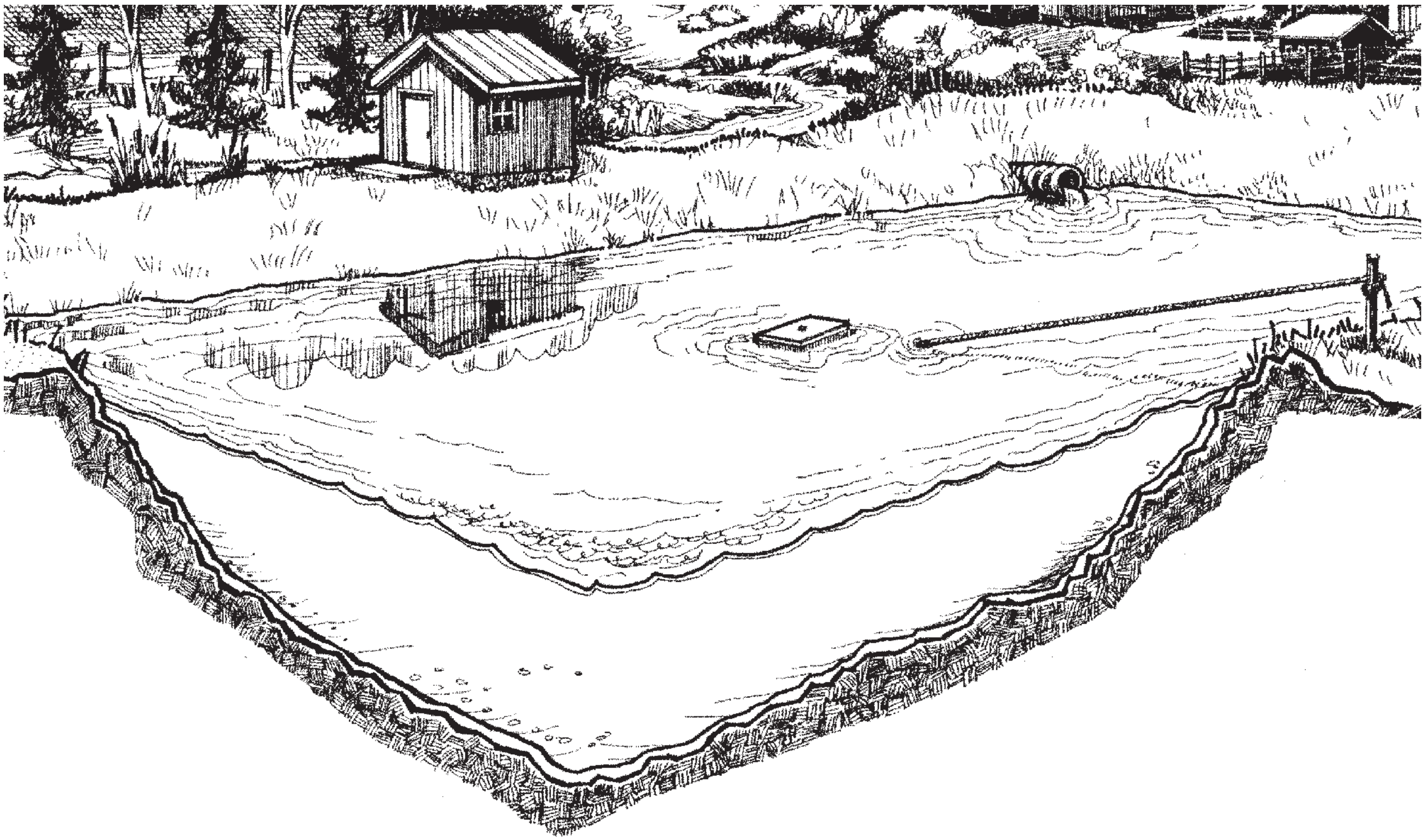
Operating Systems



Equipment Systems

A well-designed and efficient water system is a very important part of a farming operation. Dugouts are large reservoirs of water that can be pumped at a much faster rate than most wells on the Prairies. This is only an advantage if the water intake, pump, and water distribution lines are sized to meet the peak demands of the farm. Dugout aeration systems can make a dynamic improvement in dugout water quality. Remote watering systems that pump out of pasture dugouts help protect livestock from illness and injury as well as improve water quality and livestock production.

Intake Systems

Research has shown that water in the top 4 to 5 feet (1.2 - 1.5 m) of a dugout is of higher quality than water at the bottom and edges of the dugout. It has also shown that many farm dugouts become depleted of dissolved oxygen resulting in black smelly water. For these reasons, floating, water intake systems are recommended for all farm dugouts.

Floating Intake Systems

Use floating intake systems in order to make use of the higher quality water in the top area of the dugout.

For the past 20 years, floating, water intake systems have been used in dugouts. The floating intake draws the better quality water from near the dugout water surface. These systems are usually installed with a wet well beside the dugout which contains a submersible pump. However, with jet pumps, the intake assembly hooks directly to the suction line, and a check-valve is installed next to the pump. This eliminates the need for a wet well. Whatever the chosen system, it is recommended that intakes be planned and installed at the time of dugout construction. Floating intake systems include the components shown in Figure 5-1 Floating Intake.

Figure 5-2 Submersible Pump and Intake System shows a submersible pump and intake system. Install the intake pipe inside another larger pipe where it enters the dugout. This will protect the intake line from possible damage or collapse during back filling of the intake pipe trench. The perforated intake pipe supplies water to a wet well located beside the dugout. The water flows by gravity as water is pumped from the well. Since plastic pipe is lighter than water, small concrete weights must be secured along the intake pipe. Generally, medium density 75 psi CSA rated pipe is recommended for the intake line. Install the dugout air line in the same trench as the intake line. This installation will protect the air line from freezing.

Figure 5-1 Floating Intake

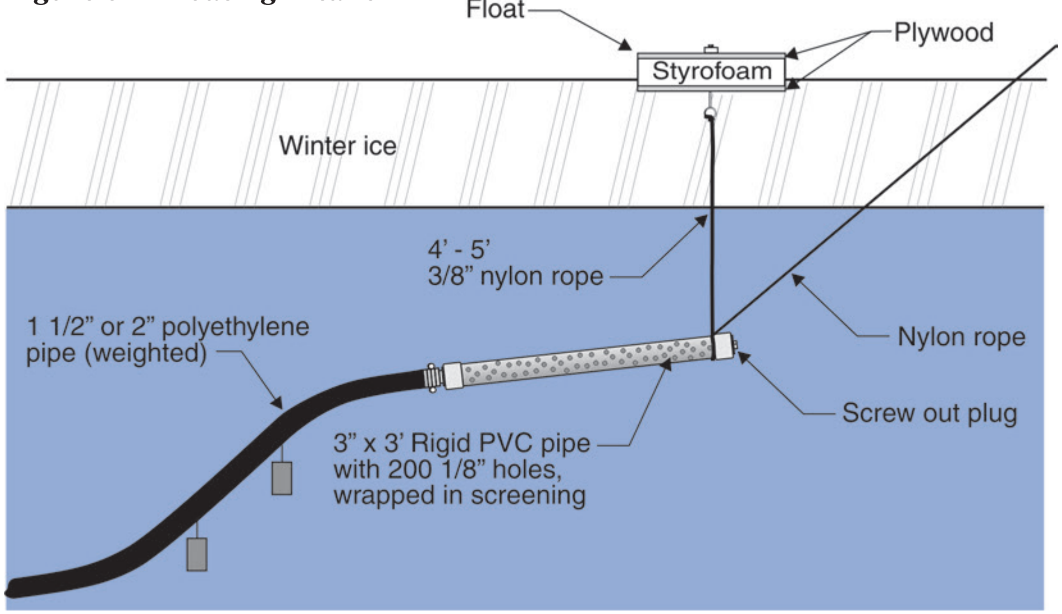


Figure 5-2 Submersible Pump and Intake System

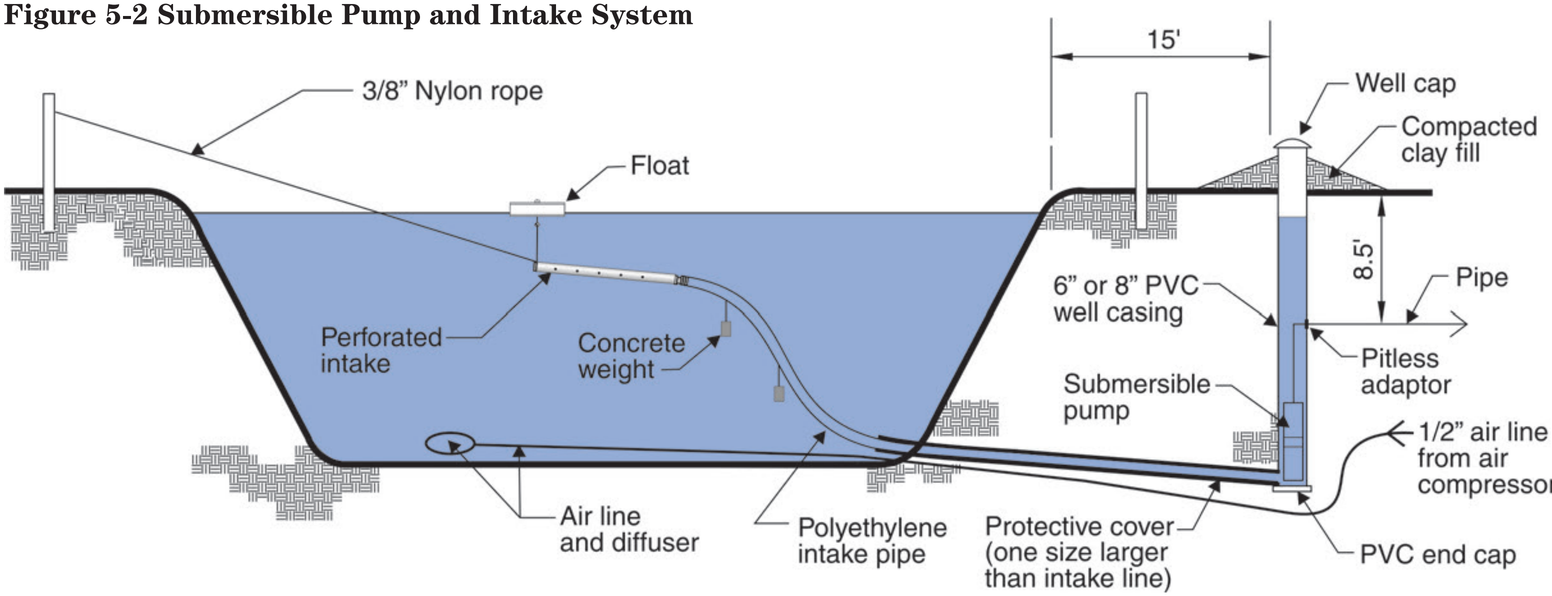
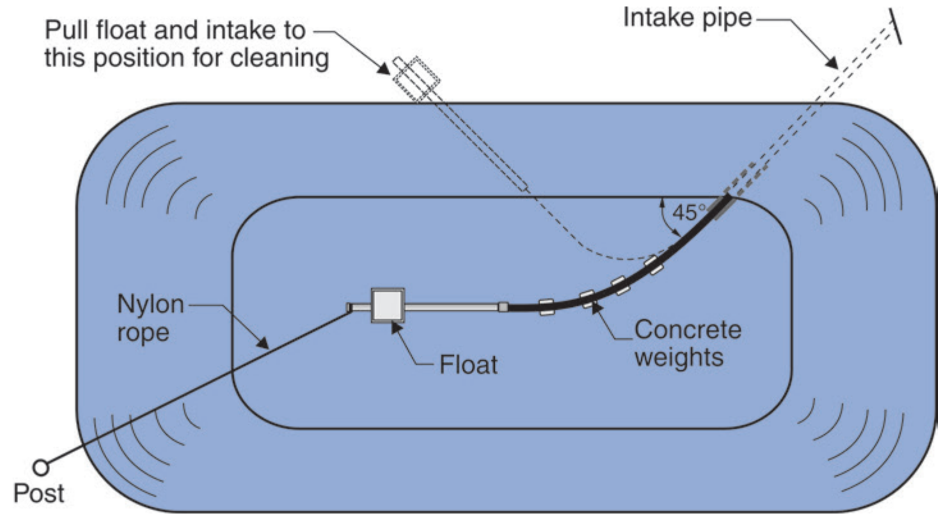


Figure 5-3 Plan View of Intake System

Figure 5-3 Plan View of Intake System shows a plan view of a dugout and the intake installation. The intake pipe should enter the dugout on a 45 degree angle to reduce the chances of kinking when the intake is pulled to shore for maintenance.



Other Intake Systems

Over the years, other types of water intake systems have been tried for dugouts. They are not recommended. Two common but unsatisfactory systems are:

1) Gravel infiltration trenches

Gravel-filled trenches between the dugout and a wet well beside the dugout have been unsuccessfully tried in the past. **They are not recommended.** The trenches can be effective filters for several years but will eventually fail due to plugging of the spaces in the gravel with soil, plant material, microorganisms, and biofilms. Flows to the wet well are inevitably reduced. Due to high levels of biological activity in the trench, oxygen levels fall which leads to the release of hydrogen sulphide gas. These conditions produce black smelly water in the wet well. It is also common to see a ten-fold increase in total dissolved solids, and greatly increased problems with iron, manganese, and hardness due to leaching of dissolved minerals from the gravel material. The only solutions are re-excavation and replacement of the gravel every few years, or replacement with an intake pipe.

2) Dugout bottom intakes

Large 4 to 12 inch (10 - 30 cm) horizontal piping has been used to convey water from the bottom of the dugout to a wet well. Although these systems do not plug, poor water quality is a problem. Unless the dugout is continuously aerated, the poorest water quality is always near the dugout bottom. Large open-ended pipes often result in water bugs entering the wet well, pumps, and distribution system. In some cases, bugs can plug impellers on pumps and screens. Avoiding this problem requires installation of screens around the dugout intake or the pump intake in the wet well.

Avoid using gravel infiltration trenches and dugout bottom intakes.

Wet Wells

A wet well is usually required beside the dugout to permit easy access to the pump. The water flows by gravity into the wet well as water is pumped from the well. For many years, two to three foot diameter, steel culverts were used for wet wells. Large diameter wells allow for some settling of solids to take place. However, recent monitoring of these installations has shown that dissolved oxygen levels are much lower in the wet wells than in the dugout water. The reasons for this include the large water storage capacity of wet wells and slow replenishment with fresh dugout water. Conditions in these wells can be similar to those that develop in gravel trenches: hydrogen sulfide gas formation, lower pH, and a high concentration of nutrients at the bottom of the wet well.

To avoid the problems associated with a large diameter wet well there are several options:

- Hire a vacuum-truck to come in every few years and suck out the black decayed plant material and sediment at the bottom of the wet well. It is very important that vacuum equipment be clean. A dirty hose can contaminate the wet well.
- For jet pump installations, elimination of the wet well is desirable with the intake assembly installed directly below the float in the dugout.
- For new submersible pump installations, a smaller diameter, 6 to 8 inch (15 – 20 cm) PVC well casing and pitless adapter are the best option. The smaller diameter PVC casing can also be installed inside an existing larger wet well. A smaller well has a steady supply of fresh dugout water and thus eliminates the poor water quality associated with larger wet wells. The PVC casing will last much longer than steel culverts which eventually corrode.

Pumps

There are many types and sizes of pumps for dugout water systems. Some are designed for drawing from the water source only. Others draw the water and force it through the rest of the distribution system. Some pumps are used for special purposes such as boosting pressure or supplying a special outlet. Therefore, it is important to select the proper type and size of pump for the application.

Select the proper type and size of pump for your application.

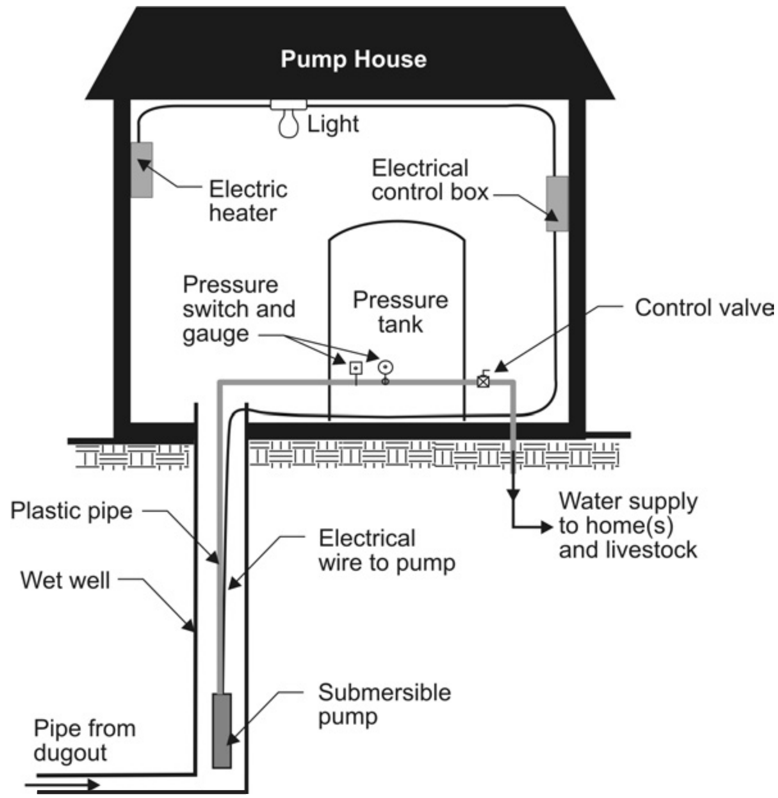
The most common pumps used for dugout supply systems are shallow well jet and submersible pumps. Shallow well jet pumps have a suction lift of approximately 20 vertical feet (7 m), including friction losses. Once water has been lifted to the pump, it can be pushed to higher elevations. Jet pumps can be installed away from the dugout in the basement of a house, heated shop, or pump house. Ensure that the suction line is adequately sized. Jet pumps require a larger intake pipe than submersible pumps but save the cost of running electrical power to the dugout. Jet pumps are not as efficient as submersible pumps and are more suited for supplying smaller volumes of water for rural residences.

A submersible pump can lift water hundreds of vertical feet. It operates like a shallow well pump but has a number of impellers or stages mounted close together on a shaft. Generally, because of the low lift required for dugout applications, a pump with six to ten stages or impellers will supply all the pressure required. The most common size of submersible pump is 4 inches (10 cm) in diameter. These pumps are available in 1/2, 3/4, and 1 horsepower motors and larger.

The pumps are placed in a wet well beside the dugout. Generally a small heated pump house is set over or beside the wet well to house the pressure tank, pressure switch, electrical controls, and any other dugout pumping or aeration equipment (Figure 5-4 Submersible Pump, Wet Well, and Pressure Tank).

A rural water system requires a pressure tank. Pressure tanks store water and maintain water pressure between specified limits. As the water in the tank rises, air is compressed until the upper limit or cut out point is reached and pumping stops. The compressed air in the tank acts like a spring. When the valve is opened, the compressed air in the tank forces water to flow into the system. Demands on the water supply cause the tank pressure to fall until the lower limit or cut in point is reached and the pump restarts. Without this buffer, the pump will start each time a small amount of water is drawn. Constant starting and stopping causes unnecessary wear on a pump. A larger pressure tank will save some wear on the pump from cycling. A 30 to 50 psi pressure switch is most common for farming operations. Variable rate pumps are also now commonly used to eliminate this concern.

Figure 5-4 Submersible Pump, Wet Well, and Pressure Tank



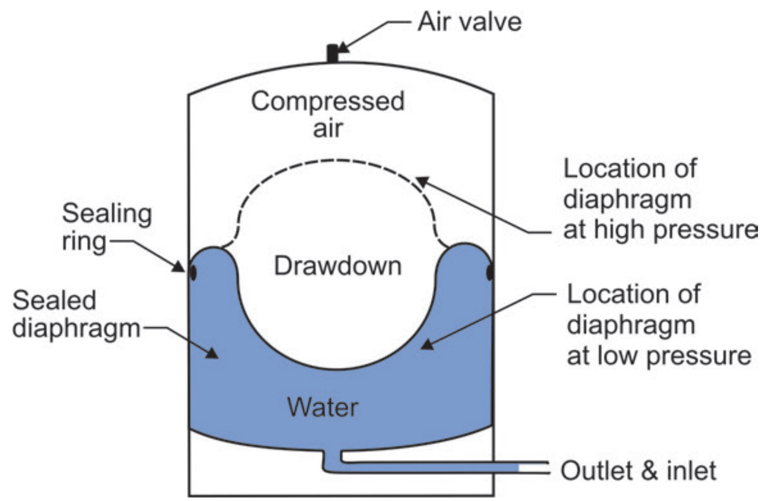
A small heated pump house can house dugout pumping and aeration equipment.

There are four types of pressure tanks:

- a plain galvanized steel tank
- a plain galvanized steel tank with floating wafer or disk
- a diaphragm tank, pre-charged with air
- a bladder tank, pre-charged with air.

For dugout applications, it is best to have a sealed air diaphragm or bladder tank for submersible pumps as shown in Figure 5-5 Sealed Air Diaphragm Pressure Tank.

Figure 5-5 Sealed Air Diaphragm Pressure Tank



Dugout water has little dissolved gas and can absorb the air in a plain galvanized steel tank. When most of the air is gone from the tank, the tank is said to be waterlogged. This is like not having a pressure tank and causes premature wear of the pump motor. If a tank has no bladder or diaphragm, waterlogging can be avoided with regular addition of air to the tank. An air volume control can be added to jet pumps to add air to less expensive steel or floating wafer tanks.

The size of the pressure tank is also important. Select a pressure tank that has at least one gallon of drawdown between low and high pressure, for each gallon per minute (**gpm**) of pump capacity. For example, a 10 gpm pump requires a pressure tank with ten gallons of drawdown.

Water Distribution System

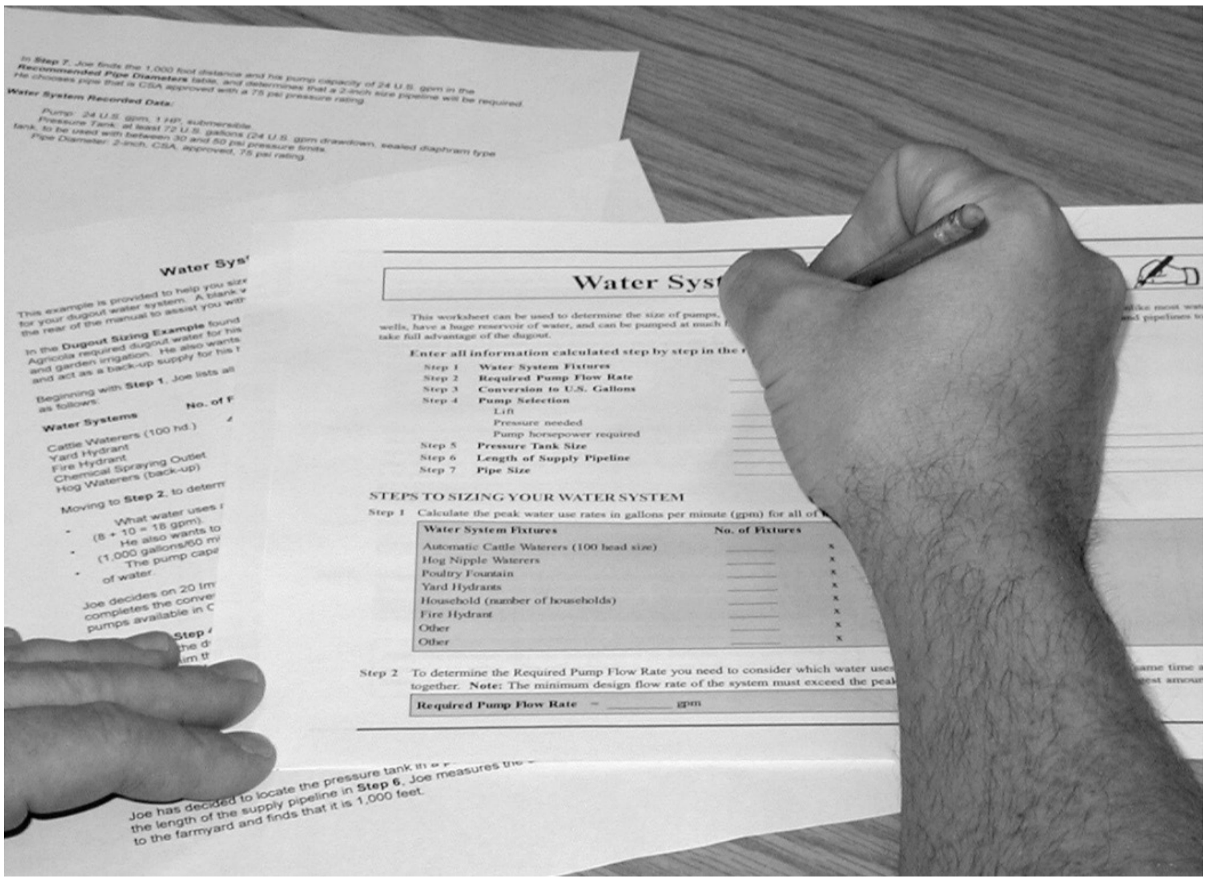
The water distribution line should be sized to effectively supply the required amounts of water and pressure throughout the system. As a rule of thumb, try to maintain no more than a five pound per square inch (**psi**) pressure loss due to friction, throughout the system.

For dugout applications, generally 75 – 100 psi, CSA approved, polyethylene pipe is suitable for underground burial and general use in the water distribution system. Polyethylene pipe comes in low, medium, and high density. Low-density pipe is recommended because it is more resistant to damage, more flexible, and easier to join.

For pipe connections, it is best to use fittings that will not corrode from the water or contact with corrosive soil in an underground trench. Nylon, plastic, or brass fittings are recommended. Use 100 per cent stainless steel clamps for all connections and double clamp underground connections.

Figure 5-6 Water System Sizing Example continues the example of the Joe Agricola farm to illustrate pump, pressure tank, and water pipe sizing for farm dugout, water distribution systems. Carefully work through the complete example contained in the pocket at the front of the manual. Blank worksheets for sizing the components of your water distribution system are contained in the pocket at the rear of the manual.

Figure 5-6 Water System Sizing Example



Work through the water system sizing example found in the front pocket.

Dugout Aeration Systems

As previously outlined in the Understanding Prairie Dugouts Module, Biology of a Dugout section, an important part of maintaining water quality is ensuring that the level of dissolved oxygen in the water stays high all year round.

Under natural conditions in a dugout, oxygen exchange with the environment is not sufficient. In summer, a layer of warm water forms on the surface. The layer of warm water floats above a layer of deeper, cooler water. The layer of cold water, having no contact with the atmosphere, becomes depleted of oxygen. Under low-oxygen conditions, plant nutrients, metals, and swamp gases are released from the dugout sediments and held by the cold water layer.

To prevent low-oxygen conditions, aerate your dugout continuously.

In fall, air temperature and the surface waters of the dugout cool rapidly. When the surface of the dugout reaches the same temperature as the cooler, bottom layer, the dugout ‘turns over’. This means that the water in the dugout is no longer stratified and wind mixing of all the dugout water occurs. Nutrients and unwanted compounds become evenly distributed throughout the water.

During winter, ice cover prevents the transfer of oxygen from the atmosphere to the water. When oxygen is depleted, microbial activity in the sediments again begins to release unwanted compounds. One of these compounds, hydrogen sulphide, produces the rotten-egg smell that often develops in small water bodies in late winter.

The ice melts in spring, the surface warms, and the water mixes completely, distributing the unwanted compounds throughout the water. Dissolved nutrients become readily available to plants and algae near the surface. As the air temperature increases, the cycle begins again.

In order to prevent this cycle of low-oxygen conditions from developing, supplementary aeration is required. This adds oxygen to the water and ensures complete mixing of the water so that contact with the atmosphere is maximized. Research has shown that dugouts should be aerated 24 hours per day, year round.

Types of Aeration Systems

Many types of aeration systems have been tried over the years including electrical, wind-powered, and solar-powered systems. Where possible, electrical systems are always preferred, but for remote locations, other power sources are required. All systems have advantages and disadvantages.

Wind-powered systems can be effective in low-sunlight winter conditions but only in areas where winds are relatively constant. Solar systems are very portable and work best in hot sunny conditions coinciding well with peak demand for water. Producers should try to find options that suit their operations and their geographic area.

Some floating systems that churn up the water on the surface and introduce air into the water are available, but research indicates that these systems are not very practical or effective for prairie dugouts.

Select an aeration system that suits your operation and geographic area.

Components of an Aeration System

There are four components to an aeration system:

- power supply
- air compressor
- aeration line
- diffuser.

Power Supply

As with pumping systems, aeration can be powered by electricity, solar power, or wind. For dugouts stocked with fish, use an electrical type compressor, as it will provide a continuous supply of dissolved oxygen. This is crucial for fish survival in a dugout. Windmill type systems may not pump sufficient dissolved oxygen for fish survival during low wind conditions at night or during hot calm periods in summer.

Air Compressors

Bank-mounted windmills use a diaphragm-type pump that pushes air into an aeration hose that extends to the bottom of the dugout. Windmills are suitable for areas with good wind conditions and for remote sites where electrical power is too costly to install. However, they perform poorly on sites where winds are obstructed by hills or trees, water is deep (over 20 feet or 6m), or there are high concentrations of organic matter in the water.

The most common types of electrical compressors are the oil-less diaphragms or piston pumps. These compressors are quiet, relatively inexpensive to purchase and operate, and require little maintenance. When choosing a pump, make sure it is rated for continuous use. As a rule, a diaphragm-type compressor that pumps approximately one cubic foot per minute (**cfm**), for every million gallons of dugout water, is adequate. For best results, locate the compressor in a heated building or enclosed box to protect the motor, diaphragm, and electrical supply.

Aeration Lines

Aeration lines convey air from the pump to the dugout. For new dugouts, the aeration line should be buried with the water intake line. This will prevent damage from frost, ultraviolet light, ice, and animals.

Diffusers

Choose a diffuser that creates fine to medium-sized bubbles.

A diffuser is a device to release air into the water. Research has shown that the type of diffuser is very important. Diffusers that create fine to medium-sized bubbles are more efficient at circulating and aerating water than open-ended hoses that produce large bubbles. An open-ended hose requires three times the volume of air to saturate water with dissolved oxygen compared to an air stone or perforated hose. Proper location of the diffuser maintains oxygen levels from top to bottom, as shown in Figure 5-7 Aeration System. It is important to place the diffuser at the bottom of the deepest spot of the dugout. Recommended types of diffusers are:

- Figure 5-8 Airstone Diffuser
- Figure 5-9 Linear Diffuser
- Figure 5-10 Membrane Diffuser.

It is a good practice to attach a rope to the diffuser in order to be able to retrieve the diffuser for periodic inspection and maintenance.

Figure 5-7 Aeration System

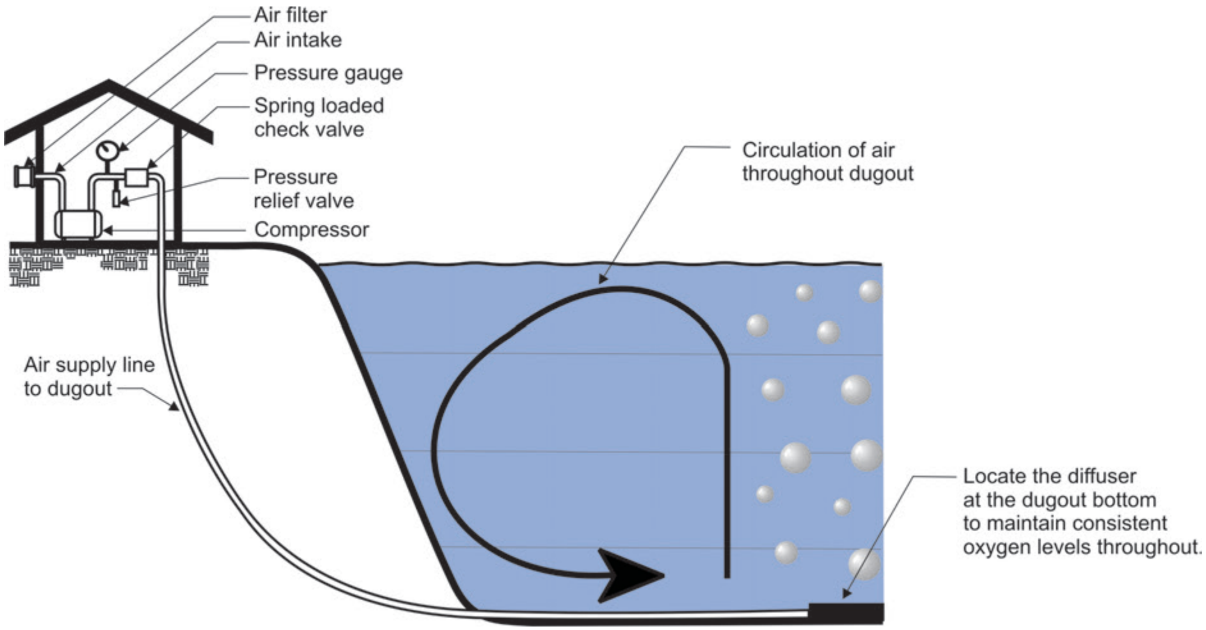
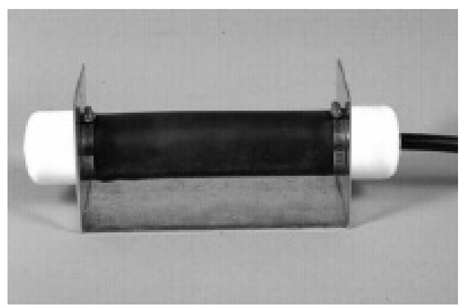


Figure 5-8
Airstone Diffuser

Figure 5-9
Linear Diffuser

Figure 5-10
Membrane Diffuser



Safety

During winter, dugout aeration systems can result in open or weak areas in the dugout ice. These conditions can be very dangerous for young children, pets, and people snowmobiling at night. It is essential to educate your children about these hazards and post the area with highly visible warning signs and fluorescent snow fence around open water areas.

Remote Pasture Water Systems for Livestock

In the past, livestock were turned out to summer pasture and allowed to walk through and drink from any slough, creek, river, or lake available to them. In the winter, livestock either ate snow or holes were cut in the ice of these natural sources for them to drink. When these natural water sources were not available, dugouts were constructed.

Today, allowing livestock direct access to surface water sources is a concern to livestock producers and to other water users. The practice is also a concern for livestock safety and may lead to animal health concerns from poor water quality.

Livestock producers want to provide a safe, reliable supply of good quality water for their livestock and increase their management to better utilize their pastures for livestock production. Many producers are using remote water systems and applying the latest technology available for extended livestock grazing and winter feeding of livestock away from the farmyard. Livestock producers, like other water users, want to do their part to protect both natural and constructed water sources from environmental damage and address herd health problems.

Problems with Direct Watering

Allowing livestock direct access to surface water sources has led to a number of environmental, herd health, and pasture utilization problems.

Environmental Problems

Environmental problems with direct watering include the following:

- damage to banks of streams and dugouts
- siltation problems in spawning areas for fish
- loss of riparian habitat and vegetation
- loss of water storage in dugouts and streams
- nutrient buildup in both the source and downstream water bodies
- rapid growth of weeds and algae
- deterioration in water quality.

There is enough dissolved phosphorus in the manure from one cow in one day to cause an algae bloom in 250,000 gallons (over 1 million L) of water.

The amount of oxygen needed to decompose the manure from one cow for one day will deplete all dissolved oxygen in 8,000 gallons (over 30,000 L) of water.

Herd Health Problems

There are a number of herd health problems related to direct watering:

- increased exposure to water-transmitted diseases, bacteria, virus, and cyst infections
- increased exposure to blue-green algae (cyanobacteria) toxins
- foot rot
- leg injuries
- stress
- death by drowning from falling through the ice or being stuck in mud
- reduced rates of gain.

Poor Pasture Utilization and Nutrient Transfer Problems

Other problems with direct watering include:

- overgrazing near the water source
- poor nutrient transfer caused by an accumulation of manure in the area near the water source.

Pasture Water System Trials

Poor access to water and poor water quality can affect livestock behaviour and production on pasture. In a pasture trial, however, it is extremely difficult to isolate what, how, and when these factors become significant. There are so many variables in the cattle, the pasture grass, the water source, and the water quality.

There are many benefits to pumping water to cattle and keeping them out of water sources.

Some pasture studies have shown a significant increase in cattle production where water was pumped to them versus direct watering from dugouts. Other studies have shown little or no improvement in cattle production. The studies have all shown cattle prefer that good quality water be pumped to them, versus direct watering from a dugout.

Remote Pasture Water Systems Benefits

The benefits of a well planned and constructed pasture water system include:

- water source protection and thus longer water source life
- improved herd health
- increased livestock production, in some situations
- better pasture utilization
- riparian protection and thus a more environmentally friendly livestock industry
- an alternative winter water supply and system for livestock away from the farmyard which reduces manure hauling costs, manure buildup in the calving area, and associated animal health problems.

For an average pasture dugout where livestock are allowed direct access for watering, the loss in dugout water storage and additional maintenance costs range from $300 to $600 per year.

Pasture Water Systems

A variety of livestock watering methods are available to suit any type of pasture and location. The power options to move water to livestock include solar, wind, fuel, stream flow, mainline electricity, and gravity flow. Selecting the most appropriate one can be a challenge.

Establish a list of priorities for a pasture water system and use some of the natural advantages of the site and equipment.

Consider the following factors when you select a pasture water system:

- type and location of available water sources
- site locations and conditions (remote location, topography, riparian features)
- type of grazing system (intensive or extensive)
- number of livestock
- access to power source (mainline power, solar, wind, animals, etc.)
- pumping system (amount of lift, automated versus manual)
- flexibility and portability
- reliability and maintenance
- temporary or seasonal water storage
- need for frost protection (swath grazing or winter watering)
- cost/benefit and cost/animal
- personal preference.

Livestock Watering Alternatives

There are many viable alternatives to direct watering. These alternatives are described in some detail below.

Access Ramps

An access ramp is the minimum improvement that can be made to a water source (Figures 5-11a Cross-section View of Access Ramp and 5-11b Plan View of Access Ramp). Ramps are most appropriate for large herds of livestock in remote locations (i.e., rangeland pastures) where animals are seldom checked or moved. The reinforced ramps provide better footing for livestock drinking from dugouts, sloughs, and streams where soft soils (e.g., peat) exist.

These ramps require a relatively low slope of 5 to 6 feet (1.5 - 1.8 m) for every foot (.3 m) of drop. Lay down a strip of crushed road gravel preferably with sizes from 1-inch (2.5 cm) diameter down to 10 to 15 per cent fines. The gravel layer should be a minimum of 1 foot (.3 m) thick. Start the gravel layer 10 to 15 feet (3 - 4.5 m) back from the water's edge and continue down to below the lowest water level of the dugout. Use a small caterpillar or 4-wheel drive tractor to spread and compact the gravel.

In soft soil conditions, place a plastic polygrid or geogrid under the gravel to provide added support. The material comes in 3 or 4 metre wide rolls and can be overlapped for wider ramps.

The water source is usually fenced off, so livestock can only drink from the access ramp. Some producers have found that fencing is not necessary because once the cattle have convenient access to water, with good footing, they will water almost exclusively from the ramp.

Figure 5-11a. Cross-section View of Access Ramp

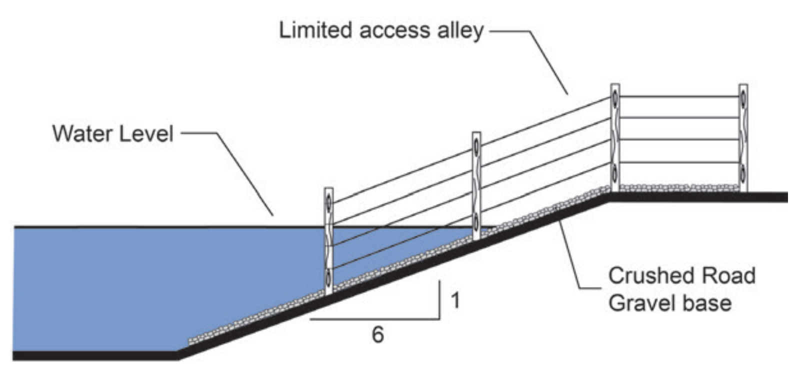
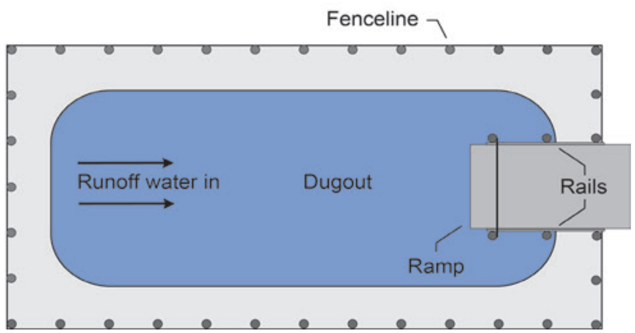


Figure 5-11b. Plan View of Access Ramp



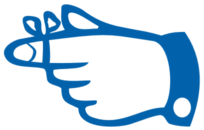
Water Hauling

Although it may seem like a step back in time, water hauling can be a viable alternative. In intensive livestock grazing management, cattle are sometimes moved daily from pasture to pasture. Access to water is often the limiting factor. By utilizing an old truck with a main storage tank and an easily moved stock tank, the watering source, along with the cattle, can be continuously relocated throughout the pasture. The nutrients from the manure are more evenly distributed and are kept on the same field.

Water Storage

Alternative energy powered water pumping systems (including fuel, solar, and wind powered) all require water storage. The water storage tanks or reservoirs provide the necessary livestock water between pumping cycles. Most are raised above the stock tank to allow for the gravity flow of water. They are generally sized to hold a three- to seven-day supply of water for cattle. For sizing the water storage, use the following cattle water consumption rates for cattle on pasture:

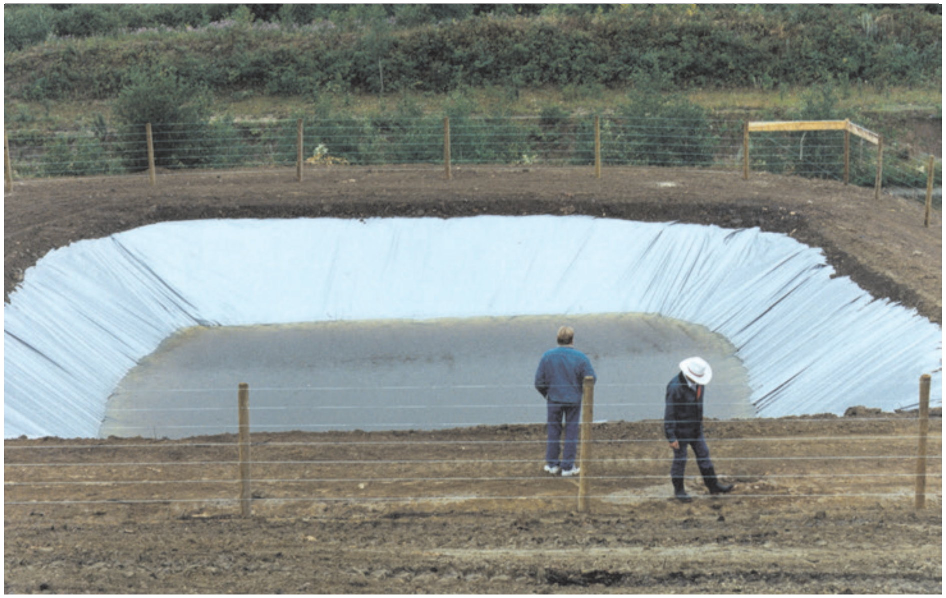
- yearling steers or heifers – 8 gallons per day (36 L)
- cow-calf pairs – 12 gallons (55 L) per day.



These are average water consumption rates for cattle on pasture. On hot summer days, peak water consumption can reach 1.5 times these numbers.

Water storages can be made from almost anything as long as they safely store water at a reasonable cost. The most common are plastic, fiberglass, concrete or metal tanks, elevated earthen reservoirs, grain bin rings, large rubber tires, or large stock watering tanks. The cost of water storages ranges from about 5 cents per gallon (1 cent per L) to well over $1.00 per gallon (23 cents per L). The lowest cost water storage (5 to 10 cents per gallon or 1 to 2 cents per L) is the elevated earthen reservoir (Figure 5-12 Elevated Earthen Reservoir with Woven Polyethylene Liner).

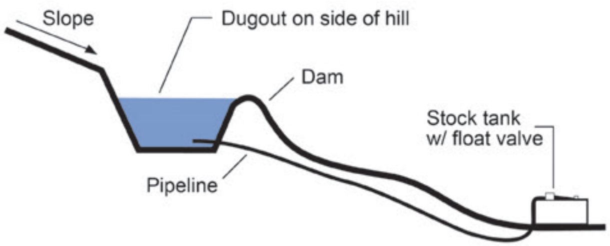
Figure 5-12 Elevated Earthen Reservoir with Woven Polyethylene Liner



Gravity-fed Systems

Gravity-fed systems are ideal systems on sloping pasture land where it is possible to locate a dugout or dam upslope from a watering site. A pipeline can then be run from the dugout downslope into a stock tank. As a rule, the water level in the dugout should be at least 5 feet (1.5 m) higher than the stock tank plus 1 foot (.3 m) additional height for every 100 feet (30 m) of pipeline to the stock tank as shown in Figure 5-13 Gravity-fed System.

Figure 5-13 Gravity-fed System



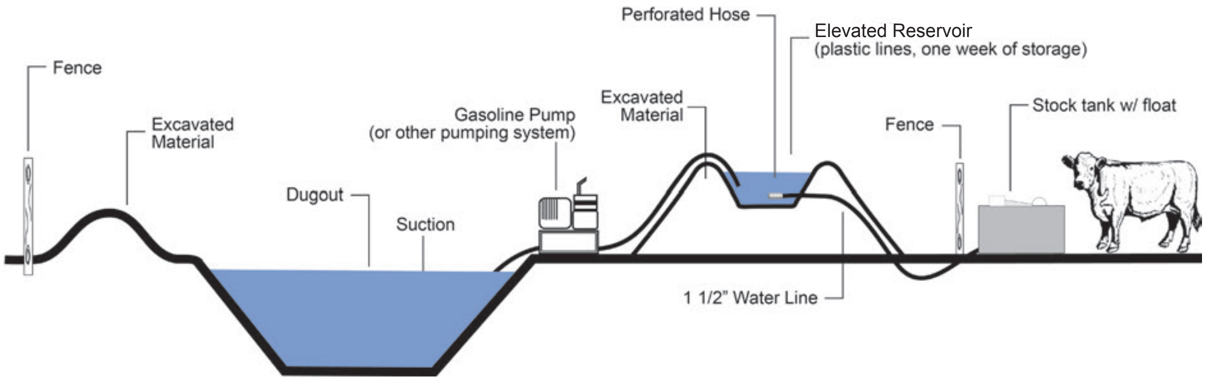
Gravity-fed systems can also be used for springs where there is sufficient elevation drop to the stock tank. On long, undulating and/or steep drops, take extra care to avoid leaks or air blockages.

Consult a knowledgeable contractor or consultant if you are constructing a gravity-fed system.

Pumped Gravity Flow Reservoirs

These reservoirs are generally constructed by digging a small reservoir on top of the excavated dirt piles from a dugout (similar to Figure 5-12). A standard backhoe can construct these in a few hours. The reservoir is then lined with a woven polyethylene liner to prevent seepage and to keep the water clear. The reservoir bottom must be higher than the top of the stock tank. This approach will provide adequate gravity flow from the reservoir through the water line and float valve assembly and into the stock tank as shown in Figure 5-14 Pumped Gravity Flow Reservoirs.

Figure 5-14 Pumped Gravity Flow Reservoirs



Selecting the proper size water line and a high capacity, low-pressure float valve are also important to ensure adequate flow rates. Table 5-1 shows the dimensions and water volumes for a typical elevated earthen reservoir.

Table 5-1 Elevated Earthen Reservoir Water Volume (5 ft. deep)

Reservoir Dimensions (ft.) Top	Length x Width x Depth Bottom	ApproximateWater Volume (Imperial Gallons)
25 x 15	15 x 5 x 5	6,500
35 x 15	25 x 5 x 5	9,600
40 x 20	30 x 10 x 5	16,600
45 x 20	35 x 10 x 5	19,000
45 x 25	35 x 15 x 5	25,000
45 x 45	35 x 35 x 5	50,000

A woven polyethylene liner is placed inside the elevated reservoir to prevent water seepage. Reservoir water volumes are calculated using 5 ft deep and 1:1 side and end-slopes.

Animal Operated Pasture Pumps

These pasture pumps are commonly called nose pumps because cattle operate them by pushing them with their noses as shown in Figure 5-15 Nose Pump. The pump provides a very low cost pumping system (approximately $20 per cow-calf pair) and is good for about 20 cow-calf pairs.

Nose pumps provide a very low cost pumping system; however, cattle must be given time to learn how to operate them.

There are three or four manufacturers of nose pumps currently being sold, including one frost-free pump that is suitable for winter use. Some of the pumps are slightly easier to push than others. They all supply approximately .2 gallons (1 L) of water for every stroke of the nose device. The conventional pumps can lift water a maximum of 20 vertical feet (6 m) and, with the use of a shallow buried pipeline, can also be offset a quarter of a mile or more from the water source. The frost-free nose pump uses a piston pump and has been used with over 40 feet (12 m) of lift, but must be located directly above the dugout wet well. Minimize the amount of elevation lift from the water to make it easier for cows and calves to operate the pump. Shallow burial of the pipeline from the dugout to the pump is recommended to protect the pipeline.

Figure 5-15 Nose Pump

Although pasture pumps are very reliable and easy to move from pasture to pasture, cattle will take a day or so to learn how to operate the pump. This training period is done best at the farmyard after calving and before the cows go out on pasture. Small calves will generally not learn to operate the pumps until they are about 300 pounds (136 kg). There are several options to overcome this problem. One is to fill a stock tank with water where only calves have access. Another option is to collect some of the water pumped by the cows into a small tub or stock tank for the calves to drink.

Do not try to train livestock to operate the pumps during extremely hot temperatures.

Pipelines

Shallow buried pipelines are ideal for farms with a very intensive rotational grazing system within one to two miles distance of existing water and mainline power. Pipelines allow livestock producers to better utilize their water source (i.e., usually a well or dugout) rather than constructing many small dugouts scattered around the pastures. They are very flexible systems, and watering sites can be located at the preferred location rather than where a dugout will fill from runoff.

Caution: Phone Alberta First Call to identify the location of shallow buried utility lines before you do any trenching.

For shallow pipeline burial (approximately one foot or 0.3 m deep), some producers use a ripper type plough mounted on either a three-point hitch of a tractor or a pull type unit. A 1-inch (2.5 cm) diameter plastic pipe can be installed for about 85 cents per foot ($2.80 per m). It is important to design the system properly to ensure the right combination of pipe size and stock tank.

Some producers are also using deeply buried pipelines in several of their pastures close to home. They can then use these pastures year round for pasture as well as for feeding, bedding, calving, and weaning. This approach helps to reduce animal disease problems as well as manure hauling and spreading costs.

In the future, shallow buried pipeline systems will likely become more popular because of their many advantages and due to the shift to more intensive grazing systems.

Further information on pipeline design can be found on the Alberta Agriculture and Forestry website located at: ***http://www.agric.gov.ab.ca***

Click on the search button and then in the search box type in ***"Pasture Pipeline Design".***

Gas-powered Pumping Systems

These systems are a low cost alternative for pumping water to larger herds of livestock. They work well in combination with an elevated reservoir system, containing about one week's water storage. The pumps are very portable and can be moved easily from one water source to the next.

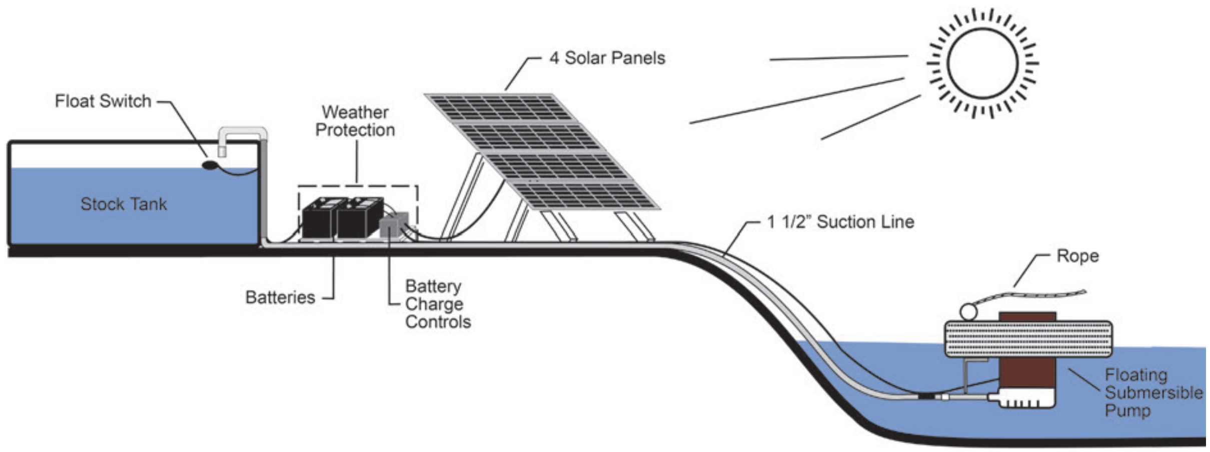
Some producers use a gas-powered generator to run a submersible dugout pump. These systems can be automated to start on a float switch device located in a stock tank or reservoir. Both pumps and generators can be used for other purposes on the farm. These systems can be sized to pump a large volume of water from dugouts.

Gas-powered pumping systems are a low cost alternative for pumping water to large herds.

Solar-powered Pumping Systems

Solar systems are becoming more popular because of their reliability and low maintenance. They can be used to pump water from dugouts. An array of solar panels collect and convert sunshine into electrical energy, which can be used to pump water or be stored by rechargeable batteries as illustrated in Figure 5-16 Solar-powered Pumping System. Due to the variation in sunshine intensity, a minimum of three days or greater of water or battery storage is desirable.

Figure 5-16 Solar-powered Pumping System



Solar-powered systems can be portable and are durable.

For the solar direct systems without batteries, it is important to match the solar panel's output (in watts) to the power requirements of the pump for maximum efficiency. For solar systems with batteries, it is important to select good quality deep cycle type batteries (e.g., recreation vehicle type). It is also important to install electrical controls that have both low and high voltage disconnects. These protect the battery from under or over charging conditions, which will drastically reduce battery life. Obviously, a sunny spot is desired for these systems, but also choose a location that is not in plain view and is sheltered from high winds.

Solar powered systems have the added advantage of pumping the most water on hot sunny days when cattle are drinking lots of water. Excess power can be used to energize an electric fence for the pasture. Although the initial costs of this system are somewhat higher than for others, they will last for many years. The portability of the solar pumping system is another advantage.

Wind-powered Pumping Systems

Windmills perform best in areas that have higher than average wind speeds, such as the southern parts of the Prairie Provinces. For central and northern areas of the prairies, where wind speeds are lower, consider adding additional water storage such as an elevated earthen reservoir.

Windmills can be used to pump from dugouts and wells. Place windmills on higher ground where they have good exposure to the wind, such as the excavated dirt pile from a dugout. Also, locate them away from trees as far as possible, at least 15 to 20 times the height of the trees as shown in Figure 5-17 Wind-powered Pumping System.

Windmills must be located on higher ground away from trees so they perform efficiently.

Figure 5-17 Wind-powered Pumping System

There are presently two windmills that can be used for both dugout water pumping and dugout aeration. The initial costs of the system are somewhat high, but most of the windmill systems are very reliable and will last for many years. A windmill system should have at least three days of water storage. Be prepared to use an alternate pumping method or haul water during prolonged calm periods.

Options for Winter Watering Livestock at Remote Locations

Although livestock prefer water, snow is an acceptable water source for mature cows and young cattle in good condition. For snow to be used as a water source, there must be an abundant supply, and it must be clean, unpacked, and with no crust so that it's easily accessible by livestock. Provide lactating cows with calves, as well as first and second calf heifers, with water to maintain body condition during the winter months.

In the last few years, more producers are installing winterized pasture water systems from dugouts and water wells to supply water to their livestock. The reasons for these systems include:

- extending the pasture grazing season and fall and winter swath grazing
- lack of water at the farmyard site
- winter feeding of cattle on pasture and cropland to reduce manure hauling costs
- providing increased flexibility for separating cattle at weaning and calving times
- preventing manure buildup in the calving areas
- reducing animal health problems associated with the above
- death losses due to drowning.

With the proper planning and design, almost all the traditional summer pasture water systems can be modified and used throughout the winter. To prevent freezing, you need to supply heat, reduce heat loss, or use a combination of the two. There are many options for winter watering including commercially available "earth-heated" waterers, super insulated "energy free" waterers and water troughs that rely on the heat stored in the water itself to keep it from freezing, and propane heated waterers. There are also continuous water flow-through systems to prevent freezing, frost-free animal operated nose pumps, and solar and wind powered pumping systems for winter use.

Each system has its place, and personal preference, reliability, livestock herd size, cost, remoteness, and the site location are all factors to consider when choosing an appropriate system. For remote dugout locations on the Prairies, watering systems must be durable and able to withstand temperatures that drop to - 40°C.

Most winter watering systems available on the market today have a common setup. The main components are an intake water line from the dugout, wet well, power source, and pump (see Figure 5-18 Watering Bowl with a Drain Back System).

The most common pumping systems currently being used during the winter are solar powered. The solar panels are used to charge batteries which supply electrical power for running a pump. Two basic design concepts prevent freezing – a drain back system or a well-insulated trough system. The basic components of a solar system itself are:

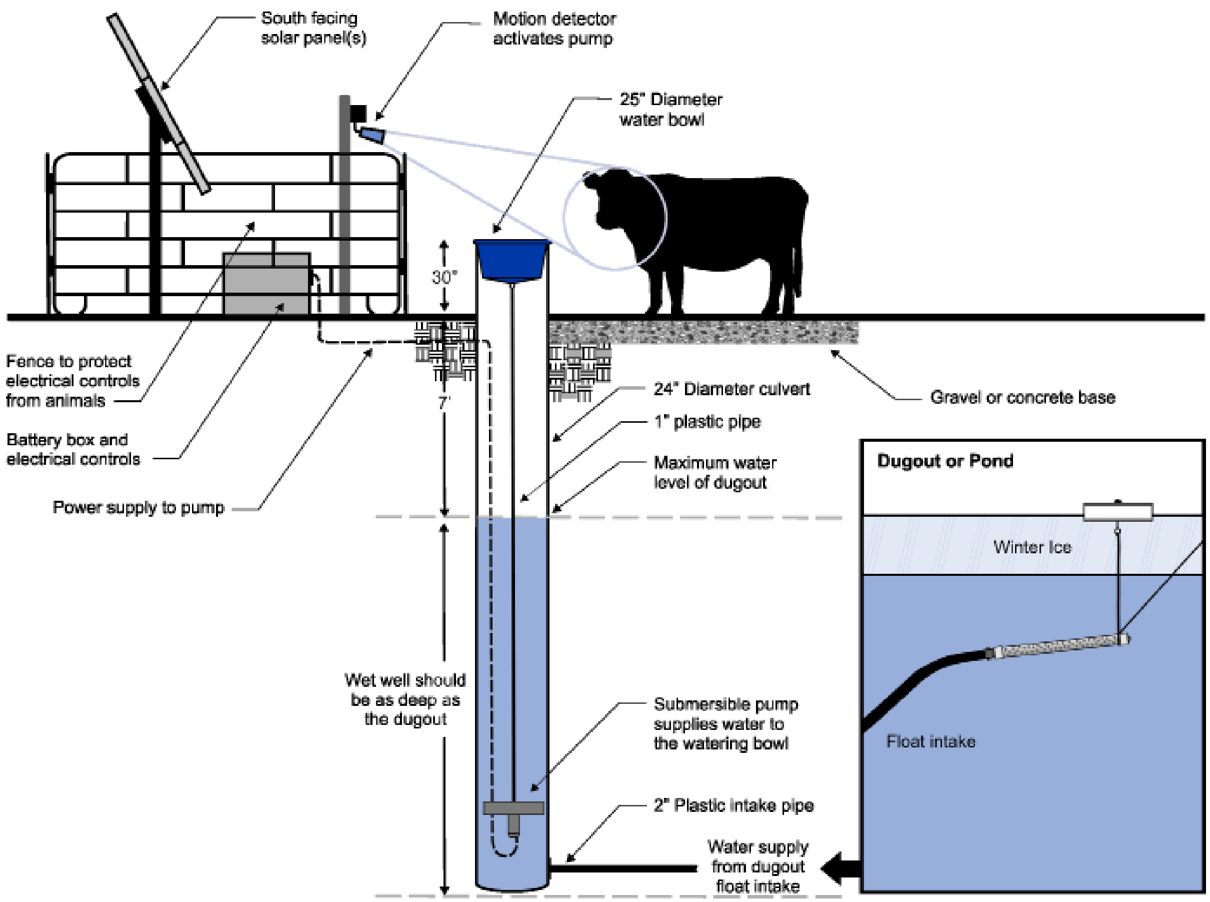
- solar panels
- deep cycle batteries
- battery charge controls
- pump
- a motion detector or float switch to start and stop the pump
- water lines
- a watering bowl or water trough
- other options including a wind turbine to supply additional power for the batteries during extended cloudy periods and an aerator to improve dugout water quality.

Watering Bowl with a Drain Back System to Prevent Freezing

This system is set up directly over the wet well beside the dugout and uses a motion sensor to activate the solar-powered pump. The motion sensor starts the pump when livestock approach the watering bowl to drink. Water is pumped into the bottom of a 25-inch (63.5 cm) diameter round watering bowl located on top of a 24-inch (60 cm) diameter culvert or wet well. The water level rises in the bowl to a set of overflow holes that return excess water back into the wet well. These holes are located near the top edge of the bowl to prevent overflow onto the ground. The pump will run as long as there is livestock motion within the range of the motion detector. To prevent the pump from starting and stopping, a delay is built in to allow the pump to continue running for a preset time. This delay allows the next animal to approach the watering bowl and get water before the pump shuts off. Water remaining in the bowl after the cattle have finished drinking drains back to the wet well through the bottom of the bowl so that no water remains in the bowl to freeze. Motion detection systems are adaptable to a variety of setup configurations as shown in Figure 5-18 Watering Bowl with a Drain Back System.

The ground level at the watering bowl site should be at least 7 feet (2.13 m) higher than the maximum water level of the dugout. This amount of soil cover will prevent frost penetration and freezing of the water in the wet well. Slope the site away to provide good drainage to ensure a dry, clean, safe watering site during mild thaw weather events.

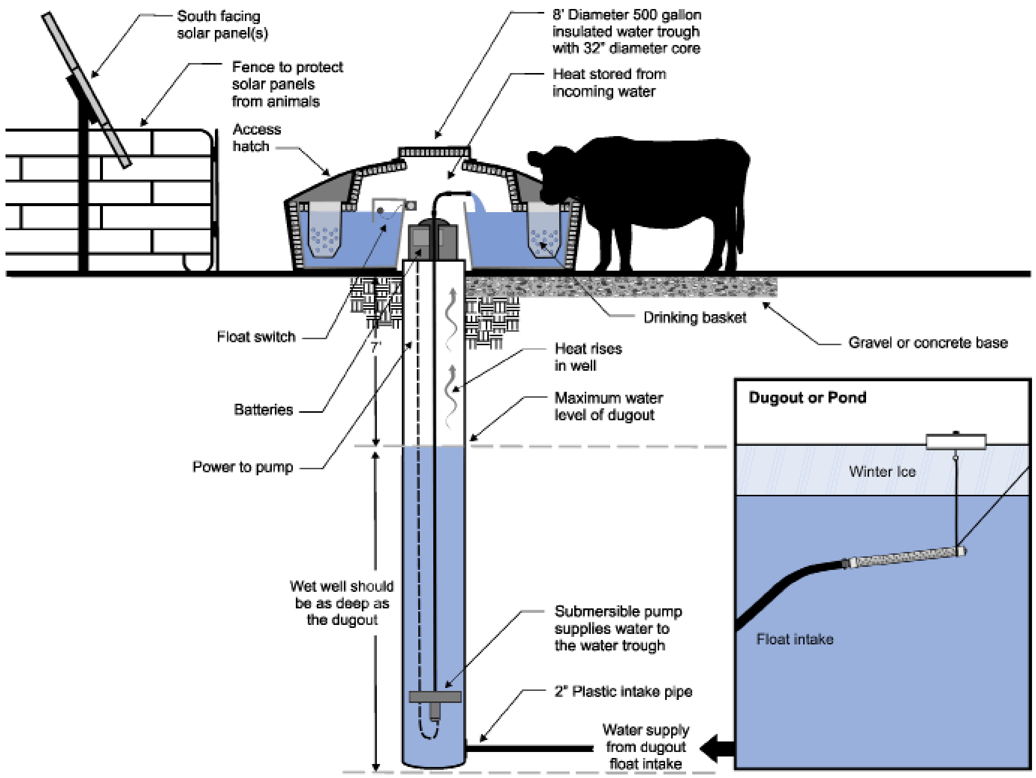
Figure 5-18 Watering Bowl with a Drain Back System



Well-Insulated Trough System to Prevent Freezing

Similar to the drain back system, this system is set up directly over the wet well beside the dugout. The solar-powered system pumps water from the wet well into an insulated, doughnut-shaped trough. The float switch signals the pump when the water level is low to keep the trough full. Livestock drink water through access hatches in a fitted, insulated lid that sits on top of the wet well. The trough has several access hatches that can be opened for larger herds. On extremely cold nights, all but one of the access hatches may have to be covered to prevent heat loss and freezing. This system relies on the heat stored in the incoming water to keep it from freezing and thus must have a minimum number of livestock drinking from it each day during freezing temperatures. This system is shown in Figure 5-19 Well-Insulated Trough System.

Figure 5-19 Well-Insulated Trough System



The Frost-free Nose Pump

The frost-free nose pump is also a drain back type of winter watering system as shown in Figure 5-20 Frost-free Nose Pump. The cows push a nose pad that operates a piston in the bottom of the wet well. The piston lifts the water up into a small drinking bowl. The cow drinks the water out of the bowl, then pumps more water. When the cow is finished drinking, the water in the drop pipe that brings the water up from the well drains below frost. The pump supplier recommends a maximum of 50 cow/calf pairs per pump. For larger herds, a second pump can be mounted on top of the wet well. Daily inspections of the functioning and icing of pump are recommended especially during extremely cold and windy conditions to ensure adequate water availability for livestock.

Figure 5-20 Frost-free Nose Pump

No matter the size of a livestock watering system, proper planning and design play an important role. Good installation cannot compensate for an inadequate water source. Good quality water and quantity are both vital to livestock. Dugout and off-stream livestock watering systems are an important tool in protecting water sources, riparian areas, and livestock.