Soil & Crop Improvement Association of Nova Scotia

NOVA SCOTIA ENVIRONMENTAL FARM PLAN

Solar Powered Pumping Systems for Livestock Watering

Factsheet 2008 Revised 2015

In Nova Scotia, many producers are adopting alternative watering systems to limit livestock access to streams and ponds. Solar powered pumping systems can be used to supply water from a pond or watercourse. For information on other methods, see the factsheet titled "Alternative Livestock Watering Systems for Pastures."

Fig. 1. An alternative watering system and riparian fencing will protect the surface water source.

What is a Solar Powered System?

Solar powered pumping systems (Fig. 2) convert the sun's energy into DC power which runs a 12-volt, high volume water pump. The solar panel converts the sun's energy to either run the pump directly (called a *direct* system) or stores the energy in deep cycle marine batteries which in turn run the pump (an *indirect* system).

Fig. 2. A solar powered pumping system pumping water from a pond to a 570 L trough with a 100 watt panel.

The direct method is at least twice the cost of an indirect system because the required panel wattage is much higher to offset lower power on cloudy days and at night. Solar powered systems have been limited to summer use in the Maritimes. However, they have been shown to be effective in supplying water year round in places like Manitoba, provided the system is well insulated.

How Does it Work?

Figure 3 demonstrates the setup of the indirect system. Note that a reservoir has been included; a reservoir may be necessary in cases where water consumption is very high or where there is a concern of insufficient recharge due to several successive overcast days. The inclusion of a reservoir is not mandatory provided that there is adequate water flow to the trough during peak use (see "Water Volume Pumping Capacity" for more details).

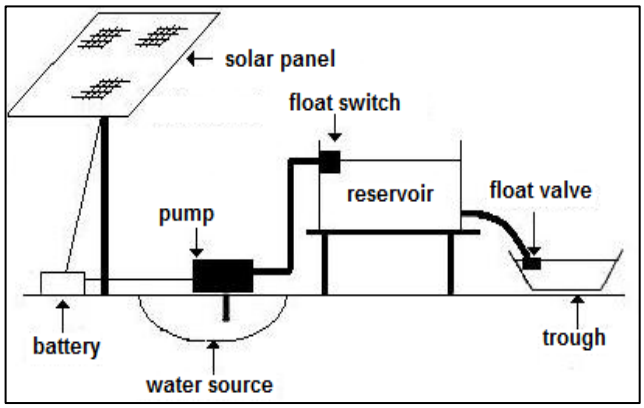

Fig. 3. In a solar powered pumping system, water can either be pumped to a reservoir first and then gravity fed to the trough, or be pumped to the trough directly.

A float switch is wired into the system between the battery and the pump. Place the switch high enough in the trough so that pumping starts as soon as the cattle begin to drink. This will prevent the water level from getting too low. The pump, batteries, float switch and solar panel all connect to a charge controller, which prevents the batteries from being over - or undercharged.

Either one 12-volt battery or two 6-volt batteries can be used in the system. The key is to have high amperage hours so that the batteries can run the pump for several days when recharge is low. The solar panel can recharge the battery in over cast conditions, but only at a third of the rate compared to full sun. In full sun, batteries can be completely recharged in less than four hours if the solar panel is sized properly for the system.

Batteries specifically designed for solar powered systems are available. They are more expensive, but are more durable and last longer between recharges than most deep cycle batteries. However, regular deep cycle batteries can be sufficient for many on-farm watering applications, and their cost savings can make them a worthwhile purchase.

Is Solar Pumping Right for You?

One of the benefits of a solar system is its adaptability to a wide range of site applications. It can supply water to medium and large herds, and can pump water from a variety of water sources, including streams, rivers, ponds and wells. All that needs to be calculated is the volume of water required, the amount of lift to be pumped and the resulting amount of power needed to pump the water to the supply station. However, as the power needs increase, so too does the cost. The cost of this system may not be justifiable for small herds (fewer than 25 cow-calf pairs).

Water Volume Pumping Capability

The volume of water pumped will depend on the lift (Figure 4). Demonstrations by the Nova Scotia Pasture Improvement Initiative (NSPII) have shown that various 12-volt pumps with solar panels ranging from 64 to 100 watts can pump on average 60 L/min (3.5 gpm), or over 20,000 L/day (5,000 gpd) at a horizontal distance of 30 m (100 feet) and vertical lift of two metres (seven feet). Increasing the vertical lift over 3.6 metres (12 feet) will require a stronger pumping system, such as one that includes a pressure switch. The following graph shows flow values that can be expected with a typical 12-volt solar system.

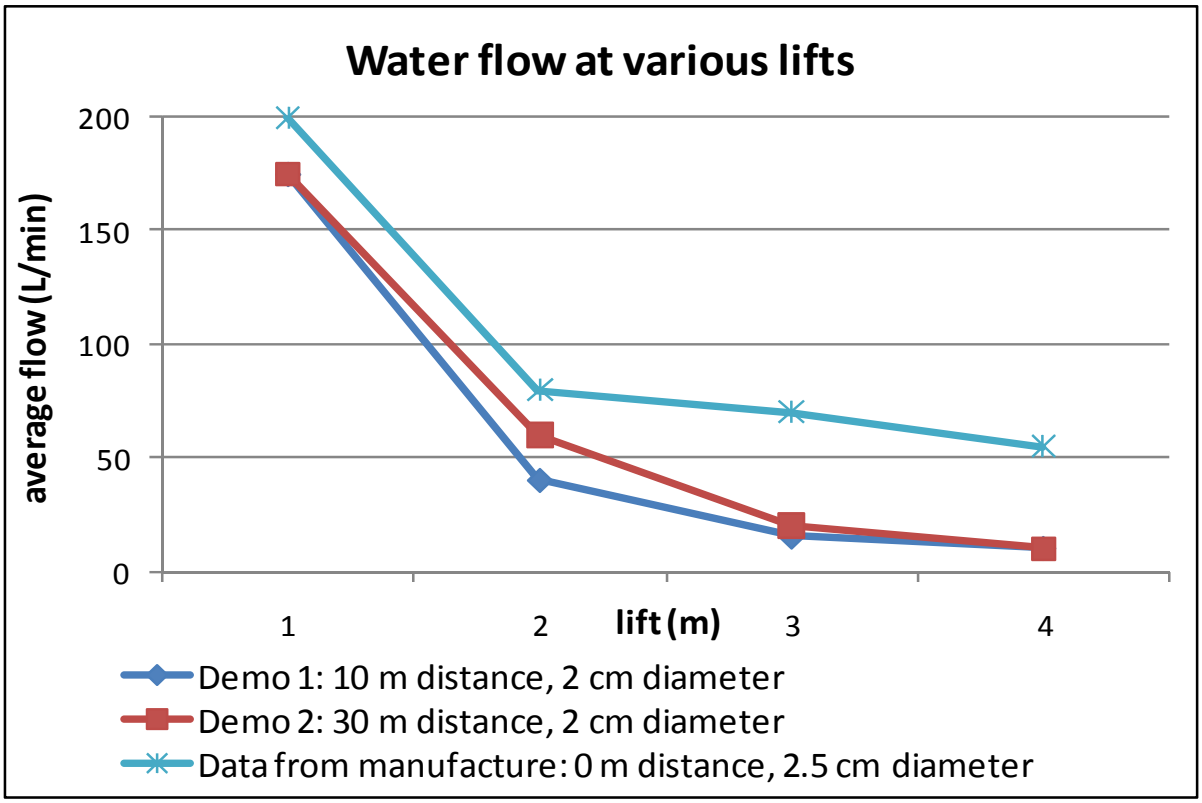

Fig. 4. Water flow rates listed by manufacturers and recorded by the NSPII at various lifts.

Determining Trough Size

In order to properly size the trough, determine:

- the total herd water requirements (see Table 1);
- how accessible the trough is to the herd and how far the herd has to travel (the closer the trough the fewer the cattle at any one time); and,
- how long the batteries can last without re-charge.

The minimum trough size required is one quarter of the daily herd volume requirement, and should be able to refill within an hour. Refill time must be quicker for large herds or herds that must travel a distance to reach the trough. At 16 L/min, a 570 L (125 gal.) plastic stock tank (Fig. 5) would take 35 minutes to fill completely. By leaving the float high, the water flow should keep up with two cows drinking at once.

Table 1. Average daily water intake by livestock

Livestock type	Intake per day § Litres	Gallons
Cow-calf pairs	55	12
Dry cows (both dairy and beef)	45-55	10-13
Growing cattle* (150-350 kg)	20-40	5-10
Growing cattle* (350-550 kg)	30-55	7-13
Dairy cows	75-95	15-20
Sheep, goats	10	2
Horses	30-45	6-10

§On days over 25°C, intake can increase by 50-100%
*Finishing cattle may require more water

Fig. 5. Trough size depends on herd size and travelling distance. A 570 L (125 gal) trough can supply water to 40-50 cow-calf pairs.

A Sample Calculation

The following example shows how to assess the watering requirements for 50 cow-calf pairs, and determine whether a solar powered system can fit this situation.

A pasture system is laid out along a stream that has a bank of one metre high. At certain times in the pasture rotation, cattle will have to travel up to 500 m to reach the water trough.

From Table 1, a 50 cow-calf herd requires 50 x 55 L = 2,750 L/day (600 gpd).

Calculate the **minimum** water flow required:

- minimum trough size (25% of daily herd requirements) = 700 L (150 gal).

  Filling the trough in one hour requires a minimum of 15 L/min (3.3 gpm)

- If using a larger trough = 4,500 L (1,000 gal.):

  Filling the trough in 24 hours requires a minimum of 3 L/min (0.7 gpm)

This situation could use a solar powered water pumping system, since a one metre lift will provide over 100 L/min of flow, so the trough will be filled in 15 minutes (Fig. 4). However, note that because the cattle will be travelling farther at some points in the pasture rotation, a larger trough may be necessary in order to prevent the water level from getting too low. Personal observation is the best indicator of what will work in this situation. While the minimum size of the trough may be suitable on most days, increasing the size to accommodate another 15-20% volume is safer.

To be sure that the herd always has enough water, allow for three days storage, whether that be in the form of stored energy in the batteries, or as a reservoir or very large trough (2,500 L or 560 gal).

System Care & Maintenance

The solar panel face has a durable glass or scratch-resistant coating. Install a fence around the panel and reservoir so animals cannot rub against it. Place the batteries and charge controller in a waterproof container (Figure 6). Avoid setting the pump on the bottom of muddy water sources to minimize the uptake of debris. Secure the water

tub and place it on a firm surface (i.e. gravel, concrete) so the area around the trough will stay dry.

Some deep cycle marine batteries need to be filled periodically with distilled water. Also be sure to keep the panel free of debris so that it is not shaded and can charge the pump at a maximum rate.

Fig. 6. Protect the batteries and charge controller from the elements.

Cost

The cost of a system will depend on the water volume and lift required. For typical beef herds in Nova Scotia with lift demands under three metres, the panel, controller, float switch and pump will cost about $1,500*. A system costing $1,500 could potentially include a 60-100 watt panel and will supply enough water to 125+ cow calf pairs, assuming a lift of no more than two metres (seven feet).

Very high water demands, lifts over three metres (10 feet) or pumping distances over 60 metres (200 feet) may require larger or several solar panels and/or a stronger pump. Pumps with a pressure switch can work in this situation, but may be at the top of the price range. This will increase the price to as much as $2,500.

Batteries will range in price from about $100 for a lower quality model to over $300 for high quality solar models. Either can work well within the system; it is dependent on the producer's preference.

Be sure to obtain several quotes on a particular system as the price can range much more than this. Some solar dealers may not be familiar with providing water to livestock, and may unknowingly oversize the system resulting in a much higher price.

Where to Find a Solar Pumping System

Many companies can supply whole systems with a minimum of information from the purchaser and shipping is usually low. Search online for dealer listings across the country. Alternatively, individual components can be purchased from local department stores or distributing centers online.

Fig 7. Providing a solid surface further reduces damage to soil in riparian areas.

There are solar powered cattle watering demonstrations that can be viewed. For more information, contact the Nova Scotia Environmental Farm Plan program at (902) 893-2293.

*Costs as of December 2007.

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