

Water Facts 2

Water System Planning—Estimating Water Needs

This fact sheet allows a homeowner or farmer to estimate water needs and calculate how much water must be delivered from a private water supply to meet these needs. These planning assumptions are based on long-term averages for various water uses in Pennsylvania. Your actual water use may vary significantly from these averages.

Whether you are building a new house in a rural area or increasing the size of a dairy herd, adequate supply from a private water well or spring is critical to your plans. Planning should be done prior to having a well drilled or spring developed to ensure that an adequate supply of water is available.

Estimating Home Water Use Needs

In general, we use 50 to 100 gallons per person per day in our homes (200 to 400 gallons per day for a family of four). The household water use estimates given in Table 1 can be used to calculate more specific daily water use values for your home.

Appliance	Water Use
Clothes washer (top-loading)	43 to 51 gallons per load
Clothes washer (front-loading)	27 gallons per load
Dishwasher (standard)	7 to 14 gallons per load
Dishwasher (efficient)	4.5 gallons per load
Garbage disposal	4 gallons per day
Kitchen sink	3 gallons per minute of use
Bathroom sink	2 gallons per minute of use
Shower or tub	5 gallons per minute of use
Toilet (low-flush)	1.6 gallons per flush
Toilet (standard)	5 gallons per flush
Outside hose (½-inch)	5 gallons per minute of use
Water softener regeneration	50 to 100 gallons per cycle

Table 1. Typical water use for various appliances and fixtures in the home.

For the purposes of planning a water system, the total daily water use is less important than the peak daily water use or the *peak demand*. In reality, most of the water used in the home occurs over a very short time period, usually in the morning or evening. As a result, for planning purposes it is recommended that a water system be able to supply all of the days projected water use in a 2-hour peak demand period. If you estimate that your home water use will be 400 gallons per day, the water system should be sized to provide this much water in a 2-hour period.

So, how much water can be delivered from your well or spring in a given period of time? This is referred to as the well or spring *yield*. The yield from a spring can be easily measured by determining how many gallons of water flow from the outlet pipe every minute. This flow rate will likely vary considerably with weather conditions, but, for planning purposes, it would be best to measure flow during a dry time period. For a well, the yield is considered the maximum rate in gallons per minute (GPM) that a well can be pumped without lowering the water level in the borehole below the pump intake.

For most single-family homes, a minimum flow of 6 GPM is suggested from a well or spring. This flow would provide 360 gallons of water each hour, which would be sufficient to meet most home water peak demands. Higher flow rates may be necessary for larger homes with more fixtures, appliances, and residents that may all be using water at the same time. The values in the table below give the suggested minimum flow rates for various numbers of bedrooms and bathrooms in a home.

Ideally, the yield from the well or spring will exceed the recommended minimum flow rates in Table 2. If not, you may need to rely on water storage to meet peak demand periods. For a drilled well, the borehole can provide a significant amount of water storage. A typical 6-inch-diameter well will store about 1.5 gallons of water for every foot of standing water in the borehole and a 10-inch well stores about 4 gallons of water per foot. Therefore, a 6-inch-diameter well with about 100 feet of standing water in the borehole would contain about 150 gallons of stored water. In the case of a spring, a large spring box can be constructed where the spring emerges or a water storage tank can be added after the spring box to provide extra water storage to meet peak demand. The water stored in the borehole, spring box, or storage tank would be helpful when water use in the home exceeds the amount of water flowing from the well or spring. Well storage and spring flow can vary dramatically with the natural groundwater level, with the highest levels typically occurring in spring and the lowest levels in fall. These natural variations can be accentuated by drought conditions. So, while water storage can allow for the use of wells and springs with lower flow rates than shown in Table 2, it may not be reliable during severe droughts. An approximate estimate of the amount of water needed before a well or spring is developed can allow the professional contractor to utilize the combination of local knowledge, yield, and storage to meet water demand. For wells that yield extremely low amounts of water, an intermediate storage system can be added (see *Water Facts #3—Using Low-Yielding Wells*).

# of bedrooms in home	Number of bathrooms in home			
	1.5	2	3	
2	6 GPM	8 GPM	10 GPM	
3	8 GPM	10 GPM	12 GPM	
4	10 GPM	12 GPM	14 GPM	16 GPM
5		13 GPM	15 GPM	17 GPM
6			16 GPM	18 GPM

Table 2. Minimum flow rates (GPM) for homes based on number of bedrooms and bathrooms. (From *Private Water Systems Handbook*, 1992.)

Estimating Farm Water Use Needs

Planning for water supply needs is generally much more important for farms because much larger amounts of water are often needed, especially for dairy operations or farms with large acreage in irrigation. Midwest Plan Service guidelines suggest that farms using 2,000 gallons per day (GPD) will need a water source flow rate of 16 GPM, those using 6,000 GPD will need 36 GPM, and those using 10,000 GPD will need 48 GPM. Planning for larger operations starts with an estimate of total daily water use from Table 3.

*The amount of water used for irrigation is seasonal and varies greatly depending on natural water availability from precipitation.

Animal Water Use

Milking cows	35 gallons per animal per day
Sprinkler cooling for animals	20
Dry cow, beef cattle, or steers	12
Calves	
- 1-month old	1.5
- 2-month old	2.0
- 3-month old	2.5
- 4-month old	3.5
- 5 to 14 months old	4.5
Heifers	
- 15 to 18 months old	7.0
- 18 to 24 months old	9.0
Swine	1.5
Horses or ponies	12
Sheep or goats	2
Chickens (per 100 head)	9
Turkeys (per 100 head)	15

Milkhouse and Parlor Water Use

Automatic bulk tank	50 to 60 gallons per wash
Manual bulk tank	30 to 40 gallons per wash
Pipelines	70 to 120 gallons per wash
Pail milkers	30 to 40 gallons per wash
Milking system Clean-in-Place (parlor)	12 to 20 gallons per unit
Miscellaneous equipment	30 gallons per day
Cow preparation (per milking)	
- Automatic	1 to 4.5 gallons per cow
- Manual	0.25 to 0.5 gallons per cow
- Wash pen	3 to 5 gallons per cow
Milkhouse floor	10 to 20 gallons per day
Parlor floor (hose down)	50 to 100 gallons per wash
Parlor floor and cow platform	500 to 1,000 gallons per wash

Parlor and Holding Area Floor with Flushing

Parlor only	20 to 30 gallons per cow
Parlor and holding area	25 to 40 gallons per cow
Holding area only	10 to 20 gallons per cow

Automatic flushing	1,000 to 2,000 gallons per wash
Irrigation	
Sprinkler*	4,000 gallons per acre per day
Drip*	1,000 gallons per acre per day

Table 3. Estimated daily water use in gallons for various farm animals, equipment, processes, and irrigation in Pennsylvania.

Using the estimates from Table 3, current and future daily water demands on the farm can be estimated. The farm water system would need to be designed to include sustained yield and storage from one or more wells or springs. Where large quantities of water are needed from a well, it may be worthwhile to hire a professional hydrogeologist to locate a high-yield well using fracture trace mapping. For more details on this technique, consult *Water Facts #5—Water Well Location by Fracture Trace Mapping*. It should also be noted that farms using more than 10,000 GPD must report their annual water use to the Pennsylvania Department of Environmental Protection as required by the Water Resources Planning Act.

The required water source flow rate does not necessarily need to equal the yield from the well or spring. If water availability is projected to be insufficient for the calculated peak water demand, additional sources must be developed or additional storage must be used (see *Water Facts #3— Using Low-Yielding Wells*).

Sources of Water Use Estimates

1. *Planning Guide for Water Consumption*. 1981. Agricultural and Biological Engineering Fact Sheet SW-1. Penn State Cooperative Extension.
2. *Private Water Systems Handbook*. 1992. Midwest Plan Service. MWPS-14.
3. *Handbook of Water Use and Conservation*. 2001. WaterPlow Press. Amherst, MA.
4. *Consumptive Water Use Restrictions in the Delaware River Basin*. 2002. Agricultural and Biological Engineering Fact Sheet F-199, Penn State Cooperative Extension.
5. *Guideline for Milking Center Wastewater*. 1998. Natural Resource, Agriculture, and Engineering Service. NRAES-115.

Additional Resources

For further information on management of wells and springs in Pennsylvania, visit the [Penn State Extension Water Quality](#) website or contact your local cooperative extension office. More details on water system planning and sizing can be found in *Private Water Systems Handbook* (MWPS-14), which can be ordered for \$7 from the [Natural Resource, Agriculture, and Engineering Service](#) or 607-255-7654.

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