Great Lakes Basin Grazing Network
and
Michigan State University Extension

Watering Systems for Grazing Livestock

Great Lakes Basin Grazing Network and Michigan State University Extension

Purpose

This booklet will help you

1. Provide "how to's" for setting up water systems that will serve your livestock, your grazing systems and the environment.
2. Explain the role water systems can play in livestock production, pasture production, and the impact livestock can have on wetlands, riparian areas and the environment.
3. Determine requirements for water sources, livestock and various delivery systems.
4. Identify other information sources about various watering systems.

Credits

The Great Lakes Basin Grazing Network funded the major portion of this booklet and much of the on-farm information. The Great Lakes Basin Grazing Network was funded by the Great Lakes Protection Fund and is organized by the Wisconsin Rural Development Center, Mount Horeb, Wisconsin.

Source: Michigan Hay and Grazing Council.

Author

Ben Bartlett, D.V.M., Michigan State University Extension District Dairy and Livestock Agent.

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How to put a water system together

Rules of thumb

Intensively grazed pastures

Where animals drink individually and there is less than 600 to 900 feet from water to far corner of paddock, provide a flow rate that supplies water in four to eight hours and use a small tank that allows two to four percent of herd to drink at once.

Continuously grazed pastures

Where animals drink as a herd and can graze more than 900 foot from water, provide a water tank that holds a minimum of one-quarter of total daily needs and accommodates five to ten percent of herd. The tank refill time should be one hour or less.

Daily animal water requirements

Animal	Gallons water	Range
Dairy cow	20	(15-25)
Beef cow pair	15	(12-20)
Yearling bovine	10	(6-14)
Horse	10	(8-14)
Sheep	2	(2-3)

Source: Michigan Hay and Grazing Council.

Plastic pipe sizing chart

Gallons per minute										
Pipe diameter	Pipe length									
	100’	200’	350’	500’	750’	1000’	1500’	2000’	3500’	1 mile
1/2”	4	3	–	2	–	–	1	–	–	–
3/4”	8	8	6	5	4	3		2	–	1
1”	13	13	10	8	7	6	5	4	3	2
1-1/4”	23	23	21	19	15	12	9	8	6	4
1-1/2”	30	30	30	26	22	19	15	12	9	7
2”	50	50	50	50	43	37	29	25	18	15

Information from Kentucky Grazers Supply

Examples

Number one

System: Intensively grazed
Animals: 60 dairy cows
Distance to water in paddock: less than 600 feet
Distance to water source: 1,500 feet from water source to most distant paddock
Daily water consumption: 60 cows x 25 gallons water = 1,500 gallons

Number four

System: Intensively grazed
Animals: 400 ewes and lambs
Distance to water in paddock: 660 feet or less
Distance to water source: 2,640 feet
Daily water consumption: 400 x 2 gallons water = 800 gallons per day
(**NOTE:** Daily water intake for sheep is highly variable depending on temperature and moisture content of grazed forage)
Tank refill rate: 800 gallons per day supplied in four-hour period or 240 minutes = flow rate of 3.3 gal/min.
Pipe size: (from chart, page 2) one inch for entire distance or one inch for 1,600 feet and 3/4 inch for last 1,000 feet.

Important: If sheep run out of water for whatever reason, even for a short time period, it is CRITICAL to have adequate drinking space or to be at the tank maintaining orderly animal access until the rush to get a drink is satisfied.

Number five

System: Intensively grazed
Animals: 70 stocker cattle (one semi-truck load)
Distance to water in paddock: Less than 900 feet
Distance to water source: 5,280 feet (one mile)
Daily water consumption: 70 head x 10 gallon/day = 700 gallons per day
Tank refill rate: 700 gallons divided by 240 minutes requires a flow rate of three gallons per minute – If this was a case where the one-mile away paddocks are only used for a limited period each grazing season i.e. 30-acre hay field grazed just once for 30 days in late August/September.

Cost comparison of four alternatives

1-1/4 inch pipe will provide four gallons/minute at one mile and one-inch pipe will provide two gallons/minute at one mile.

5,280 feet of 1-1/4 inch @ $.20/ft plus 10 percent for fittings plus a small tank = $1,250.
5,280 feet of one inch @ $.15/ft plus 10 percent for fittings plus a large tank = $1,050.
1,100 gal tank ($425) on your hay wagon plus fittings plus small tank = $550.
Pay neighbor $100 to pump water to paddocks for a month plus fittings plus small tank = $225.

It's important to remember that everyone's situation is a little different and it's necessary to pencil out the options. The key point is that the cost to supply water when pasture is available is almost always cheaper than not using the pasture and feeding mechanically harvested feed.

Water's impact on the environment, grazing, livestock and pasture productivity

Environmental considerations

In most grazing situations, what is good for the environment will be good for the grazing livestock. When cattle damage creek banks and foul water with manure and urine, not only does wildlife suffer, but in many cases, livestock accessing the water will also suffer. In the past, the only alternative was fencing livestock away from the waterways, but recent research shows that in many cases, pumping water or improving water access combined with a managed rotational grazing plan optimizes animal performance, pasture use and wildlife in riparian areas.

Source: Michigan Hay and Grazing Council.

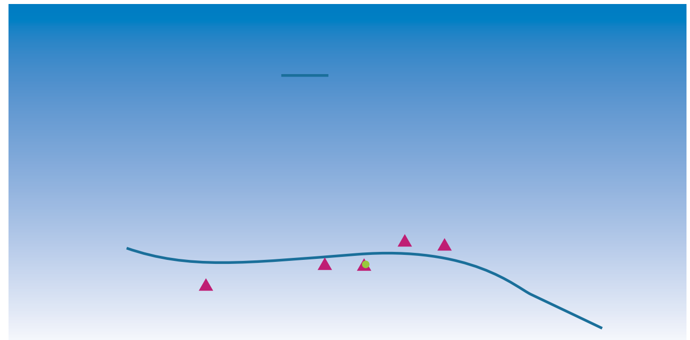
Research has shown that given a choice, cattle drink from a spring-fed water trough 92 percent of the time and only eight percent of the time from a stream. Luring cattle away from a stream reduces fecal streptococci bacteria in the water by 77 percent, nitrogen by 54 percent, phosphorous by 81 percent and total suspended solids by 90 percent.

Although electric fencing is the best way to keep cattle away from a stream, research underscores the usefulness of an alternative water source. In some situations fencing out livestock is the only option, for instance, trout streams can be very sensitive. Grazing may become a tool to harvest riparian areas and enhance wildlife habitat for woodcock or nesting waterfowl.

Livestock can often damage a water source, as in silting up ponds, or dugouts, requiring frequent maintenance and spring flows. If cattle go into a stream or pond to drink, it may be necessary to provide access sites, especially when the ground is saturated. Data from an Oregon trial demonstrates that providing watering sites and salt away from a stream decreases animal drinking and can increase performance. Recent research in Ontario has shown that cattle frequently drink from only a few limited access points. If stream bank degradation occurs, it may be due to lack of feed/pasture in the upland areas or the draw of shade.

Animal behavior and grazing efficiencies

One of the most exciting considerations when evaluating water systems is the impact that watering access can have on grazing behavior. While improved watering systems can have variable effects on individual animal performance, they frequently increase the amount of harvested forage and the output of milk or meat per acre. Missouri research has shown that when the distance to water approaches 900 to 1,000 feet, utilization of standing forage decreases (see Graph B). Research on Wyoming rangeland on a pasture of more than 2,000 acres, found that 77 percent of grazing occurred within 1,200 feet of the water source (a circle of 1,200 feet radius is less than 105 acres). More than 65 percent of the pasture was at least 2,400 feet from the water, but only supported 12 percent of the grazing.



In another Missouri study, a 160-acre pasture only produced the equivalent of 130 acres of grazing when the cattle had to travel 1,320 feet or one-quarter mile to water. Providing water access that would have improved utilization in this example would increase the "pasture yield" by almost 19 percent.

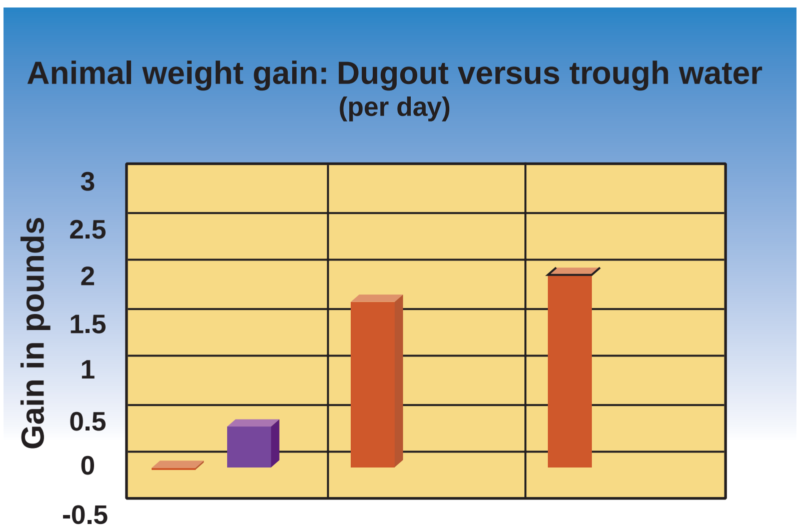
Another factor regarding distance to water is ease of travel. In mountainous Oregon, cattle preferred grazing within 656 feet of water and mostly avoided grazing areas beyond 2,000 feet. In past water availability considerations, the most common criteria was whether the animal could reach water without using excess energy or hurting performance. Long distances to water can cause uneven grazing, with overgrazing near water and under-grazing (under-harvesting) in paddock far corners. This uneven forage harvest could potentially cost more on productive land that has seed and fertilizer improvements.

Additionally, when livestock travel more than 900 feet to drink, they travel as a herd. This whole-herd watering greatly increases the demand on the water tank and system's recharge capacity. Just as the forage usage depends on ease of travel, the desire to water as a herd is affected by the group's "flockingness," pasture visibility, level vs. hilly and other considerations. It's important to remember that watering access that is 900 feet or less from the farthest point in a paddock, increases forage use and reduces tank size and the water system's recharge capacity requirements.

Does water access and quality affect animal performance? It's hard to find research data that demonstrates a clear-cut performance advantage for water in each paddock. With high performance dairy cows, many farmers report increased milk output, two to five pounds per cow, when water is available.

Lower producing animals, like dry beef cows, would be less likely to show the water access advantage. Nearby water access provides grazing animals the opportunity to reach their maximum output, barring any other limiting factors, such as forage quality and quantity, weather, etc.

It's important to remember that water access also means adequate room at the tank to drink without undue peer pressure. When a herd of graziers travel to drink, the dominate animals take their fill and leave to graze or rest in the shade. Often the subordinate animals follow without adequate drinking or sometimes not drinking at all.



Each 2.3 foot in rise (or fall) decreases or increases water pressure by one psi. That

It's important to decide whether the waterline is buried or left on top of the ground. For most operations, the water lines will not be used in the middle of winter, so making

Water systems options

Water sources

There are two main water sources: wells or underground sources and surface sources, such as ponds, lakes, streams, etc. In the upper Midwest, with regular winter feeding most operations depend on subsurface systems. Further south, with the increasing number of beef cattle comes an increased use of surface water. The most flexible and cost effective water source can be well water with electric pumps. If the pastureland is too far from a well, doesn't have a well or a potential well site, inadequate well water quality and quantity, then explore the surface water option.

Surface water can be obvious, such as ponds or streams, but can also be developed at seeps, wetland or marshy areas. In addition to development costs, the other main limitation to surface water is that it is usually found in the pasture's low spot, far from electrical access. This means the watering spot can only serve limited acreage to minimize traveling distance. Otherwise, the water system must be portable or constructed in many locations. These limitations are mentioned only because in many situations, plastic pipe from the homestead well is the least costly and most effective option. A stream running through the pasture may or may not be the best way to provide water and control stock movement as they harvest the forage.

Source: Michigan Hay and Grazing Council.

Since summer watering for large animal groups greatly increases water usage, work with a local well driller to test your well's water yield and draw down. Contact local governmental agencies to learn about potential cost-share programs for developing livestock watering systems. In many cases, the situation can be a win-win arrangement with improved wildlife habitat and an improved stock watering system.

If your pastures improve and you run more stock, have you built expansion potential into the system? While piping and electric wells may be the most common system, be prepared to tap various water sources to increase flexibility and provide an emergency backup system. When the submersible pump dies on July 4 and the temperature is 100 degrees, a pond or stream access can make the holiday much more enjoyable for you and the stock.

Always remember water is an invaluable resource and contamination errors, whether to ground water or surface water, never have quick and easy fixes.

Gravity

A spring or pond that lies above the paddocks can utilize gravity. Gravity is a free way to provide the energy to move water, though where you want the water may not always be downhill. Gravity systems are usually low pressure and so piping has to be bigger to maintain flow rates, but low-pressure pipe is usually lower cost. If using a reserve tank, monitor level and don't forget to take the cost of the reserve tank into account. Pumping water up into a reservoir has advantages if you have a high point relatively close to the water supply, and don't have access to public electricity to operate a pump. The reservoir can be filled with a high capacity gasoline pump and then gravity will "ration out" the water over a three-to seven-day period. Slower-moving gravity systems freeze up sooner unless you have an abundant water supply and can allow for overflow to keep the water moving. Gravity is free, but don't let the system's limitations cost more than a positive pressure system.

Pumps

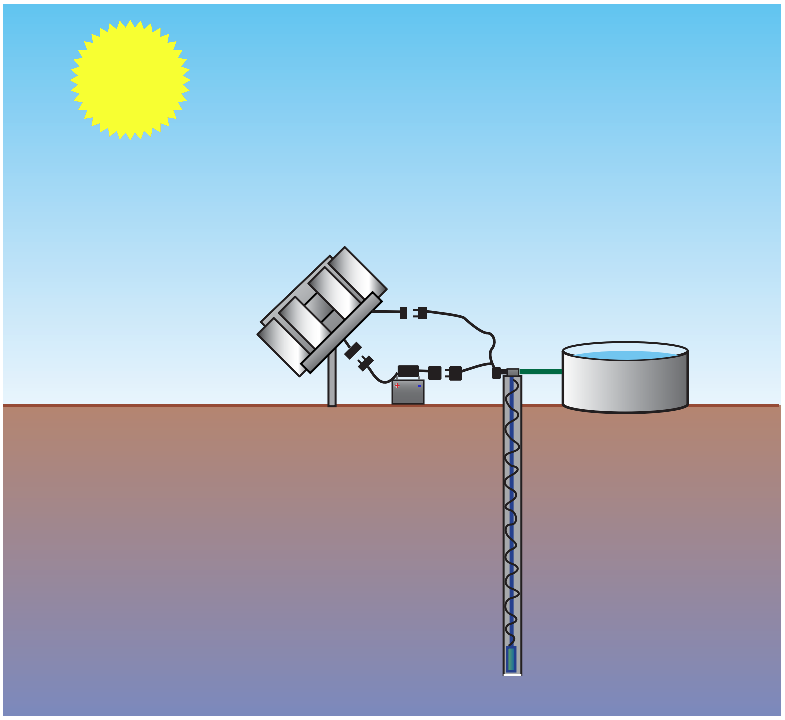
Pumps move water in two ways: 1) to **suck** water up shallow jet pumps, centrifugal pumps or diaphragm pumps or, 2) to **push** water, pistons, impellers or jets. Pumps that suck water up can only draw water up about 22 feet, surface to pump, because it is the atmospheric pressure that pushes the water into the vacuum that the pump creates. These pumps are generally lower cost and can often move large quantities of water at medium pressure levels. The most common push-type pump is the submersible pump, which is put down the well into the water source. The other type is the piston pump, which is often used with windmills or as a booster pump to increase pressure to go up hills.

Pump power options

It takes energy to move water, and the more water to move, the more energy is needed. A steady power supply that could run different kinds of pumps and operate at a low cost is preferred since stock drink daily. Public electric power is the closest thing to an ideal power source, except it is not available everywhere. In many cases it's necessary to look for alternative ways to pump water. Every producer and farm has different resources and goals, so each alternative should be judged on an individual basis.

Alternative pumping systems

Much of the producers' experience quoted below was generated by two years of on-farm trials supported by the Great Lakes Basin Network Research Project. This anecdotal information is added to give some sense of how the various systems may perform. Most were on-farm operations, with a few examples from MSU experiment station farms.

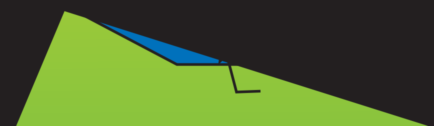


Solar pumps

Solar energy has a lot of appeal because it is new technology, environmentally friendly and once set up, is "free." In addition, it is relatively maintenance-free, can go anywhere and offers various pump options. Additionally, when the weather is hot and dry, water consumption increases and so does the solar unit's pumping ability. The biggest drawback is that it only works when the sun shines. In the upper Midwest, the solar powered pump will not work at night or on many cloudy days. The system has to "store" energy either in batteries or water storage for the down time, which adds to the system's cost. Other disadvantages are susceptibility to vandalism in remote locations, the technical nature of the panels and their operation and that the solar system is a relatively expensive investment.

Wind powered pumps

Windmills once dotted almost every farmstead, but have not been used recently in the Midwest, except for the recent interest in wind generator farms. Windmills are low cost



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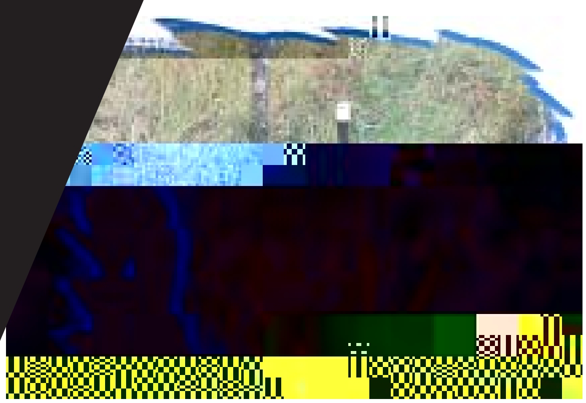
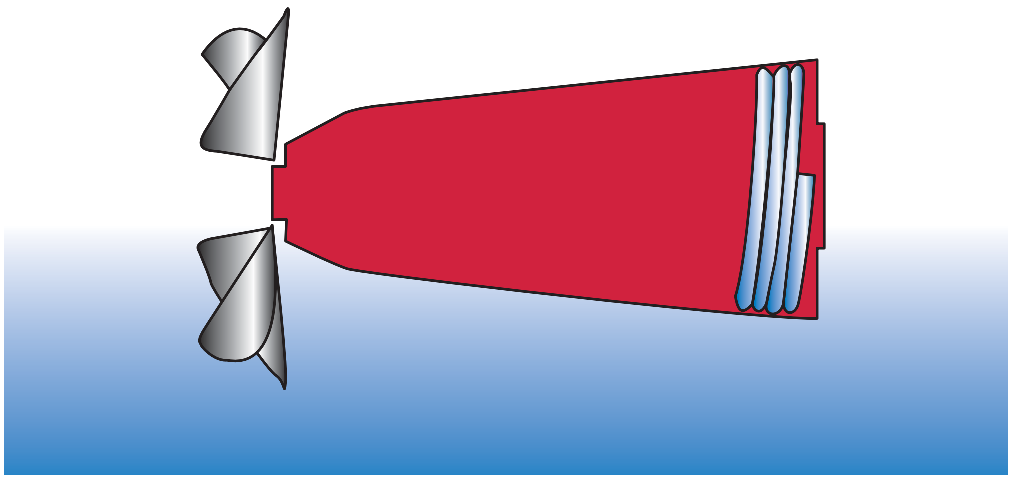
the source.) Once in motion, the two valves will

nuously pumping water to the higher elevation.



Sling pump

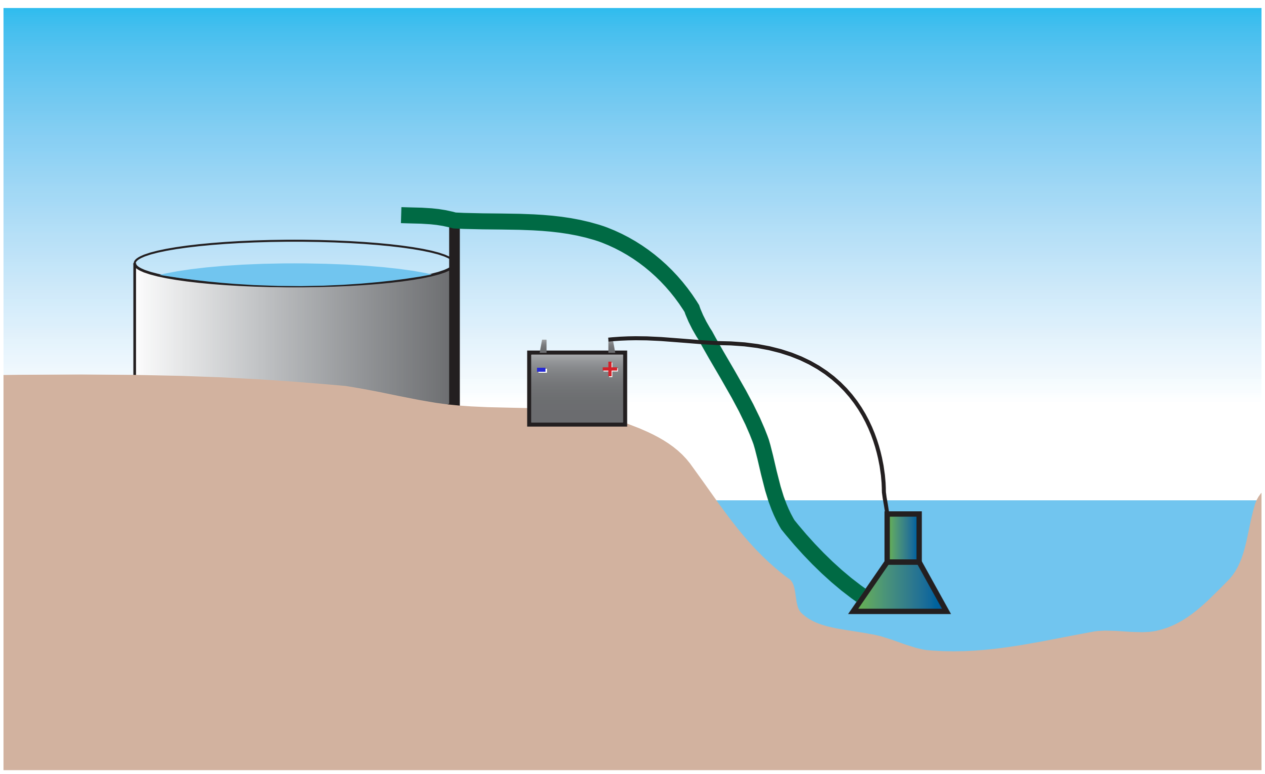
Sling pumps use a plastic drum with internally coiled piping. The drum is open to water at the rear and has a propeller on its front. It is tethered in a flowing stream and floats half in and half out of the water. As the propeller turns the drum, water then air is taken into the coiled piping. As the drum turns, the air rises and pushes the water along in the piping and eventually out of the sling pump to the stock tank (see diagram below). A wind-powered version of this system uses a windmill-like fan and belt to spin the drum in standing water. The sling pump requires a moderate initial investment, no operating cost and is simple to set up and operate. The sling comes in various sizes, from the small one, which in a stream flow of two feet per second, pumps more than 800 gallons per day with a 26-foot head, to the large size that pumps 1,500 gallons with a 49-foot head. Slower flows have the same head, but less volume. Pumps cost from $700 and $1,000 each.



The sling pump's main drawback was that when the largest volume was desired (mid summer), the streams had the lowest water levels and slowest flows. A minimum of a 12-inch water depth is listed for small pumps, but many of our trial operations experienced difficulties in keeping the pump spinning. When the pump turned, it worked great and pumped 24-hours per day, non-stop. Since there is no way to turn the pump off, the stock tank overflow has to be controlled to prevent mud around the tank. Floating debris has been mentioned as a problem, but that was not our experience. One concern expressed by one of our trial farms was the sling pump's potential to impeded canoers or be vandalized by canoers or rafters.

Battery pump

With the availability of sump pumps that work off 12-volt batteries and the need to move water from a stream or pond just up the bank to prevent stock access, an Ontario farmer developed an inexpensive livestock watering system. This battery system is portable, economical, uses locally available parts and can move large volumes quickly if with minimal pumping height. The system costs about $300–$150 for the pump, $100 for a good rechargeable marine battery and $50 for an on/off tank fill switch and miscellaneous wiring. The switch is like a sump pump mercury switch, except it works opposite, in this case up is off and down is on. The figure below shows how the unit is set up. If large volumes of water are required, or more pumping height is needed, the battery life between recharging can be as short as one day. New pumps are available that appear to be more energy efficient and this should extend battery life. Situations vary, but it appears that between 3,000 and 15,000 gallons can be pumped per battery charge. The float must be protected from stock to prevent unnecessary pumping and damage.



Gasoline/diesel pump or generator and hauling water

This is a different power source. Gas-powered centrifugal pumps that can move large volumes of water very fast can be used to charge storage systems. Generators can be used to provide electricity in remote locations to run regular electric pumps. One operator learned that half a tank of gas operates a submersible pump to deliver 1,000 gallons to a large stock tank. He adds the gas, starts the pump and leaves. The generator and pump cost about $1,000–less than a solar system–and uses off-the-shelf equipment. Hauling water is an additional option that is very flexible but can be time consuming. How much water you can haul on one trip that will last for at least one day determines how much stock can be supplied hauled water. Most pickups, tractors and regular farm wagons can pull or carry about 1,000 gallons, or four tons of water. One thousand gallons serve 66 cows at 15 gallons per day, or 100 yearlings at 10 gallons per head, per day. The crunch occurs during hot weather, when consumption triples and more trips are necessary.

Source: Ben Bartlett.

These alternative systems can serve as the main water supply system, but in many cases are used for the out-of-the-way, underutilized paddocks or as a backup to the homestead well system. They also may be a watering system that allows stock regrouping for increased performance or better forage use. These systems allow you to give your stock the option to not water in the creek or pond and improve wildlife habitat without extensive fencing.

Source: Ben Bartlett.

For more information

Well capacities, electric pump sizing:
Your local well drillers, local plumbing shops

Ponds, construction, sizing, utilization; stream access construction:
Your local NRCS office

Nose pumps

Blue Skies West (Aquamat Nose Pumps)
110 Michigan Hill Road
Centralia, WA 98531
1-888-NOSEPUMP

Rife Company
P.O. Box 95
Nanticoke, PA 18634
570-740-1100

Farm'Trol Equipment (Utina)
409 Mayville Street
Theresa, WI 53091
414-488-3221

Sling pumps

Rife Company
P.O. Box 95
Nanticoke, PA 18634
570-740-1100

Ram pumps

The Ram Co. (Fleming Hydro Ram)
HCR 61, Box 16
Lowesville, VA 22951

Rife Company
P.O. Box 95
Nanticoke, PA 18634
570-740-1100

Wind powered

Dutch Industries Ltd.
P.O. Box 4497
Regina, Saskatchewan
Canada S4P 3W7
306-781-4820

(Magazine Article) *Farm Water Supply Factors: Dairy Exporter*, January 1994, pg. 22-23,