Livestock Watering
FACTSHEET

BRITISH COLUMBIA
Ministry of Agriculture and Lands

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ACCESSING GROUND WATER SOURCES

This Factsheet outlines sourcing and options to develop ground water sources for livestock water use.

Introduction

Ground water occurs both in rock and unconsolidated materials. Water in rock occurs in fractures, in the inter-granular openings in the rock and, in the case of limestone, in cavities and channels. The largest amount of ground water comes from unconsolidated materials receiving water from precipitation or from nearby surface watercourses. Refer to Figure 1, next page. The amount of water which can be obtained from a well depends on the permeability of the materials, the thickness of saturated material through which the well passes, and on well construction.

Environmental Issues

Water Quality Protection. Ground water quality can be impacted by surface activities, such as some farming practices. To protect ground water quality, wells must be located and constructed so as to avoid entrance of contaminated surface water. Wells are vulnerable from the top (condition of well cap and surface seal), side (condition of casing seal) and from below (contaminated ground water):

- under the *Health Act*, *Sanitary Regulations*, Section 42, wells must be located at least 30.5 m (100 ft) from any “probable source of contamination” (on farms, things such as manure, petroleum, fertilizer, and pesticide storages, etc.)
- under the *Water Act*, *Ground Water Protection Regulation*, well drillers qualification requirements and well construction is specified

Water Quantity Protection. Ground water quantity can be impacted by water withdrawal at rates faster than it can be replaced, lowering the water table, and in turn possibly impacting levels and flows in adjacent watercourses. Indications of a lowering water table include:

- the necessity to deepen wells to maintain water flows
- wells running dry during times of the year when they previously had flow
- nearby bodies of surface water experiencing reduced flows or depths

To reduce overuse of ground water, monitor the water table by measuring the static water level in the well at the same time of year (some variations are normal). Minimize the use of wells near watercourses, especially when their levels are low.

Ground Water Sourcing

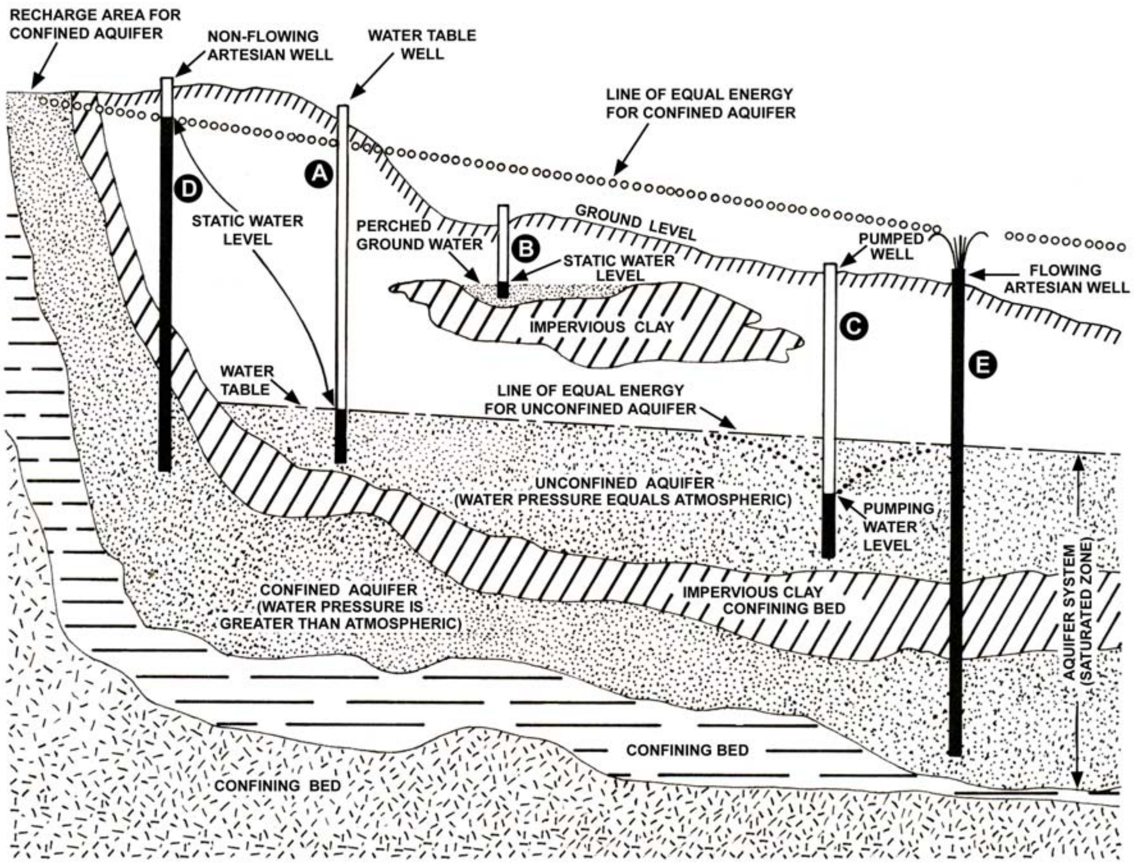
Dowsing. Dowsing is sometimes called water witching or divining while skeptics will call it a hoax. Using a divining rod, forked stick or other items, dowsers believe they can find ground water which cannot otherwise be seen. Not a science but an art, dowsing is generally inexpensive (especially compared to a 'dry' hole) and may be helpful when deciding where to drill for water. Talk to area farmers or others who have used their services for names of local dowsers. A number of books on dowsing are available at the American Society of Dowsers, Inc at http://www.dowsers.org/

Unconfined aquifers are at atmospheric pressure - wells **A**, **B** & **C** are into an unconfined aquifer and must be pumped.

Confined aquifers are pressurized above atmospheric pressure - wells **D** & **E** are into a confined aquifer.

D water level rises above aquifer but not to the well head – it must be pumped.

E water level rises above the well head.



Adapted From: Water Wells and Pumps (University of California May 1978)

Figure 1 Ground Water Conditions, Types of Aquifers and Wells

Types of Wells

Wells may be drilled either vertically (most typical) or horizontal (note that in the petroleum industry a drilled well can consist of both types).

Vertical Wells. Most wells for livestock water are drilled vertically. The pump, wire and piping are lowered down the well. Energy is required to power the pump, and this is often the limiting factor to the use of wells in remote areas.

Horizontal Wells. These are drilled horizontally into specific geologic formations where water may be trapped. Once drilled, this type of well could be considered a "spring" as water flow will occur due to gravity without pumping energy. A valve is used to control water flow. Horizontal well drilling is a specialized service and may not be available in all parts of BC.

Shallow Wells. These wells are less than 10 m (33 ft) deep. Depending on the geologic formation, they may be easily affected by surface conditions such as contaminated runoff and drought conditions.

Deep Wells. These wells are usually drilled and are usually less prone to contamination and drought. The water quality may, however, be hard compared to shallow wells as the water has had a long exposure to minerals.

Well Construction Methods

There are several methods of constructing wells; one may be more suitable than another for conditions at a given location. Consider the volume of water required and the relative costs.

Dug Wells. The oldest wells were hand dug and lined with suitable cribbing. Today, dug wells are constructed using power equipment for shallow wells or sumps of less than 6 m (20 feet). Upright steel culverts can be used for lining the well.

Driven Wells. Driven wells, also referred to as sand points, gravel points or well points, are often used for farm water supplies when the water table is not far below the surface (10 m or less) and where the aquifer is fairly permeable. Sand points are usually 30 – 50 mm (1¼ to 2 inches) in diameter. A sand point consists of a short length of screened pipe equipped with a sharp point. The point and attached pipe are driven into the ground to the necessary depth with pipe being added to the top end as needed.

Well points may be arranged in groups, coupled to a common suction header, to increase the capacity required. Unless a jet pump is to be used, it is essential that the water table be shallow enough (less than 6 m) so that a shallow well pump on the ground surface may develop sufficient suction.

Churn (Cable-Tool) Drilled Wells. Drilling by this method is accomplished by raising and dropping a heavy "tool string" equipped with a bit. The tools are suspended by a wire rope. Drilling is done with water in the hole and cuttings are removed by means of a bailer. In deep holes, several sizes of casings may be required increasing the costs. Although somewhat slower than rotary drilling, churn drilled wells may detect water in thin or low producing aquifers.

Rotary Drilled Wells. In this method, drill pipe, equipped with a cutter called a bit, is turned in the hole. During drilling, a fluid is pumped down the drill pipe and through the bit in order to transport the well cuttings back to the surface. Mud rotary drilling is inexpensive and rapid, particularly in unconsolidated materials. Air rotary drilling, a common drill method, is well suited for drilling in rock.

Well Construction and Use

In addition to the environmental issues previously mentioned, there are other good practices which should be used in constructed a well:

- construct wells with durable materials
- locate wells in high areas, wherever possible, to prevent runoff from collecting at the well head and seeping into the water supply
- construct well casing 0.3 m (1 ft) above the level of the surrounding land
- construct well casing above 100-year-flood levels
- construct upland berms, grade land to prevent runoff from contaminating the well
- plant and maintain grass covers around well heads to slow and filter runoff
- use a full length casing with a pitless adapter where water lines may freeze (rather than terminating the casing in the ground below frost level)

Well Casing and Screens. Rock wells will usually not require casing except for an upper, short ground seal case section and a means to hang the pump and pipe. In unconsolidated material, casing will usually be required. Minimum casing should be 100 mm (4 inch) diameter; however, a preferred minimum diameter is 150 mm (6 inches). To some extent the amount of water required will determine the well diameter. For most stock water applications, the 150 mm diameter should suffice.

Wells drilled in a coarse, clean, gravel aquifer and where the water requirements are not high, can use a single open-end casing in the gravel to extract the water. Where the well is in a fine-grained aquifer, a well screen is essential. The aquifer material must be sized and a suitable screen matched to the aquifer layers. Once screens have been installed, the well can be developed.

Pitless Adapters. This device is used where the delivery water line is affected by frost. It allows the casing to extend to the normal position (above the ground surface) while providing a direct route to the trenched (below frost level) location of the water line, as shown in Figure 2, below. The name is derived from the old practice of terminating the casing in a pit below ground level (below frost level) to connect to the water line. This produced a risk of surface contaminants entering the well.

The pitless adapter passes through the casing and is secured to it. It is constructed so as to allow the removal of the well portion of the water line. The pump wiring goes to the top of the casing, over the casing edge (a special well cap accommodates the wire) and down into the trench where it can be routed to the electrical supply.

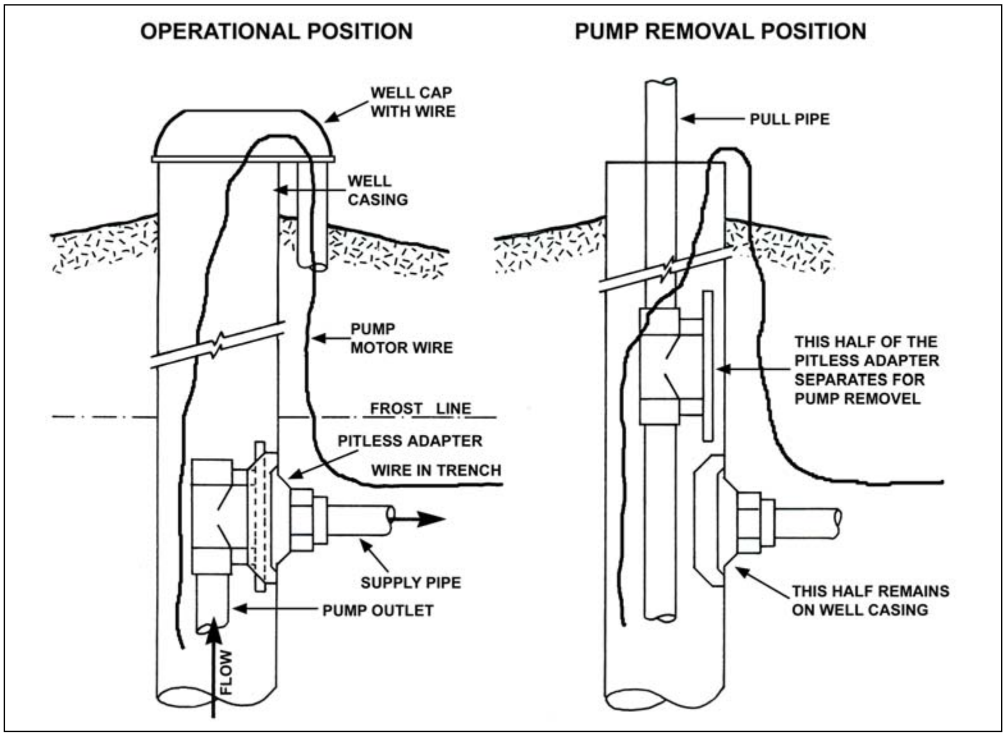


Figure 2 Pitless Adapter Installation in a Cased Well

Well Development. This is the process of making water enter the well easier and can assist in producing a satisfactory well. The object is to remove the fine particles from the aquifer in an area around the screen. Once these particles are removed by bailing, a coarse filter zone remains which will allow better water flow and reduce the possibility that the well will pump sand during production.

Well Testing. Upon completion, the capacity of the well should be determined. If the well is obviously producing far more water than required this step may not be necessary. However in many cases the well output must be known, especially when sizing a pumping system. In testing a well, by either bailing or pumping, the amount of water removed in a given time is compared to the measured change in the water level in the well. The time taken for the water to return to its original level after bailing or pumping has stopped is the well recovery or capacity.

Well Logs. A well log is a written description of the drilled well supplied by the contractor on completion of the well. It should contain the details of the well construction (casing size, type and depth), the type of formations the well goes through and the well test results. A copy of the well log is usually registered with the Ministry of Environment. A completed well log is very useful when sizing and installing a well pump.

Well Abandonment. Improperly closed or abandoned wells can be sources of ground water pollution and must be sealed as required by the *Water Act*, *Ground Water Protection Regulation*.

Well Terminology. Figure 3, below illustrates terms related to wells.

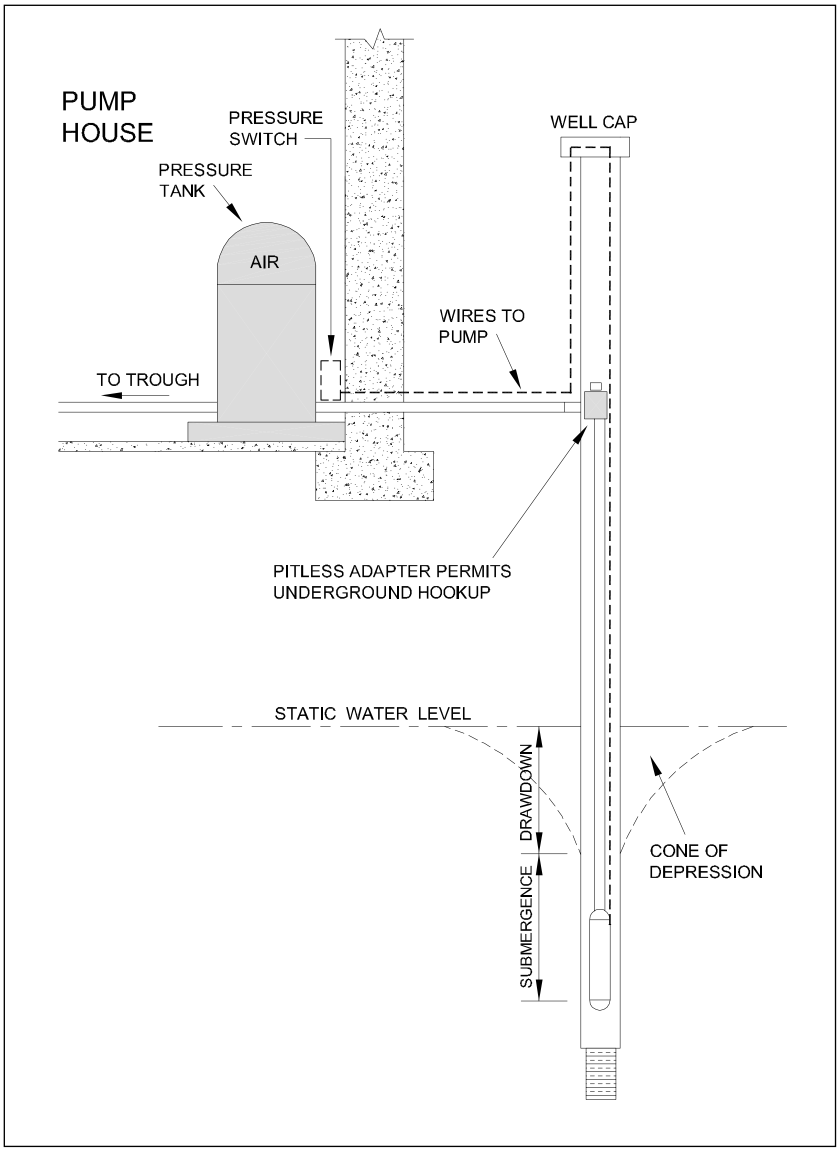
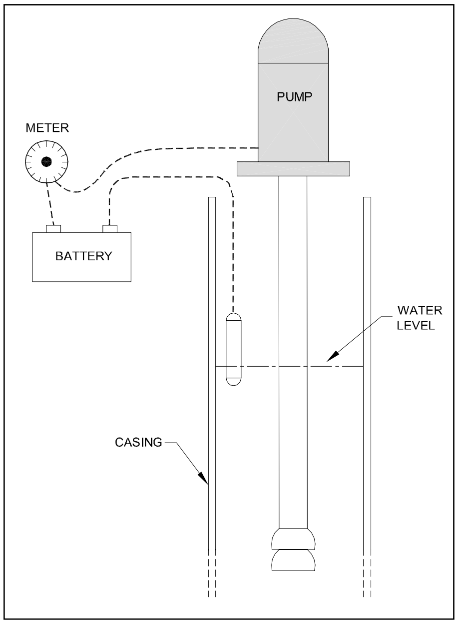


Figure 3 Well Terminology

Well Water Level Measurement

The following are three ways to measure the water level in a well. They can be used to measure the static water level (pump not operating) or to measure the draw down level (pump operating). Note that all three involve lowering something down the well and in operating wells there may not be a lot of space with the delivery pipe and pump wiring hanging in the casing.

Steel Tape. A steel measuring tape with a weighted end can be lowered down the well. Note the measurement at the well head, withdraw the tape and subtract the wetted length of the tape from the well head measurement. This process may need to be tried a few times until the tape has been lowered enough to reach the water level.

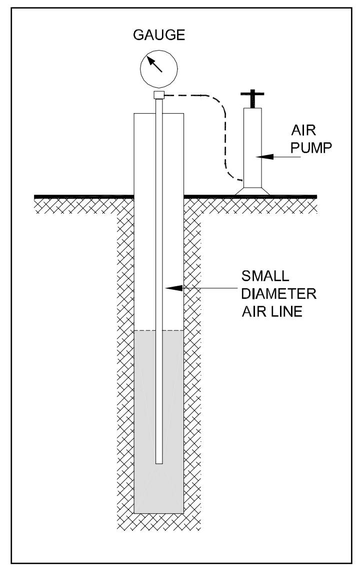


Electrical Wire

Electrical Wire. This method uses the electrical conductivity of water. An insulated single-conductor wire with a weighted end is lowered down the well. The wire is connected to one terminal of a battery with the other terminal running to a conductivity gauge then to the well casing. Once the wire touches the water, the meter will indicate a flow of electricity. Mark the point on the well wire, withdraw it and measure the wire distance – this equals the distance down to the water. This device is available as a commercial unit with a battery, gauge and a windup wire marked off in 10 foot intervals.

Air Line. This method uses a known length of small diameter air line (say, 1/8 or 1/4 inch copper tubing) set down the well until at least 10 feet is submerged into the water. A pressure gauge is connected at the well head and air is pumped into the line. Air is pumped until a maximum pressure is achieved. This pressure is converted into feet (1 psi = 2.31 feet) and subtracted from the total air line length for the distance from the well head to the water level.

This method can be used to determine drawdown if the pressure reading before pumping and during (it will be a lower reading if there is a drawdown) is subtracted - the pressure difference converted to feet is the drawdown.



Air Line

Other Information

For further information on wells refer to the following publication.

- "Water Wells …. that last for generations", Alberta Agriculture
- for information on *the Health Act, Sanitary Regulation*: http://www.qp.gov.bc.ca/statreg/reg/H/Health/142_59.htm
- for information on the *Water Act, Ground Water Protection Regulation*: http://www.qp.gov.bc.ca/statreg/reg/W/Water/Water299_2004/299_2004.htm

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