

Groundwater Notes 1

What is Groundwater?

February 2009

Introduction

Groundwater is part of the **water cycle**. It is water that is located beneath the earth's surface in pores and crevices of rocks and soil. Because it is beneath the ground it cannot be seen. This presents different challenges for quantifying and managing the groundwater in comparison with surface water.

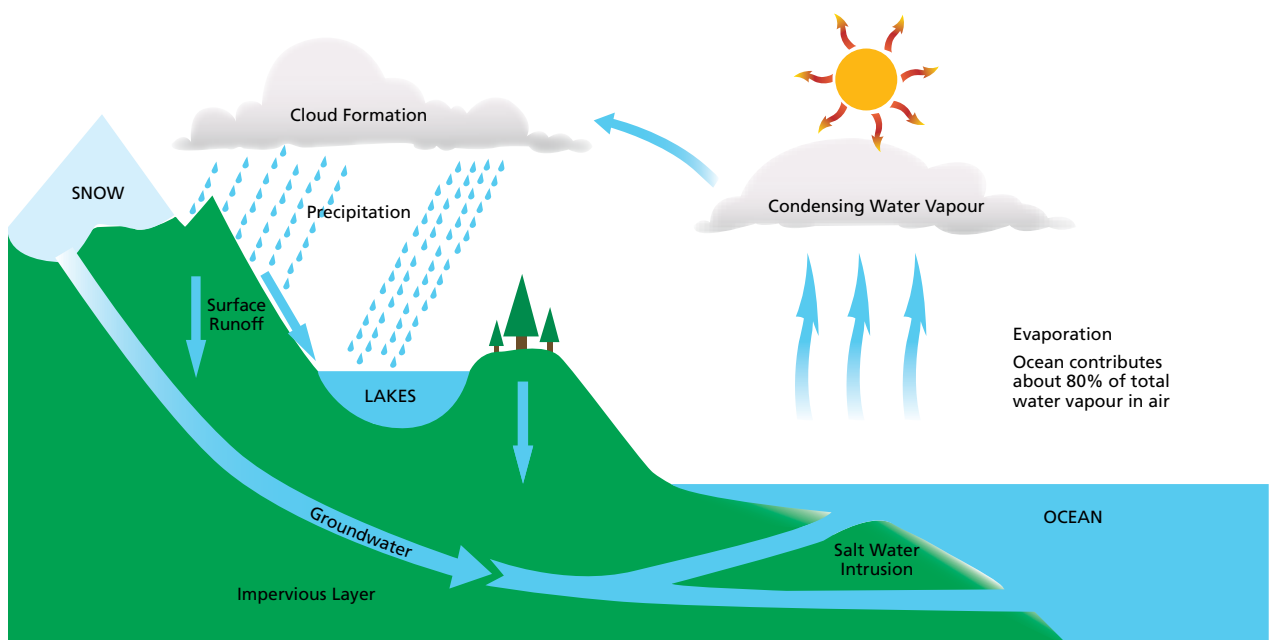


Figure 1: Groundwater is part of the water cycle.

When rain or snow falls on land, some of it evaporates, some flows to streams and rivers, and some seeps into the soil. Some of the water in the soil is used by plants but some continues to move further down until all the available pores and crevices in the soil and rock are full of water. This is known as the water table and this water is called groundwater.

The process of water entering the ground to become groundwater is called **recharge**. The volume of recharge and how fast it enters groundwater is dependent on climate, the depth to the water table, the types of plants that use water in the soil and the types of soil and rock it must pass through.

The number of pores and crevices in soil and rock and how well they are connected determines how easily groundwater moves through the ground and how much groundwater comes from a particular layer. Where useable volumes of groundwater can be pumped from a soil or rock layer, the layer is called an **aquifer**.

Types of Aquifers

Aquifers may be unconfined or confined.

- An **unconfined aquifer** forms the water table. It behaves a bit like a bucket in which the water table is the level of water in the bucket.
- In a **confined aquifer** the groundwater is under pressure: its movement upward is capped by a layer of rock or soil that does not easily allow the water to move through it. This is called a **confining layer** or **aquitard**. When a bore intersects the aquifer, the water level rises above the top of the aquifer. How high it rises depends on the pressure. Where the pressure is high enough, the groundwater rises above the ground's surface. This is commonly called a 'free flowing' or artesian bore.

An unconfined aquifer may have one or more confined aquifers beneath it. This is a **multiple aquifer system** (Figure 2). The groundwater in each of these aquifers may have different water levels and water chemistry.

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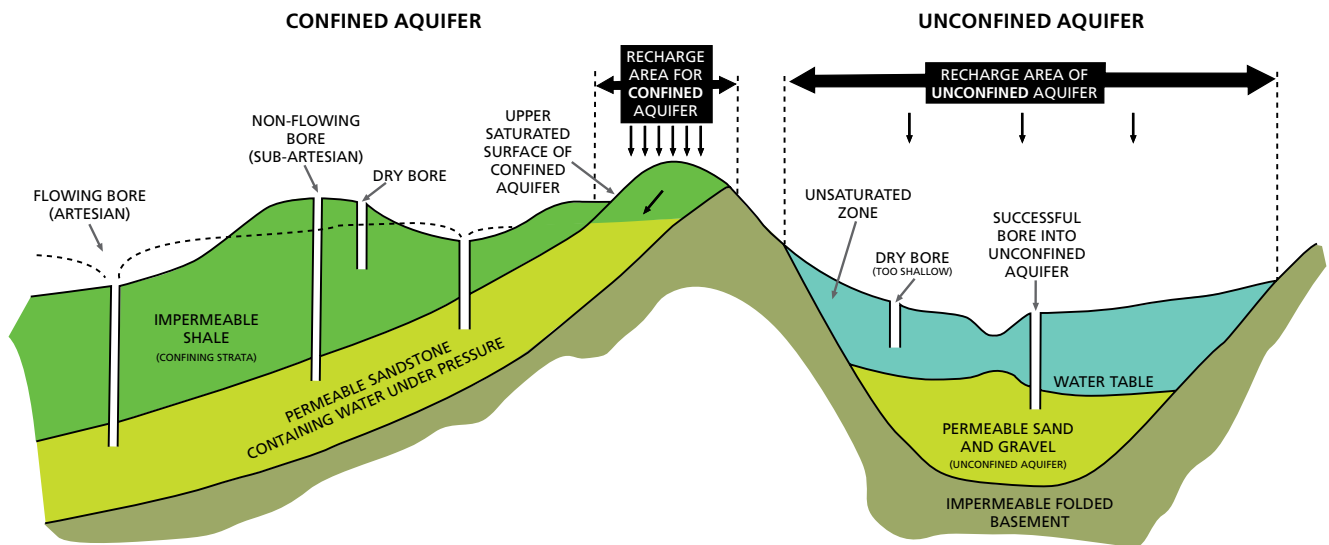


Figure 2: Diagrammatic representation of a multiple aquifer system.

Groundwater Flow

Because groundwater has to move between pores and crevices in soil and rock, it moves much more slowly than surface water. Water can move down a river in hours, days or perhaps weeks. Groundwater in an aquifer may take ten, one hundred or many thousand years to flow through an aquifer. Management of groundwater needs to consider the amount of water going into the aquifer, how much is stored in the aquifer, and how long it takes to move through it.

Uses of Groundwater

Groundwater is an important part of the environment. It flows into rivers and wetlands, often sustaining them during the summer months or in drought. Trees, shrubs and grasses may also rely on groundwater as their key source of water particularly during times of drought.

People pump groundwater for lots of reasons. Groundwater provides drinking water for more than 80 cities and towns in Victoria. It is also used to irrigate crops, provide drinking water for stock and to support industry. In some parts of Victoria, groundwater is pumped-out to evaporation basins or mixed with other water for reuse, to protect crops, pastures and waterways from salinity. Mining industries also remove groundwater to keep mines safe from collapse.

For more information about groundwater, take a look at some of the other Groundwater Notes in this series.

1. [What is Groundwater?](#)
2. [Groundwater in Victoria](#)
3. [Groundwater Management in Victoria](#)
4. [Can I Become a Groundwater User?](#)
5. [Looking After Your Water Bore](#)

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Groundwater Notes 2

Groundwater in Victoria

February 2009

Introduction

Groundwater is a resource shared by many users. In Victoria, groundwater provides drinking water for approximately 80 cities and towns including Geelong, Ballarat, Portland and Sale. It is also used to irrigate crops, provide drinking water for stock and for industrial purposes.

Approximately 526,000 million litres of groundwater were extracted in Victoria in 2006-2007. Dependable groundwater supplies from private bores are often available at depths of less than 50 metres in most areas of the State.

Where is the Groundwater?

Groundwater occurrence varies in size and volume throughout Victoria. It lies beneath all parts of the state but is not always useable. Its potential for use depends on its salinity and how much can be pumped out (aquifer yield).

Knowledge of groundwater occurrence is the result of more than a century of groundwater use and more than 30 years research by many state and federal agencies and private companies.

The hills and mountains of the Great Dividing Range and the Grampians form the geological backbone of the State. The rocks that make up this formation generally yield low volumes

of groundwater. Its quality and yield mean that it is most commonly used for stock watering and as a source of drinking water for individual residences and some small towns.

To the north and south of the Highlands lie sedimentary basins. Over the past 50 million years sands, gravels, limestones and clay have filled the basins. This has created a range of aquifers that lie on top of each other. In some cases volcanoes have erupted and lava has spread on top of these basins to form a 'capping' of basalt rock.

The yield and water quality from the sand, gravel, limestone and basalt aquifers is highly variable. Where good quality groundwater occurs it supplies irrigation, stock watering and household needs.

The Gippsland and Otway basins are the major sources of groundwater south of the Divide while the Murray Basin is the dominant source north of the Divide. The Port Phillip and Western Port basins are important smaller basins south of the Divide.

Where can I find out more?

Because aquifer yield and depth can vary locally, even on adjacent parcels of land, potential groundwater users are advised to seek accurate information relevant to their property's specific location.

Figure 1 provides a general guide to the salinity of groundwater resources in Victoria and their suitability for use.

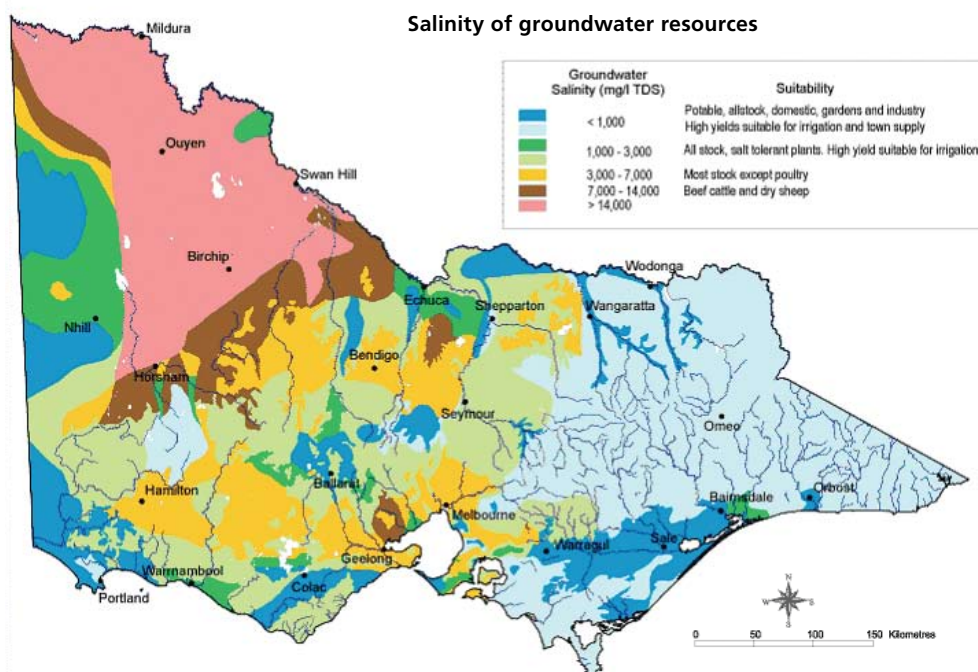


Figure 1: Salinity of groundwater resources (taken from Victorian Water Accounts 2006-07)

Groundwater Notes 2

In addition to this *Groundwater Notes* series, it is possible to obtain additional groundwater information from a number of sources:

- **Victorian Water Resources Data Warehouse**
More than 120,000 bores have been drilled across the State. While many of these bores were drilled for mineral purposes for which limited records were kept, bore logs, groundwater levels and chemistry for more than 50,000 water bores are held on the central Groundwater Database (located on the Victorian Water Resources Data Warehouse www.vicwaterdata.net).
- **Rural Water Corporations**
Rural Water Corporations are responsible for issuing groundwater licences and administering the *Water Act* 1989. They will be able to provide information regarding groundwater in their regions and may be able to provide contact information for local licensed drillers.
- **Australian Drillers Industry Association (ADIA)**
In accordance with the *Water Act* (1989), groundwater bores must be drilled by licensed drillers. The ADIA can provide contact details for its members. www.adia.com.au

Goulburn-Murray Water Corporation

PO Box 165 TATURA, 3616

Ph: (03) 5833 5500

Web site: www.g-mwater.com.au

Email: reception@g-mwater.com.au

Southern Rural Water Corporation

PO Box 153 MAFFRA VIC 3860

Ph: (03) 5139 3100 or 1300 139 510

Web site: www.srw.com.au

Email: srw@srw.com.au

Grampians Wimmera Mallee Water Corporation

PO Box 481 HORSHAM VIC 3402

Ph: (03) 1300 659 961

Web site: www.gwmwater.org.au

E-mail: info@gwmwater.org.au

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Groundwater Notes 3

Groundwater Management in Victoria

February 2009

Why Do We Need To Manage Groundwater?

Department of Sustainability and Environment's (DSE's) Groundwater and Licensing Branch is the Victorian Government's lead organisation responsible for overseeing the monitoring and management of Victoria's groundwater resources.

Rural Water Corporations have a major role in groundwater management. In addition to undertaking research, investigations and groundwater monitoring, they issue licences for bore construction and extraction of groundwater in accordance with the *Water Act* (1989).

Groundwater is a complex resource. The unseen nature of groundwater makes it difficult to quantify, however careful monitoring and management of groundwater resources helps to guard against over-extraction and ensure reserves do not become stressed or drop below sustainable levels.

It may also be impacted by climate change. However, by recording water levels and assessing recharge rates, it is possible to better-understand the resource and the impacts that climate change may have upon it.

While groundwater can be a reliable source of water, its overuse can result in failure of supply.

The risk of loss of supply or changes to groundwater quality is increased as surface water systems become fully allocated and more people access groundwater to meet their water needs.

Problems Caused by Increasing Demand for Groundwater

• Local bore interference

If bores are situated too close to each other, pumping from one can lower the water level in neighbouring bores. This can mean that when one neighbour begins to pump, there may be insufficient water depth in the bore to achieve usual bore yield.

• Regional over-extraction

The total volume of groundwater pumped in a region may be greater than the volume that can be recharged. This leads to lower regional water levels, reduced bore yields and higher pumping costs. It may also result in water from sources such as lakes, the sea or rivers entering the groundwater. In extreme cases pumping of large volumes of water can lead to compaction of some soils causing land surface to sink. This can damage buildings, bridges and sewers, increase erosion and flooding, and reduce the capacity of aquifer to store water.

• Changing water quality

Groundwater quality can change over time. In shallow aquifers, the use of groundwater for irrigation purposes will result in some of that water returning to the aquifer. Each time the groundwater is recycled, a certain amount of evaporation occurs concentrating the salts in the soil. These salts are then washed or percolated down to the water table, leading eventually to saltier groundwater. In addition to increased salinity, of the water over time, fertilisers and other contaminants used above-ground, can transfer into the aquifer, polluting it.

In addition, continued pumping or poor siting of bores can draw water from surrounding areas into the aquifer. Where the quality of these waters is poor, it mixes and increases the salinity of the groundwater in the aquifer.

Pollution of aquifers can also occur as a result of industrial activities, leaks from fuel or chemical storages and spills.

Causing groundwater to be polluted is an offence under the *Environment Protection Act* (1970).

• Interaction with surface water and springs

Bores located close to surface water (usually streams or springs) may cause water to flow from the stream to the bore, reducing their flow, potentially drying them up.

Balancing the Needs of Community, Users and Environment

Problems arising from increasing demand for groundwater can be prevented if the resource is appropriately allocated and shared among users. Under the *Water Act* (1989) the State Government has the right to the use, flow and control of all water in a waterway and all groundwater. It has created laws to ensure that allocation and sharing of groundwater occurs for the benefit of the community, groundwater users and the environment.

The Crown co-ordinates and delegates authority to government departments and water corporations to develop and manage the groundwater resource in an integrated and planned manner.

Licensing Extractions

Licensing is the main way of managing groundwater extraction. Groundwater for stock and domestic purposes may be accessed by a landowner for use on their own property with a Bore Construction Licence. All other extraction of groundwater requires applying for an additional Take and Use licence.

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Rural Water Corporations are responsible for the issuing of licences. Where both a Bore Construction Licence and a Take and Use Licence are required, the two licences are normally incorporated into one licence document. In all cases, bores must be constructed by a licensed driller.

Licences are issued from between 1 year and 15 years with conditions relating to the exact location from which groundwater can be extracted, the annual volume of water that can be pumped and the rate at which pumping can occur. A range of matters will be considered when assessing groundwater licence applications including:

- the existing and projected availability and quality of groundwater in the area;
- any adverse effect that the allocation or use of groundwater might have on the:- existing authorised users- a waterway or aquifer;- the drainage regime;- the environment;
- any water the applicant is already entitled to;
- an approved management plan for any groundwater supply protection area;
- the purposes for which the water is to be used.
- the permissible consumptive volumes

Permissible Consumptive Volumes

Limits on access to groundwater resources are imposed to prevent the resource being depleted or causing adverse impact such as:

- loss of water supply;
- reductions in base flows in rivers and streams;
- changes to water quality.

A key groundwater management provision under the *Water Act* (1989) is the setting of a cap on extraction. The Minister for Water may make an Order declaring the total volume of water that may be taken from the area or water system specified in the Order. This is known as the Permissible Consumptive Volume (PCV).

Once the allocation limit set by the PCV is reached, no additional extraction from that source may be authorised. In areas fully committed, new commercial and irrigation ventures may only obtain a licence entitlement through a *transfer* of a licence entitlement from a person holding an existing groundwater licence.

The declaration of a PCV for an area provides certainty as to the limits of groundwater available for extraction.

Groundwater Management Units

The consumption of groundwater from Victoria's aquifers is managed according to geographical area. Management areas are defined as groundwater management units (GMUs). GMU boundaries may fall across more than one river basin. A GMU can be a Groundwater Management Area; Water Supply Protection Area; or Unincorporated Area.

• Groundwater Management Areas

Groundwater Management Areas (GMAs) are the geographical areas from which water is extracted from an aquifer. They have been identified by DSE as areas in which groundwater has been intensively developed or has the potential to be developed.

Areas classified as GMAs are metered and carefully monitored under DSE's State Observation Bore Network. Most have PCVs.

• Water Supply Protection Areas

A total of 23 Water Supply Protection Areas (WSPAs) have been declared under the *Water Act* (1989) to protect groundwater or surface water resources in specific locations. They are generally GMUs where a PCV has been established as the aquifer is considered to be in need of strict management.

Some WSPAs also have detailed management plans.

• Unincorporated Areas

Unincorporated areas are generally areas in which groundwater development is limited by information about resource availability. In some areas there is poor quality and yields. In others there is substantial, but unquantified, groundwater resources of varying yield and quality. Unincorporated areas currently do not have defined permissible consumptive volumes (PCVs).

As Victoria continues to experience the impacts of sustained drought and climate change, access to groundwater resources of poorer quality and yield is increasingly being sought in the unincorporated areas. With this increased demand, if part of an unincorporated area is identified as being at risk of over-extraction, a groundwater management area will be declared and a specified management regime developed to ensure that the level of groundwater extraction remains sustainable.

More information about the way groundwater is managed in your region can be obtained by contacting your local Rural Water Corporation (see Groundwater Note 2 for contact details).

Groundwater Notes 4

Can I Become a Groundwater User?

February 2009

Introduction

Groundwater is a finite resource that, like surface water, is allocated under the *Water Act* (1989). A Bore Construction Licence is required by all persons wishing to drill for groundwater including for domestic and stock purposes. Taking and using groundwater for commercial or irrigation purposes requires additional licences.

It is important for intending groundwater users to clarify the purpose for which they seek to extract groundwater in order to establish their licensing obligations under the *Water Act* (1989).

Groundwater for Domestic and Stock Purposes

Under the *Water Act* (1989) the right to take and use groundwater for domestic and stock purposes does not require a Take and Use licence by virtue of an individual's private ownership of or access to land.

While a Bore Construction Licence is required, and the bore must be constructed by a licensed driller, a Take and Use Licence is not required.

Groundwater for Irrigation Use or Commercial Purposes

Unless the groundwater is intended exclusively for domestic and stock use, intending commercial groundwater users must apply to Rural Water Corporations for a Take and Use Licence in addition to a Bore Construction Licence.

Both a Take and Use Licence and a Bore Construction Licence can be refused on the grounds that they may adversely impact on the existing users, the environment, water reserve, drainage or a waterway/aquifer.

In all cases, bore construction works must be undertaken by a licensed driller (registered with the Australian Drilling Industry Association).

The two licences are normally incorporated into the one licence document. Separate licences will be required to construct, alter, remove or decommission any works on a waterway or a bore.

Licence Conditions

Licences are issued with conditions to ensure that:

- the bore is constructed to protect the groundwater resource;
- information and data obtained in relation to the bore is recorded for future reference; and
- the bore is located to minimise extraction interference with other users or the environment.

Groundwater Potential

It is also important for intending groundwater users to make an initial assessment regarding the likely potential of groundwater in a particular area by conducting local enquiries.

Assessing the groundwater potential is about finding out the likely:

- depth to groundwater;
- groundwater quality; and
- yield.

Information can be obtained from a number of sources, including neighbours and the local Rural Water Corporation. From this information intending users can begin to determine the best aquifer to target and clarify:

- whether the water will suit their needs;
- the cost of drilling and construction; and
- the cost of pumping.

Bore Decommissioning

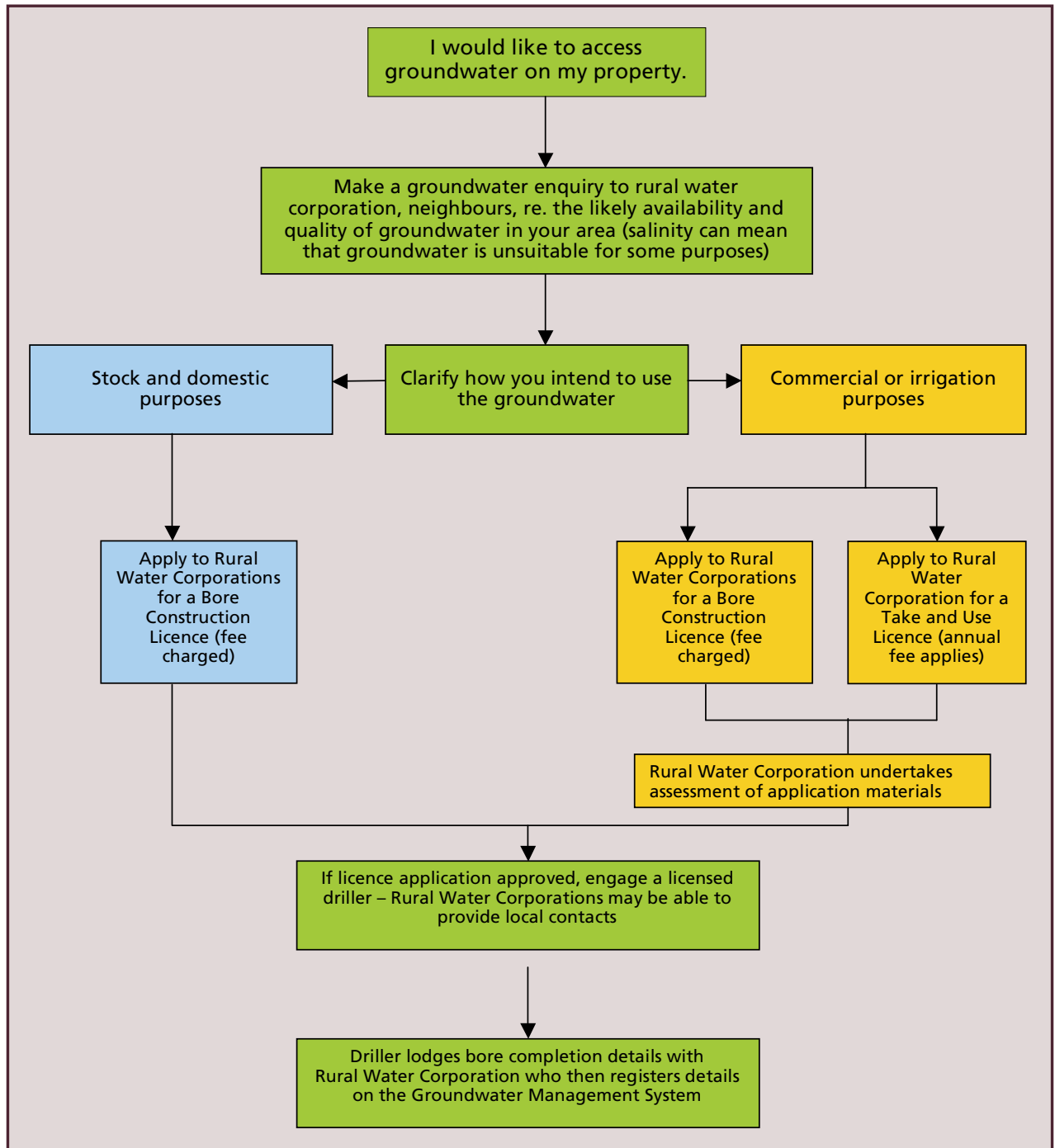
If a bore is damaged and can't be fixed, or is no longer required, it must be properly decommissioned. This prevents the bore becoming a path for contamination reaching the groundwater, potentially spoiling it for other bores. Under the *Water Act* (1989), a Bore Decommissioning Licence is required to decommission an existing bore. For further information contact your local Rural Water Corporation.

Causing groundwater to be polluted is an offence under the *Environment Protection Act* (1970).

Groundwater Notes 4

Possible Access to Groundwater

By working through this flow chart, you can identify the steps that need to be followed to establish the likely availability of groundwater in your area and your licensing obligations in relation to access.



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Groundwater Notes 5

Looking after your Water Bore

February 2009

Introduction

An efficiently-operating bore saves money. Poor construction, installation and maintenance of bores increases the cost of pumping groundwater and the chances of pump failure. This groundwater note describes what you can do to maintain your bore.

What Should You Do To Protect Your Investment?

- **Maintain the pump** according to the manufacturer's specifications. Avoid having electrical components in connection with metal bore casing as this can cause corrosion.
- **Measure the depth to the water level** in the bore several times a year. The best time to measure is immediately before you turn the pump on and again before you turn the pump off.
 - Groundwater levels can go up and down during the course of a year. The start-up level is the water level of the bore before pumping is commenced. Continually falling start-up levels can affect the operation of the pump. The depth of the pump, and perhaps the pump itself, may have to be changed to keep the bore working properly. Start-up levels that drop continually over more than one year may mean the aquifer is being used up, or another bore is interfering with your bore. If this happens it is recommended that you talk to your local Rural Water Corporation.
 - The shut-off level is the water level of the bore immediately before the pump is shut-off. Continually falling shut-off levels can mean the screen or slots that allow water into the casing or perhaps the casing itself is becoming clogged. Your local driller can provide advice on cleaning out the bore.
- **Take a sample of the water** from the bore at least once a year (preferably more frequently than this). Allow the bore to be pumped from at least 20 to 30 minutes before you take the sample.
 - Measure the salinity of the water and see if there is any sand or grit coming up with the water. Salinity can be measured using pocket salinity meters (usually obtained from agricultural or pump suppliers). It is important to follow the manufacturer's use and care instructions to ensure the meter remains accurate.
 - Increasing salinity can mean salty water is leaking from another layer. This may be due to a hole in the bore casing or can mean that pumping of the aquifer is drawing in salty water from further away. Talk to neighbouring groundwater users – they might be able to tell you if it is something that is happening with other bores in the region. If it is just your bore, you may have to replace the bore casing or decommission your bore and drill a new one.
 - If you use the bore for drinking water, more comprehensive water quality tests are recommended. These tests can be done by National Association of Testing Authorities' (NATA) accredited laboratories. Australia's drinking water standards are set out in The National Water Quality Management Strategy Australian Drinking Water Guidelines 6.
- **Keep detailed records of your bore performance.** This includes all of the recommended information above, but also pumping dates, durations and rates. This information can help you see longer term changes in performance that may require maintenance or replacement of your pumps and possibly of the bore.

Remember: Under the *Water Act* (1989), a Bore Construction Licence is required to deepen or alter the casing or screen of an existing bore. Usually it is a condition of the licence that the work is carried out by a licensed driller. For further information, and the names of local licensed drillers, contact your local Rural Water Corporation.

Accessing an Existing Bore

When buying or leasing a property, existing groundwater bores may be on site. The following approach is recommended to check the bore before it is used:

- Talk to previous owners, neighbours and local drillers to find out as much information about the bore as possible. Drillers often keep information on bores they have drilled;

Groundwater Notes 5

- Take a good look at the bore. Measure the inside and outside diameter of the casing. Note what the casing is made of. Use a weight attached to the end of a cord or measuring tape to work out the depth of the bore. Measure the depth to water (if the bore is not dry) by listening for the “plop” as the weight hits the water.
Do not drop anything loose down the bore. If the bore is obstructed, a drilling contractor will be required to clean it out before it can be used. A licence is not needed for this providing the bore is not deepened.
- Talk to your local Rural Water Corporation. They have a database of registered bores. If registered, construction, water quality and pumping information may be available.
- Take all this information to a drilling contractor or a pump supplier and arrange for the bore to be tested. Take several water samples during the test to determine the water salinity. If it is for potable use, (drinking purposes) then further tests on the quality are recommended using a NATA accredited testing Laboratory. It is best to take the first sample after 20 to 30 minutes of pumping.

Bore Decommissioning

If a bore is damaged and can't be fixed or is no longer needed, it must be properly decommissioned. This stops the bore being a path for contamination reaching the water, potentially spoiling it for other bores. Causing groundwater to be polluted is an offence under the *Environment Protection Act* (1970).

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