

GROUNDWATER - “ADAPTING TO DROUGHT”

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Abstract: With drought intensifying across the Murray Darling Basin (MDB), groundwater is being increasingly explored by a range of stakeholders as a resource that can provide solutions to a range of needs arising from diminishing surface water within the MDB resources. Competition for the resource between stakeholders such as irrigators, urban water authorities and the environment ensures a range of complex socio- economic and environmental issues for Goulburn-Murray Water (G-MW) to address as the manager of northern Victoria’s groundwater resources. Development of groundwater has a strong correlation with diminishing surface water availability in south eastern Australia, with each period of drought seeing an exponential growth in groundwater development. The 1982/83 drought was the catalyst for development, followed by the capping of the MDB surface water systems and the current extended dry period. Like surface water, groundwater has been capped in most areas under G-MW management’s operations. Capping the systems has predominantly coincided with the regional decline of groundwater levels. This decline has been exacerbated by drought as pumping of the available entitlement groundwater increases and rainfall recharge decreases. Understandably this has caused concern among communities as surface water availability also declines and people look to the security of groundwater. This concern is further highlighted in a recent (NHT, 2001) survey showing that 30% of the 538 groundwater management units (GMU) within Australia were either close to, or overused when compared to their sustainable yield. It could be assumed that the prolonged dry period from 2001 to present day will have exacerbated the figures further.

This concern has prompted G-MW to consult with the affected communities and develop management plans to assist in managing the sustainability of the resource for all groundwater users. Management plans provide policy and procedure that address issues such as the maximum level of draw-down the aquifer can be equitably pumped and rules around the temporary trade. This ensures the delicate socio economic and environmental balance is maintained for the long term sustainability of the resource.

Trading of groundwater has been exponential in growth as the capping of systems has developed markets for trade. This trade provides flexibility to users and also introduces a range of complex issues for management. Unlike surface water, groundwater trade is the movement of demand and impacts of extraction from one point of extraction in the aquifer to another. This demand needs to be managed to ensure that existing users and the environment are not adversely affected.

Understanding this demand highlights the need for a strong technical understanding of the aquifer parameters in which you are managing.

G-MW has a program in place outlining the key aquifers which require higher level management in order to adequately manage the resource. Currently there are 15 GMU's within G-MW's area of operations, 14 of these are capped and require temporary trade as a means of accessing water. Trading requires individual assessments while plans look at the regional health of the resource. G-MW is working with the affected communities to ensure that the future management of the groundwater resources it manages are sustainable for all users.

1.0 Introduction

With drought intensifying across the MDB, groundwater is being increasingly explored by a range of stakeholders to provide solutions to a range of uses arising from diminishing surface water supplies. Competition for the resource among stakeholders such as irrigators, urban water authorities and the environment ensures a range of complex socio-economic and environmental issues for G-MW to address as the manager of northern Victoria's groundwater resources.

Development of groundwater has a strong correlation with the diminishing availability of surface water in south eastern Australia. Each period of drought has seen exponential growth in groundwater development. The 1982/83 drought was the catalyst for development, followed by the capping of the MDB surface water systems in 1995 and now the prolonged dry period from 1997. Like surface water, groundwater has been capped in most key aquifer systems under G-MW management. Capping the systems has predominantly coincided with the regional decline of groundwater levels. This decline has been exacerbated by drought when groundwater pumping increases and rainfall recharge decreases. Understandably this has caused concern among communities as surface water availability also declines and people look to the security of groundwater. This concern is further highlighted in a recent (NHT, 2001) survey showing that 30% of the 538 GMU's within Australia were either close to, or overused when compared to their sustainable yield. With further development of groundwater in response to the 2002/03 and 2006/07 drought it is reasonable to assume that there is an increased number of Groundwater Management Area's (GMA) requiring a higher, more intense, level of management.

2.0 Key Drivers for Management Change

2.1 Regulatory

The Victorian Government signed the National Water Initiative (NWI) in 2004 which underpins the national agenda on water reform. It also released its own White Paper titled "Our Water our Future" which was the State's vision and policy direction to meet its obligations outlined within the NWI.

The NWI provides key policy direction and milestones for states and territories to achieve that will ensure water reform within Australia. It seeks a national approach to water reform ensuring the states provide for transparent rules around trade, enshrine irrigators' rights to water independent of land and importantly, from a resource perspective, consider the interaction between surface and groundwater resources and the potential of groundwater pumping on surface water entitlements.

This potential interaction between surface and groundwater resources can also lead to the double accounting of resources. One suggested solution to this problem is the concept of conjunctive management. Conjunctive management is a primary objective of the NWI and given that in many areas groundwater and surface water are interchangeable resources it is a sensible management approach to manage something that is physically connected.

Conjunctive management can greatly reduce the risk of double accounting by recognising the interaction between the resources and the potentially detrimental impact of groundwater on surface water flows. Land and Water Australia estimates around 500 GL could be lost to double accounting in the MDB (Land & Water Australia, 2007). Given time lag issues associated with groundwater this volume could see massive environmental, social and economic issues occurring within both the groundwater and surface water systems over time.

2.2 The Victorian *Water Act 1989*

G-MW operates under delegated function by the Victorian Minister for Water and is responsible for the issue of Section 67 (license for works) and Section 51 Licenses (license to take and use water). As the Corporation has delegated licensing function for groundwater and unregulated surface water, the *Water Act 1989* is paramount in the Corporation's considerations with sections of "The Act" ensuring that G-MW is considering all matters pertaining to the issue of a license.

Section 40 of the *Water Act 1989* states that the licensing corporation must consider:

- the existing and projected availability of water in the area;
- the permissible consumptive volume, if any, for the area;
- the existing and projected quality of water in the area;

- any adverse effect that the allocation or use of water under the entitlement is likely to have on:
 - (i) existing authorised uses of water; or
 - (ii) a waterway or an aquifer;
- the need to protect the environment;
- any other matter that the Minister thinks fit to have regard to.

G-MW has developed management policy and procedure to ensure that it is adequately meeting its legislative obligations. Importantly, the *Water Act 1989* states that G-MW must consider the “effect the allocation or use of water under the entitlement is likely to have on existing authorised users of water, or a water way, or an aquifer”. This statement within the *Water Act 1989* is integral to the ongoing management of the resource and the perceptions that arise from communities utilising the resource.

2.3 Community Expectation and Water Table Decline

Understandably, users of groundwater have expressed concern with the rate of physical decline in the groundwater resources which they are pumping. This concern has been widespread across G-MW’s area of operation as the last ten years of below average rainfall has resulted in increased pumping and reduced recharge, causing a decline in water level response. Concerns among users vary from the increased pumping costs that are associated with declining water levels, to domestic and stock customers’ concerns that the resource is going to be over utilised by irrigators leaving them without access to water.

These concerns are legitimate as individuals’ businesses are threatened by the declining water level and perceived lack of management intervention. As a drought response and inline with the provisions of the Victorian *Water Act 1989*, G-MW has considered the resource position in all of its GMU’s and declared moratoriums on the issue of new entitlement in 14 of the 15 GMU’s that it manages. The moratorium on new licenses is in direct correlation with the resource position and the amount of entitlement already issued within each individual GMU. Moratoriums, through the capping of entitlement, create opportunities for trade as the only avenue for new or increasing development to expand its business. G-MW has had to develop management rules around the trade of entitlement for each individual GMU in line with the considerations outlined within the *Water Act 1989*.

3.0 Management Plans - A Drought Response

3.1 What are Management Plans?

Management plans are essentially water sharing plans for the resource outlining the operational framework in which the water Corporation (G-MW) manages the resource to ensure long term sustainability. The role of the management plan is to define the potential of the resource and then detail management rules to ensure the long term sustainability of this resource.

The management plan needs to provide the operational manager and users with confidence through its prescription and direction. It also needs to ensure that it is flexible and allows users options in regard to both the permanent and temporary trade of entitlement, carryover, rules around intensity of pumping and the movement of water/stress from one area of the aquifer to another. The management plan also needs to consider the environmental assets within the aquifer, define these and then propose a management regime that ensures the protection and enhancement of these assets. Issues such as Groundwater Dependent Ecosystems (GDE), Environmental Water Reserve (EWR) and the connection between groundwater and surface water need careful consideration and require management of the resource specific to that aquifer. Defining and valuing some of these issues becomes a complex task requiring large bodies of technical work ensuring accuracy and confidence in the decisions that are taken. The long term investment of users, including the environment, need to be assured that the plan is backed by sound technical rigour and that assets are protected by security of supply .

Victoria's management of groundwater systems is based on level response and seasonal pumping drawdowns. Level response is paramount in defining sustainable development and preserving the environmental integrity of the aquifer, including both GDE's and the EWR. Periodical monitoring of key observation bores provides level response data that G-MW can use to make management decisions and provides the framework for the development and operation of management plans. By defining a management level for drawdown and recovery, G-MW can assess the impacts that pumping the aquifer will have on all users including the GDE's, EWR and the potential for interference between bores within the management area.

3.2 Why Develop Management Plans?

Groundwater development has occurred predominantly over the last 15 years. Resource planning and assessment has focused on areas of development and has predominantly been done in a wetter climate. Due to continued dry conditions, groundwater development is occurring quickly. This development has led to the potential for over-allocation given the reduced recharge to the aquifer systems and the increase in utilisation of the resource as a direct response to the ongoing drought and the reduced reliability of surface water. Increased management is required to ensure that detrimental decline in aquifers do not have an effect on the reliability of both the irrigators, domestic and stock users and the environment.

As the Minister's delegate, G-MW is charged with the development and implementation of management plans. This process involves working closely with the community and government agencies to reach an outcome that ensures the long term sustainability of the resource while meeting the social, economic and environmental needs of the community. Management plans need to ensure that flexible products such as permanent and temporary trade are available to users. The definition of trading rules within management plans is integral to the operation of the plan as moratoriums on the aquifers mean that trade is the only avenue for new and increasing development to access greater entitlement. Similar to the MDB Cap on surface water, those wishing to develop further or increase their security must trade the water from someone else within the same catchment and within the rules defined by the management plan, or as defined by the Water Corporation.

3.3 Community Input to Management

Due to the ongoing drought conditions within south eastern Australia, groundwater has been seen by some as the saviour and is often referred to as new water. G-MW, in their role as Minister's delegate for licensing, needs to ensure that the development of groundwater is sustainable, meets the requirements of the Victorian *Water Act 1989* and protects the rights of the existing users, including the environment. Understandably, existing users of the resource, whether they be domestic and stock, irrigators or the environment want security of supply assured by the manager of the resource. This concern throughout rural communities across northern Victoria has been heard by G-MW and action has been taken in the form of management plan development, along with the development of trading rules within groundwater management areas.

The development of trading rules facilitates markets, develops cash flow and provides users with options around the utilisation of the resource. These rules have been developed as a direct result of the drought to ensure that access to water is not denied even though the system may be capped. G-MW, in their role as manager of the resource, will assess the risk of the trade and facilitate the transfer.

Due to the ongoing drought conditions, trade of groundwater has been exponential in growth, with G-MW approving 130 groundwater trades for the 2006/07 season. That is an increase of 250% from the previous year. For the current season G-MW has already approved in excess of 10 GL of groundwater entitlement, which as a percentage of tradeable entitlement, is 5% of the pool. G-MW expects this exponential increase to continue as drought conditions intensify across the basin and 14 of the 15 management units have been capped, increasing the necessity for trade.

4.0 Trading Groundwater, the Risks

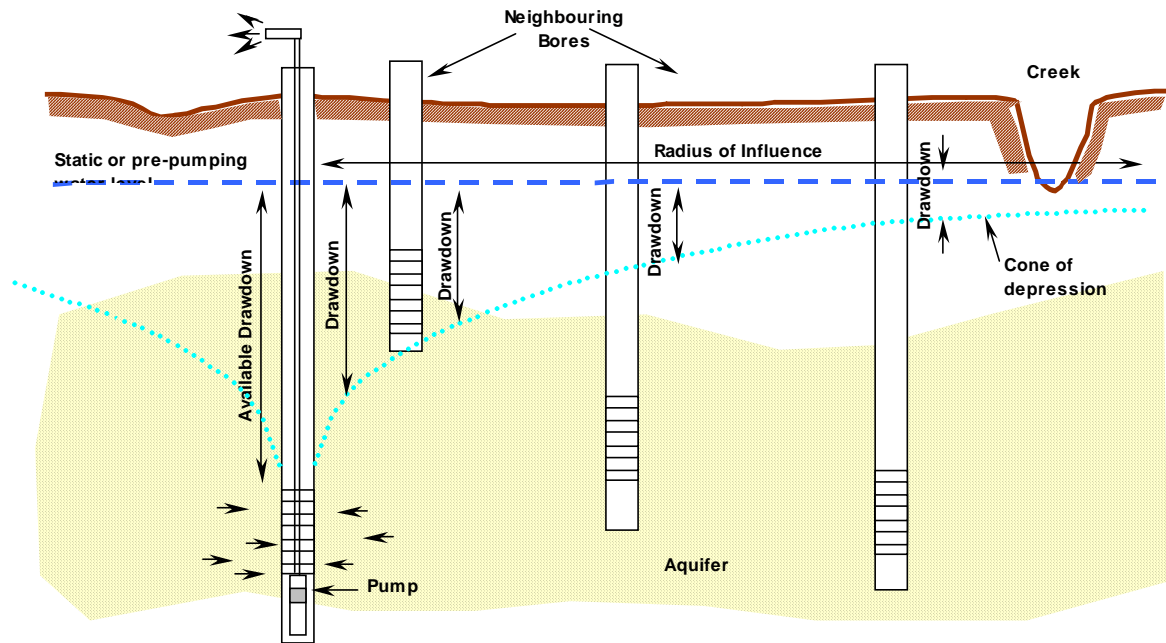
Trade provides flexibility to users but also introduces a range of complex issues for management. Unlike surface water, the groundwater trade can result in a completely different suite of issues when the extraction point changes. These issues need to be managed on a case by case basis to ensure that existing users and the environment are not adversely affected. Understanding these issues highlights the need for a strong technical understanding of the aquifer parameters.

Groundwater pumping results in a decline in groundwater levels surrounding the bore being pumped. The decline in groundwater level is referred to as the 'drawdown cone' or 'cone of depression'. The distance the drawdown cone extends and the shape of the cone depends primarily on the nature of the aquifer, the pumping rate and pumping duration. Typically the larger the volume and the higher the extraction rate, the more pronounced the drawdown at the pumping site and the larger the cone of depression is likely to be; therefore increasing the potential for adverse effects on existing groundwater users, surface water systems and the environment.

The effect of interference is shown in **Figure 1**, which schematically depicts a pumping bore, three neighbouring bores and a creek. Interference can become a significant issue because it can restrict the amount of water pumped from a neighbouring bore and can reduce environmental flows from unconfined aquifers.

The level of interference is determined by considering the reduction in available drawdown in a bore or environmental water (surface water interaction). The available drawdown in a bore is defined as the distance between the standing water level and the pump intake.

Figure 1: Drawdown cone with potential interference and stream interaction (GHD, 2007)



Specific to G-MW's management of trade is consideration of these effects. G-MW has developed an interference tool that assesses the predicted drawdown on neighbouring bores and environmental features. This tool greatly enhances G-MW considerations under the *Water Act 1989* and allows the approval of trades to be made with technical rigour providing confidence to the irrigator and other users within the cone of influence.

In order for the tool to operate accurately, aquifer parameters need to be ascertained and pumping rates defined. It is therefore integral that technical work has been done on the aquifer to ensure accuracy of the decision making tool. The tool looks at the available drawdown in neighbouring bores based on the rate and volume being extracted by the bore that has traded. It calculates the available drawdown based on the known aquifer parameters, allowing G-MW to make a decision in line with the provisions outlined in either the management plan specific to the area or the provisions of the *Water Act 1989*. The tool greatly enhances G-MW's ability to either approve or deny a trade, based on the hydrogeological effect the transfer of that

water will have on existing users and the environment specific to that area of the aquifer.

This tool has been developed to deal with the exponential increase in trading activity throughout G-MW's area of operations. It allows the resource manager to make confident decisions in approving or denying the trade and provides a level of technical rigour which, due to the increased stress on the resource as result of the drought conditions, ensures certainty and confidence in the decision making.

5.0 Management through Drought, the Outcomes

The last ten years within south eastern Australia have been uncharacteristically dry in comparison to the previous fifty. This has driven the demand for groundwater exponentially with irrigators, urban water corporations, industry and domestic and stock users considering groundwater as a potential for securing supply. G-MW, in its role as the resource manager, has been placed under enormous pressure to respond to these considerations from both existing users, environmental managers and those considering development.

In order to manage these pressures, G-MW has implemented a number of responses equipped to handle the demand on the resource and provide those utilising groundwater with greater flexibility and security of supply. The implementation of moratoriums on the majority of aquifers under G-MW's management and the development of trading rules associated with these moratoriums further highlights the management response to drought that G-MW has facilitated over the last 3 to 4 seasons. The development of committees on the Loddon and Campaspe systems to develop and implement management plans charged with policy direction from both the NWI and the Victorian White Paper is a strong stance that communities and Government are working together to achieve sustainable resource management. These committees are representative of the users within the area and joined by members of the relevant Government agencies to develop management plans specific to the aquifer to ensure sustainable resource management.

G-MW in its role facilitates these committees providing technical and operational input for discussion within the committees. Management plans for these two systems will be delivered to the Victorian Minister for Water in 2008, defining the operational rules for the aquifer, the permissible consumptive volume to be extracted and rules around carryover, temporary trade and permanent trade of entitlements.

Developing trade rules and the assessment tools to facilitate trade has also been a direct result of the ongoing drought with the resource being scrutinised and utilised by a larger number of people. These trading rules have allowed people to make accurate business decisions through either selling water to increase cash flow or buying water to expand or maintain their current production. Without these rules users would have been static, not being able to either access more water or sell their water. G-MW have, so far this season, traded over 10 GL of groundwater, further proving that groundwater trade markets are developing strongly in line with the capping of systems and the development of trading rules and management plans.

6.0 Conclusion

The challenges faced by those charged with managing the groundwater resource in G-MW's area of operation have increased as a direct result of the ongoing drought. However the resource position has ensured that G-MW has reviewed its systems and management to ensure the sustainable development of the groundwater resources within northern Victoria. These issues are complex and provide a range of social, economic and environmental challenges that must be considered in order to develop a holistic approach to management of the resource.

G-MW is working with communities and relevant government agencies to ensure that all issues are considered in the development of management regimes for these aquifer systems. Community consultation has been highlighted as an example of government and users working together to achieve sustainable development and G-MW has a number of committees in place to consult with over resource issues.

Drought has brought forward the need for increased groundwater management. Management of the groundwater resource is greater scrutinised as a result of this and G-MW has implemented a number of systematic responses as a direct result of this. Working within the legislative framework of the Victorian *Water Act 1989* and working to meet the goals set in the NWI, G-MW continues to work at consulting with affected communities and Government to ensure long term sustainable access to the groundwater resource.

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