead animal burial pits. Note that these are minimum distances, and greater spacings are highly advisable.

Proper well siting and construction are critical in preventing pollutants from entering the water supply

When contamination occurs at a well site, it is usually because water-borne pollutants flow down the inside of the well casing, or around the outside of the casing. For this reason, wells should not be sited in low-lying areas subject to flooding or where water is likely to accumulate. Well construction is also important. An improperly constructed well creates a direct conduit between the ground surface and the underground water supply. It is especially important that the upper part of the well be protected by a sanitary seal or cover, and that any space between the casing and the bore hole be grouted with impermeable materials to a depth of at least 10 feet, and preferably all the way to the water-bearing formation. A watertight concrete pad or curb sloping away from the casing at least two feet in all directions will also help prevent pollutants from entering the well.

Table 1. Drinking Water Quality Standards for Poultry			
Contaminants	**Average Levels**	**Maximum Acceptable**	**Remarks**
BACTERIA			
Total bacteria	0/mL	100/mL	0/mL is desirable
Coliform bacteria	0/mL	50/mL	0/mL is desirable
ACIDITY/HARDNESS			
Total Hardness	60-180 ppm	110 ppm	< 60 is unusually soft; > 180 is very hard.
pH	6.8-7.5	6.8-8.0	< 6.0 is undesirable; < 6.3 may degrade performance
NITROGEN COMPOUNDS			
Nitrite (NO_2)	0.4 mg/L (NO_2-N)	4 mg/L	- - -
Nitrate (NO_3)	10 mg/L (NO_3-N)	25 mg/L	Levels of nitrate from 3 to 20 mg/L may affect performance.
NATURAL CHEMICALS			
Calcium (Ca)	60 mg/L	- - -	- - -
Chloride (Cl)	14 mg/L	250 mg/L	Even 14 mg/L may be detrimental if sodium level is higher than 50 mg/L
Copper (Cu)	0.002 mg/L	0.6 mg/L	Higher levels of copper produce bitter flavor
Iron (Fe)	0.2 mg/L	0.3 mg/L	Higher levels of iron produce bad odor and taste.
Lead (Pb)	- - -	0.02 mg/L	Higher levels of lead are toxic.
Magnesium (Mg)	14 mg/L	125 mg/L	Higher levels of magnesium have laxative effect. Levels > 50 mg/L may affect performance if sulfate level is high
Sodium (Na)	32 mg/L	50 mg/L	> 50 mg/L of sodium may affect performance if sulfate or chloride is high
Sulfate (SO_4)	32 mg/L	250 mg/L	Higher levels of sulfate have laxative effect. Levels > 50 mg/L may affect performance if magnesium and chloride are high.
Zinc (Zn)	- - -	1.5 mg/L	Higher levels of zinc are toxic.

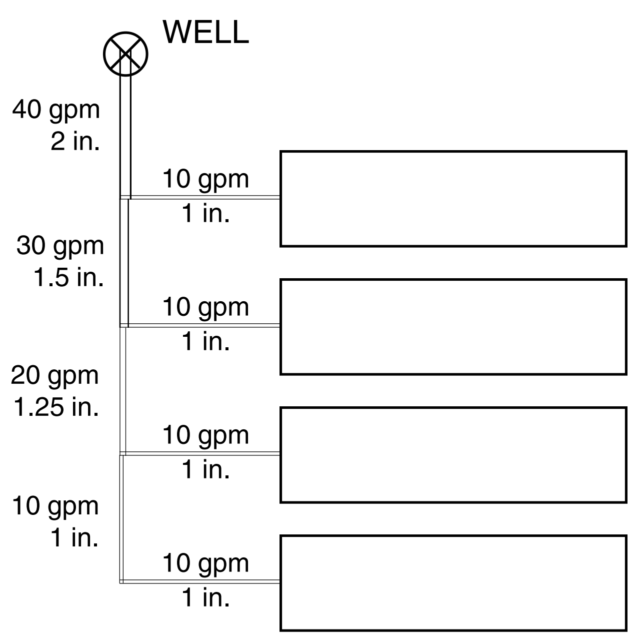
Adapted from T.A. Carter and R.E. Sneed, *Drinking Water Quality for Poultry*, PS&T Guide No. 42, Extension PoultryScience, North Carolina State University, Raleigh NC, 1987.

Table 2. Pipe Sizes for Poultry House Supply

Flow Rate (gpm)	**PVC Pipe Size** (inches)
0-10	1
10-20	1.25
20-30	1.5
30-50	2
50-70	2.5
70-100	3

Notes: Table gives "rule of thumb" sizes for main supply line, assuming furthest house is not more than 300 feet from well. For greater differences, or if a large elevation difference exists between the well and the houses, larger pipe sizes would be needed. Main supply line pipe size can be reduced between houses, as shown in Figure 1. Systems should be designed in consultation with a specialist. Chart is for Schedule 40 PVC.

Figure 1. Example Pipe Layout and Sizing



Note: Illustration shows how water supply line size can be progressively reduced between houses, as flow rate needed drops. This is a "rule of thumb" example for illustration only, and assumes that no run at any pipe size is more than 150 feet.

The pump must be able to deliver the flow rate needed at the required pressure. Pump sizing will depend on the depth of the well, the elevation change (if any) between the well and the poultry houses, and pressure losses in the piping. Pressure at the broiler house should be about 40 psi; pressure at the wellhead is typically 50-60 psi. A qualified professional should be employed to determine pump size. Pump quality is also critical, since a pump failure can be life-threatening to the birds. Adequate power failure alarms and backup power systems must also be provided.

Both quality and sizing of pumps, pressure tanks and pipes must be adequate to assure reliable, efficient water delivery

A bladder-type pressure tank is recommended. The purpose of the pressure tank is to extend the pump on-off cycling time, so the pump starts up not more than once every 5 or 6 minutes. This reduces wear and tear on the pump. A bladder pressure tank should be sized at about 5 times the capacity of the pump in gallons per minute. That is, if the pump will deliver 40 gpm, the bladder tank should hold 200 gallons. Non-bladder pressure tanks should be sized at 10 times the pump capacity. Caution: manufacturers sometimes rate bladder tanks by "equivalent size" rather than by actual capacity. For example, a bladder tank holding 200 gallons might be given a "400-gallon rating" because it could replace a 400-gallon non-bladder tank.

Schedule 40 PVC pipe is recommended for poultry house water delivery systems. Pipe size needed depends on the flow rate needed and the distance water is to be delivered. The higher the flow rate and the longer the pipe must be, the larger the pipe diameter must be. If the pipe is not large enough, pressure will drop and the needed flow rate will not be achieved. Table 2 gives rule of thumb pipe size recommendations, and Figure 1 shows an example layout, with reduced pipe sizes along a main trunk line. Pipe layout and sizing should, however, be determined with the advice of a professional. Maintaining adequate pressure and flow rate is too important to try to save a small amount of money by buying minimally-sized pipe.

The Bottom Line

In considering any new poultry production facility, a grower must have reasonable assurance that an adequate supply of good-quality water can be provided. If the water supply does not meet the minimum requirements, the enterprise will simply fail. More often, a marginally adequate installation in terms of well yield, water quality, or equipment results in an inefficient, problem-plagued system that fails to give the grower the expected or possible return on investment. In this regard, water quality is an often overlooked limiting factor. For either new or existing facilities, a modest investment in water testing can reveal unsuspected problems and enable the grower to take steps to eliminate the problems and maximize returns. Help is available through the state Extension system, as well as state environmental and/or water agencies. In Alabama, ADEM maintains a toll-free help line: 800-533-ADEM. For questions about water quality and testing, Alabama residents can call AU water specialist Jim Hairston (334-844-3973), and for advice on pumps, piping, etc., water engineering specialist Larry Curtis (334-844-4181).

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ALABAMA COOPERATIVE Extension SYSTEM

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