The Drilling Of The Water Supply Borehole:

In the past, the water borehole (domestic) drilling industry in Southern Africa has had a checkered history. This has mainly been attributed to a combination of the following factors:

- Ignorance of the public about all matters relating to drilling and construction of the borehole and the fact that in the past there were no codes of practice or standards for the drilling industry. This situation allowed poor workmanship to enter and become manifested in the industry. As a general rule of thumb, the cheaper the quote, the nastier the product. This situation was unfortunately perpetuated by the ignorance of the public at large who generally favored the cheapest quotation. This had a two-fold effect, one was to force the standard of workmanship and materials used, down to a lower level so that the contractor using a higher standard of material and workmanship was forced to lower both to compete in the domestic borehole market. The second effect was to support the “cheaper” contractor and thereby perpetuate the cycle of “the inferior product comes at a lower cost”.

**FACTORS TO CONSIDER WHEN CHOOSING A CONTRACTOR:**

- **Does he have a contract?** – It is in your interest to sign a contract that details all the costs that are likely to be incurred. (N.B. A standard form of drilling contract is included in this publication and can be found at the back of the Membership Directory).
- **Insist on the fact that the contractor’s drill rods are straight.** Many of the smaller air drills use light duty drill rods that can be easily warped or bent – it is absolutely essential that your borehole be perfectly straight and vertical or there can be very serious problems with both the installation of the pump as well as its day to day running.

  - Ask him about casing the hole – What sort of casing does he use, in other words, is it steel or plastic and what is its thickness? How much do the various types and thicknesses of casing cost? How much casing does he expect to install and is he prepared to install well screens if necessary?
  - If you choose a driller who is very much cheaper than his competitors, make it quite clear that you will not have him stopping the moment he hits “hard rock” or it becomes too deep. A surcharge could be charged for drilling through very hard rocks, but these rock types are relatively rare, the most common being quartzites, banded ironstones and finally chert (silica) bands that are found in the dolomite areas (this formation requires specialized expertise).

  - Ask him who usually sites his water boreholes and what their past success rate has been like.
  - Ask him about borehole development and how he will try and improve the water yield of the borehole if it is necessary. If he does not understand what you mean by borehole development, you would not be unwise to look for another contractor.
  - Ensure that he provides samples of material of each and every metre drilled.
  - Insist that the driller provide a record of the exact depth at which the most promising water fissure is located. This information is of vital importance to the pump installer so that he can select the correct pump for your needs.
  - Ask the driller about the diameter of the borehole he intends to drill. A diameter of less than 127 mms (5 inches) makes life very difficult for the pump installer. Where possible a final width of 152 mms (6 inches) to 216 mms (8 inches) is recommended, however where very high production boreholes are expected, the diameter may need to be greater than the figures shown here.
  - Ask him about the conditions for water in your area – are they good or bad? – how deep does he expect to drill?
  - You, the prospective borehole owner can also do some investigative work. Ask your neighbours alongside of
you, across the road from you & behind you, if they have boreholes & get information from them as to how deep they were drilled & what amounts of water they yielded.

• Ensure that the driller has the equipment to reach the required depth.

OTHER FACTORS TO BE AWARE OF:

• The drilling contractor can never guarantee that he will strike water and therefore it is the client who is at risk for the cost of the borehole regardless of whether it is wet or dry.

• A modern drilling rig is large and heavy, in urban areas it can cause a certain amount of unavoidable damage to lawns and even badly laid driveways for which the drilling contractor cannot reasonably be held responsible.

• Drilling rigs are noisy and they generally make a great deal of mess; both factors are almost unavoidable. In urban areas therefore, it is not unreasonable to warn neighbours that you are about to drill on your property.

• The local municipality may require that permission be obtained to sink a borehole; The New Water Law of South Africa has all aspects of these requirements laid out – read more under the Water Act section).

• Always ensure that the site chosen for drilling is not underlain by electrical cables, sewerage or water pipes, as the drilling contractor cannot be held responsible if he drills through them.

• The drilling contractor cannot be expected to say that the borehole will cost a net amount of say R00000.000, as there are too many unknowns to consider, such as the borehole’s final depth, the amount of casing required and the time taken for its development.

• The time taken between the borehole being drilled and a pump system being installed is usually measured in weeks rather than days.

• Most drillers levy a surcharge for drilling through very hard rocks, but these rock types are relatively rare, the most common being quartzites, banded ironstones and finally the chert (silica) bands that are found in the dolomite areas.

THE DRILLING & CONSTRUCTION OF A BOREHOLE:

Once the drilling target has been located (by whatever means) the next phase is to undertake the drilling of the borehole. A drilling contractor is approached for a quotation and appointed to undertake the job. As mentioned previously, the client contracts the driller to drill the borehole to a required depth – not to find the water. The driller cannot (and will not) be held responsible for the success of the borehole (i.e., you pay for the depth drilled at the agreed rate regardless of the amount of water or lack thereof).

Most people are under the impression that you just drill and suddenly there is water and that it just depends on the depth. Again the client finds that his knowledge regarding this is inadequate and resigns himself in having to accept the word of the driller. Remember that the driller is being paid according to the depth of the borehole (not the success thereof). Unfortunately this is an area where the client can be convinced into going in “a little deeper and a little more” etc…

Be aware that drill rigs are large heavy (usually in excess of 10 tons) pieces of equipment and do not lend themselves to intricate manoeuvring in areas of limited space. They can also cause damage to lawns and paved areas - for which the driller is not responsible.

3.1 The Drilling Method

The most common drilling method employed today is known as “down-the-hole” air flush rotary percussion. A pneumatic hammer and drill bit operated at the end of the drill pipe rapidly strikes the rock while the drill pipe is slowly rotated. The shattered splinters of rock are removed from the borehole continuously by the air used to drive the hammer. The drilling process is very noisy and can be very messy (either dusty or muddy). Drilling in urban areas is restricted to normal working hours and it is advisable to notify your immediate neighbours (to close their windows) the day drilling is to commence. A domestic borehole can usually be completed within a few hours.

Drilling usually proceeds until either sufficient water is intersected (i.e., successful borehole scenario) or the client’s budget is exhausted.

3.2 Borehole Construction

Boreholes are initially drilled 8.5’ (215mm) in diameter through the topsoil and weathered overburden rock. This larger diameter facilitates the installation of steel casing (165mm). The borehole casing effectively stabilises that portion of the borehole sidewall that is unstable and prone to collapse. The average depth of overburden and hence casing required in the Johannesburg area varies between 8m – 24m. Insufficient casing can result in borehole collapse with severe financial implications for the client (loss of pump, pipes and the entire borehole).

Usually casing is only required through the unstable overburden however high yielding fracture zones, (commonly associated with weathered and decomposed rock) may require that the borehole is cased throughout (tip to bottom). In this case perforated casing (casing slotted in such a way as to allow water in whilst keeping rock out) would be installed opposite the water bearing fractures. The amount of casing required is unique to each borehole and can only be deduced from the results of the drilling.
The primary reason for installing casing is to prevent the loose sidewalls of the borehole from caving in. However, it is also to prevent contaminated water on or near the surface from entering the borehole. Various types of casing are available in Southern Africa today. Steel and plastic are the ones most favoured by drillers. Steel is much more robust than plastic but it does have the drawback of being subject to rusting and corrosion. The thicker the casing, the more durable it will be. When the water-pumped from a borehole is not clear, it usually means that the casing has not been properly installed. If the is drilled in loose, unstable formations, casing must be installed to the very bottom of the hole in order to seal off the sand and the grit.

Casing is either solid or perforated with small holes. These holes allow the water to pass into the borehole so that it can be pumped to the surface, but they hold back the solid particles such as gravel and grit that could damage the pump and block up the borehole.

For high production boreholes to primary aquifers, corrosion resistant (e.g. stainless steel or PVC) screens should be installed adjacent to the water-bearing zone in preference to perforated casing. These screens are much more effective and efficient in allowing the maximum amount of water to flow into the borehole. They are unfortunately much more expensive to install than perforated casing.

Where very soft or fractured zones are encountered, the more competent drilling contractors will flush gravel into place between the perforated casing and the sidewall of the borehole. This acts as a secondary filter to remove solids from the water, entering the borehole. The importance of the use of gravel packing in a successful water borehole in unstable formations cannot be stressed enough.

The surface area around productive boreholes may often need to be grouted with cement or concrete to prevent contamination. Some countries now enforce this practice as a means of standard groundwater protection.

In certain instances, specialist drilling techniques may be required, such as using stabilising foams. However, these are normally needed only when cavens, clay, unstable gravel or boulder beds are encountered during drilling operations. You should ensure that your contractor is capable of coping with these types of difficult drilling conditions.

The concept of borehole development is relatively new in Southern Africa. It involves the opening up or the cleaning out of dirty fracture zones in order to make the groundwater flow more freely. Flushing and surging with high-pressure air is the method most widely used today.

The customer should insist that a 30 minute flushing and surging at least, is undertaken on each successful water borehole. Special chemicals may also be used to remove fine-grained clay particles and improve the water flow.

Sinking a borehole can be a disappointing experience if no water is found and there is usually no reason to blame the drilling contractor. He after all, does not have X-ray vision with which to see into the ground. However, the client should expect high standards of workmanship from the contractor. Perhaps considerations of competence, rather than cost, should guide the client in his final choice of contractor. After all, a water borehole is not simply a hole in the ground.

Competent drilling contractors will provide the client with a drilling log depicting borehole construction, casing types and depths, geology and water strikes. Keep this record in a safe place.

Assuming that the borehole is successful, the driller will 'guesstimate' the yield thereof. The accurate yield of a borehole can only be determined by means of an aquifer test (pumping test). These tests involve installing a test pump and pumping the borehole for a period of time at a given rate (yield) whilst monitoring the drawdown (lowering of water level in the borehole as a result of abstraction).
A SUCCESSFUL BOREHOLE IS ONE THAT HAS BEEN DRILLED STRAIGHT!

Extract of an article taken from the January 1986 issue of the Borehole Water Journal – by Mike Piche’

Looking at this from the customer’s point of view, being the layman that most of them are, we must understand that what the customer ultimately wants is either a lovely green garden which he can be proud of or water for drinking purposes and household use needed to survive on. Whatever reason he needs the water for, the name of the game is that he needs water, not just a hole in the ground; or a lot of dust, or problems, but water in and this particular case, groundwater.

The customer arranges for the contractor to come and drill the hole and another contractor or the same one to install the pump. (They are called contractors because they are contracted to do the job). We should not rely on the customer to tell the contractor where to drill, how deep to drill, how fast to drill, what equipment to use or where and how to install the pump. In exactly the same way you would not be required to tell the garage how to fix your car or the plumber how to fix your geyser, etc. He therefore looks to the contractor for this sort of valuable information and guidance and relies on him for the best expert advice that he can get.

The contractor on the other hand, is expected not to take on any work that he cannot complete, that is, if he does not have the expertise or the equipment or the ability he should not get involved or take on the work. The contractor should also be able to advise his client and recommend what equipment to put in the hole, how deep to put the pump in, how much development work to do, what type of casing to use, etc. He, after all, is the trained professional who does make a living out of the groundwater industry. If he cannot undertake that responsibility, then he shouldn’t be in the business.

There is no way a contractor can guarantee water, but, what he should be able to guarantee is that if he drills a borehole and on his recommendation and evaluation of the drilling samples he will equip the borehole sufficiently straight enough to accept borehole pumps that will not collapse or pump sand for a period of 12 months from the date that it was installed. In other words, all we are asking him to do is guarantee his workmanship.

To help overcome this problem, the Borehole Water Association has drawn up a Standard Form of Agreement.’ (This form can be found at the back of the Membership Directory).

If the SABS Standards are adhered to, all the odd sized boreholes and badly constructed boreholes in terms of the wrong casing, etc will be eliminated and boreholes will be constructed to last for at least 25 years or more rather than 5 years or less. (See elsewhere for information on the SABS Standards for the Groundwater industry).

The best way to overcome any problems that may arise, is to have a means of communicating with each other, and the best means of doing so, is by using an agreement or contract between two parties. Now let’s be quite clear on this point before we go any further, these agreements or contracts are simply a means of communicating instructions between two parties so that they are clear and concise and everybody knows and understands what the contents of the instruction are and at the same time, a confirmation of the pricing and costing of the job is included so that the customer knows clearly what he is going to have to pay at the end of the day and the contractor knows clearly what he is going to have to do in order to be paid at the end of the day.

The BWA has a ‘Standard Form Drilling Agreement form’ which can be found at the back of the BWA Membership Directory, to be found at the back of the Membership Directory.


‘Psst…! Wanna buy a borehole?

How does one separate the wheat from the chaff, the good contractors and suppliers from the bad? Here are a number of guidelines that will give a fair indication of the calibre of businessman with which you are dealing:

How did you come by his name?

A recommendation or advertisement? It is always advisable to ask for references preferably from clients who have had time to assess the quality of work over a reasonable period. Eighteen months ago, I spoke to a new borehole owner. He was then very impressed with the standard of work of the contractor who had just completed his borehole installation. Now he has a very different opinion, however, as problems are beginning to appear.

What is the condition of his equipment?

Clean equipment is a good sign of attention to detail and a prediction for long-term commitments. Many of the so-called ‘fly by nights’ have filthy equipment and ‘cheap’ prices.

Does he use a standard form of contract?

If he does, who drew it up?

The Borehole Water Association has a standard contract that was drawn up to protect both parties. The cornerstone of good negotiating is the creation of a win-win situation. If either party feels cheated the net result is usually not necessarily to the advantage of both parties.

*Does he work to a recognized standard, or do you get the impression that it is mostly ‘off the cuff’?

There are SABS Standards now available for the groundwater industry.

What records does he keep of work carried out?

You may wish to sell your house at a later stage and the borehole represents a substantial capital investment. A driller’s log, construction certificate, yield test certificate, electrical clearance, pump details and commissioning data will be positive

Extract taken from an article in the October 1985 issue of the Borehole Water Journal – by Mike Piche’

‘To case or not to case?

That is not the question. The real question is when to case, how to case and what type of casing to use when drilling a borehole? What happens if the borehole is pumping sand or the pump is stuck in the borehole? Both these problems relate to bad installation of the casing.

In cases where we have drilled a larger diameter hole leaving a large annulus as discussed before, it goes without saying that if you start pumping a borehole of this nature, the water not only empties inside the borehole casing, but will also empty in the hole itself – in the annulus. Every time you switch on the pump you will get an immediate rush of water down the annulus and wondering about the perforations at the bottom of the hole. Unless this annulus is sufficiently sealed or grouted to stop this rush of water, you may incur severe damage to the borehole construction by letting all the mud and clay be washed down and block up the apertures in the perforated casing or alternatively, we may induce a lot of surface contamination, that is, pesticides, herbicides, etc. running down the outside of the casing and then going into the hole.

Then we wrongly blame the groundwater for being of bad quality, but all that has happened, is that there is a lot of surface water running down the side and it is for this reason not only in this type of borehole, but also in the hardrock type borehole that the casing be properly grouted at the surface.

Extract taken from an article in Vol. 7 of the Borehole Water Journal – by Peter Mony

Did You Know?

‘The establishment of borehole water supplies is estimated to have cost South Africans some R200 million in 1984, but also nearly R10 million of this was wasted as a direct result of poor workmanship and inferior materials.’

Footnote:

This Drilling section was put together using information supplied to us by Mr. Derek Whittfield of E.D.M.S. who is also the Drilling Division Head of the BWAA EXCO, and also from the BWAA’s Know Your Own Borehole and Groundwater – Guidelines for Boreholes booklets. Other information used is individually acknowledged.
The Drilling Of The Water Supply Borehole: LAYMAN’S GUIDE

Well - Points as a Water Supply
Extract taken from an article written by Gordon Maclear.

Well-points or tube-wells are small diameter pipes (usually PVC or polyethylene) jetted into unconsolidated sandy or gravelly formations. The bottom of the pipe is slotted to allow sand-free water to flow into the well-point from where the groundwater is pumped to the surface. Well-points are most often utilized for small-scale water-supply or dewatering applications. Depending on the water transmitting capability of the formation, and the capacity of the pump, a number of well-points can be connected most effectively in a ringmain configuration for medium-scale supply (3-15/s)..

The unconsolidated nature of the sand and shallow water-table in the CFAU (Cape Flats Aquifer Unit) make for ideal well-point installation and operating conditions. In Cape Town a large number of home-owners on the CFAU have capitalized on this situation and successfully use well-points for garden irrigation. The installation of well-points for uses other than domestic garden irrigation is highly feasible and strongly encouraged as a water-saving strategy in the GCTMA (Greater Cape Town Metropolitan Area). They are cheap to install and operate, and the potential savings (both in water and capital) are significant as outlined below.

Installation and Operating Costs:
The cost to install a complete operating well-point varies between R3000 and R4000 (including fittings and pump) depending on whether they are installed by the home-owner or by a well-point contractor. The centrifugal pumps, which are most often connected to the well-points, are self-priming and designed for continuous operation with minimal servicing required, resulting in low maintenance costs.

A 1Hp pump connected to a well-point yielding 0.15 L/s produces 1000 L of water (1m3) in approximately 2 hours, utilizing 1.5 kW, at a electricity supply cost of 70c. Whereas 1000 L of water supplied by a municipality costs approximately R4.30 (supply + sewage discharge)*. In this example groundwater supplied by a well-point is 6 times cheaper than municipal water.

*Figures based on September 2006 service charge for water and electricity in the Nelson Mandela Bay Municipality, Port Elizabeth.

The example presented above is, however, a conservative estimate of potential savings since it has been the author's experience that a correctly designed and installed well-point in a transmissive saturated sand horizon, can easily deliver the same or more water than a garden tap, in which case groundwater becomes at least 10 times cheaper than municipal water.

Potential Savings:
Studies carried out by the author show that summertime water consumption reductions of between 60% and 80% are realized in an average middle-income household after installation of a well-point utilized exclusively for garden irrigation purposes. This has resulted in large savings on water-bills and these savings will continue to increase as the cost of water escalates with time.

Enterprising home-owners could install a dual-recirculation system in their house (provided the groundwater pipeline is isolated from the municipal supply), where groundwater from the CFAU is used for all household purposes, except drinking and cooking (& also for filling a swimming pool). This could result in a total saving of 91% on a domestic water bill.

If chemical analysis indicates the water to be hard (causing scaling) or have a high iron content (stains laundry), then water-treatment methods can correct the situation. If water-treatment is not considered to be an economically viable option, then savings of 80-80% on the domestic water-bill can still be realized if groundwater is utilized on the cold-water line for garden irrigation, bathing and toilet flushing.

Conclusion and Recommendations:
In 2005 an increased water conservation and awareness ethic was called for by the Minister of Water Affairs and Forestry. One area in which potentially huge water-savings can be realized in the Cape Town Metropolitan Area is by utilizing groundwater from the Cape Flats Aquifer Unit, especially for irrigation purposes. Groundwater abstracted from the CFAU by means of well-points is cheap, viable and an environmentally friendly water-supply method and will reduce Cape Town’s present dependence on limited surface water resources. Water-savings achieved in this way will assist in realizing the government’s objective of “Water for all”, where purified water presently being utilized for e.g. garden irrigation can be targeted instead for community supply and sanitation.

An urgent appeal is made to all water-consumers who have the financial means to implement water-saving options, such as middle-to-high-income home owners, schools, municipalities and water-supplying authorities in general, to consider the implementation of groundwater supply systems. This will greatly help reduce the pressure placed on surface water resources supplying the Greater Cape Town Metropolitan Area, and the unnecessary wastage of purified water that presently occurs annually in Cape Town for uses which do not require water of such high quality.

Mathias Varinyu, groundwater technician in SRK Consulting's Port Elizabeth office, jetting in a well-point in the St. Francis Bay area, Eastern Cape
BUILDING EFFICIENT PRODUCTION WELLS: THE LONG-TERM PERSPECTIVE ON OPERATING COSTS AND WELL DESIGN

Introduction

A municipal, irrigation, or industrial water well is generally expected to be in service for many years, and should be both efficient and productive throughout its useful life. Under most conditions, these are reasonable expectations if the well was designed and constructed with high-quality materials, i.e., well casing and well screen.

However, an all-too-common scenario is for the owner, designer and/or well drilling contractor to focus a disproportionate amount of attention on the capital cost of the well rather than the long-term cost of its operation. Selection of a lesser grade material, such as mill-slotted casing, in an attempt to reduce the capital cost of the well will probably end up costing more because of its inherent low efficiency. Over its lifetime, the well's low efficiency will lead to higher accumulated power and maintenance costs that can easily eclipse any savings the owner may have once realized initially during the construction phase. Therefore, more financially prudent approach would be to use high-quality well casing and screen to build an efficient well that costs less to operate.

This memorandum briefly explains the importance of well efficiency, its relationship to well design, and how building an efficient well will help to lower and control long-term operating costs.

Well Efficiency

Well efficiency (expressed as a percentage) is the ratio of the drawdown in the aquifer to the drawdown in the well. A typical range of efficient wells is from 70 to 80% (or greater). In an efficient well, ground water flows from the aquifer(s) through the gravel pack (if installed) and into the well through the well screen with a minimum of head loss. Head loss is synonymous with drawdown; it is the sum of aquifer loss, damage zone loss (e.g. filter cake), turbulent loss through the gravel pack, and well losses. The latter are generated as ground water flows through the well screen and are caused by turbulent flow conditions.

Factors pertinent to well efficiency are related to the well construction, the well screen, and well development. An efficient gravel-packed well would typically be: 1) constructed with gravel that is appropriately matched to the gradation of the aquifer(s); 2) completed with a type of well screen that inherently minimizes well loss; and 3) fully developed to remove residual drilling remnants, such as drilling mud and cuttings.

Head Loss and Well Screen

The relationship between head loss and well screen design has important implications to the operation of wells. In part, this is because over time the apertures in well screens become partially or completely clogged by materials such as fine sediment, angular gravel and formation material, bacterial growth, and encrustation. When clogging occurs, the open area of a well screen is reduced, which causes an increase in the amount of head loss through the well screen. When this type of hydraulic change occurs, performance is affected and the well will exhibit a decline in specific capacity. (Specific capacity is defined as gallons per minute produced per foot of drawdown (gpm/ft)).

It is important to understand that some types of well screen are more prone to clogging than others due to the geometry of the screen openings. This is particularly true of mill-slotted casing, which can exhibit an acceptable level of efficiency when it is installed. Unfortunately, the efficiency of mill-slotted casing often declines precipitously as the slots plug, even if the well is gravel packed. By comparison, louvered screen with downward-facing apertures actually 1) facilitates the stabilization of both gravel pack and aquifer formation, 2) avoids clogging, and 3) promotes higher well efficiency. Similarly, wire-wraped well screen exhibits high efficiency, on a par with louvered screen, and is particularly effective for fine-grained aquifers in non-gravel envelope wells where aperture widths of 0.040" or less are needed. Empirical results from production wells have shown that the efficiencies of louvered screen and wire-wraped screen are essentially the same.

Operating Costs

A major benefit of an efficient well is its lower cost of operation. Generally speaking, an efficient well exhibits less drawdown and its pump requires less energy, e.g., electrical or diesel fuel, to lift the water from its pumping level to ground level or other point of discharge.

The following example illustrates the cost savings that are possible:

Assumptions:

Case 1: Well completed with mill-slotted casing. It operates with a total dynamic head (TDH) of 358 feet and an efficiency of 65%.

Case 2: Well completed with louvered screen. It operates with a TDH of 308 feet and an efficiency of 75%.

Where: Cost/Unit = gpm x TDH x 0.746 x Cost/KWH 3960 x Efficiency

Based on this example, the 10% difference in efficiency with 50 feet less drawdown of the louvered screen would result in an annual savings of $17,341.

Summary

Constructing a highly efficient well is an achievable objective that can pay substantial dividends.

Three keys to successful well projects are:

1) carefully drill the well;
2) construct it with inherently efficient well screen (louvered or wire-wraped); and
3) fully develop the well to maximize its production.

An efficient well can be reasonably expected to save its owner money in power costs throughout its long lifetime. As shown in the example in this memorandum, the annual savings in power costs can be substantial. Such savings can quickly offset the cost differential between a highly efficient well screen over a less efficient screen.

References


<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CASE 1</th>
<th>CASE 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumping Rate</td>
<td>1500 gpm</td>
<td>1500 gpm</td>
</tr>
<tr>
<td>Pumping Level</td>
<td>300 feet</td>
<td>250 feet</td>
</tr>
<tr>
<td>Discharge Pressure</td>
<td>58 feet</td>
<td>58 feet</td>
</tr>
<tr>
<td>TOTAL DYNAMIC HEAD</td>
<td>358 feet</td>
<td>308 feet</td>
</tr>
<tr>
<td>Power Cost</td>
<td>$0.10 KWH</td>
<td>$0.10 KWH</td>
</tr>
<tr>
<td>Well Efficiency</td>
<td>65%</td>
<td>75%</td>
</tr>
<tr>
<td>Annual Operation</td>
<td>4380 hours</td>
<td>4380 hours</td>
</tr>
<tr>
<td>Annual Cost</td>
<td>$68,168</td>
<td>$50,827</td>
</tr>
</tbody>
</table>
Checklist for having A Borehole Constructed:

A borehole is an asset that should last you at least 10 to 15 years at very little ongoing cost, provided you buy correctly at the start! If you don't, it can become a very expensive and time-consuming liability with continual repair or replacement of pumps, the causes of which could either be traced back to poor borehole construction or incorrect pumping or pump installation.

The Borehole Water Association has prepared this checklist to assist you in your buying decision, one that should be based on value and not on price alone.

**Location of Water:**

1. You could do some "homework" to determine if there are boreholes in your neighbourhood by checking with your neighbours to see who has a borehole. If they have water, how much, how deep is it and then you can work out (very basic information used only to back up professional opinions) which way the aquifer is running & what your chances of finding water are, e.g. if the person behind you has a successful borehole is the person across the road from you, the same, & no one next to you has, the chances are that the aquifer is running from behind your property, through your property, to across the road from you & beyond.

2. Pinpoint the location for drilling the borehole. Get a geohydrologist to do this. Check on the past success rate of the person they usually use to "site" their boreholes. In an urban environment cultural interferences (powerlines, top lines, cables etc.) include the scientific siting of the borehole. In a limited space urban environment the borehole is often drilled where the rig can fit in average water well rigs are +15t & truck mounted.

3. Check if the person you hired to site the borehole uses more than one method of cross-checking?

**Choice of Driller:**

4. Check references of previous clients who have had time to assess quality of work over a reasonable period of time.

5. Check if his/her works to a recognized Standard. There are SABS Standards now available for the groundwater industry. SANS 10295 - 2003 Development, Maintenance and Management of Groundwater Resources.

6. Check what condition his/her equipment is in.

7. Check if his/her drill rods are straight.

8. Check on type of casing/well screens to be used.

9. Check diameter of borehole to be drilled. A diameter of 152.4 mm (6 inches / 216 mm (8 inches), is recommended for a domestic borehole.

10. Check if equipment can reach target depth.

11. Check if the borehole depth will improve water yield if necessary. If it does not understand the meaning of borehole development, get another driller.

12. Check if he/she provides samples of material of each and every metre drilled.

13. Check if he/she provides records of work carried out, e.g. driller's log, construction certificate, electrical clearance, yield test certificate, pump details & commissioning data. When selling property, a borehole represents a substantial capital investment.

14. Check that the driller provides a record of exact depth at which the most promising water fissure is located. This information is vital to the pump installer to enable him/her to select correct pump for your needs.

15. Check if he/she has a standard form of contract. Of vital importance to both parties. The BWA has such a Contract to offer the end-user.

16. Check if he/she is a member of the Borehole Water Association. Membership of the Association shows that the contractor/supplier you are dealing with is interested in the long-term viability, professionalism and survival of the industry. It also gives you, the end-user recourse should any problems arise during construction of your borehole.

**The Pump Installer:**

1. Check that he/she can provide you with proper yield, drawdown and step tests. This is required to enable him/her to select the correct pump for your needs. If he/she does not know what this means, do not use him/her.

2. Check that a qualified electrician is used to sign the installation off.

---

More horsepower does not equate to a better pump.

A borehole is an asset that should last you at least 10 to 15 years at very little ongoing cost, provided you buy correctly at the start! If you don't, it can become a very expensive and time-consuming liability with continual repair or replacement of pumps, the causes of which could either be traced back to poor borehole construction or incorrect pumping or pump installation.

Other factors that need to be taken heed of by you, the end user!!

- The drilling contractor can never guarantee that he/she will intersect water and therefore it is the client who is at risk for the cost of the borehole, regardless of whether it is wet or dry.
- A modern drilling rig is large & heavy in urban areas it can cause a certain amount of unavoidable damage, and the contractor cannot reasonably be held responsible.
- Drilling rigs are noisy and they generally make a great deal of mess, both factors are unavoidable. In urban areas neighbours should be warned that drilling would be taking place on your property.
- Under the New Water Law, your water usage may need to be registered with the Department of Water Affairs and Forestry – contact the "Acting Director of Water Resources Management" at DWA. Discuss with contractor as to who is responsible for making enquiry.

- The local municipality/council may require that permission be obtained to sink a borehole. Discuss with contractor as to who is responsible for making the enquiry.
- Ensure that there are no electrical cables, sewage or water pipes hidden under the ground where the drilling will take place.
- There are many unknowns, such as final depth, the amount required & time taken for development, so you need to agree on a suitable amount to be allowed for "add-ons" with your contractor.
- Drillers levy a surcharge for drilling through very hard rocks, e.g. Dolomite formation requires specialized expertise to drill into. The time taken between the borehole being drilled and a pump system being installed is usually measured in weeks, rather than days.
- Make sure that the driller caps the hole after drilling to prevent any foreign material entering the well.

---

**Web Page References:**

- A C Industrial Services and Sales: www.acindustrial.co.za
- Africa Geo-Environmental Services (Pty) Ltd: www.agp-group.com
- All Power: www.allpower.co.za
- Aspira Microbiological and Chemical Laboratory: www.aspira.co.za
- Atlas Cepaco SA (Pty) Ltd: www.atlascapaco-compressors.com
- Aurecon: www.aurecongroup.com
- Borehole Water Association of South Africa: www.bwa.co.za
- Como Pumps: www.comopumps.com
- Designation Use: www.weightproject.co.za/designation
- Drilling Enterprises & Compressors: www.drillingcoza.co.za
- Elsso (Pty) Ltd: www.elsso.com
- Franklin Electric SA (Pty) Ltd: www.franklin-electric.com
- Geomacrom Services: www.geomacrom.com
- Geostm Systems: www.geostm.co.za
- G.M. Todd Irrigation cc: www.toddirrigation.co.za
- Global Services: www.globalcoza.co.za
- Goboka Drilling Contractors: www.goboka.com
- Groundwater Practitioners: www.gwp.co.za
- Groundwater Consulting Services cc: www.groundwaterconsulting.com
- Gesto Pumps cc: www.gestopumps.co.za
- Hose Manufacturers: www.hoses.co.za
- Imbols Air Products (Pty) Ltd: www.imbols.co.za
- Incledon-Div: D.P.I. Plastics (Pty) Ltd: www.dpiplaastics.co.za
- Jooste Cylinder & Pump cc: www.joostecylinders.co.za
- Kholani Geomacro Consultants: www.kgc.co.za
- KLZ Consulting Services: www.klzco.co.za
- Lindokuhle Drilling: www.lindokuhledrilling.co.za
- Midlondons Pumps cc: www.midlondons.co.za
- Pro-Mechland (Pty) Ltd: www.promechland.co.za
- R.J. Bespoeg: www.bespogroup.co.za
- Re-Solve Consulting (Pty) Ltd: www.re-solve.co.za
- Robertson Geologging: www.geologging.com
- Roon Moss Company: www.roonmoss.co.za
- S.M. Ewinor: www.mw denominators.co.za
- Soil & Groundwater Remediation Services: www.sgrs.co.za
- Spinknerts For Africa: www.spinknertsforafrica.co.za
- SIRK Consulting: www.sirk.co.za
- Stewart & Lloyds: www.stewartlloyd.co.za
- T & T Drilling (division of T & T Marine): www.ttdrilling.co.za
- TPD Water Services: www.tpd.co.za
- Temba Pumps (Pretoria) (Pty) Ltd: www.temba-pumps.co.za
- Terratek (Pty) Ltd: www.terratek.co.za
- Topline Boreholes: www.toplineinfra.co.za
- UIS Analytical Services (Pty) Ltd: www.uis-a.co.za
- Umnoho Africa cc: www.umnoho.com
- WaterLab: www.waterlab.co.za
- Water Research Co. Ltd: http://www.terayond.co.za
- Water Resources Consultants (Pty) Ltd: www.wrc.co.za
- Watercools Edms Bpk & WA DRI DRILLING & Grouting Contractors: www.wandrilling.com
- WJ Water Drilling: www.wjdrilling.co.za
- South African Department of Water Affairs and Forestry: www.dwa.gov.za
- Standards South Africa (A division of SABS): www.sansa.co.za