Alternative Watering Options for Grazing Livestock
Considerations, Strategies, Methods & Products

NOFA-NY Winter Conference
Alternative Watering Options for Grazing Livestock
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Saratoga Hilton and City Center
Saratoga Springs, NY

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Graze-Ayr Pasture Acres
Norwich, NY
INFLUENCE OF WATER AVAILABILITY ON ANIMAL PERFORMANCE, HEALTH, & COMFORT!
WATERING OBJECTIVES

1. Sufficient Quantity
2. Acceptable Quality
3. Close Proximity
HOW MUCH IS ENOUGH?

LIVESTOCK DAILY WATER NEEDS

MILKING/HOUSING FACILITY

GRAZED FORAGE (~80% water)

DEW, FROST, & RAIN

PASTURE WATERING SYSTEM

GRAZED FORAGE (~80% water)
WATER REQUIREMENTS

Determine Animal Dietary Needs

**TOTAL DAILY VOLUME**  gallons/head/day

- **Lactating Cows (@ 80lbs milk)**: 25 - 40
- **Dry Cows**: 10 - 15
- **Dairy Heifers**: 10 - 15
- **Beef Cow-Calf Pairs**: 12 - 20
- **Beef Steer**: 6 - 14
- **Sheep**: 3 - 4
- **Horses**: 8 - 14
## Animal Water Intake & Air Temps

<table>
<thead>
<tr>
<th>Livestock</th>
<th>Water Needed Per Animal (50°C Day)</th>
<th>Water Needed Per Animal (90°C Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry beef cows</td>
<td>8 - 12 gallons</td>
<td>20 - 30 gallons</td>
</tr>
<tr>
<td>Lactating beef cows</td>
<td>12 - 20 gallons</td>
<td>25 - 35 gallons</td>
</tr>
<tr>
<td>Lactating dairy cows</td>
<td>20 - 30 gallons</td>
<td>30 - 40 gallons</td>
</tr>
<tr>
<td>600-pound weaned calves</td>
<td>6 - 9 gallons</td>
<td>10 - 15 gallons</td>
</tr>
<tr>
<td>Horses</td>
<td>8 - 12 gallons</td>
<td>20 - 25 gallons</td>
</tr>
<tr>
<td>Sheep and goats</td>
<td>2 - 3 gallons</td>
<td>3 - 4 gallons</td>
</tr>
</tbody>
</table>

NON-CONVENTIONAL WATERING OPTIONS

• More Expensive per Gallon Delivered
• Generally Involve Greater Operation Attention or Maintenance
• Fewer Contractors to Choose
• Site Requirements More Demanding & Limiting
Nose Pump

Livestock actuated diaphragm pump integrated into a water bowl.
Nose Pump

OVERVIEW

- **Maximum lift 20-26 feet** or upper limits of horizontal distance 125 - 300, depending on manufacturer. One claims that for every ‘unused’ vertical foot, the pump can operate ten feet (10') of horizontal distance.
- **The greater** the combined vertical and horizontal distances involved, the more force required at the pump to actuate.
Nose Pump

OVERVIEW

• Limited number of livestock supported per unit; only one animal can use unit at a time. May present problems for timid/subordinate animals in a group. Manufacturers claim 20 - 30 head/unit, however farmer experience indicates this figure may be too high, especially for large high water demanding livestock (i.e. lactating dairy cattle) and periods of heat stress.
Nose Pump

La Buvette®
Aquamat™ II

basic unit only
$343
Nose Pump
PRODUCTS

La Buvette®
Aquamat™ II NC

Basic unit only
$388
Nose Pump

PRODUCTS

Rife Hydraulic Engine Mfg Co
Pasture Pump

basic unit only
$399
Nose Pump

PRODUCTS

Farm ‘Trol

*Utina M*

no longer in business

basic unit only

$399 new in 1999

$200-269 used
Photovoltaic Powered Pump

Directly converting intercepted solar radiation into electricity to power water pump.
PV Array Siting Criteria

- Southerly aspect
- No visual obstructions
  - static or moving objects
- Low wind exposure
  - Keeps mechanical stress & fatigue to minimum
- Close to pump placement
- Least public view
  - Vandalism
  - Theft
  - Accidental damage
- Soil properties
  - Deep
  - Stable
Positioning Array

Guiding principle – position surface of array perpendicular to sun as much as possible and/or practical

- Elevation
  (tilt, altitude)
- Azimuth
  (compass heading)
Positioning Array

- **Fixed frame**
  - Change tilt seasonally
    - Summer: latitude-15°
    - Winter: latitude+15°
  - Least expensive
  - Least impacted by winds
  - Low overall efficiency

- **Array trackers**
  - Passive
  - Active
    - Single axis
    - Double axis
  - Vulnerable to wind damage
  - High efficiency (boost 40-45%)
System Approaches

Storage bridges gap between demand and service

Battery option
- Possibly reduce size of PV array & pump capacity
- Higher maintenance
- Possible safety issues (hazardous fluids, explosive gases) depending on battery type selected
- Charge controller/regulator required
- Low voltage disconnect required
- Expensive over time
- Energy loss
System Approaches

Gravity feed storage tank option

- Requires tank positioned at higher elevation relative to watering locations
- Likely need more pipe to supply storage & distribute to animals
- Possible algae growth if storage tank is not shaded, buried, or opaque
- Generally lower cost if terrain permits; sometimes mount constructed for elevated placement
Pump Control

Methods to turn pump on & off as draw dictates

• Pressure switch & pressure tank

• Float switch (water storage tank only)
Industry Terms

• Pump Controller (a.k.a., Linear Current Booster or LCB) – interface between PV array and pump. Matches pump demand with appropriate voltage & current to maximize efficient operation.
Pump Environment

Surface
- Easy access for installation, maintenance, & repair
- Vulnerable to freeze damage unless protected
- Requires shelter from livestock, wildlife, weather.
- Suction limited to about 22 feet maximum

Submersible
- More involved access for installation, maintenance, & repair
- Generally protected from freezing
- Due to construction & placement isolated from livestock, wildlife, weather.
- Suction not an issue; immersed in water column
Pump Classification & Types

- Positive Displacement
  - Diaphragm
  - Piston
  - Vane
  - Helical rotor
  - Jack

- Centrifugal
  - Single stage
  - Multiple stage
Designing Steps

1. Determine minimum water requirements (normal daily, high stress situations, service period).
2. Evaluate water supply attributes (issues, limitations).
3. Establish needed pump rate to fill storage & minimum reservoir capacity.
4. Calculate TDH (targeted min. flow, pipe reach & size, additional constrictions, baseline pressure requirements, etc.).
5. Determine appropriate pump & matching PV array. Increase calculated wattage needs by at least 25% (heat, dust, aging).
Hydraulic Ram Pump

Devices which use the kinetic energy of falling water to raise a small portion of that water to an elevation higher than the source.
Hydraulic Ram Pump

OVERVIEW

• Cost range $210 - $2300+ for basic unit. Necessary piping, fittings, site prep, and other essential hardware can add significantly to overall project cost.

• Does not need traditional inputs of power (e.g. petroleum fuel, electricity, wind, solar, etc.) to operate.

• Continuous attendance-free operation and relatively low maintenance once properly setup and water source consistent.
Hydraulic Ram Pump

OVERVIEW

• **Low energy efficiency** (approximately 60%), and high wastage of source water unless provisions are made to capture and utilize it.

• **Minimum fall** between intake of drive pipe and pump typically 2.0 - 3.0 feet.

• **Minimum inflow** through drive pipe 2.0 - 3.0 gallons/minute.
Hydraulic Ram Pump

OVERVIEW

• Manufacturers claim of 10:1 rise to fall ratio (thus maximum lift of water theoretically is 150 - 500 feet, depending on model). However, under real world conditions, more like 5:1 ratio for practical yield at terminus of delivery pipe.
Hydraulic Ram Pump

OVERVIEW

Site for locating pump must allow for free and quick drainage of "waste" water.
Supply, stand, and drive pipes must be rigid (i.e. steel or PVC SCH 40 minimum).
Hydraulic Ram Pump

OVERVIEW

• All measures to conserve kinetic energy of water traveling through drive and supply pipe, and the pump itself, must be observed:

  • anchor securely for the entire length.
  • avoid any curves or turns, especially sudden/sharp ones (i.e. 90°); straight shot from intake to pump is ideal.
  • pump fastened solidly to ground or platform.
Hydraulic Ram Pump

OVERVIEW

• Essential to have sustained/uninterrupted flow at water source.
• Typical applications are perennial watercourses with sufficient gradient; although large ponds with strong seeps continually feeding into them, and high yielding artisan wells or springs may also be opportunities.
Sling Pump

Propeller tipped buoyant cone with helically-wound pipe on inner surface driven by either stream flow or wind.
Sling Pump
Sling Pump

OVERVIEW

• Does not need traditional inputs of power (e.g. petroleum fuel, electricity) to operate. **Flowing water in a channel supplies energy.**
• Moderate to high maintenance, depending on characteristics of watercourse & watershed.
Sling Pump

OVERVIEW

Should constantly check for loading of debris on propellers to avoid interference, reduced performance, or shut down.
Sling Pump

OVERVIEW

- Continuous operation once setup and maintained properly.
- **Maximum lift** of water 26.0 - 82.0 feet depending on model.
- Maximum horizontal pumping distance is 6600 feet.
- **Minimum stream velocity** is 1.5 feet/second.
Sling Pump

OVERVIEW

• Minimum total daily pumping volume at slowest operating speed is 554, 660, or 1056 gallons depending on model. At a flow of 2.0 feet/second, flows increase to 832, 1056, and 1585 gallons, respectively.

• Minimum stream depth at point of deployment 1.00 -1.5 feet; depending on model.
Sling Pump

OVERVIEW

• Yields a mixture of approximately 50% water and 50% air in oscillating pulsations, thus water delivered is highly oxygenated.
Sling Pump

OVERVIEW

• Currently only one manufacturer known to produce and market this device. Only three models available now.
• Price ranges from $410 to $629 in 2015.
• Wind driven models require minimum of 4.5 miles/hour sustained breeze. This option no longer available as new.
Pneumatic Pump

Utilizes compressed air to power specialized water pump.

- Positive displacement (?)
- Bubble aeration
Pneumatic Pump

$400 in 2006
Pneumatic Pump

$795 in 2015
Wind Mills

Convert energy from moving air mass to another form of energy to pump water.
Wind Mills

- Intermittent & variable energy source
- Generally lowest during summer
- Require sturdy platform at great height
- \[ P \approx D^2 V^3 \]
- Site must have good exposure but no obstructions
- May require additional local permitting & land use restrictions
- Significant maintenance, most in awkward locations
- Lifespan 10-20 years
Wind Mills

Mechanical

• Oscillating linkage to positive displacement pump
Wind Mills

Compressed Air

• For bubble aeration lift
Wind Mills

Electrical

• Generate voltage & current to power pump motor
Internal Combustion Pump
Water Wagon

1. Adequate capacity nurse tank
2. Rugged running gear
3. Tractor for hauling rig to sites
Cold Weather Service
Frost-Free Hydrants
Propane Heater

$427

$716
Air Bubbler De-Icer

~$350
Continuous Flow
Temperature Determined Flow

Ice-Preventer

$95
“Energy-Free” Waterers

- Super insulation (plastic & foam)
- Geothermal heat
- Constant fresh warmer incoming water
“Energy-Free” Waterers
“Energy-Free” Waterers

Heat Tubes
“Energy-Free” Waterers

Bar-Bar-A

$484
“Energy-Free” Waterers
“Energy-Free” Waterers
“Energy-Free” Waterers

$850 for model LB at 5-6’ deep waterline

Cobett

TWO TO THREE HEAD AT A TIME.
“Energy-Free” Waterers
“Energy-Free” Waterers
“Energy-Free” Waterers

Jug
“Energy-Free” Waterers
Re-circulating Waterers

Johnson Artificial Spring

$435

24” diameter bowl +

fittings, hat, hose clamps, water caster
Re-circulating Waterers
Frost-Free Nose Pump

$1399 for pump head unit
Earth Covered Concrete Waterers
Earth Covered Concrete Waterers

Commercially pre-cast concrete units

$568 + freight

No known local retailer
Earth Covered Concrete Waterers

Farmer fabricated concrete & wood units
Earth Covered Concrete Waterers

- **4" x 6" Treated posts** - Set 48 inches in ground and imbedded in concrete. Set 54 inches apart.
- **2" x 8" Treated planking**
- **Minimum Earth fill**
- Drill 5/16" holes
- **Float Valve**
- **Overflow 1-1/4" pipe**
- **Shut-off Water supply 1" pipe**
- **Gravel fill**
- **Hand-shaped depression for tank drainage and cleaning**
- **Concrete paving**
- **Step**

Diagram details:
- **4"**
- **12"**
- **1"**
- **1-1/4"**