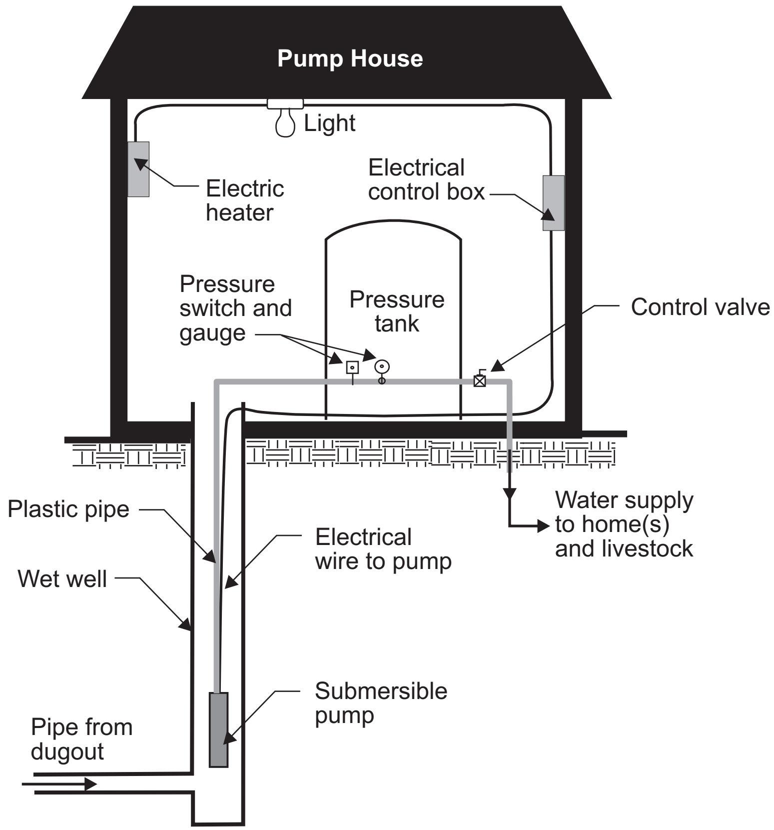
Water System Sizing Worksheet



Joe Agricola Example

This example is provided to help you size the pump, pressure tank, and water distribution piping for your dugout water system. It contains a written explanation of the process and completed worksheets for the Joe Agricola farm. A blank **Water System Sizing Worksheet** is provided in the pocket inside the back cover to assist you with this task.

In the **Dugout Sizing Example** found in the front pocket of the manual, we learned that Joe Agricola required dugout water for his 200 head of beef cattle, chemical spraying, plus yard use and garden irrigation. He also wants to size the dugout water system to provide fire protection, and act as a back-up supply for his hog operation should one of his wells or well pumps fail.

Beginning with **Step 1**, Joe lists all the water system fixtures he plans to supply from the dugout.

In **Step 2**, Joe considers the following to determine the required pump size and flow rate:

- What water uses are likely to occur at the same time?
  Most likely cattle and hog watering (10 + 10 = 20 Imperial gpm).
- He also wants to be able to fill a 1,000 gallon tank for chemical spraying in a hour
  (1,000 gallons ÷ 60 minutes = 17 Imperial gpm).
- The pump capacity must be at least equal to the peak use of the fixtures that use the largest amount of water.

Joe decides on 20 Imperial gallons per minute to meet the above considerations, and in **Step 3**, completes the conversion of 20 Imperial gpm to 24 U.S. gpm. This is necessary because most pumps available in Canada are sized in U.S. gpm.

To complete **Step 4**, Joe contacts a reputable, pump supplier, and is asked how much **lift** there is from the dugout to the farmyard and what pressure he requires from the water system. Joe informs him that the lift or elevation is 21 feet (lift = the dugout depth + farmyard elevation above the dugout). The dugout depth + 10 feet of additional elevation to the farmstead totals 31 feet. Joe also advises that the water system will operate between 30 and 50 psi, and so the average **pressure** required is 40 psi.

The pump supplier advises him that a one horsepower, submersible pump will do the job.

The purpose of **Step 5** is to size the **pressure tank**. As indicated in **Step 2**, Joe has determined that he needs a pump capable of delivering 24 U.S. gpm. When selecting a pressure tank, the rule of thumb is to have a tank with at least one gallon of drawdown, between high and low pressure, for every one gpm of pump capacity. Joe needs a pressure tank that has a least 24 U.S. gallons of drawdown to match his 24 U.S. gpm pump. He also opts for a tank with the recommended sealed diaphragm so he does not have to routinely add air to the tank. Such tanks produce only 1/3 of their capacity as available water. This means that his tank must be at least three times the available water or drawdown between high and low pressure, **or 3 x 24 = 72 U.S. gallons or larger.**

Joe has decided to locate the pressure tank in a pump house beside the dugout. To determine the length of the supply pipeline in **Step 6**, Joe measures the distance of the dugout pump house to the center of the distribution system and finds that it is 1,000 feet.

In **Step 7**, Joe finds the 1,000 foot distance and his pump capacity of 24 U.S. gpm in the **Pipe Diameter** table, and determines that a 2 inch size pipeline will be required. He chooses pipe that is CSA approved with a 75 psi pressure rating.

Water System Sizing Worksheet

This worksheet can be used to determine the size of pump, pressure tank, and water pipe required for a farm water system. Dugouts, unlike most water wells, have a huge reservoir of water, and can be pumped at much higher flow rates. Therefore, it is important to properly size dugout pumps and pipelines to take full advantage of the dugout.

Enter all information calculated step by step in the recording section below as follows:

Step 1	**Water System Fixtures**				
Step 2	**Required Pump Flow Rate**	*20*	gallons per minute		
Step 3	**Conversion to U.S. Gallons**	*24*	U.S. gallons per minute		
Step 4	**Pump Selection**				
	Lift	*31*	feet		
	Pressure needed	*40*	psi		
	Pump horsepower required	*1.0*	hp	other specifications	*Submersible*
Step 5	**Pressure Tank Size**	*72*	U.S. gallons	other specifications	*24 U.S. gallons drawdown, sealed diaphragm*
Step 6	**Length of Supply Pipeline**	*1,000*	feet		
Step 7	**Pipe Size**	*2*	inches	other specifications	*CSA approved, 75 psi rating*

STEPS TO SIZING YOUR WATER SYSTEM

Step 1 Calculate the peak water use rates in gallons per minute (gpm) for all of the existing and proposed water system fixtures.

Water System Fixtures	No. of Fixtures		Peak Use Rate		Totals	
Automatic Cattle Waterers (100 head size)	*2*	x	5 gpm	=	*10*	gpm
Hog Nipple Waterers	*10*	x	1 gpm	=	*10*	gpm
Poultry Fountain		x	1 gpm	=		gpm
Yard Hydrants	*1*	x	5 gpm	=	*5*	gpm
Household (number of households)		x	5-10 gpm	=		gpm
Fire Hydrant	*1*	x	10 gpm	=	*10*	gpm
Other *Chemical spraying outlet*	*1*	x	*17* gpm	=	*17*	gpm
Other		x	gpm	=		gpm

Step 2 To determine the Required Pump Flow Rate you need to consider which water uses listed in **Step 1,** will likely occur at the same time and total those together. **Note:** The minimum design flow rate of the system must exceed the peak use rate of the fixture(s) that use the largest amount of water.

Required Pump Flow Rate = *20* gpm

Step 3 Convert the Required Pump Flow Rate from **Step 2** into U.S. gallons because practically all pumps available in Canada are rated in U.S. gpm.

Conversion to U.S. Gallons
Required Pump Flow rate *20* gpm x 1.2 = *24* U.S. gpm

Step 4 To select a pump you need to determine the lift and pressure. It is recommended that you take this information plus the Converted Pump Flow Rate from **Step 3**, to a reputable pump dealer or a water specialist for correct pump selection. They will recommend the required pump horsepower and other specifications.

Pump Selection		
Lift	Depth of dugout *21* feet + Farmyard elevation above dugout *10* feet =	*31* lift in feet
Pressure needed		*40* psi
Pump horsepower required		*1.0* HP

Step 5 Sizing a pressure tank is based on the Converted Pump Flow Rate and the amount of useable water volume or drawdown. The drawdown is the amount of water that can be withdrawn from the pressure tank between high and low pressure settings. For dugouts, the sealed diaphragm or bladder type tanks are the best choice. In these types of tanks only 1/3 of the volume of the tank is available as drawdown. Therefore, the Pressure Tank Size must be 3 times the drawdown and match the gpm rating (flow rate) of the pump. For example a 10 gpm pump requires 10 gallons of drawdown or a 30 gallon tank size.

Pressure Tank Size = 3 x Pressure tank drawdown *24* U.S. gallons = *72* U.S. gallon capacity or larger

Step 6 Measure the distance from the dugout to the center of the distributing system.

Length of Supply Pipeline = *1,000* feet

Step 7 To determine the Required Pipe Size match the pump flow rate from **Step 3**, in the left column of the adjacent table with the length of the supply line from **Step 6.**

Required Pipe Size = *2* inches

Note: The minimum pipe size recommended for farmyard water distribution systems is 1¼ inches. This will reduce friction losses in the pipe and allow for future expansion that was unforeseen.

Pipe Diameter (inches)

Flow Rate (U.S. gpm)	Length of Pipe 200 ft	400 ft	600 ft	800 ft	1000 ft
2	1	1	1	1	1
4	1	1	1	1	1
6	1	1	1¼	1¼	1¼
8	1	1¼	1¼	1¼	1¼
10	1¼	1¼	1¼	1½	1½
12	1¼	1¼	1½	1½	1½
14	1¼	1½	1½	1½	2
16	1½	1½	1½	2	2
18	1½	1½	2	2	2
20	1½	1½	2	2	2
25	1½	2	2	2	2
30	2	2	2	2	2½
35	2	2	2½	2½	2½
40	2	2½	2½	2½	2½

Note: In sizing the above lines, no allowance has been made for elevation differences. For more specific information contact a water specialist in your area.