Farm Home Water Systems

Source and Location of Water Supplies, Inexpensive Water Systems, Cisterns and Septic Tanks
Pumping Water

Squeak, creak,
Squeak, creak,
An old fashioned story to tell
Squeak, creak,
Squeak, creak,
The windlass unwinds at the well.

Up-down, up-down,
Work, jerk, work, jerk,
The pump handle goes
Whizz-br-r, whizz-br-r
Quick-click, quick-click
The windmill wheel blows,
Bringing water from the ground
Up and down, and 'round and 'round.

Chugity-pop, chugity-pop,
The gasoline engine can tell
How machinery helps the farmers to pump
Cool water out of the well.

—Author Unknown.
Farm Home Water Systems

By EXINE DAVENPORT, Economist in Home Management

This bulletin presents a plan for the installation of a simple and easily-constructed water system which will deliver both hot and cold water under pressure to one or more plumbing fixtures—the sink, bathtub, lavatory, toilet, or laundry tubs which may be attached to the system.

The simple life on a farm as lived two or more generations ago may have much to recommend it from the standpoints of thrift, work that brought tangible results, training in ability to meet situations and see things through to completion, but if many of these same living conditions were met today, they would hardly be tolerated.

Standards of living, and living conditions in general have changed greatly. The majority of people are demanding more and more comforts and conveniences, yet there remains a large percentage of farm homes in which there is no running water.

To those who are accustomed to drawing water freely from any number of taps located in different parts of the house, it is almost beyond belief that there are homes where every drop of water used for bathing, cooking and washing must be carried from a well or cistern located at varying distances from the house. In some districts of the state water is brought to the farms in tanks from neighboring towns.

Allow 25 Gallons Per Person.—A minimum allowance of water should be about 25 gallons per person per day, or an average allowance for various purposes in the farm home should be about 150 gallons per day, a weight of approximately 1300 pounds. It is easily seen that the labor required to transport such an amount, even when distributed among different members of a family, would be a heavy task. Moreover, unless there are arrangements for the disposal of waste water, much of it must be carried out of the house.

To learn that the task of carrying water is unnecessary will come as a surprise to many people who seem to think that running water in a house is a luxury requiring a considerable expenditure of both time and money. As a matter of fact, it is quite possible to install a satisfactory water system at small cost.

The convenience of running water will do much toward
promoting the health of the family in lessening fatigue with consequent irritability; in making available sufficient water for general household and toilet purposes. The latter factor will have a far-reaching effect on the health of the family.

People do not bathe as frequently when taking a bath means carrying the bath water sometimes as far as 75 feet, heating the water and assembling some sort of a tub and other necessities. Neither do people drink as much water when they have to walk a considerable distance for it, and perhaps operate a pump or drink water which has stood for hours in an open bucket, as they do when it can be drawn fresh from a faucet. Then too, a water-flush toilet inside the house is an important factor in the health of the individual members of the family.

**Fresh water is a necessity** for cooking purposes and for washing vegetables which may have been grown where there was seepage from danger spots or where the irrigation water was far from sanitary.

A plentiful supply of running water will enable the housewife to do her laundry and cleaning whenever the spirit moves her without using physical energy for lugging heavy buckets, or waiting for a convenient time or suitable weather to carry the water. With her housework simplified, she will have more leisure which she will be in better physical condition to enjoy.

Running water will save a considerable amount of time for the farmer in carrying water for stock, for keeping barn and dairy clean, and other purposes. Time saved in these ways will cut down operating costs and release energy for labor in other phases of farm work which may result in increased income. Improved conditions in barns and pens will make for better livestock which will bring greater profit.

The exterior of a house equipped with running water usually responds to the inside improvement and a general "sprucing up" outside is quite apt to occur. If the pressure will allow the installation of an outside faucet for attachment of a hose, flowers may be attended to easily, and nothing will add more to the attractiveness of a home. Fire hazards too will be considerably lessened. All of these factors cannot help but increase property valuations.

**Use Only Pure Water.**—The first step and one of greatest importance in planning any water system is to locate a source of pure water. Many sources of water are subject to pollution and even though clear and tasteless, should be considered with an attitude of caution until some simple tests are made to prove the quality.
Both wells and springs are considered sources of pure water, and may in themselves actually be so, but both are liable to pollution by seepage from barns, septic tanks or outdoor toilets. To obviate this danger the slope of the land and the character of both surface and sub-soil should be studied as well as the probable direction of flow of any drainage. It should be remembered that water will sometimes flow several hundred feet horizontally. The nearness of barns and outhouses also should be considered.

The desirable requirements of water for household use are that it shall be clear, without odor, neither acid nor alkaline, preferably soft, of a temperature from 50° to 58° Fahrenheit, and free from all traces of contamination. If there is any suspicion as to lack of purity the water should be analyzed in a well-equipped laboratory, for water-borne diseases may be very serious. If contamination exists which cannot be remedied, another source of water should be located.

**Gravity Pressure Most Desirable.**—Natural gravity should be used wherever possible to bring the water to the house, or as near to it as possible. When the source of water is located on ground higher than the place from which the water is to be drawn in the house, gravity is the best method. But on most farms it is necessary to bring the water to the surface by means of an engine or windmill, confine it in a tank, and draw it from the tank by means of a kitchen force pump as needed. If the tank can be located higher than the fixtures, no kitchen pump will be needed. For the farm without a convenient hill in which to bury the tank, it can be kept near the windmill or well, and the overflow allowed to fill the stock-watering tank.
Force Pump Is Start of System.—In the simple, inexpensive kind of system with which this bulletin is concerned, the pitcher force pump, which is usually placed at the kitchen sink, is the keynote of the whole system. It differs from the ordinary kitchen pump in that when the handle is operated water may be forced through pipes to higher levels than is possible with the ordinary pump. With the exception of the hand labor required, which is not at all difficult, the owner has the convenience of a city water system. The addition of a small tank in the attic or second story to be filled by pumping in leisure moments may be advisable in some homes.

The installation of a pump alone will serve as a beginning of a water system to which additions may be made from time to time. If the connections with the source of supply or supply tank are properly made, water will be delivered at the spout of the pump. The sink, faucets, bathroom fixtures, laundry tubs, and other equipment may be added at a later time.

To provide hot water it is necessary to have an open tank or a hot-water boiler attached to the system and also connected by means of coils with the kitchen range or some other source of heat. The plumbing fixtures may be on the same floor as the pump or on floors above or below.

For all interior piping leading to the fixtures, a galvanized pipe, one-half or three-quarters of an inch in diameter is used. One to one-and-one-quarter-inch pipe is commonly used for the water-heating coils and to conduct the hot water from the stove to the tank.

One advantage of this system over others is that the hot-water boiler cannot become partly emptied through neglect or oversight and thus allow the entire system to fill with steam from a hot stove. In order to draw hot water from any faucet, it is necessary to operate the pump and force an equal amount of cold water into the bottom of the boiler. The operation of the pump forces the hot water out of the top of the boiler into the pipe to which the faucet is attached. The tank therefore is always full of water without any special attention.

Operation of System.—Note the sharp bend in the pipe marked “offset” in the diagram. There are two reasons for having an offset. Note first that there is no faucet on the pipe leading to the bath tub. The reason for this is that when cold water is heated it expands, and the absence of a faucet permits the water to expand without any possibility of damage to the system. Another reason for having an offset is that in many cases it will do away with the need for a faucet.
Pipe line 1 is the supply pipe from the source of cold water, or from the supply tank to the pump. Pipe line 2 is the cold-water house-piping, and pipe line 3 is the hot-water house-piping.

In drawing hot water in the sink it comes to the faucet through pipe 3, and unless there is something to retard it, as an upward bend in a part of the pipe, some of the water would likely run past the sink and be wasted in the bath tub, but with the offset, the water tends to pass out at the faucet in the sink.

Tests have shown that an offset of 15 inches will not prevent leakage at the bath tub when the pump is being operated rapidly. A remedy for this would be to put a faucet on the hot-water pipe in the bath tub and leave it slightly open. Another remedy would be to make the offset from 3 to 5 feet in depth. This would allow for necessary expansion and there would seldom be any leakage.

In a test carried out in a system constructed like the diagram, a 12-quart pail set in the bath tub was easily filled from the hot-water supply in 45 seconds. With proper care the material in this system will have a useful life of at least 20 years.

**Danger of Freezing.**—If the family is to be absent from the house for any length of time during cold weather, the entire system must be drained to prevent freezing and consequent damage.
Supply Tanks and Pumps.—A supply tank is almost a necessity except in cases when water can be drawn directly from the ground with the pump. Windmills and even other means of drawing water from the ground cannot be counted on for operation every day in the year; therefore, a supply tank as large as deemed advisable is needed.

The supply tank may be partly above ground and partly underground and should be accessible for inspection either through a tight-fitting wooden lid or through a manhole if the tank is a large one. There will be little danger of freezing since the tank will be only partially full, and there will be an air space between the water and the top. A further protection from cold may be provided by a covering of barnyard manure or closely-packed straw placed on canvas spread over the tank. If the tank is located below the pump, there should be a check-valve in the pipe between the supply tank and the pump to prevent the return of water to the tank.

In altitudes below 7,000 feet a pump will lift water about 18 feet. In theory the lifting power should be considerably greater, but friction in the pipe line will lessen the amount of lift and the longer the pipe line the more friction is involved. As the altitude increases, the water-lifting ability of a pump decreases. For sources of water too deep to be reached by the pitcher pump, the cylinder must be lowered.

If no pump is used, the supply tank should be 5 to 10 feet above the faucets in order to give a fairly good pressure. A supply tank may be kept filled by means of a windmill-operated pump, a small engine, or by a motor if electricity is available. A galvanized pipe one-and-one-quarter inches in diameter which leads from the supply tank to the house will furnish water for the operation of the pump.

Select Pump Carefully.—The exact kind of pump needed is determined by the source of the water, its depth and amount of water obtainable; the maximum amount necessary; the distance from which the water must be brought from pump to supply and then to house, and the difference in height between these points.

Complete pumping units equipped with electric motor or gasoline engine, and different drives are available to meet varied conditions and requirements.

An estimate as to the size of motor to meet specific requirements should be made by a reliable firm handling pumps.

Cisterns.—There are many times when it is necessary or advisable to store water for daily or emergency use. This is
especially true in Colorado where ground water is frequently hard; in cases where it is necessary to go to great depth in digging wells making the cost almost prohibitive; and in seasons of drought when streams and springs from which water is procured run dry.

For these reasons, cisterns are used in many parts of the state. A cistern is really nothing more than an underground tank for the storage of water. Such tanks are usually made of concrete. They may receive water from a spring or may be filled by water brought from nearby sources or towns. In some cases rain water is collected and a common sight in many areas is the rain barrel set under a spout bringing water from the roof and gutters on the houses. Water obtained in this way is far from clean, and again in drought areas rain may fall through dust-laden air and thus become contaminated. To obviate dangers of pollution, it is necessary that filters be used.

If rain water is collected in a barrel, a filter may be provided by layers of gravel on the bottom, topped with about 15 inches of sand and the same depth of water. It is a good plan to filter the water in a separate vessel and then allow the pure water to pass to the cistern through a small pipe from the bottom of the barrel. After the cistern is filled, the filtering material should be exposed to the sun and air for purifying or be discarded entirely.

**Cistern Construction.**—In constructing a concrete cistern, a round excavation should be made 1½ feet wider than the proposed diameter of the cistern and from 1 to 1½ feet deeper than the desired depth of the tank.

A cylindrical form of boards is then built inside the excavation and far enough from the sides to permit the construction of 6 or 8-inch concrete walls. The top of the cylindrical form should be about 4 feet below the surface of the ground.

When the soil is sufficiently firm the concrete can be plastered directly onto it to a depth of from 2 to 3 inches and an acceptable cistern made.

The top of the tank is then sloped to a manhole directly over the center of the large cylindrical portion. To accomplish this, fit planks over the top, bracing them well. Cover this flooring with canvas, then pack with sand or wet earth in a cone shape. The shape of the cone should allow a diameter of at least 2 feet for a manhole 1 foot above the ground level and directly over the center of the cistern. Before the concrete is placed on the sides of the cone a thimble should be inserted in the top.
Place the concrete directly onto the sides of the cone to meet the lower portion of the cistern, tamping it to the same thickness as the walls of the cylindrical portion. It should be well tamped to reduce the possibility of air pockets which might cause leaky concrete.

While the concrete is still green, trowel on a coating of grout in the proportion of 1 part of cement and 1 part of clean fine sand. This coating should extend well over the joints of the top and sides. It will make the top waterproof. The same mixture may be used on the inside of the tank to waterproof it.

**Water Softeners.**—In many localities, water takes up salts of magnesium and calcium from the soil. These salts make the water hard and when soap is used with hard water, it does not form a lather, but instead unites with the salts, forming curds. If a sufficient amount of soap is used, the hardness will all form into curds and when the curds are removed, soft water is left. This, however, is an expensive way to soften water.

Hardness which may be removed by boiling is known as temporary hardness; that which cannot be removed by boiling is known as permanent hardness. Certain alkalies and salts may also be used to soften water. The most common of these are borax, ordinary washing soda, and tri-sodium phosphate. Borax is too expensive to use except for small amounts of water in cleansing the skin or in washing delicate fabrics. Washing soda and tri-sodium phosphate are satisfactory softeners. If these softeners are dissolved before adding them to a large amount of hard water, the water will be softened more quickly, and, if the water to which the softening solution is added can be heated beforehand, the action of softening will be speeded up. Soap should not be added until the softening process is completed.

The most satisfactory method of obtaining soft water for the home is by the installation of a commercial water softener, which softens the water before it gets into the house water system. Such a softener should be placed between the supply tank and the outlets in the home. These softeners contain an artificial zeolite which is known as permutite. This attracts the salts of calcium and magnesium, leaving the water pure and soft. Commercial softeners are in the form of tanks varying in size according to the hardness of the water and the amount of water likely to be used.

Tanks for softening water contain an amount of zeolite definitely gauged to suit the degree of hardness found in an analysis of the water.

The large water-softener tanks work in conjunction with a
second tank containing salt and brine. Softeners are usually chosen of a size to supply soft water for one week. After this time, the softening process stops, until the zeolite is conditioned or has the calcium and magnesium salts washed out by flushing the zeolite with the brine. The zeolite will last for an indefinite period when treated in this way, and water softened by zeolite is pure for drinking purposes. Considering the labor saved, a water softener large enough to care for the water supply of a family is a good investment.

There are also on the market, portable water softeners which may be attached to faucets. These contain a sufficient amount of zeolite to soften about 100 gallons of water, after which the zeolite will need to be conditioned in the same manner as in the larger softeners.

**Septic Tanks.**—The proper disposal of household wastes is a matter of vital concern to farm homes. The installation of a complete water system should be followed immediately by some means for the disposal of waste. When there is no public sewerage system, the septic tank is the best, and practically the only sanitary method of handling this difficult problem.

The difference between a septic tank and a cesspool is that a septic tank is permanent in its operation, while a cesspool may become filled, and cause clogging of the surrounding soil so that a new cesspool has to be constructed in another location. Unless this is done, the liquids from the cesspool will percolate through the soil carrying with them matter which may contaminate water supplies.

Briefly stated, a septic tank is a water-tight box or tank made of a durable material like concrete. This tank acts as a settling chamber in which, by the action of certain bacteria which thrive in the absence of light and air, the solids in the sewage are changed to liquids and gases.

The gases leave the tank through a vent in the cover or the tank may be ventilated through the soil-stack which is installed up through the roof of the house. The liquids, known as effluent, are comparatively clear and colorless when discharged from the tank, but nevertheless, they contain a large number of harmful germs. Therefore, the disposal of the effluent is a matter of much importance.

The particles of the solids not acted upon by the bacteria settle on the bottom of the tank and remain as sludge, or accumulate on the top forming a thick scum or mat and aiding further in the exclusion of light and air from the bacteria.
To permit satisfactory bacterial action, the contents should remain in the tank not less than 24 hours, consequently a septic tank should be so planned and constructed that the passage of wastes will not be too rapid.

Location of Septic Tank.—If possible, the tank should be located 20 or 30 feet from the foundation of the house. This should be regarded as the minimum distance since, if for any reason the tank fails to operate properly, there will be little danger of odors reaching the house. On the other hand, the tank should be located as near the house as advisable in order to shorten the intake sewer as this is a place where clogging is likely to occur.

The tank should be located somewhat downhill from the house and at least 50 feet from the source of the water supply. If possible, place it away from roadways where there is likely to be much traffic over sewer and distribution lines. A lawn where there is no traffic is a good place for a septic tank.

The top of the tank should be slightly below the ground level so that it can be easily covered with earth. This will place the outlet 15 to 18 inches under ground which has proved a desirable depth when good conditions for soil drainage exist, but deep enough to allow for plowing and cultivation of the soil.

In cases of occasional excess surface water, or when a high watertable exists, it is best to have a tight cover with protruding manholes since excessive dilution of the contents may stop necessary bacterial action in the tank. For this reason, also, strong disinfectants should never be allowed to enter the sewage.

Construction of Septic Tanks.—Single-chamber tanks, such as illustrated, are the simplest to construct. The size of the tank is of great importance as the liquid is still by a large tank as well as by the positions of the intake and outlet, and by the use of baffle boards which are a help in preventing currents that might carry solids over in suspension. The passage of any solids into the drain would cause clogging.
The tank should be sufficiently large to contain the output of sewage of any one day allowing for times when the amount is large. As a rule, the capacity of the tank should be enough to allow for 4 cubic feet below the outlet pipe for each individual in the family, taking into consideration the accumulation of sludge in the bottom of the tank and the extra number of people who may be in the family occasionally. It is false economy to make a septic tank too small, as the saving in materials is negligible; moreover, a large tank will need cleaning only at very long intervals. It is, therefore, recommended that a tank large enough for ten people be installed for even moderate-sized families.

The following table gives suggestions as to capacity of septic tanks needed to serve farm families varying in size.

<table>
<thead>
<tr>
<th>Number Persons Served</th>
<th>Inside dimensions</th>
<th>Gallon capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length</td>
<td>Width</td>
</tr>
<tr>
<td>7 or less</td>
<td>6 ft.</td>
<td>3 ft.</td>
</tr>
<tr>
<td>10</td>
<td>7 ft.</td>
<td>3 ft.</td>
</tr>
<tr>
<td>14</td>
<td>8 ft.</td>
<td>3 ft.</td>
</tr>
<tr>
<td>21</td>
<td>9 ft.</td>
<td>4 ft.</td>
</tr>
<tr>
<td>24</td>
<td>10 ft.</td>
<td>4 ft.</td>
</tr>
</tbody>
</table>

Having decided on the position and size of the tank, before beginning to excavate, make a frame of boards the size of the outside dimensions of the tank. The corners of the frame should be absolutely square. Place this frame on the ground in the position which the tank is to occupy. The excavating should be done just inside this frame, and of sufficient depth so that when the form is lowered, the top of the form will be not less than 18 inches below the ground level.

In many cases, it is planned to use the sides of the excavation as the outer form; therefore, they should be kept as perpendicular as possible, checking up occasionally with a level. If the soil is very crumbly and will not hold up, the excavation will have to be made large enough so that an outside form 5 to 6 inches larger on all sides than the inside form can be used. The concrete is then placed between the forms. The illustration shows the inside form.

The sheathing is of inch lumber surfaced on one side. Generally, enough old lumber can be secured on the farm for this purpose. The use of 2-by-2 inch pieces in the corners aids materially in removing the forms, and makes it possible to use them over and over again in one community.
Use 2-by-2-inch material for inside corners with double-headed nails driven from the inside for attaching to the boards. Instead of lapping the boards at the corners let them just meet, filling in the corner with quarter-round, as shown in detail drawing in the illustration. The 2-by-2-inch corner pieces should extend 3 feet above the box. Cross pieces are fastened to these four corner pieces and thus the form is suspended in the excavation with possibilities of adjustment.

The sides of the form should be braced in the middle to prevent them from being forced out of line by the fresh concrete.

Grooves for the baffle boards are made by attaching 2-by-3-inch strips nailed to the outside of the form with 4-penny nails. If the edges of the strips are beveled, they are more easily removed and less apt to injure the green concrete when removed.

Grooves for the cover slabs are made by nailing 1-by-2-inch boards on the outsides of the side-wall forms flush with the top.

A hole should be made in the center of each end at the proper height for openings for the intake and outlet both of which should be of "Y-branch" sewer tile. The best method is to hold the end of the tile against the form in a desired position and mark around it with a pencil. Then with a keyhole-saw
carefully cut a hole the exact size of the tile. This is done before
the form is lowered into the excavation. The tile should be in-
serted in the holes and the concrete placed so a close contact is
made between the tile and concrete.

To prevent sticking of the concrete to the forms and make
it easier to remove the form, all surfaces which will come in con-
tact with the concrete should be well greased. Oil from the auto-
mobile crankcase may be used. It is applied with a swab or
whitewash brush. Forms should be cleaned and re-oiled before
being used again.

How To Mix Concrete.—In mixing the concrete use not over
6 gallons of water to 1 sack of cement. To this paste add sand
and gravel and mix well until the concrete is of a quaking con-
sistency. If the sand is wetter than merely damp, not over 5½
gallons of water to the sack of cement should be used. Since
the concrete should be placed within 45 minutes after mixing,
the form should be lowered and ready before the concrete is
mixed. The septic tank should be reinforced by several lines of
small steel rods which extend around the entire tank.

The floor of the tank is placed immediately after hanging
the form in the excavation. It should be about 6 inches thick.
It should be deposited in layers, smoothed with a spade or trowel
so that it will fit all corners, and should be well tamped. After
the floor has been allowed to set for an hour, the concrete walls
are placed, making them 6 inches thick.

Cover Slabs.—Not the least important part of a septic tank
is its cover, which should be made to fit closely. The most satis-
factory covering for a septic tank consists of a number of con-
crete slabs, each one fitted with iron lifting rings or handles.
The best place to cast the cover slabs is on the tank in the posi-
tions which they are to occupy.

To provide a level foundation for the slabs a number of
planks should be cut to fit in the grooves, and placed loosely but
flush with the top of the tank. To prevent the concrete from
running over the edges, planks may be placed in the ground
around the outer edges of the foundation, but close to it. They
should extend sufficiently above the foundation to allow for
placing the concrete to a depth of almost 4 inches.

The concrete should be of the same consistency as that used
in placing the form itself. The boards and top of the walls
should be covered with building paper or newspapers before
placing the concrete. If a vent in the tank is desired, place a pipe
coupling in the concrete of one of the slabs. Later on a pipe of
the right length may be screwed into this coupling. The cement
top should be divided into slabs approximately 1½ feet long and
the width of the tank. The divisions may be made by doubled
strips of building paper, tin or thin boards. The cover slabs
should be reinforced by 3 steel rods placed lengthwise near the
underside of the slabs. After the concrete is hardened, lift off
the slabs, remove the boards and replace the slabs.

**Distributing System.**—The distribution of the out-flow
from the septic tank is every bit as important as the construc-
tion of the tank itself.

The most satisfactory method of disposal of the liquids is
by means of a pit located not less than 10 feet from the outlet
of the tank. The pit should reach to gravel, and be filled with
boulders or coarse gravel. The liquids will drain through this
and leach away.

If such a pit is not possible, distribution lines of drain-tile
may be laid leading directly from the tank. The tiles should be
in a continuous line, with the joints about 1/8 inch apart. The
line of tile should be near enough to the surface of the ground
so that the liquids may be absorbed in the top soil, that portion
of the ground from the top to about 20 inches or more below the
surface.

The length of the tile lines will depend on the character of
the soil, whether it will absorb the liquids rapidly or not, and
on the amount of sewage. In some kinds of soil, an allowance of
30 feet of tile per person in the family will be adequate, while
if the soil does not absorb rapidly, more tile will be required.
The appearance of sewage on the ground is an indication that
the amount of drainage tile is insufficient.

In digging the trench for the tile, a slight slope is desir-
able. The trench should be of a depth so that the tile will be
about 18 inches below the surface and the ground may be plowed
over it. If cinders or gravel are placed in the trench around the
tile, absorption will be increased.

Since the joints of the tile are open, tar paper should be
placed over the top halves of the joints before the trench is fill-
ed in.