

Irrigation Bores - Best Management Practices

Groundwater Series: Skills & Knowledge | Fact Sheet 4 | Produced by Cotton Catchment Communities CRC and UNSW Water Research Laboratory

The quantity and quality of water extracted from irrigation bores can be improved by best management practices (BMPs) focused on design, materials and construction methods and operational strategies.

This fact sheet includes information on:

- Preparing for drilling
- Bore site selection
- Design of bore
- Drilling and construction
- Test pumping, operation and monitoring
- Rehabilitation and decommissioning.

It is recommended that 10-20% of the total budget for bore installation be allocated to adequate preparation, site selection, design and testing of water bores to ensure the best investment outcome.

Further investment in careful construction, quality materials and on-going monitoring of water levels and water quality can increase the life expectancy of a water bore to over 30 years (Figure 1).

Preparing for drilling

A landholder, driller and hydrogeologist are responsible for various aspects of bore installation work, subject to written agreements. Quotations from drillers are generally based on unit rates per metre of drilling and for construction materials. The optimal depth of water bores depends on local hydrogeology and required water yields. The capabilities of a specific drill rig should not dictate the target depth of drilling.

Qualified and experienced practitioners can be found on these websites:



Figure 1 Typical water bore for irrigation

www.iah.org.au (hydrogeologists)

www.adia.com.au (drillers)

In NSW, a driller must hold a current driller's licence from the Department of Water and Energy (DWE), with a Class 4 licence required for screened bores including a gravel pack.

A licence to drill a test bore must be obtained by the landholder from DWE prior to work commencing. Some areas are subject to an embargo which precludes any new groundwater licences, while all groundwater systems are subject to conditions of use and sustainable management as determined by government agencies.

Bore site selection

Selecting a suitable bore site involves practical issues such as proximity to power and water usage and an understanding of local hydrogeology. It is critical that overhead wires, buried services and potential sources of contamination are identified and avoided.

Drilling records and the registered bore database (Figure 2) can be used to check subsurface conditions in the area but does not



generally include information on water quality or unsuccessful bores.

<http://waterinfo.nsw.gov.au/gw/>

NSW Groundwater Works

Preformatted reports containing information about licensed water bores, wells and excavations.

Instructions

Click the map to zoom to your area of interest, then select the info tool  and click a monitoring site  for data.

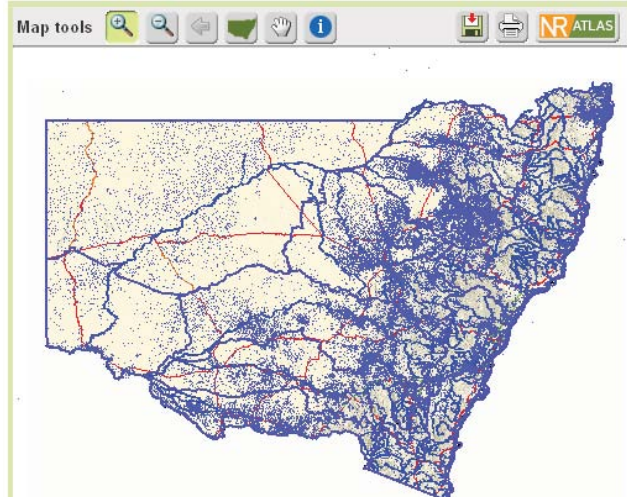


Figure 2. Registered bore data base available on the web.

Identifying buried permeable sediments and structural features in fractured rock can improve the probability of a successful bore

supply. Geophysical surveys such as resistivity imaging (Figure 3) can be used in non-urban areas to identify more favourable drilling sites.

No scientific techniques can guarantee subsurface variations. In some environments two bores drilled only meters apart can have quite different results.



Figure 3. Resistivity Imaging



Figure 4. Typical drill rig for installation of an irrigation bore.

Drilling and construction

Detailed information on suitable drilling methods and rig capability (Figure 4), drilling fluids, casing, grouting, screen design are provided by ADIA (2003).

Two important design features are often overlooked:

1. Sealing and grouting to prevent leakage of shallow poor quality groundwater.
2. Completion of a protective bore monument above ground level that prevents ingress of stormwater water and contaminants.

In addition, it is recommended that all new water bores incorporate the following features, shown in Figure 5:

3. Installation of a 'dip' tube for water level monitoring on the inside of the casing, and if applicable within the gravel pack on the outside of the casing.
4. A water meter installed correctly near the bore head.

5. A water sampling tap installed as part of the bore head.

Unfortunately there are many examples of bores that were not adequately sealed by grout in areas with shallow saline groundwater. Some irrigation bores in thick sediments were gravel packed up to the surface allowing leakage of poor quality water. The annulus space between the drilled hole and bore casing should be sealed by using a temporary tremmie pipe to deliver cement grouting to the required depth.

A 'dip' tube is simply a PVC tube that is about 25 mm diameter, with an end cap and slotted section near the base. Installed during bore construction, the tube allows a 'dip' measurement of water levels or installation of an automatic water level logging device. Without dedicated tubes, 'dip' tapes easily tangle with pumps and rising mains. For bores installed in alluvial sediments, the difference in water levels between the dip inside the casing and outside the casing in the gravel pack provides an indication of screen efficiency and developing blockages that require cleaning.

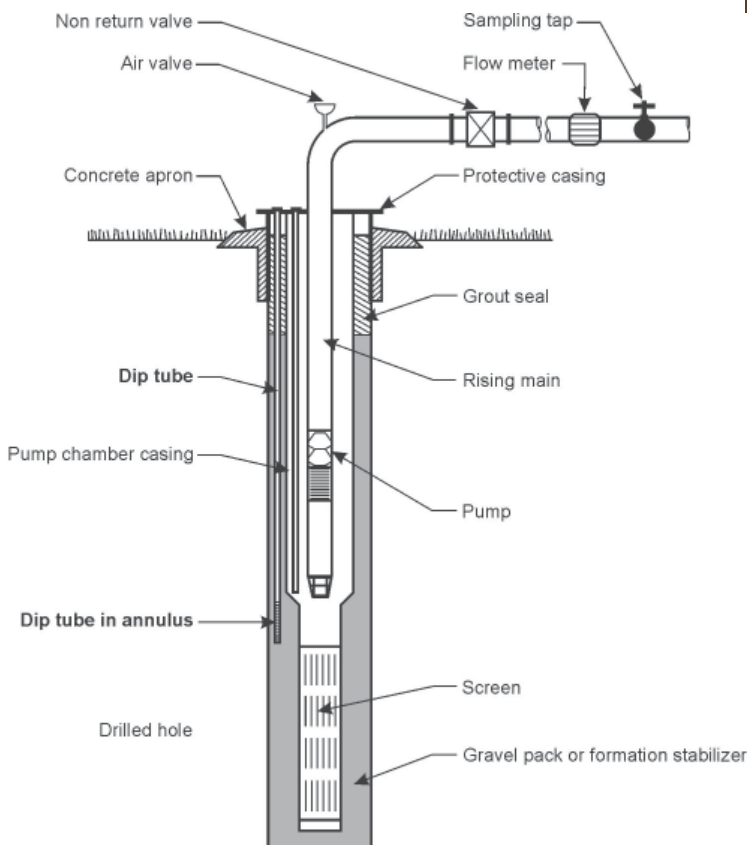


Figure 5. Dip tubes and sampling tap installed with a water supply bore to allow for groundwater monitoring.

All water bores should include a water meter and sampling tap. These basic and inexpensive devices are essential to maintaining and protecting groundwater supplies. Currently, sampling taps are rare and only high yield bores are legally required to be metered.

Test pumping, operation and monitoring

Test pumping is important for all new water bores. There are various types of test pumping as follows:

- **Air lift testing** – rough yield estimates over several minutes typically carried out by the driller during development (or cleaning) of new bores (Figure 6)



Figure 6 Air lift testing to estimate bore yield

- **Step testing** – controlled flow rate testing of a bore over several hours, with increasing steps or flow rates with water level monitoring to identify the optimal pumping rate of a bore under different pumping regimes (Australian Standard AS 2368-1990). Recommended for all new water supply bores, except small spearpoints.
- **Constant rate testing** – pumping of a bore at the optimal rate typically over at least 24 hours to confirm the most suitable pump and optimal intake depth (Australian Standard AS 2368-

1990). Recommended for all new water supply bores, except small spearpoints.

- **Aquifer system testing** – pumping of a test bore with detailed monitoring in nearby bores to determine the hydraulic properties of the groundwater system. The test bore and monitoring bores are specifically designed to enable calculation of aquifer transmissivity, storativity and the presence, type and distance of any hydraulic boundaries. The details of aquifer system testing is based on AS 2368-1990, depending on the nature of the investigation and site specific conditions. Slug testing using compressed air can be used on small diameter monitoring bores to rapidly measure aquifer permeability (Figure 7) Such extensive testing is carried out by irrigation management authorities, research and regulatory agencies.



Figure 7 Slug testing monitoring bores to measure aquifer permeability.

Basic landholder rights to access groundwater are associated with the responsibility for operating a safe and sustainable water supply. Water level monitoring is essential to identify any trends with pumping and variable rainfall over the years. Regular water quality testing for agriculture or drinking water use is the responsibility of the landholder. Bi-annual testing of parameters such as major cations and anions, iron, arsenic and bacterial indicators such as E. Coli are recommended as a minimum.

Sustainable management of increasingly

valuable groundwater supplies in some areas already include real-time information for all bores on the web. Acting on BMPs for water supply bores are the first steps towards smarter usage of groundwater.

Rehabilitation and de-commissioning

Diagnosis of non-flowing bores can identify problems with the bore, pumping equipment or the state of the groundwater resource. Information on bore cleaning is provided by ADIA (2003). Decommissioning of a bore that has reached its use-by date is important to remove hazards and protect the groundwater resource. Standard sealing techniques for abandoned bores are outlined by ADIA (2003).

Further information:

ADIA, 2003. Minimum Construction Requirements for Water Bores in Australia. 2nd Edition, Published by Land and Water Biodiversity Committee and The Australian Drilling Industry Association. Available from State Government Agencies including Queensland Department of Natural Resources and NSW Water and Energy.

AS 2368-1990. Test Pumping of Water Wells. Published by Australian Standards.

WRL Solutions - Groundwater Bore Design & Testing. UNSW Water Research Laboratory, Capability No. 1100

WRL Solutions - Optimising Groundwater Supplies. UNSW Water Research Laboratory, Capability No. 3100

WRL Solutions - Groundwater Quality & Beneficial Use. UNSW Water Research Laboratory, Capability No. 2400



Australian Government
Department of Agriculture,
Fisheries and Forestry
National Landcare Programme