Clear Creek

Gravity Feed Water Supply

by hugh eliot

How Much Water?

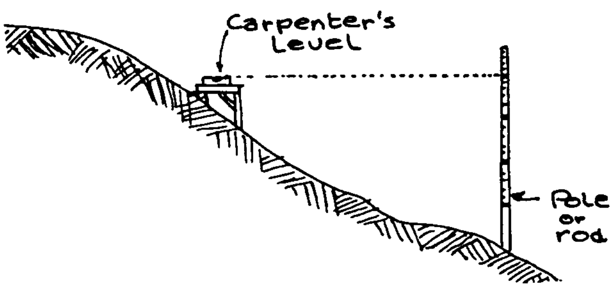
After access to a homesite, a water supply is next in importance. Electric power and telephone are relative luxuries. Just as we assume that access means by motor vehicle, in these days a water supply means a piped supply. In B.C. in particular there is often a supply of good water at a higher level than a house site. To help those who want to install their own gravity supply, I will try and deal with some of the problems involved and state in a simple way the laws of hydraulics involved. I assume the problem is to obtain water from a stream and that plastic pipe will be used.

How much of a supply do you need? To run a sprinkler with a 30 foot radius and still be able to fill a bath without interfering with either operation . . . 10 gallons per minute at 20 lbs. per square inch. Is it available? What size pipe should be used? How deeply should it be buried?

The Survey

To get any answer to these problems you have to find out the distance from the source to the site and what the difference in level or head is. First go over the route. Determine its direction and mark it out with stakes. Where it goes through bush, slash a line of sight. To measure the distance use a steel tape or a piece of wire 200 to 300 ft. long. Put in pegs each time the wire is moved along a length, marking the pegs with the distance.

On a preliminary survey the relative heights of the source and the site might be taken off a map if a large one is available. The best map is one which is scaled one-half inch to the mile with 50 ft. contours. It will help to check with your own survey. This can be done with an 18 inch carpenter's level and a 15 to 20 ft. pole. The pole should be marked at one foot increments, as well as a highlighted marker every five feet. The process involves setting up the level on a box or table. Make it level and then site along to the pole at a 100, 200 or 300 ft. distance. The person holding the pole can help by pointing to the bars with another stick, clearly identifying the bar sighted. The level can then be set up at the foot of the pole and the pole moved further down the slope. The process can be used to find the relative level of the site below the source, adding all the steps together. In the preliminary survey it will be sufficient to determine the gradient in per cent of each stretch of the route where it is seen to change. Multiply the distance on the ground by this percentage and then add up these drops. Check them against altitudes on a map. For example: if the level is 2 1/2 ft. off the ground and sights to the 14 ft. bar, the difference in level between the two points is 14 minus 2 1/2 or 11 1/2 ft. If the distance between the level and the pole is 120 feet, the gradient is 11.5/120 x 100 or 9 per cent. With care, this kind of survey could yield all the data necessary to know if the system would work and what it would cost. The length of the route is the sum of the sections. The drop or head available is the drops in each section. The average total gradient as a per cent is the total drop over the total distance times 100.



Necessary Pressure

What will the pressure be at the house? What should it be? It should be at least 20 pounds per sq. in. to come out of domestic fittings so that you don't have to wait a minute to fill a kettle, and half an hour to get a bath. Each pound per sq. in. is the result of 2.6 ft. of head or drop in the supply line. To produce 20 p.s.i., you will need 52 ft. of head but that will only be the static head. As soon as you turn a tap on and start drawing water the pressure drops. How much? It depends on the size of the pipe and rate of flow. It is stated in tables as the loss of head in ft. per 100 ft. of lengths of pipe for different rates of flow. A table (available from the manufacturers of plastic pipe) would show that for a flow of 10 gallons per minute there is a loss of 2 ft. of head or .8 of a p.s.i. If the drop in your line is only 5 ft. per 100 ft. of run, 40 per cent of your pressure will be lost in friction. If your line is coming down a mountain on a 25 per cent gradient the loss will be only 2 ft. in 25 ft. or 8 per cent of the head.

Choosing Your Pipe

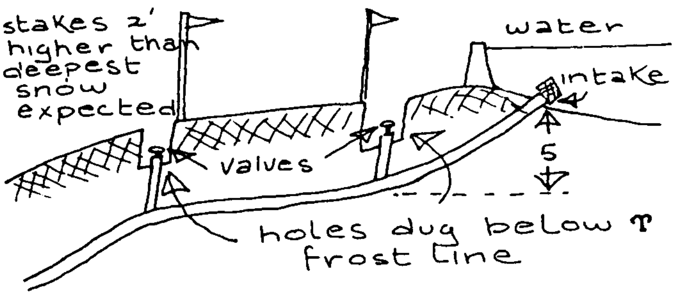
It's said lightly that the way to choose the size of pipe is to decide on the largest pipe you can afford, borrow some more money and get the next largest size . . . then you'll have the proper pipe. Pipe cannot be too big except for its cost; and the fact, for a given wall thickness, as a pipe gets larger the pressure it will withstand gets smaller. As a rule of thumb figure for a preliminary survey, I would suggest that for a line to a single homestead with some garden and a lawn, if the overall gradient of the line is around 5 per cent, the pipe should be 1 1/2" inside diameter; around 10 per cent gradient, 1 1/4" i.d.; over 20 per cent gradient, one inch pipe if it will withstand the pressure involved.

There can be two regrets after laying a water line, both quite futile . . . the pipe is not large enough and in the colder climates, the pipe is not buried deeply enough for winter temperatures. Skimp on burying a pipe and you'd better build an out-house. Nothing goes out of commission quicker than indoor plumbing when the water freezes. Listen to the more conservative estimates of necessary depth. Relative savings can be made where a pipe is in bush but where pipe is under a road or footpath, or wherever snow might be removed or packed, bury it the maximum depth for the area. Keeping water running to prevent a line from freezing is not very practical. Too many accidents may happen. It's also wasteful and illegal to use water this way.

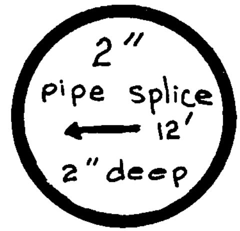
Other common practical problems are: (a) assuring enough water over the end of the pipe at the intake to fill it at all levels of the creek, (b) getting rid of dirt in the water. The theory of getting rid of dirt is very simple . . . much theory is. Fast moving water can carry dirt. Standing water will drop it. So water should stand nearly still for a time before entering the pipe. That means storing a hundred gallons in a tank, pool, or ditch with a very slight drop. Whatever the arrangement is, it must not freeze and there must be some arrangement for flushing out the material that has settled out. None of these things are easy to arrange when obtaining water from a creek at the bottom of a narrow steep ravine. That is the kind of a creek that will be heavy with silt when it's in flood. The common approach to such a creek is a trail, sloping uphill very slightly, bulldozed into the hillside. Bulldozing is expensive; 10 to 15 dollars per hour. Sometimes this much of a capital cost can be shared, as well as parts of pipe trenches to different homes. That begs the question why not a communal water supply . . . which gets into social, legal and economic engineering. The behavior of people over water is a far more complicated business than the behavior of water itself.

Air in a pipe obstructs flow of water. There should be valves all along the line to release air, especially if the route is a series of humps and dips. It is best that a route should slope uniformly downhill but where the terrain is irregular, the line will work if there is an air bleeder at the bottom of each dip or at least at every splice between 300 ft. lengths of pipe. A bleeder in its simplest form is a T instead of a sleeve joining two lengths of pipe and a hose valve on the branch line; this installed in a frost proof hand hole and marked with a stake higher than the deepest snow expected.

Another simple but important point: where a pipe leaves a creek along an almost level trail cut in the hillside, try to arrange that there are a few feet of head immediately after the water enters the pipe. Locate your intake works 5 feet vertically or 50 feet of pipe on a 10 per cent grade from the beginning of the level stretch. Put a bleeder there and at the next splice down the level stretch.



Remember that your bleeder points are test points. When there is trouble with frost, dirt, or air, you may be able to recover your shortcomings as a hydraulic engineer with the bleeders. Put durable markers to show the location of the pipe and/or splices. It may be years before you or someone else wants to know where it is. I suggest that you bury a number of one gallon cans of concrete flush with the ground. Inscribe in the wet cement pertinent information about the pipe.



Some consideration **before** spending money on a water supply:

(1) See the government department concerned with water...how much will they allow you to take from the creek. What are the requirements to obtain a license. In my experience Water Rights engineers are very helpful even beyond information about official requirements.

(2) Find out the history of the creek from old inhabitants. Does it ever dry up? Does it flood badly?

(3) Is the creek water fit for drinking. Is it likely to become polluted. Is there building land for sale upstream.

(4) Laying a pipe line... legal, personal, engineering, financial... what are your rights. Are your neighbours agreeable. Are they interested in sharing the cost of a ditch and intake works. My experience is that people are able to share these items but not the pipe itself. Everyone lays their own pipe. As the neighbourhood develops and the land gets sub-divided it becomes a plastic spider web...one reason for putting in precise durable markers showing where **your** pipe is.

(5) Digging the ditch...get estimates from back-hoe operators and consider with them the possibilities of hitting rock, other pipes and buried cables. Get permission and the requirements for crossing a public highway. It generally requires an outer steel pipe to be buried at a depth specified by the highway department.

Chuck Valentine, a neighbour of Hugh Eliot, has also hasseled with homestead water problems. Here he comments upon Hugh's article and relates a few of his own experiences.

v.m.

I feel 20 lbs. per square inch static pressure is minimal. Try for 60 to 80 lbs. if you can. Once you start gardening a homestead, demands for water will grow from year to year and a dry spell brings all the demands at once. Every valve you turn on drops the pressure due to friction losses in the pipe. Modern faucets are designed for higher city pressures and let little water through.

While Hugh's survey method will work well, I find it cumbersome. It almost takes two people to sight a carpenter's level in the bush, and someone must carry the rod too. A method I always use is quite accurate enough for a home water supply:

Buy a small, cheap hand level, now $8.79 in Simpsons-Sears catalog, no. 09 30 32050T (on the surveyors' instruments page). Measure the height of your own eye while standing erect on the ground. Start at your housesite and follow any route that will take you to your intended intake point at the stream. You don't have to follow the route of your pipe, which may be inaccessible at this planning stage. Sight horizontally through the level to any object on the ground that you can identify and stand on a rock, stick, tuft of grass, child's hand or foot. Then walk and stand there and sight again. Each sighting will take you one eye-height higher. When you reach your intake point multiply number of sightings by eye height and voila! you will have the height of your intake above your house. Then lend the hand level to anyone else who needs it. My $4.00 hand level has been used for 18 years in our community this way. These levels have a bubble, a little mirror set at 45 degrees to see the bubble, a small peep hole and a cross hair. To use them, just line up the bubble and the cross-hair (which appear side by side) and see what you're looking at. Certainly accurate within 5 percent, probably better. Also good for levelling post and beam buildings, irrigation ditches and drainage trenches.

The figure for head or drop to produce each pound per square inch pressure is 2.31 ft.

Hugh's figures at the end of paragraph "Necessary Pressure", as he says, are dependent on size of pipe, but he doesn't say what size pipe he refers to. Take them as a general idea of losses to be encountered, not to calculate from.

Without specifically checking his figures I agree from practice here that 1 1/4" and 1 1/2" plastic pipes are suitable sizes for 10 percent and 5 percent gradients. Never go smaller than 1" for most purposes, and even that is questionable.

Don't miss that important point about arranging some drop in the pipe first if you have to go near-horizontally out of the creek canyon. It's very hard to start water through a near-horizontal pipe. Regarding bleeder valves along the pipe route, I've never seen this done but would think they should be at the high points if they are to let air out, not at low points. Air rises and it's hard to get it out of the high points.

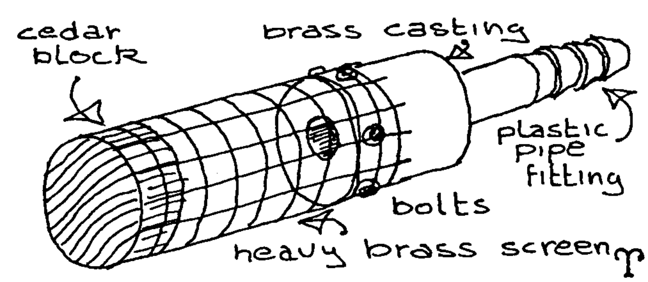
Do check the pressure range of your pipe before you buy it. If you have to have high pressure, over 80 pounds, buy heavier strength pipe for that portion of the line, not a smaller size. Avoid having the larger sizes of plastic pipe (1" and over) lying on the ground in the hot sun with water pressure in them and no water flowing. Then they can heat up, weaken, expand, and perhaps burst.

By the way, don't take that lightly about borrowing money to buy the next larger pipe than you can afford. I wish I had followed that advice myself.

When burying plastic pipe, cover it first with fine material and be careful not to have large rocks over it: they could collapse it later. Best also to fill the pipe with water before backfilling for strength and pre-shrinking.

Intake filters

My intake is quite makeshift but seldom requires a trip to the creek. I formed a 5" cylinder about 16" long out of a piece of very heavy brass screening I found on this place. I bolted one end to an extremely heavy brass casting I found (using brass bolts) and plugged the other end with a circle of cedar board, nailed on. The casting, probably a packing gland for an inboard propeller shaft, had a hole the right size to take a plastic pipe fitting! Then I wrapped the whole thing with brass mosquito-size screening, clamped on with stainless-steel clamps meant for 5" plastic pipe. I simply dropped the heavy thing to the creek bottom and kept it from washing downstream by driving a piece of drill steel into the creek bed.



Some sand and sediment leaks through this and it was always a nuisance, so for the main house I ran the entire supply through an old hot-water tank (or "range boiler", the type that connects to a waterfront on a wood-coal stove) 12" in diameter and 60" high. Plugging the side holes, I cut off the filler pipe so that it extends only halfway down the inside of the tank from the top. This throws the dirt to the bottom of the tank at rather high speed, but the water rises slowly through the 12" tank to the outlet at the top, leaving the sediment behind. Works quite well. Needs cleaning about twice a year.