Electric
WATER SYSTEMS
for FARM and HOME

M. G. HUBER

Oregon State System of Higher Education
Federal Cooperative Extension Service
Oregon State College
Corvallis

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Figure 1. Running water and modern equipment eases washday chores.

Figure 2. Water at the kitchen sink—the greatest convenience in the home.
Electric Water Systems for Farm and Home

M. G. HUBER
Extension Agricultural Engineer

A
N ABUNDANT supply of pure water conveniently furnished is one of the greatest conveniences that can be installed in the rural home and on the farm. Carrying water is an unpleasant task at any season of the year and particularly during the cold and wet seasons. No other type of equipment is used as often and returns so much for a small expenditure as a good, safe, pure, well-planned water system.

The average farm family carries from 20 to 30 tons of water for kitchen use only. Add to this the requirements for washday and livestock, and the magnitude of the task can be imagined.

A few cents per day for electricity will pump all the water required under pressure to wherever needed on the average farm.

Figure 3. Improperly protected, or unprotected, water supplies are a menace to the family's health.
Human beings have been known to live for almost two months without food, but no one has ever survived more than a few days without water. Aside from air, water is the greatest necessity to man. Water is essential to all life. It should be protected from contamination (Figures 3 and 4) and should be given careful consideration by those living on the farm and in suburban areas.

Contaminated water is often responsible for the transmission of certain diseases and intestinal disorders, including typhoid and paratyphoid fevers, dysentery, diarrhea, cholera, and infantile paralysis. It must be stressed, however, that all polluted waters do not necessarily contain disease organisms. If

Figure 4. Dug wells should be protected from surface contamination by using a concrete platform with ridges around the openings, and covered or sealed, to prevent water from running back into the well. Good drainage should be provided away from the well.
wastes or sewage seep into a water supply, the supply is a potential carrier of disease germs.

Animal contamination is not generally associated with the transmission of specific diseases, but large amounts of animal waste in a water supply may cause intestinal upsets. The Oregon State Board of Health, Division of Sanitary Engineering, Portland, maintains a laboratory to analyze private water supplies for purity. This service is free, but persons desiring this service are required to pay charges on suitable containers that are furnished by the department.

The rural water supply is obtained from springs and wells, and in some cases from streams, although

Figure 5. Keep the grass and garden green.

Figure 6. Increased milk production results with an abundance of fresh water.
streams are so easily contaminated, that they are an undesirable source. The ground surrounding the sources of supply must remain in a clean condition, free from human wastes and sewage, and animal wastes. Once a ground water supply is found unsafe for human consumption, it may take a long time before the effect of the pollution will disappear. Cases are on record of wells that have been known to remain polluted for years.

THE AUTOMATIC PRESSURE WATER SYSTEM

Running water adds health and happiness to every member of the rural family. It saves labor and time, facilitates sanitation in the home, and induces a greater use of water. The following points represent some of the benefits of having water available at the turn of the faucet:

1. An adequate and convenient supply of water in the home (Figures 1 and 2).
2. Water for improved sanitary facilities, such as bath, flush toilet, etc. (Cover illustration).
3. Water at outbuildings for livestock, dairy, and poultry (Figures 6, 8, and 10).
4. Water for irrigation of garden, lawn, etc. (Figure 5).
5. Limited fire protection (Figure 7).

Water under pressure may be supplied in a number of ways. In hilly and mountain regions water can frequently be supplied by gravity at low cost. In some cases, hydraulic rams may provide the best method of supplying water under pressure. However, these conditions are prevalent on only a limited number of farms; elsewhere power equipment must be used. Since most of the pressure systems installed will be electrically operated, this bulletin will discuss such power-operated equipment.

Figure 7. Water, under pressure, may save a home or a barn.
Automatic electric water pumping equipment has been developed so that this system of pumping includes all the necessary features that should be included in the plant. Briefly, a complete automatic system has the following advantages:

1. Completely automatic
2. Inexpensive to operate
3. Automatically maintains a predetermined pressure in the tank
4. First cost is reasonably low
5. Quiet in operation
6. Clean and sanitary
7. Little servicing and attention required
8. Adaptable to most farm conditions
9. Available and adaptable to all sources of water supply
10. May be used with or without storage tank

**PLANNING AND SELECTING THE SYSTEM**

Water may be pumped from wells, springs, streams, or cisterns. Regardless of the source, the water supply should be pure, dependable, and sufficient for all farm and home uses.

**Types of Wells**

Wells are classified according to the method employed in developing them. There are drilled, driven, bored, and dug wells. All types of wells should be protected against the entrance of surface water by using a properly-made concrete platform (Figure 9). In the case of dug wells, a concrete water-tight wall should extend down in the well a minimum of ten feet, or as deep as possible. The base of pumps should be sealed when pumps are located directly over the well. The pipe entering the well curb or casement should be made watertight with a well seal or other material.

Figure 8. Water in a poultry house saves time and labor.
Location of Wells
Wells should be located on high, well-drained soil and at least 50 feet (more is safer) from contaminating sources, such as privies, septic tanks, barns, and poultry houses.

How Much Water Will be Used?
A water supply must be safe and adequate. Since it is very probable that more water will be used when a water system is installed for such facilities as bathrooms, flush toilets, irrigation, etc., it is a good plan to determine the maximum daily use and check whether the source of supply will fill these requirements. Table 1 can be used to determine the daily consumption.

DAILY WATER REQUIREMENTS

An example is given in Table 2 to show how much water may be required daily on a farm having a complete plumbing system with pipe lines to the barn, poultry house, lawn, and some garden irrigation.

A good method for determining the pump size is to determine the fixed daily needs from Table 1. The pump should be large enough to supply the average needs in 2 hours of operation per day. Therefore divide the daily requirements by 2 to determine the necessary pump capacity.

In this example the size of pump would be based on the 813 gallons, or a 400-gallon-per-hour

Figure 9. Drilled well should be protected from surface contamination.
pump would be the desired size. In case irrigation and other requirements would increase the demand, a proportionally larger pump would be required. However, should other requirements exceed 1,000 gallons or more per day, a separate pumping unit installed for that particular job would be desirable and give more satisfactory performance.

Table 1. WATER CONSUMPTION

<table>
<thead>
<tr>
<th>Description of use</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>For each member of family (total average daily consumption allowing for kitchen, bathroom, and laundry)</td>
<td>35 per day</td>
</tr>
<tr>
<td>For each cow (winter, 4 to 8 gallons; summer, 8 to 18 gallons)</td>
<td>30 per day*</td>
</tr>
<tr>
<td>For each horse</td>
<td>15 per day</td>
</tr>
<tr>
<td>For each hog</td>
<td>13 per day</td>
</tr>
<tr>
<td>For each sheep</td>
<td>2 per day</td>
</tr>
<tr>
<td>For each 100 chickens</td>
<td>22 per day</td>
</tr>
<tr>
<td>For sprinkling (1-inch hose) (10 gallons will sprinkle 100 square feet.)</td>
<td>200 per hour</td>
</tr>
<tr>
<td>For sprinkling (.1-inch hose) (20 gallons will soak 100 square feet.)</td>
<td>275-300 per hour</td>
</tr>
</tbody>
</table>

* Statistics show that high producing cows sometimes drink as much as 35 to 40 gallons a day.

Table 2. WATER CONSUMED DAILY

<table>
<thead>
<tr>
<th>Description of use</th>
<th>Gallons per day per user</th>
<th>Total gallons per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 persons</td>
<td>35</td>
<td>175</td>
</tr>
<tr>
<td>20 cows</td>
<td>30</td>
<td>600</td>
</tr>
<tr>
<td>2 horses</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>200 chickens</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Total daily requirements for home and livestock</td>
<td></td>
<td>813</td>
</tr>
<tr>
<td>Lawn or garden, 2 hours per day at 300 gallons per hour</td>
<td></td>
<td>600</td>
</tr>
<tr>
<td>Total daily requirements for home and farm</td>
<td></td>
<td>1,413</td>
</tr>
</tbody>
</table>

The Tank Size to Select

Although there is no fixed rule to follow in this matter, experience has indicated that a 42-gallon tank is the most practical for the average farm needs (Figure 11). A smaller tank may

Figure 10. Adequate water, under pressure, will keep the barn clean and sanitary.
be equally satisfactory where there are few requirements for water outside the home or where space is limited. The best rule that can be given is to make the tank capacity about one-seventh of the hourly pump capacity.

SELECTING THE PUMP

There are two general types of pumps, depending on the depth from which they are designed to pump water. They are commonly called (1) shallow well pumps and (2) deep well pumps (Figure 12).

Shallow well pumps are used where the water level does not at any time exceed a vertical distance of more than 22 feet below the level of the pump cylinders. Shallow well pumps need not necessarily be placed over a well and may be placed in the basement of the house, outbuilding, or frost-proof pit. Thus, this type of pump lends itself to small, compact units tucked away in out-of-the-way places and operating automatically.

Deep well pumps are used where the low-water level is more than 22 feet from the surface.

Shallow Well Pumps

Shallow well pumps are classified as follows:

Figure 12. Shallow well pump, for suction lifts of 22 feet or less (right); deep well pump, for wells deeper than 22 feet (left).
1. Reciprocating plunger, double acting
2. Straight centrifugal
3. Turbine-type centrifugal
4. Jet centrifugal
5. Rotary gear

The automatic reciprocating plunger pump lifts and discharges water on both strokes operating at a speed of about 250 to 300 strokes per minute.

The straight centrifugal pump is generally used on larger pumping operations. The suction limit varies from 15 to about 25 feet. This type of pump gives its best efficiency when pumping large quantities of water under low pressures. The pumping capacity decreases rapidly with increase in pressure or when the suction lift is increased.

Some manufacturers have recently introduced these pumps on farm water systems. They are simple and low in first cost and upkeep.

The turbine type centrifugal pump is somewhat different in design from the centrifugal pump in that it has only one impeller and the water enters the pump through the outer edge of the housing. The water is then carried forward and thrown from the outer edge of the blades through the discharge opening which is also located on the outer edge of the housing.

Figure 13. A rotary gear pump.

Figure 14. Cylinder used with deep well reciprocating pumps: left, open type, and right, closed type. The open type permits plunger and valve replacements without removing drop pipe.
The jet centrifugal pump has been used for some time on the West Coast. It consists of a straight centrifugal pump with jet. The jet is placed in the well making this pump applicable for deep well installations. Manufacturers do not generally recommend it for greater than 100- to 120-foot lifts. Some recommend a maximum of only up to about 80-foot lifts.

**A Rotary Gear Pump**

The rotary gear pump is not commonly used on farms. Its chief advantage is its low initial cost and simple construction. It is simply two gears meshing together inside a close fitting housing (Figure 13.) Then as these gears rotate, the teeth disengage and open next to the suction pipe thus creating a vacuum. The water is carried between the teeth to the discharge pipe where it is forced out through the discharge opening by the engaging teeth. The maximum suction lift is considered to be about 22 feet.

Although the performance of the rotary pump, when new, compares favorably with other types, a small amount of wear will cause its performance to drop off. The low price of these pumps makes it advisable to replace the complete pumping unit rather than attempt repair.

**Deep Well Pumps**

If the water level lowers more than 22 feet when pumping, a deep well pump must be used (Figure 15). There are several types of deep well pumps in common use. They are classified as:

1. Reciprocating or piston pumps (Figures 14 and 15).
2. Jet centrifugal pumps (Figures 16, 22, and 23).

Deep well reciprocating pumps are available in any size and are made for all practical lifts. They are similar in the principle of operation to that of a deep well hand pump except for the pump head.

This pump consists of (1) the working head which includes the crosshead, gears, the plunger or sucker rod of either wood or steel, pulleys and belts, and oil bath or force feed oiling system; (2) the cylinder which is either opened or closed and is brass or brass lined, as
brass does not corrode, thus the leathers last long.

Open cylinders are usually preferred to closed cylinders because the drop pipe is larger than the cylinder itself permitting the removal of the plunger and check valve without removing the drop pipe. The cylinder valves are quick acting. A separate air pump with control valve in the system assures positive delivery and control of the air in the tank at all times.

This type of pump will deliver with proper design to high or low pressures on the discharge and can be obtained for wells up to 800 feet or more in depth.

The deep well jet centrifugal pump (Figure 16) is operated by a direct-connected motor to the centrifugal impeller with a jet in the well. The pumps are mounted both horizontally and vertically although vertical installation is the most common.

Part of the discharge water from the centrifugal pump at the surface is bypassed through the pressure pipe to the nozzle in the ejector located in the well (Figure 17). Water passing through the nozzle at high velocity creates a partial vacuum that draws water from the well through the foot valves. At the same time the water from the well and return pipe passes through the venturi in the jet. The

Figure 16. Ejector on jet type pump.
velocity is converted to pressure that carries the water to the centrifugal pump through the delivery pipe.

This type of pump can be obtained for use in wells about 200 feet deep, but generally is not recommended for lifts over 100 feet. The important features of the jet pump are:

1. It does not have to be installed over the well.
2. Pumping capacity increases as the discharge pressure decreases.
3. Pumping capacity decreases as the water level lowers in the well.
4. It is simple, having few easily accessible parts.
5. Sand or dirt may cause injury to impeller and jet.
6. It is quiet in operation.
7. Air in lift or delivery pipe will cause pump to discontinue pumping water on most pumps of this type.

Figure 17. The ejector used with the jet centrifugal pump. The ejector must always be within 22 feet of the water level.

Figure 18. A shallow well reciprocating pump.
Pump itself on most makes requires no lubrication.
This pump cannot be used where high pressures are required.

Buying a Pump

Pumps bought from a reputable manufacturer, as a rule, can be considered of good quality. No established manufacturer is interested in placing poor quality pumps on the market that might reflect on the reputation of the company. Cheap pumps are more likely to be of poor quality and are confined to the low-capacity units.

When buying a pump, check the following points for quality:
1. The pump should have 2 crankshaft bearings.
2. It should have repulsion-induction or capacitor motor.
3. Air volume control is desirable.

Figure 19. Typical shallow well installation with pump located in basement.
4. It should be designed to operate with or without pressure tanks.
5. Wearing parts should be easy to replace.
6. It should be made by a reputable manufacturer.
7. Repair parts should be available from locally established dealers.

The Electric Motor

Horsepower requirements for pumping water vary, and depends on the pump capacity, lift, operation pressure, and efficiency of pumps. It is the dealer’s responsibility to equip the pump with the proper size motor for new installation. When replacing a motor, the information on the name plate should be noted. When adding a motor to an old pump, manufacturers’ recommendations should be followed.

Split-phase motors should not be used as they will not start under load.

Installing Shallow and Deep Well Pumps

The first step in installation is to decide on the location of the pump. The following points should be kept in mind when selecting a location:

1. The suction line should be as short and straight as possible.
2. The suction line, when pump is offset from well, should slope toward the well so as to avoid air pockets.
3. Provide drainage if in a pit.
4. Provide accessibility for servicing and lubrication.
5. Provide ventilation if located in a pit.
6. Place pump so it will be affected last in case of fire.
7. Bolt pump to rigid base above floor level.

Figure 20. A well seal with vent prevents surface water from flowing into the top of the casing.
Often tile casings are used.

Figure 21. Pit installation of a deep well reciprocating pump. This type of pump is always located over the well.

8. Provide drainage and protect against flooding.
9. Provide for air circulation under bottom of tank as this helps to prevent rusting on the bottom.
10. Provide protection against freezing.

Shallow well pumps need not necessarily be placed over the source of water supply and may be placed in the basement of the house (Figure 18), outbuilding, or frostproof pit (Figure 21). This type of pump is made up in so-called package units and may be installed in out-of-the-way places. However, when locating the pump away from the well or other source of water supply, the suction lift (including pipe friction) should not exceed a total lifting head of 22 feet (Figure 19).

Plunger Type Deep Well Pumps

With reference to plunger type deep well pumps, the following points are noteworthy:
1. The pump must be installed over source of water supply.
2. Pit or well house installation needs pressure tank with pump.
3. A frost proof length may be used in cold areas (Figure 24).
4. The power head must be fastened solidly.
5. The cylinder must be installed in the well preferably below water level.
6. Manufacturers' recommendations should be consulted.
The Ejector Type Pump

If a deep well ejector type pump (Figure 22) is selected, these points should be considered:

1. It may be installed away from the well with the horizontal pipe sloping upward from the well.
2. The venturi tube or jet is installed in the well preferably 5 to 10 feet below water level.
3. Manufacturers’ recommendations on installation should be followed.

A foot valve (Figure 25) is necessary to assist the pump in holding its prime.

It must be located below the low water level.

Pump Houses

Pump houses are recommended as being most satisfactory in western Oregon. Well-built houses are not costly and provide more satisfactory protection than pits. Some advantages of the pump house for western Oregon are:

1. It can be drained easily.
Air Volume Control

Most pumps used in pressure tank service are provided with one of several methods for supplying and controlling the volume of air in the tank. Without some means of automatic control regulating the air volume, frequent attention would be required.

Three types of air volume control are used depending on the type of pump used. They are all mounted on the side of

Pipe Size and Friction Loss

When water flows through a pipe, the inside surface resists the flow which is commonly known as pipe friction. To reduce the friction loss for a known flow of water, the diameter may be increased or the length of pipe shortened.

Friction loss increases as:

1. Flow of water increases.
2. Pipe length increases.
3. Pipe diameter decreases.
4. Inside roughness of pipe increases (roughness generally increases with age of pipe).
5. Elbows are added.

Table 3 indicates the pounds pressure or equivalent head in feet friction loss in pipes from ½ inch to 2 inches in diameter at rates of flow from 2 to 16 gallons per minute.

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Figure 24. A deep well pump installation with Frostproof set length. This permits the pump to be placed above ground level in a pump house.
the tank and each is adapted to the particular type of pump.

On shallow well plunger type pumps, the air volume control (Figure 26) admits air to the pressure tank only as required. This type may be identified by the copper tube connected to the air valve on the pump.

Deep well pump type of air volume control (Figure 27) releases air from tank when too much air collects. A separate air pump cylinder continually pumps air to the tank.

The diaphragm air control (Figure 28) for shallow well turbine and deep well jet pumps is mounted on the tank with tubing connected to suction line of pump. When the pump starts, the diaphragm opens to the operating, or open, position. When the pump stops, the diaphragm moves to closed position forcing trapped air into tank. This action is repeated with each starting and stopping of the pump. The above-mentioned air volume controls are the most common. Other types are used particularly on jet type and turbine pumps.

Figure 25. (Left) a foot valve and strainer and (right) a relief valve.

Figure 26. Pressure tank air control valves used with shallow well plunger pump.

Air vent port
Float shown in down position, which opens air vent and allows air to escape from pressure tank.
Fresh Water Faucet

An arrangement for a fresh-water faucet (Figure 29) may be inserted in the kitchens or elsewhere. All that is necessary is to insert a fresh water check valve and tee in the pipe line between the pump and pressure tank. The tee branch must have a downward take-off.

The water from a small tank or frequently used supply is ordinarily kept fairly fresh and is satisfactory for drinking purposes.

A Nonfreezing Farm Hydrant

A farmstead equipped with water under pressure often has a
place for a faucet located in the yard or barn or other building. In such case, cold weather presents a problem of keeping the riser pipe from freezing.

This is accomplished by installing a hydrant with a shut-off valve below the frost line, permitting the draining of the riser pipe (Figure 30). During freezing weather the water is controlled by the stop and waste cock and during warm weather by the faucet.

**Wiring for the Motor**

Pump motors of one-third horsepower or less can be operated on 115 volts. Larger motors will give better operation if connected to a 230-volt circuit. The repulsion-induction type motor will operate at either voltage by a change of connections. This information is usually found on the nameplate of motors.

The 230-volt circuit permits smaller wire size that is an advantage particularly if the pump is located some distance from the meter. It prevents flickering of house lights and other appliances due to a lowered voltage. It also tends to prevent motor overheating although a motor of proper size will carry the load under all satisfactory operating conditions.

An electrician or power company representative should be consulted for proper wire size. It is a good plan to have the pump motor on a separate circuit. This is desirable when making adjustments and repairs. The circuit should be one that might be affected last in case of fire.

**Some Suggestions for Maintenance and Service**

Maintenance and upkeep need very little attention on the better

Figure 29. Arrangement for a fresh-water faucet with an automatic pump and pressure tank.
grade of pumps. Periodical servicing and checking will avoid unnecessary trouble and keep the unit performing many years without any other attention.

Lubrication

Lubrication is the most important part of the maintenance program. The instructions furnished with the equipment should be followed.

Belts

Keep belts sufficiently tight to prevent slipping. New belts will lengthen somewhat with use. Most motor bases can be shifted to provide the necessary adjustment.

Pump Starts Too Often

If the pump starts each time a faucet is turned on, the cause may be a water-logged tank. Insufficient air in the tank means that the air control valve is not working properly. The air control valve should be repaired and the tank drained so as to replenish the air volume.

If the pump starts and stops when no water is being drawn, the pump valves should be checked for leakage due to wear or material lodged under the valves.

Water Squirts at Faucet

This is caused by an air-bound tank which means there is too much air in the tank. This may be caused by an air leak in the suction line or the pump. Also, the air control valve may have ceased to function properly.

If the pump capacity decreases, check—
1. For a loose belt.
2. For possible lowering of water level in well.
3. For obstruction or worn valves.
4. For air lock in suction pipe.
5. For leak in pump or suction line.
6. For obstruction in nozzle of ejector body or in the impeller on jet pump.
If the pump is noisy, the cause may be:
1. Valves sticking.
2. Water flowing to the pump from source.
3. Partly clogged suction line.
4. Pressure tank located away from the pump without an air chamber at the pump.
5. A long suction line operating at maximum suction lift.

Table 3. PIPE FRICTION PER 100 FEET OF ORDINARY IRON PIPE EXPRESSED AS FEET AND AS POUNDS*

<table>
<thead>
<tr>
<th>Flow</th>
<th>⅛-inch</th>
<th>¼-inch</th>
<th>½-inch</th>
<th>¾-inch</th>
<th>1-inch</th>
<th>2-inch</th>
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<tbody>
<tr>
<td>Gallons per minute</td>
<td>Feet</td>
<td>Pounds</td>
<td>Feet</td>
<td>Pounds</td>
<td>Feet</td>
<td>Pounds</td>
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<tr>
<td>2</td>
<td>7.4</td>
<td>3.2</td>
<td>1.9</td>
<td>.82</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>3</td>
<td>15.8</td>
<td>6.85</td>
<td>4.1</td>
<td>1.78</td>
<td>1.26</td>
<td>.65</td>
</tr>
<tr>
<td>4</td>
<td>27.0</td>
<td>11.7</td>
<td>7.0</td>
<td>3.94</td>
<td>2.15</td>
<td>.93</td>
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<td>5</td>
<td>41.0</td>
<td>17.8</td>
<td>10.5</td>
<td>4.56</td>
<td>3.25</td>
<td>1.41</td>
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<td>6</td>
<td>61.4</td>
<td>25.7</td>
<td>14.7</td>
<td>6.36</td>
<td>4.65</td>
<td>1.97</td>
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<td>8</td>
<td>85.8</td>
<td>35.9</td>
<td>25.0</td>
<td>10.8</td>
<td>7.8</td>
<td>3.38</td>
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<td>10</td>
<td>110.1</td>
<td>46.1</td>
<td>35.8</td>
<td>16.4</td>
<td>11.7</td>
<td>5.07</td>
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<td>12</td>
<td>134.5</td>
<td>56.4</td>
<td>46.4</td>
<td>21.1</td>
<td>16.4</td>
<td>7.10</td>
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<tr>
<td>14</td>
<td>158.9</td>
<td>66.7</td>
<td>57.0</td>
<td>25.8</td>
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<td>9.52</td>
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<td>16</td>
<td>183.3</td>
<td>77.1</td>
<td>67.6</td>
<td>30.5</td>
<td>28.0</td>
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<tr>
<td>18</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
</tbody>
</table>

Feet of pipe equivalent to 90-degree elbow

| Feet of pipe equivalent to 90-degree elbow | 5 | 6 | 6 | 8 | 8 | 8 |

*1 pound pressure = 2.31 feet water column; 1 foot water column = .43 pound pressure.