I Want To Drill a Well To Irrigate My Yard

Part of a series of documents created by Tim Guishard Enterprises discussing relevant subjects in the groundwater industry.

This document discusses some facts and myths about wells and how to determine just how much water you need to get in well production to operate your irrigation system. As well as information about sizing water storage tanks and pumps to efficiently make your irrigation system work.

WATER STORAGE SYSTEMS
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I want to install a well to irrigate my yard, because my water bill is "THROUGH THE ROOF". What is the cost to drill a well?

We in the Groundwater industry get this call a number of times each year. There is not an easy answer to this question. All wells are not the same. Some might be deeper or shallower than others. One might produce more or less water than a well just a few feet away. Some have unanticipated treatment costs. Some irrigation systems might need a storage tank and booster pump system to meet the pressure and volume requirements of the irrigation system.

Some well and pump facts (and a few myths):

Let me first state: Many of the facts below are relevant to wells constructed in fractured rock located in Southern California, and may not be relevant for a well located in any other type of formation or location.

FACT: No well will last forever.

Wells are affected by so many factors; it could take several pages to discuss them all. I will discuss a few below. Wells constructed to keep the initial price low, will typically only last less than 20 years. Quality wells, that are designed for longevity might be 2-times more costly today, but will not need to be replaced for 40 years or more.

FACT: Just like local droughts affect surface water or streams, droughts effect wells usually in a time delayed fashion.

Rain today, may mean groundwater several years down the road. A drought today may not affect a well for many years later. Studies have computed that water only travels about 1-2' per year into the formation. Your 500' deep well is producing water that fell on the ground 500- 1,000 years ago!

FACT: No well is sand free. No matter how much you spend on getting a well drilled, it will never be sand free. Frequently property owners only look at the price when choosing their well driller, and choose the lowest price. To compete for price; drillers cut corners and omit development or set shallow steel casings in their well construction estimates. Both of these factors affect the final outcome of a well. Add in Mother Nature that likes to throw in her 2-bits, and now you have a recipe for disaster.

The driller may not want to increase his price, because you are on a tight budget and may not even drill a well if it gets too costly. If he comes back for a change order, you think the driller is trying to take advantage of you. Well drilling estimates should never be compared by the price-

per-foot. Drillers are at fault here for quoting by the foot, and not by the actual time and materials needed to properly construct a well.

If a well only has 20' of casing, it most likely is not cased into really hard rock, and may even start to collapse during drilling. Too many times, drillers think that the well is collapsing down deep, when the problem is really just below the bottom of the casing. I highly recommend having a video survey before a "liner" is installed in a new well. It is much better to add more casing than install a liner. Once a liner is installed, the well cannot be deepened in the future.

AGAIN: No well is sand free!

Sand also wears out your sprinkler heads, causing them to consume more water, which lowers the pressure, decreases the irrigation efficiency, and increases the maintenance costs. Likewise, sand wears on the pumps as well, increasing maintenance.

FACT: Many wells will need borehole maintenance just to keep providing water. Water chemistry like hardness, or microbiology like Iron Reducing Bacteria, will plug a well.

Chemical intervention is needed to restore capacity. For cost reasons in today's marketplace, chemical intervention is costly. However if you only have one place for a well, and it can be brought back up in capacity, this might be a viable option.

FACT: The pressure variations that are inherent to all submersible and booster pump systems when controlled by a pressure switch will decrease the hydraulic efficiency of the irrigation system.

When the pressure varies by 20 PSI or more as needed for the pressure switch to work, or the water levels in a well change (reducing pump output by 50% or more), these are transferred to the irrigation system. This is especially troublesome if a pump is oversized or the well is deep. VFD or Variable Frequency Drive technology improves the pump system efficiency and makes the pressure more stable so that irrigation systems work more efficiently, within the capacity of the pump. A VFD is like a cruise control for your pump.

FACT: Not all pumps are created equal. Pump efficiencies vary by model and manufacturer.

One should not choose a pump by HP and price alone. The buyer should choose a pump by the: electrical, and hydraulic, efficiency that can described as GPM @ Total Dynamic Head (or pressure in PSI) combined with the motor's horsepower and electrical efficiency. Frequently the more efficient a pump is; the motor HP can be lowered, resulting in a lower cost for the electricity to operate the pump in the long run. We also have what are known as PREMIMUM EFFICIENT motors available, and these motors can save several KWH over a standard motor. Since KWH is what your electric bill is based on, the savings are directly impacted.

MYTH: Bigger is better when it comes to motors! The reality is:

Larger motors cost more to buy. Larger motors, on most household power supplies, have shorter life spans than smaller motors on the same power supply. Larger motors consume a lot more energy to get started than a smaller motor. Larger motors that are not worked at their design capacity consume more KWH than a smaller motor that is worked at design capacity. This is kind of like putting an 8-cylinder motor in a compact car. A certain amount of gas is needed just to get the large engine to idle.

MYTH: A bigger pump is better than a small one! Again the truth here:

Larger pumps cost more to buy. Using a larger pump than is needed, is like applying the brake on your car instead of letting off the gas, when you need to go slower up a hill. You are only wasting energy. If the pump is controlled with a pressure switch, the bigger pump will turn on and off more frequently, which is like traveling in stop and go traffic. The pressure variations significantly affect the irrigation efficiency again.

MYTH: A VFD will reduce power consumption, even on an oversized pump system. There is also some truth here!

However since the larger pump and motor take more energy just to idle, putting a VFD on an oversized pump will not be as efficient as using a property sized pump and motor. This would be like one person taking a bus to work, when they only need a mid-sized sedan or maybe even a compact car.

MYTH: Well water is free!

While the water you get today might be free, the cost to drill and equip the well in the first place, the electricity to pump the water, and the costs to maintain the pump/ well/ and related components, is not free. If you hire a contractor by price alone, you might end up with a well that only lasts a few years. Additionally, there are efforts by people at various water districts that think that by you pumping water out of "their watershed" you are stealing "their water". Be careful, the next time you see a ballet measure that is looking to "protect our rivers and streams" or "some other catchy water, or pollution, related title", as it might be the measure that takes the well (you paid to construct and develop) away from you.

MYTH: The well pump needs to be set at the bottom of the well to get everything the well will produce. OR The drillers log accurately shows how much water the well makes.

While this may be true for a small percentage of wells, this is not the truth for most constructed in fractured rock found in San Diego County. Frequently some water is obtained at very high fractures in the well. The driller and property Owner might be looking for more water production, which is never found. In these cases the well should be backfilled to within 50', or so, of the lowest producing fracture. Then tested for production using a pump and what is known as a "step-draw-down test".

Sometimes water is found in many fractures, all the way to the bottom of the well. Again a step-draw-down test, with a pump, should be conducted.

A step-draw-down test is a test where an oversized pump is installed in the well. The water levels in the well are monitored while pump is turned on and adjusted to various flows based on time. The results are then tabulated and one can determine various data like:

- How much total volume in GPM is really available? *Sometimes the air used to purge the cuttings from the well, and this air will actually hold back some water. When the well is pump tested there is more water at a higher elevation available than the airlift indicated. More often than not, the well driller hits a fracture with a lot of storage, but little recharge and the well reduces capacity after a short time.*
- Where in the well is most efficient? *Pumping from a higher elevation takes less electricity, than pumping the same amount of water from a deeper elevation. Ta higher pumping level can allow a smaller pump to be installed, which also allows using smaller wire, saving money at the time of installation and future maintenance.*
- What will the pumping level be? *Pumps are designed to work within a set of specifications. Work outside these specifications, and the pump may cavitate, have excessive up-thrust, or continuously overload the motor, causing the pump or motor to fail prematurely.*

Follow a step-draw-down test with a constant-rate test, and one can determine the effects of long term pumping. This test has shown that many wells cannot sustain long term pumping at a rate shown on the drillers log, and can predict the well will go dry after days-weeks-months. It also can show that at a specific pumping rate and you can pump the well 7-24 without worry (assuming there are no external factors added in later, like another well being drilled that is on the same fracture!).

Myth: I need a 10,000 gallon tank to have enough water to irrigate my yard.

While this may be true for a small amount of people, in fact most yards only need a tank that is 1000 to 5,000 gallons.

Get out a water bill, for a winter month like January where no irrigation should be occurring. Compare this to a bill from the summer months like August. These bills will show how much water was used during a specific time period. Subtract the winter use (usage not dollar amount) from the summer use, and you will get a quantity of water very close to your irrigation needs. Divide that

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number by the days between readings on the summer bill, to get an average daily use. You may need to convert the number from CU/FT of water, or units, into gallons. Most water bills in our area are reported in units of 100 CU/FT. If this is the case on your bill, multiply the number of units by 748 to get gallons. ***Now you have how many gallons you use per day, and a tank any larger than this is a waste of money!***

You can divide the gallons per day by 1440 to get the minimum well yield you will need. (24 hours per day x 60 minutes per hour =1440 minutes per day). Since we rarely want to design a well pump system to run 24 hours per day, divide the total volume by a smaller number like 720 for a 12 hour run time to get you a more realistic well yield. ***Multiply your actual well yield, by the time the irrigation system runs in minutes, and you can subtract this number from the daily usage. The new number is how many gallons of daily usage will need to be replenished when the irrigation system is off. You can reduce your tank size to this new number.***

How to determine how many GPM, and at what pressure, the pump will need to produce to make your irrigation system work:

The next step is to get an average, or better yet the high and low, GPM. There are two easy methods for this:

1. Is to divide the daily usage (from the water bills) by the hours and minutes the irrigation system actually runs. Most residential irrigation systems run between 3-6 hours per day.
2. A more accurate method is to use your water meter. Most meters have a needle that goes around like a speedometer. You need to carefully look to determine what one revolution means. In many 5/8-1" water meters, one revolution is usually 1 or 10 CU/FT. I CU/FT is 7.48 gallons, while 10 CU/FT is 74.8 gallons. Usually the next step is faster with two people, one at the irrigation time clock and one at the water meter. You should also make sure that the required backflow prevention assembly is installed at your water meter, during these tests. You also need to make sure no one uses water in the home while performing these tests!
    a. Turn on an irrigation valve and wait for all heads to work normally. Using a stop watch, check to see how much water is registered on the meter In a 1-minute time period. Record the volume for this irrigation valve.
    b. Repeat this for every other valve in the system.

Once you find the highest and lowest volume, your then need to install a pressure gage at a representative point in your irrigation system to get the pressure needed to size the pump. It is best to test where the well will be connected into the irrigation system. With no water flowing, record the pressure. With the highest volume valve operating, record the pressure. With the lowest volume valve operating, record the pressure. The volumes and pressures should then be re-tested.

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Because of piping, hydraulics, and elevation specifics, this data is not 100% accurate. If the pressures are measured close to the water meter, and the well is going to tie in at this point, these measurements are relatively accurate for sizing a pump.

If the well is going to tie into the far end of the irrigation system, and the pressures are measured there, then there may not be enough pressure to properly operate valves near the water meter. A competent person will need to make some hydraulic calculations and assumptions to get more accuracy. Small irrigation water mains are the greatest area of concern here.

If possible, it is best to connect the irrigation system into what is known as a "looped main", where water is fed to both the meter and far ends of the irrigation system at the same time. You will probably notice the volume and pressure go up on the valves that are farthest from the water meter. In fact you may find too much pressure for many heads, and the heads are now "misting" due to the increased pressure. If the heads are misting, reduce the volume by partially closing one of the valves on the backflow prevention assembly, and recording the new values.

With these values you can size a pump. If you had to turn down the pressure, during the final steps, then these are the values you should use for pump sizing. If you find that you need more than about 50 PSI when irrigation valves are operating, there are most likely issues in your irrigation system that need to be addressed. If you have a static pressure over 100 PSI, careful attention, or design, needs to be taken to prevent the pressure tank at the pump system from being damaged.

MYTH: A well costs less than city water! *I had to increase the font to make the point! While you currently can pump more water with electricity than the same cost of water, you need to calculate into your water cost:*

- *The initial cost of the well.*
- *The cost of maintenance.*
- *The future cost of power/water.*
- *The eventuality the well will need replacement.*

At today's costs for power and water, most residential well owners will never realize a true cost savings by constructing their own well for irrigation. Well water costs much more to produce and maintain, especially if the well is not constructed properly. However if water rationing ever comes into play, then a well can pay for itself overnight by saving your landscape.

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