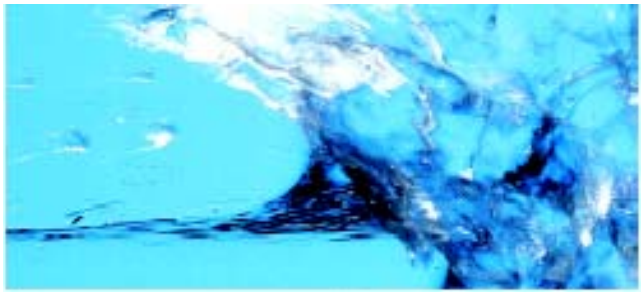
Baroota Groundwater Resource – Monitoring Review and Augmentation

DWLBC REPORT
2004/56

Government of South Australia
Department of Water, Land and Biodiversity Conservation

The Department of Water, Land and Biodiversity Conservation





Baroota Groundwater Resource – Monitoring Review and Augmentation

Scott Evans

Report DWLBC 2004/56

Government of South Australia

Knowledge and Information Division
Department of Water, Land and Biodiversity Conservation
Grenfell Centre, 25 Grenfell Street, Adelaide
GPO Box 2834, Adelaide SA 5001
Telephone +61 8 8463 6949
Fax +61 8 8463 6999
Website www.dwlbc.sa.gov.au

Disclaimer

© Department of Water, Land and Biodiversity 2002

FOREWORD

South Australia's natural resources are fundamental to the economic and social wellbeing of the State. One of the State's most precious natural resources, water is a basic requirement of all living organisms and is one of the essential elements ensuring biological diversity of life at all levels. In pristine or undeveloped situations, the condition of water resources reflects the equilibrium between rainfall, vegetation and other physical parameters. Development of these resources changes the natural balance and may cause degradation. If degradation is small, and the resource retains its utility, the community may assess these changes as being acceptable. However, significant stress will impact on the ability of a resource to continue to meet the needs of users and the environment. Understanding the cause-and-effect relationship between the various stresses imposed on the natural resources is paramount to developing viable management strategies. Reports of investigations into the availability and quality of water supplies throughout the State aim to build upon the existing knowledge base enabling the community to make informed decisions concerning the future management of the natural resources thus ensuring conservation of biological diversity.

Bryan Harris
Director, Knowledge and Information Division
Department of Water, Land and Biodiversity Conservation

Report DWLBC 2004/56

CONTENTS

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

The Northern and Yorke Agricultural Districts (NYAD) do not have abundant water resources. There is a locally significant groundwater resource that supports a regionally isolated horticultural centre located at Baroota. The Baroota Reservoir was built in 1921 on Baroota Creek just upstream of the point where it enters the coastal plains (Pirie Basin). This structure has had a major limiting effect on downstream creek flows but has enhanced groundwater recharge.

A Notice of Restriction was place over the Baroota underground water resource as there was community concern that the limits of groundwater extraction were being exceeded. Investigations (primarily desktop studies) were undertaken to ascertain the potential of the underground water resource to support this horticultural activity.

Given that the Baroota groundwater resource is understood to be significantly dependant on water from the Baroota Creek/Reservoir system, the capacity of the groundwater resource to support irrigation is now reliant on local climatic conditions. Groundwater resource management will need to accommodate this variation in recharge and consequential periods of stress on the resource.

A review of well completion practices has indicated that many wells are completed across multiple water bearing zones. To manage this resource effectively, a greater understanding of the hydrogeological processes is required. To this end, the community has sourced funding to increase the monitoring of the groundwater resources in the Baroota district. This will be achieved by the installation of a set of monitoring well designed to investigate the vertical relationships between the aquifer systems.

Drilling was attempted at a site adjacent the Baroota Creek, but this site was abandoned due to the unstable sediments at the near surface. A set of investigation/observation wells was drilled at a second site, where the Tertiary, mid depth and shallow depth Quaternary aquifer systems were investigated. Time series data of monitored water level and groundwater salinity will assist in the understanding of this groundwater resource and the impacts of horticulture development.

1. INTRODUCTION

The Northern and Yorke Agricultural Districts (NYAD) do not have abundant water resources. However, the water resources associated with the northern Mount Lofty and southern Flinders Ranges are significant at a regional scale. There are also isolated, but locally significant groundwater resources. Both surface and ground water resources are being exposed to increasing levels of utilisation as the rural sector seeks to diversify land use activities.

The adequacy of the existing monitoring network is now in question under this new regime. The sustainability of these resources may not be assessed to an appropriate level of accuracy unless the network is reviewed and improved.

Under the National Action Plan for Salinity and Water Quality program, the Northern and Yorke Integrated Natural Resource Management Committee sought, and was granted support to undertake the 'Amelioration of Salinity and Improvement of Water Quality through On-ground Works and Monitoring of Surface and Groundwater – NYAD' project (NAP2329)

The broad project objective was to establish better monitoring networks and infrastructure for groundwater in the NYAD. The prime project outcome would be the augmentation of existing groundwater observation networks in the region through the establishment of additional monitoring bores, based upon analysis of information regarding the history of recent groundwater use and an assessment of likely demand for groundwater for future developments.

Given the issues facing the NYAD community, it was decided to focus this project around increasing development of the Baroota groundwater resource. As increased regulation of this resource is being sought, the outcomes of this project would further improve the understanding of its capability to support existing and proposed new irrigation development.

The Baroota irrigation area (Fig. 1) is in the vicinity of the Baroota Creek where it leaves the Flinders Range to flow out over the Pirie Basin, approximately 10 km northeast of Port Germein and 230 km north of Adelaide. The groundwater in this area is generally of lower salinity than in nearby areas, and well yields tend to be higher, probably due to buried gravelly paleochannels and recharge from occasional flows down Baroota Creek. The catchment area of Baroota Creek is the largest (approximately 136 km^2 or 13,600 ha) for any creek that crosses the Pirie Basin north of the Broughton River.

Baroota Dam was built on Baroota Creek just upstream of the point where it enters the Pirie Basin in 1921. This must have had a major effect on groundwater recharge as the reservoir would remove all but the high flows from reaching the lower sections of the Baroota Creek. It is possible that groundwater levels in some areas have been falling ever since the dam was built. The dam occasionally overflows, providing short periods (several days in length) of intensive recharge via the gravelly and highly permeable bed of Baroota Creek.

As a consequence of constructing the dam wall on a fractured bedrock, the dam leaks. This leakage has been periodically estimated from surface flow rates in the creek bed downstream of the dam since 1988, and provides a continuous flow of at least 8 to

1. INTRODUCTION

The Northern and Yorke Agricultural Districts (NYAD) do not have abundant water resources. However, the water resources associated with the northern Mount Lofty and southern Flinders Ranges are significant at a regional scale. There are also isolated, but locally significant groundwater resources. Both surface and ground water resources are being exposed to increasing levels of utilisation as the rural sector seeks to diversify land use activities.

The adequacy of the existing monitoring network is now in question under this new regime. The sustainability of these resources may not be assessed to an appropriate level of accuracy unless the network is reviewed and improved.

Under the National Action Plan for Salinity and Water Quality program, the Northern and Yorke Integrated Natural Resource Management Committee sought, and was granted support to undertake the 'Amelioration of Salinity and Improvement of Water Quality through On-ground Works and Monitoring of Surface and Groundwater – NYAD' project (NAP2329)

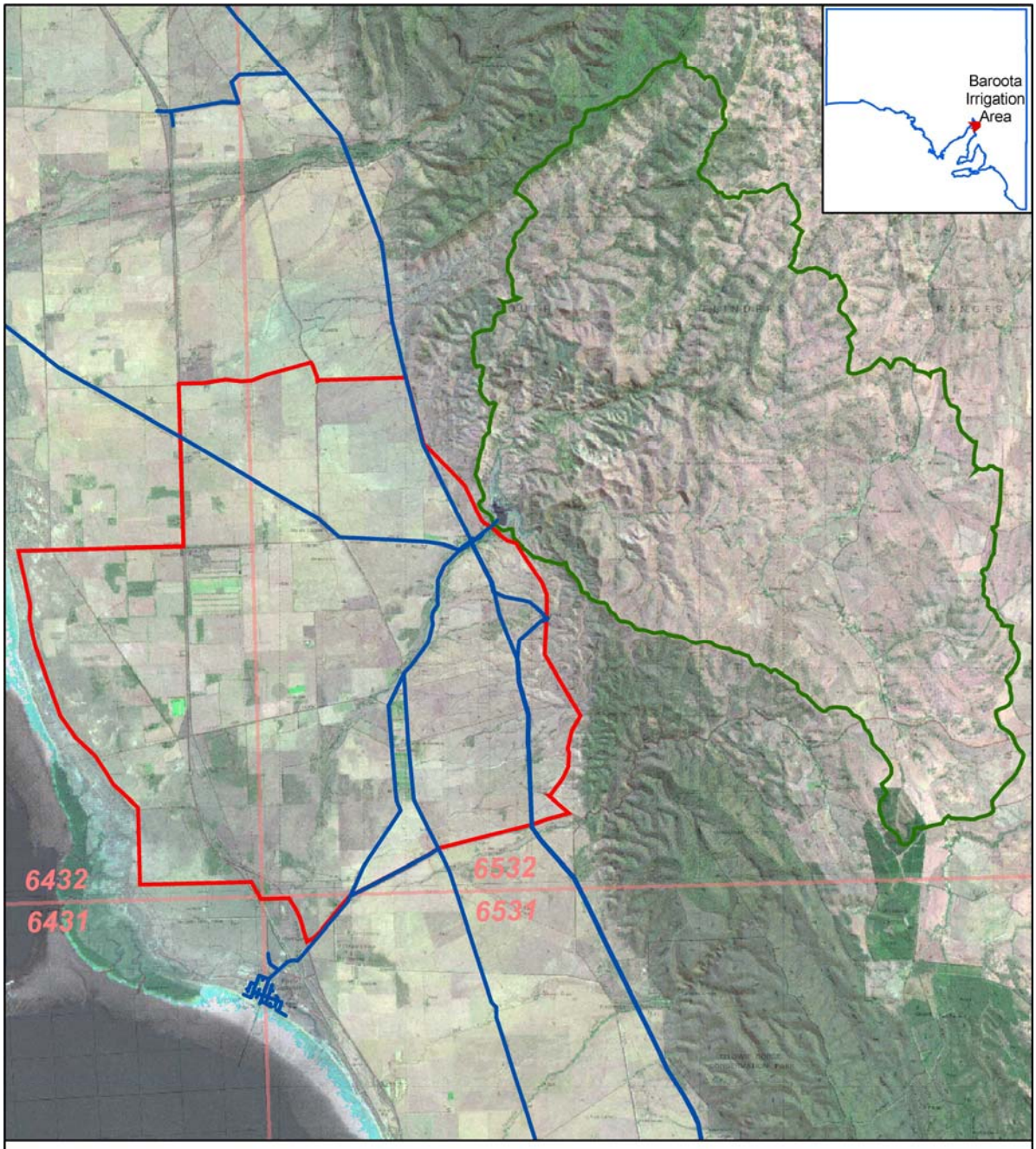
The broad project objective was to establish better monitoring networks and infrastructure for groundwater in the NYAD. The prime project outcome would be the augmentation of existing groundwater observation networks in the region through the establishment of additional monitoring bores, based upon analysis of information regarding the history of recent groundwater use and an assessment of likely demand for groundwater for future developments.

Given the issues facing the NYAD community, it was decided to focus this project around increasing development of the Baroota groundwater resource. As increased regulation of this resource is being sought, the outcomes of this project would further improve the understanding of its capability to support existing and proposed new irrigation development.

The Baroota irrigation area (Fig. 1) is in the vicinity of the Baroota Creek where it leaves the Flinders Range to flow out over the Pirie Basin, approximately 10 km northeast of Port Germein and 230 km north of Adelaide. The groundwater in this area is generally of lower salinity than in nearby areas, and well yields tend to be higher, probably due to buried gravelly paleochannels and recharge from occasional flows down Baroota Creek. The catchment area of Baroota Creek is the largest (approximately 136 km^2 or 13,600 ha) for any creek that crosses the Pirie Basin north of the Broughton River.

Baroota Dam was built on Baroota Creek just upstream of the point where it enters the Pirie Basin in 1921. This must have had a major effect on groundwater recharge as the reservoir would remove all but the high flows from reaching the lower sections of the Baroota Creek. It is possible that groundwater levels in some areas have been falling ever since the dam was built. The dam occasionally overflows, providing short periods (several days in length) of intensive recharge via the gravelly and highly permeable bed of Baroota Creek.

As a consequence of constructing the dam wall on a fractured bedrock, the dam leaks. This leakage has been periodically estimated from surface flow rates in the creek bed downstream of the dam since 1988, and provides a continuous flow of at least 8 to



Produced : Knowledge & Information Division
Department of Water, Land and Biodiversity Conservation
Projection: Transverse_Mercator
Datum: Geocentric Datum of Australia 1994 Zone 54
Date: December 2004

Figure 1: Location of the Baroota Irrigation Area

15 L/sec of recharge to the aquifers. The amount of sub surface flow through the gravels of the creek bed and fractured rock flow is unknown. Seepage rates are partly proportional to the head of water in Baroota reservoir (Clarke, 1990). Before 1986, much of this seepage water was intercepted and pumped back into the system by the (then) Engineer & Water Supply Department. No interception of seepage has taken place since 1986.

Regionally, groundwater levels are unusually low in the Pirie Basin and throughout the Mid North and Southern Flinders Ranges, due to the lack of any major natural recharge events since the very wet 1992/93 season. Consequently, Baroota Reservoir was dry or near dry for several years up to the winter of 2000. Compounding this natural decline in groundwater levels, the SA Water also chose to remove the Baroota Reservoir from the major water distribution network (due to water quality control measures), which left the reservoir off-line, with no additional mains supply water stored in the reservoir.

The recent boom in the wine industry had attracted interest in establishing more irrigated vineyards in the Baroota Irrigation Area. Due to recent requests for development approval for relatively large-scale horticultural activity, the landowners of the Baroota district pressed the District Council of Mt Remarkable to seek assurance from the then Minister for Water Resources that the water resource was able to cope with existing and potential horticultural demands. The Mount Remarkable District Council had set up a Local Area Catchment Plan in consultation with a group of Baroota irrigators. As there were no records of the area under irrigation, interpreted aerial photographs were used to estimate the area of irrigated horticultural development (Table 1), and this data indicates a very large increase in the area under irrigation in late 1998.

Table 1: Baroota District – Estimated Irrigated Horticultural Area

Date of Areal Photograph	Apparent Irrigated Area (ha)
Nov. 1980	38
Dec. 1983	70
Dec. 1986	76
Dec. 1987	50
Mar. 1991	86
Jan. 1993	86
Jan. 1996	60
Feb. 1998	57
Nov. 1998	140

These data should be treated with care because:

The areas are calculated from a inspection of colour areal photography and in a number of cases there was ambiguity about whether or not a particular patch of land was irrigated,

The photos were ‘snapshots’ from isolated times, not a continuous record.

A Notice of Restriction was placed over the Baroota underground water resource (Gazetted 8 June 2000), effective from 30 June 2000 until 30 June 2002. A land use survey to determine existing and committed horticultural development was completed by the then Department for Water Resources in 2001. Investigations (primarily desktop studies) were undertaken to ascertain the potential of the underground water resource to support this horticultural activity.

A condition of authorised use of groundwater included the installation of flow meters to monitor groundwater extraction within the Baroota irrigation area. Table 2 outlines the authorised metered use as recorded by DWLBC.

Table 2: Baroota District – Authorised and Metered Use

Year	Authorised Use (kL)	Metered Use (kL)
2001/02*	2,955,152	702,300
2002/03	2,955,152	1,916,433
2003/04	2,955,152	1,727,203

* (incomplete year)

2. AIMS

The broad project objective was to establish better monitoring networks and infrastructure for groundwater in the NYAD. Given the issues facing the NYAD community, it was decided to focus this project around increasing development of the Baroota groundwater resource. As increased regulation of this resource is being sought, the outcomes of this project would further improve the understanding of its capability to support existing and proposed new irrigation development.

Specifically, this project aimed to augment the existing Pirie monitoring network by the construction of several of observation wells within the Baroota irrigation area that would enable the monitoring of the individual aquifer zones within the Quaternary Hindmarsh Clay Formation. This would allow for improved understanding of the groundwater resource in the event of prescription and allocation of these resources. It was also decided to investigate the deeper Tertiary aquifer in the vicinity of the irrigation activity to ascertain the development potential for this resource in this region where water resources are limited.

Water quality sampling would be undertaken to further understand to hydrogeological processes that operate within the area. This sampling would be in the manner of analysing irrigator-supplied samples for the major ions for comparison with historic data.

3. METHODOLOGY

3.1 REVIEW OF THE MONITORING NETWORK

To better understand the results of the monitoring of groundwater levels and salinity, a review of the location, well construction and aquifer completion details of all existing wells was carried out. This review is driven by the potential prescription of the groundwater resources of the Baroota irrigation area.

Well completion reports were interrogated, and a well owner survey and site inspections were undertaken. Data gained has been used to validate and update the State groundwater database (SA_Geodata). This data will help ascertain aquifer interactions and potentially, the extent of influence the leakage from the Baroota Reservoir and large irrigation extractions may be having on the groundwater resources of this region.

Where logged data (lithological, driller's or geophysical) was available, individual water bearing zones were assigned a hydrostratigraphic unit interval (Table 3). This classification should allow for the determination of any unique aquifer characteristics that may exist and assist in understanding the groundwater flow processes.

The frequency of monitoring was reviewed and, assisted by the increased understanding of the hydrogeological processes that operate, a new monitoring regime was recommended.

3.2 AUGMENTATION OF THE MONITORING NETWORK

The review of the monitoring network identified knowledge gaps in the monitoring network. A site for a suite of observation wells was chosen that would help reduce this knowledge deficiency.

It is hoped that further investigations to understand the interrelation between surface flow within the Baroota Creek and the underlying aquifer systems will be carried out in addition to this program of constructing observation wells at various depth intervals, targeting the uppermost Tertiary aquifer and strategic water bearing zones within the Quaternary Hindmarsh Clay Formation.

The newly established observation wells will be incorporated into the Pirie Monitoring Network.

4. RESULTS

4.1 MONITORING NETWORK

Within the Baroota irrigation area, there are 32 observation wells (including the recently drilled wells) as shown in Figure 2. For the purpose of this report, the aquifer completion has been determined, and well construction details together with the length and frequency of monitoring record, are presented in Appendix B.

4.1.1 GROUNDWATER LEVELS

Currently, 17 wells have groundwater levels being monitored on a semi regular basis of three-monthly frequency. Historically, up to 24 wells were monitored for groundwater levels.

Analysis of the groundwater level monitoring data indicated that there are two distinct groupings of groundwater level behaviour. A group of wells, located within the vicinity of the Baroota Creek (Fig. 3), monitor aquifers that respond to climatic variation, that is seasonal rainfall (increased storage within the reservoir) or surface flow within the Baroota Creek. The second group, located predominantly in the western half of the Baroota irrigation area (Fig. 4), show no relationship to climatic variability.

4.1.2 GROUNDWATER SALINITY

Currently, 7 wells have groundwater salinity monitored at intervals ranging from randomly to 6 monthly. Historically, up to 13 wells were monitored for groundwater salinity.

Analysis of the available data indicates that salinity trends can be grouped into falling, steady and rising trends (Figs. 5, 6 & 7). Broadly speaking the falling trend grouping is biased towards the northern portion of the Baroota irrigation area and the rising trend grouping is biased towards the southern portion of the Baroota irrigation area.

Few water samples have been taken due to poor availability. Regular samples have been taken where the seepage from Baroota Dam crosses beneath the Morgan-Whyalla pipeline. The seepage has shown a trend toward increasing salinity (47 ECU/year from 1988 to the present), but nothing can be said about salinity trends in the Baroota Irrigation area generally.

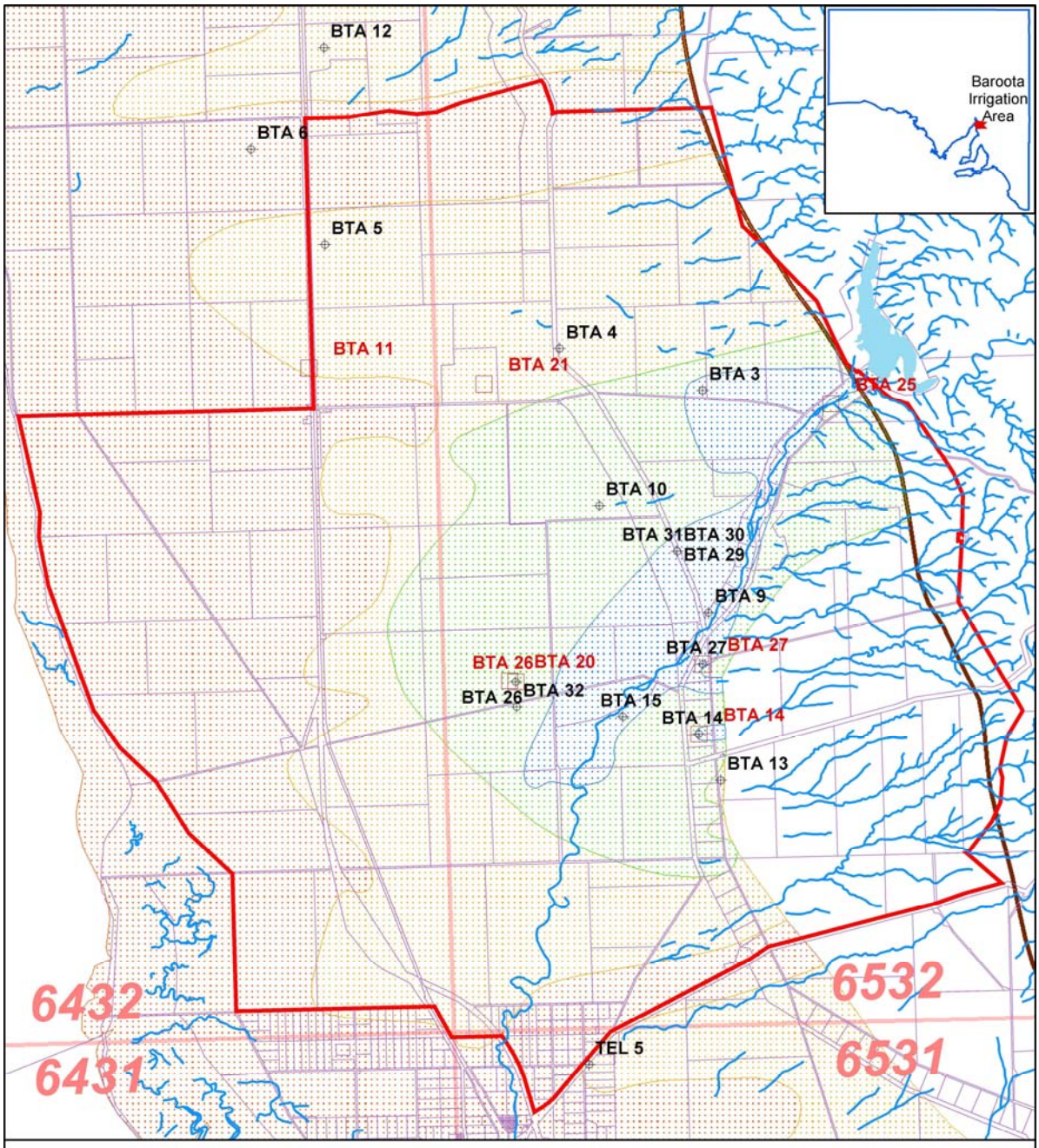


Figure 2: Pirie Observation Well Monitoring Network within the Baroota Irrigation Area

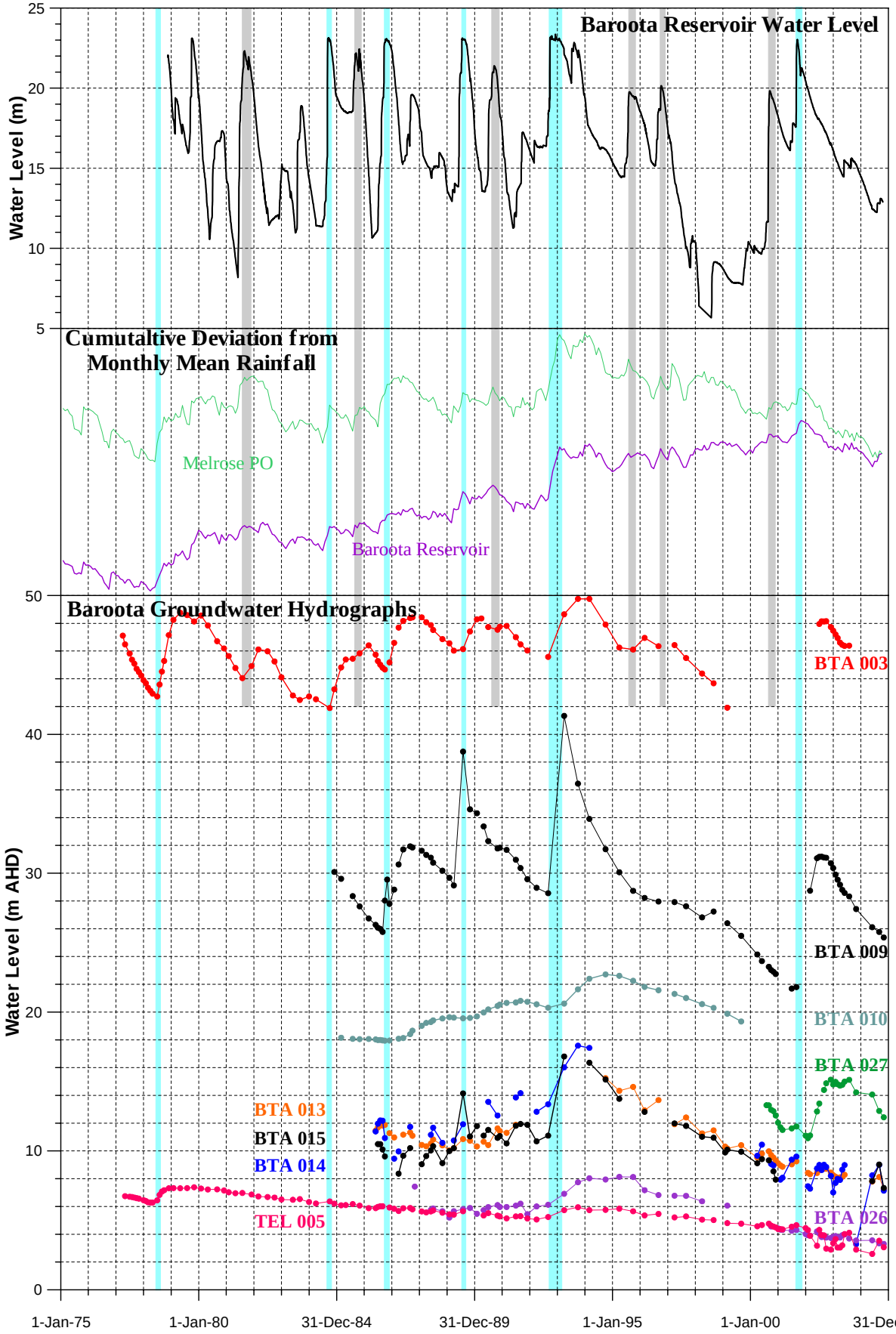


Figure 3. **Observation Well Hydrographs – Seasonal Influence**

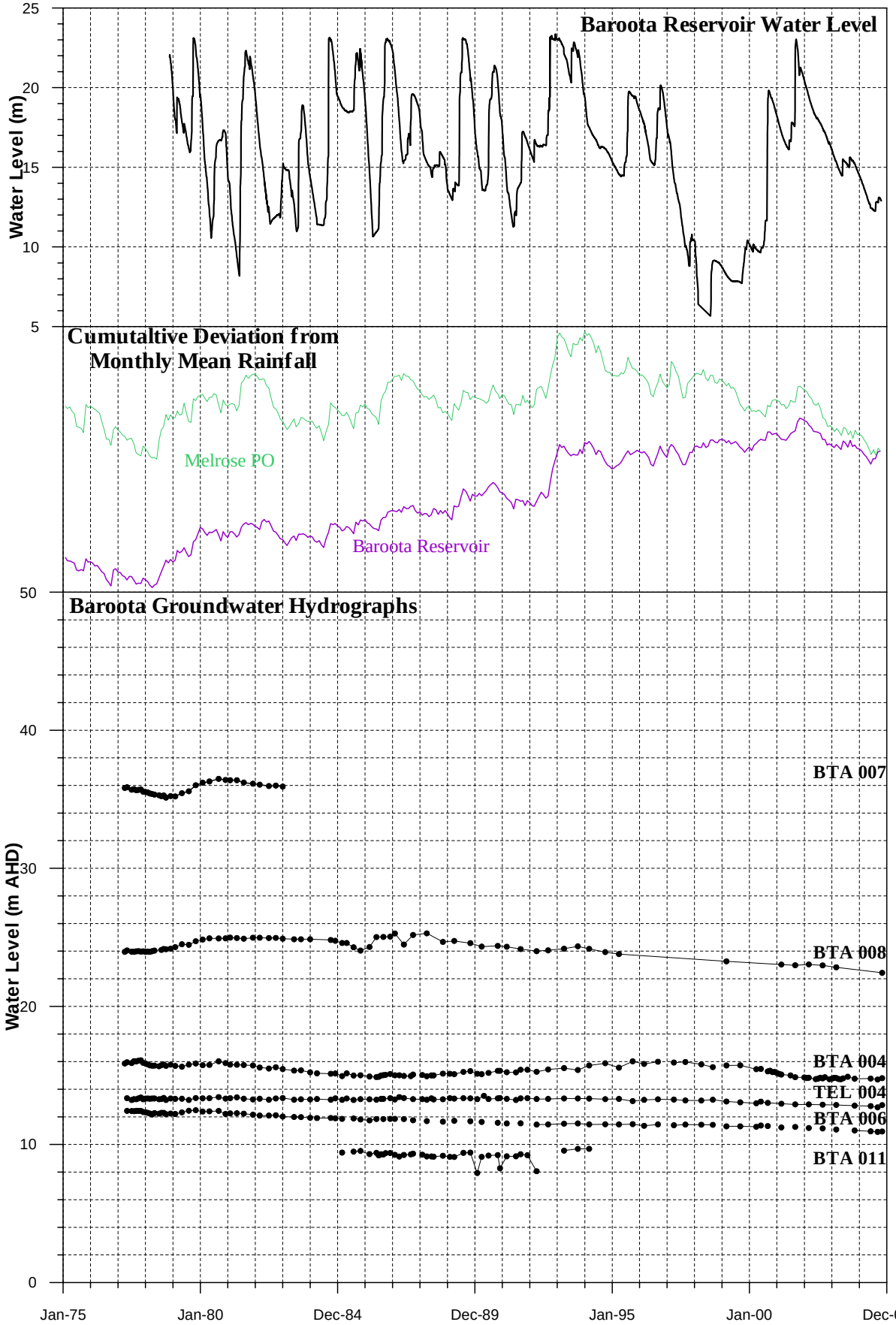


Figure 4. **Observation Well Hydrographs – No Seasonal Influence**

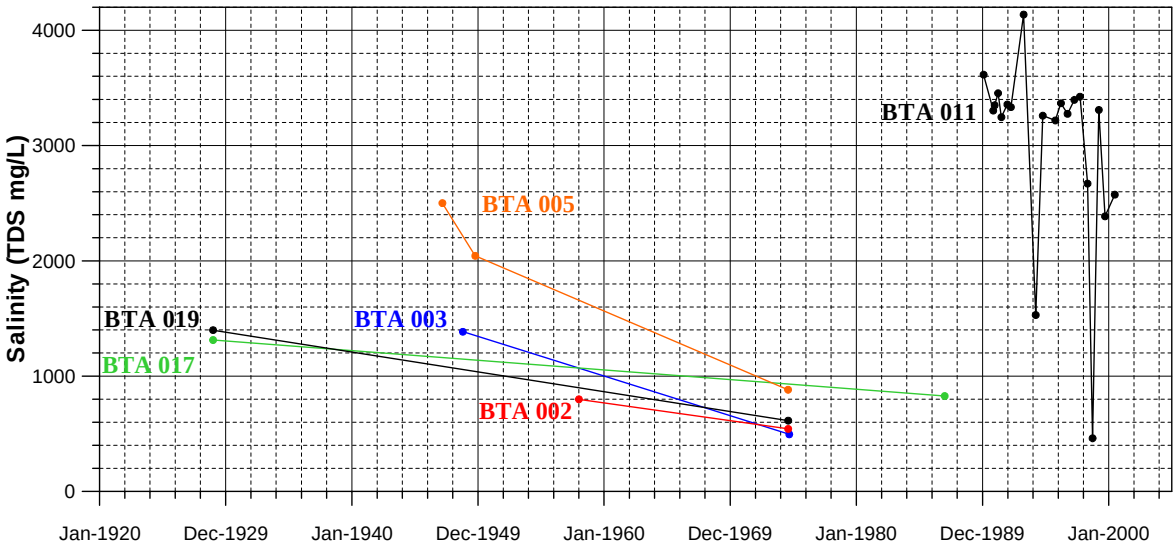


Figure 5. **Observation Well Salinity Data – Falling Trend**

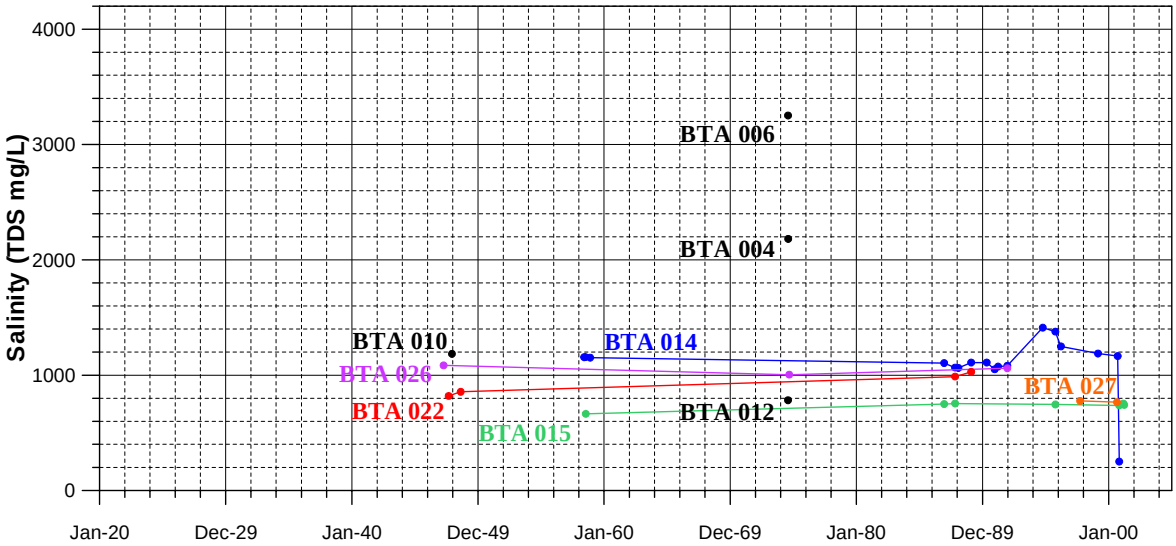


Figure 6. **Observation Well Salinity Data – Steady Trend**

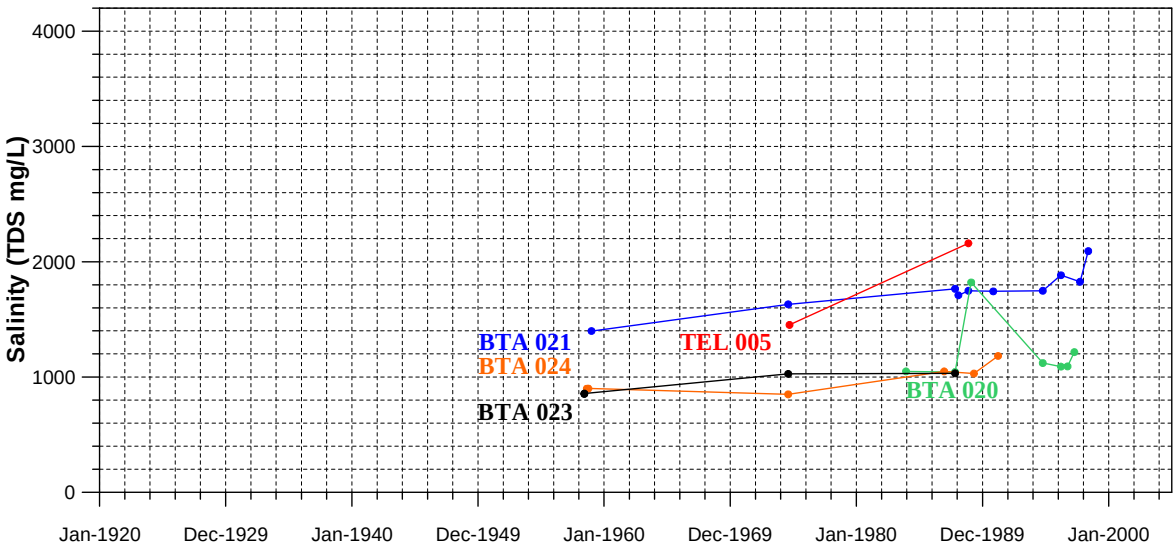


Figure 7. **Observation Well Salinity Data – Rising Trend**

4.2 DRILLING PROGRAM

The available drilling method of using rotary mud precludes the ability to identify individual water cuts during the drilling process. Therefore drilling return samples and geophysical logging results were analysed to predict potential water bearing zones.

Drilling at Site 1 (Fig. 2) commenced on the 1 September 2003 and the target depth of 120 m was reached on the 4 September 2003. Geophysical logging was run through the drill rods, as the stability of the open hole was questionable. Due to unconsolidated boulders between 11 and 15 m, the attempt to set casing repeatedly failed, and eventually the well (6532-1553) was abandoned and backfilled. The composite well log for this well is presented in Appendix C.

A second site (Site 2 in Fig. 2) was chosen and a second attempt to drill a suite of observation wells commenced on 23 September 2003. The target depth of 132 m was reached, the well was geophysically logged and was completed with slotted casing set from 122 to 127 m on the 30 September 2003 (6532-1562). Two wells were drilled adjacent to this hole, with slotted casing set at 61.5 to 66 m (well 6532-1564) and 11 to 23 m (well 6532-1563). The composite well log for the deepest well (BTA 029) is presented in Appendix C.

5. DISCUSSION

5.1 HYDROGEOLOGY

The Baroota groundwater resources that support the irrigation area lies entirely within the hydrogeological province known as the Pirie Basin, which contains Quaternary clays and gravels, and Tertiary fine sands and sandstones overlying the Neoproterozoic basement. The irrigation wells are completed in Quaternary gravels – often over multiple depth intervals. The gravel beds are frequently discontinuous making mapping of aquifers and resource assessment challenging.

The near-surface hydrostratigraphy of the southern portion of the Pirie Basin generally consists of alluvial and fluvial sediments out-washed from the Flinders Ranges. Generally, groundwater yields are low and salinities are brackish to saline. However, at locations where discharge from the Ranges is concentrated (as at the major creeks that drain from the Ranges), there is an increase in the frequency of water bearing sediments and decrease in groundwater salinity. The extent of the catchments of these creeks influences the degree of impact on the Pirie Basin.

The general hydrological processes that are understood to operate within this region indicate that little recharge to the Baroota groundwater resource is available from the minor catchments that drain from the face of the Flinders Ranges. Unaltered flows in the Baroota Creek would contribute recharge to the shallow aquifers adjacent the creek during winter flows, with the extent to which the aquifer system was recharged related to the length and frequency of these flows. The contribution of the fractured rock aquifers to the Baroota groundwater resource is uncertain, given the arid environment and the varying rock types (range from quartzite to siltstone). The observed high salinity of the groundwater resources to the north and south of the Baroota area suggests that contribution from this source is limited. The type of shallow sediment and the large depth to the aquifer away from the drainage feature suggests that infiltration of diffuse recharge across the Baroota plain is also limited.

The construction of the reservoir would have dramatically altered the hydrology of the Baroota Creek. Pre-reservoir stream hydrology would have seen short lived flows leaving the Ranges and transversing the coastal plains throughout the winter period, providing a short period of recharge to the gravels and silts of the groundwater resource. After construction, a reduction in the frequency of surface flows transversing the coastal plain would have occurred.

Reference has been made to the leaky nature of the reservoir. The leaking of stored water from the reservoir would have provided an artificial point source of recharge to the Baroota groundwater resource by holding a supply of water (for leakage) for the full year – as apart from the pre-reservoir watercourse flows which occurred predominantly during the winter period.

The rate of leakage would vary due to the level of storage within the dam (Table 4). The final portion that would be available to the groundwater resource as recharge, is a function of whether the dam operators (SA Water) chose to ‘recover’ the leakage via a collection system, or allow it to flow downstream.

Table 3: Baroota Region of the Pirie Basin — Summary of Hydrogeology

AGE	STRATIGRAPHY		HYDROSTRATIGRAPHY	
	Unit	Lithology and Occurrence	Unit	Description
QUATERNARY	**Pooraka Formation:**	Unconsolidated silty clay, sand and carbonate earth with occasional gravel lenses. Laterally discontinuous and occurs mainly along eastern margin of Pirie Basin.		Not known as an aquifer but small supplies may be obtained adjacent to watercourse drainage channels.
	Telford Gravel:	Coarse-grained sand and gravel with boulders which form fan and colluvial deposits. Laterally discontinuous and occurs frequently over Pirie Basin.		Not known as an aquifer but gravel lenses may provide small stock supplies.
	Hindmarsh Clay:	Mottled red, yellow grey clay. Overlies irregular bedrock topography and contains discrete sand and gravel lenses. Only occurs between Port Augusta and Port Pirie.	**Qpah** up to 6 water bearing zones	Semi-confined aquifer(s), and is the major exploited aquifer in the region. Salinity is highly variable ranging from <1000 to 40 000 mg/L. Yield varies between 0.6 and 15 L/sec but is typically 0.6 to 2 L/sec.Forms a confining bed to Tertiary aquifer where present.
TERTIARY	**Gibbon Beds:**	Pliocene – Pleistocene age comprising mottles clayey sand, sandy clay and conglomerate, unfossiliferous. Occurs predominantly along western margin of Pirie Basin.	**TpQag**	Unconfined and semi-confined aquifer, confining bed to Tertiary aquifer with yield typically of 0.5 to 2 L/sec. Salinity ranges between 3000 to >15 000 mg/L.
	Melton Limestone:	Upper section is composed of a fine-grained densely recrystallised quatzosed calcarenitic limestone. The middle unit typically consists of quartzose, bryozoal rich recrystallised coarse calcarenite and calcirudite. The basal unit is a gravelly quartzose, byrozoal, horizontally bedded to cross bedded calcarenite, calcirudite and calcareous sandstone. Occurs over both the eastern and western portion of Pirie Basin.	**Tomm**	Confined aquifer, typically yielding between 0.5 to 2 L/sec. Because of crystalline nature effective porosity is assumed to be low. Salinity varies from 1000 to >15 000 mg/L.
	Kanaka Beds:	Succession of carbonaceous siltstone, shale and sand, with minor lignite. In Cowell–Whyalla area, the basal part of the beds comprise 10–15 m of carbonaceous sand and minor conglomerate. Widespread throughout Pirie Basin.	**Teoa**	Confined aquifer, yields typically between 0.6 L/sec. Salinity variable with the better quality (<5000 mg/L) found along western margin in Cowell–Whyalla area. Often >15 000 mg/L along eastern margin.
NEOPROTEROZOIC		Undifferentiated sequence of quartzite, sandstone, limestone and siltstone. Forms the basement of the Pirie Basin.	**N**	Groundwater contained in fracture porosity. Stock supplies obtained on the edge of the basin at the foothills of the Flinders Ranges. Salinity and yield are variable. Volume in storage and rate of recharge unknown.

Report DWLBC 2004/56

This leakage component is only available when water is stored within the reservoir. Since about 1997, SA Water have chosen not to maintain the Baroota Reservoir as a balancing storage and has not piped reticulated mains water into it. As a result, the reservoir has been dependent only on natural runoff from the catchment of the reservoir.

Table 4: Estimates of leakage rates

Reference	Type	Leakage		
		L/sec	ML/day	ML/a
Warneke, L.J. (1979)	'Un-recoverable'		2	730
	'Recoverable'		0.5 - 6	180 – 2,190
	Total		**2.5 - 8**	**910 – 2,920**
Clarke, D.K. (2001)	'Continuous surface flow'	8 – 15*		250 – 470*

* Does not include sub-surface flow or volume lost to infiltration upstream from point of measurement.

The climatic conditions that have prevailed over the period 1994 to 1999 have caused low run-off conditions and thus low potential recharge to the groundwater. Compounded with the 'non-filling' of the reservoir by SA Water, the Baroota groundwater resource within a 5 km radius of the reservoir has experienced a dramatic decline in storage during this period.

Groundwater levels Baroota irrigation area have in general, been declining since 1993 (Fig. 2).

5.2 MONITORING TRENDS

Hydrographs of the observation bores monitoring the groundwater resource indicate a strong relationship between recharge response and distance from the creek, with the recharge response diminishing downstream. The groundwater resource appears to be responsive to periods of flow within the Baroota Creek downstream from the reservoir. Consequently, during extended periods of little or no stream-flow, groundwater levels will show a comparative decline, especially since 1994 (Obs wells BTA 3, 9, 10, 13, 14, 15, 26 & 27 in Fig. 3). Hydrographs from wells near the creek approximately 5 km downstream from the reservoir, show seasonal response to summer irrigation (this is adjacent an area of concentrated groundwater extraction).

The change in regional groundwater level contours between 1989 (Clarke,1990) and 2003 (Fig. 8), has seen a regression of water levels in the vicinity of Baroota Creek which has exceeded 10 m in some areas. This fall in water levels is most likely due to the development of concentrated irrigation activity in this area.

Groundwater salinity trends indicate there has been a general freshening of the groundwater resource within 2 km of the reservoir between 1929 and 1987. This may well reflect the addition of fresh water, leaking from the reservoir, beginning in the 1920s. In the area 4 to 8 km due west of the reservoir, groundwater salinities are higher, however the salinity trends are less distinctive (both increases and decreases). Along the Baroota Creek, 5 to 8 km downstream from the reservoir, groundwater salinity trends are predominantly steady to slightly rising. Rising salinity trends can suggest that groundwater extraction is approaching, or may have exceeded sustainable yield.

The spatial distribution analysis of groundwater hydrochemistry by Clarke (1990) suggested that a zone beneath and downgradient to the west of the Baroota Creek contained groundwater with a Cl:Ca ratio that compared with waters typical of surface water recharge (Fig. 8). The plot of groundwater salinity distribution (Fig. 2) supports this finding, as there is also a zone of low salinity groundwater in the same area. These findings support the concept that recharge to the shallower aquifer systems is strongly influenced by the infiltration of surface water from Baroota Creek.

The extension of low salinity groundwater due west of where the Baroota Creek drainage system enters the plains, may support the assumption that the construction of the Baroota Reservoir has promoted more concentrated recharge to the aquifer systems in that region. This assumption is further supported by the measured reduction in groundwater salinity and the responsive nature of the groundwater levels to reservoir storage levels as monitored in BTA 003 (Figs. 3 & 5).

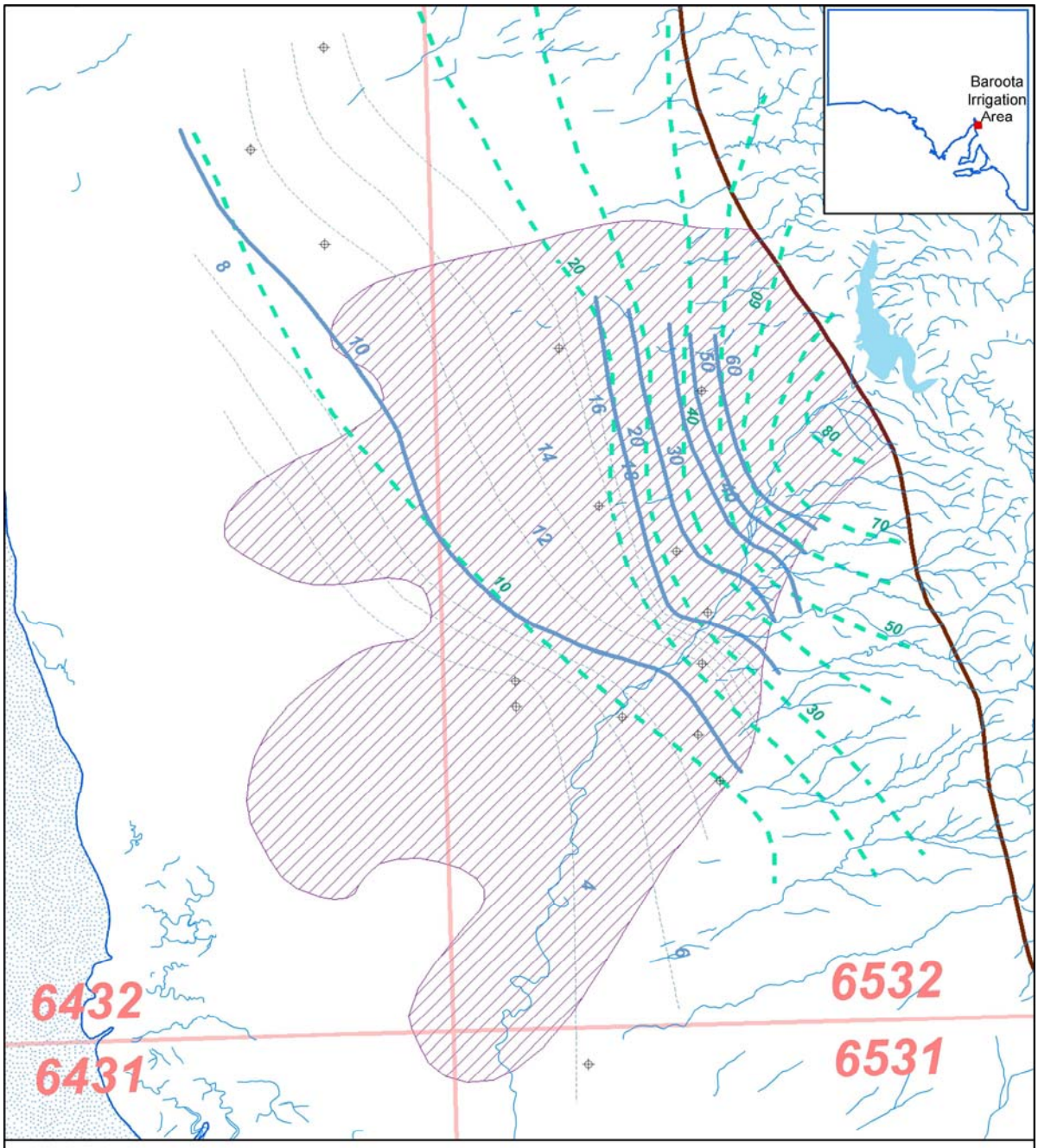


Figure 8: Groundwater Level Distribution

6. CONCLUSIONS & RECOMMENDATIONS

6.1 CONCLUSIONS

Given that the Baroota groundwater resource is understood to be significantly dependant on water from the Baroota Creek/Reservoir system, and that this system is currently not augmented with water from the River Murray, it is suggested that this groundwater resource will have a reduced capacity to support irrigation. The new resource capacity may well be limited solely to the local rainfall – runoff conditions.

Long-term management of the resource will depend on the operation of the reservoir. There will be periods where reservoir storage (and hence rate of leakage) will be low, if not non-existent, based on natural catchment flow regimes. Groundwater resource management will need to accommodate this variation in recharge and consequential periods of stress on the resource.

A review of well completion practices has indicated that many wells are completed across multiple water bearing zones. The ramification of multiple completions of wells is uncertain and effective management of this resource will be limited until this is rectified.

The limited aquifer storage and connectivity of the water bearing zones within the Quaternary Hindmarsh Clay Formation should dictate that the distribution of extraction points for irrigation purposes – both spatially and depth of production - take into account the impact of well interference.

Given the observed response of the shallower aquifer systems to varying climatic conditions, the frequency of monitoring should be able to adequately capture strategic aquifer response information.

Aquifer Storage and Recovery techniques may produce an increase in available yield by ;

- reducing losses to evaporation by minimising the time water is stored above ground
- minimising the concentration of salinity of the surface water caused by evaporation
- distributing recharging water more effectively to areas of heavy extraction
- maximising the life of the reservoir by managing the hydraulic head of the stored water that may be destabilising the dam wall.

Other management regimes to consider include;

- Investigations into establishing the optimum reservoir storage/controlled discharge regime/aquifer storage and recovery programs to provide the maximum benefit to the users of the groundwater resource. The future operating strategy for the Baroota Reservoir is uncertain.
- The environmental needs for the riparian vegetation within the Baroota Creek watercourse. What is the importance of maintaining the vegetation regime that has developed downstream of the reservoir due to the modified stream flow (over the last eighty years) ? Should there be an attempt to restore the original vegetation regime ?
- The need to protect any existing surface water use from the watercourse.
- Landuse activity and changes within the Baroota Reservoir catchment area (including the potential to regulate water use activity within the catchment), if the Baroota groundwater resource is prescribed – ie: the need to prescribe groundwater, watercourse water and catchment surface water resources.

6.2 RECOMMENDATIONS

To better understand the relationship between surface and groundwater interaction and the impacts of pumping, the groundwater level monitoring frequency should be at the least three monthly, but preferably monthly.

Groundwater salinity monitoring should be undertaken at least annually from all active irrigation wells. Full chemical analysis of groundwater from the observation wells should be undertaken on an approximate five-year cycle.

Considering the current catchment and reservoir system in place, the estimate of sustainable yield for irrigation activity should not exceed the calculated leakage from the reservoir. The preliminary estimate based on available information, of 1000 to 1500 ML/y is the suggested yield for the Baroota groundwater resource.

Based on the outcomes of the hydrogeological assessment for prescription of the groundwater resource, further detailed investigations should be undertaken into the recharge processes. Investigative techniques suggested include hydrochemical sampling and analysis (including the use of tracers) and investigations into the response of watertable to streamflow events. Estimated costs to undertake these investigations range between $25 000 and $40 000, not including the cost of drilling new holes if required. Also research into the hydrological processes that operate within the Baroota Reservoir catchment should be undertaken as it is interpreted that the source of water for the Baroota groundwater resource originates from the Baroota Creek catchment.

Well currently constructed as multiple completions should be rehabilitated or replaced to preserve the integrity of the aquifer systems and to allow for discreet allocation of the groundwater resources.

Disused and abandoned wells should be decommissioned appropriately.

GLOSSARY

Aquifer — An underground layer of rock or sediment that holds water and allows water to percolate through.

Aquifer, unconfined — Aquifer in which the upper surface has free connection to the ground surface and the water surface is at atmospheric pressure.

Bore — *See well.*

Catchment – A catchment is an area of land that is surrounded by high ground such as hills or ridges. An imaginary line that runs along the highest point through that high ground defines its boundary. All surface water within this bounded region has the potential to flow to the lowest point in the catchment. A catchment can be viewed as an individual region of land with a multitude of interactions. Management of the many and varied resources within the catchment should be undertaken in such a way that they are not compromised for other users and that the resource used is sustainable both economically and ecologically.

DWLBC — Department of Water, Land and Biodiversity Conservation (Government of South Australia).

EC — Electrical conductivity**.** 1 EC unit = 1 micro-Siemen per centimetre (µS/cm) measured at 25°C. Commonly used to indicate the salinity of water.

Groundwater — *See underground water.*

Hydrogeology — The study of groundwater, which includes its occurrence, recharge and discharge processes, and the properties of aquifers. *(See hydrology.)*

Irrigation — Watering land by any means for the purpose of growing plants.

Irrigation season — The period in which major irrigation diversions occur, usually starting in August–September and ending in April–May.

ML — Megalitre**.** One million litres (1 000 000).

Monitoring — (1) The repeated measurement of parameters to assess the current status and changes over time of the parameters measured. (2) Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, animals, and other living things.

Natural recharge — The infiltration of water into an aquifer from the surface (rainfall, streamflow, irrigation etc.). *(See recharge area, artificial recharge.)*

Permeability — A measure of the ease with which water flows through an aquifer or aquitard. The unit is m^2/d.

Recharge area — The area of land from which water from the surface (rainfall, streamflow, irrigation, etc.) infiltrates into an aquifer. *(See artificial recharge, natural recharge.)*

SA Geodata — A collection of linked databases storing geological and hydrogeological data, which the public can access at the front counters of PIRSA and its regional offices. Custodianship of data related to minerals–petroleum and groundwater is vested in PIRSA and DWLBC, respectively. DWLBC should be contacted for database extracts related to groundwater.

Stock use — The taking of water to provide drinking water for stock other than stock subject to intensive farming (as defined by the Act).

Underground water (groundwater) — Water occurring naturally below ground level or water pumped, diverted or released into a well for storage underground.

Well — (a) an opening in the ground excavated for the purpose of obtaining access to underground water; (b) an opening in the ground excavated for some other purpose but that gives access to underground water; (c) a natural opening in the ground that gives access to underground water.

REFERENCES

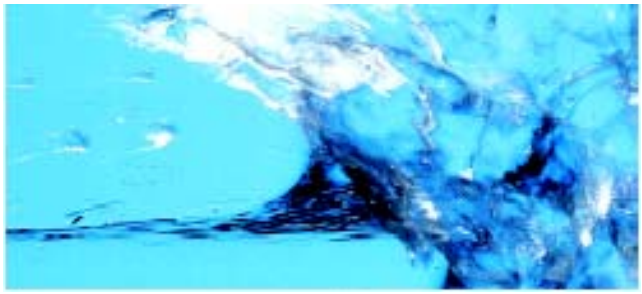
Clarke, D.K., 1990. Groundwater and irrigation in the Baroota Area, Southern Pirie-Torrens Basin. South Australia. Department of Mines and Energy, Report Book 90/39.

Clarke, D.K., 2001. Baroota Groundwater Irrigation: A status report. South Australia. Department for Water Resources, unpublished

Warneke, L.J., 1979. Baroota Dam Leakage Report. South Australia. Engineering and Water Supply Department, EWS 1632/79.

APPENDIX A





Summary of Groundwater Wells in the Baroota Irrigation Area

Table 5: Summary of Well Information – Baroota Irrigation Area

WELL NUMBER	OBS. WELL NAME	AQUIFER COMPLETION	MAXIMUM DRILLED DEPTH	CURRENT DEPTH		LOCATION		STANDING WATER LEVEL		WELL YIELD		GROUNDWATER SALINITY (TDS)		CASED TO	MIN. INT. DIA	CHEM ANAL	LOGS		PURPOSE
			(m)	(m)	Date	H'd	Lot	(m)	Date	(L/s)	Date	(mg/L)	Date	(m)	(mm)		D	G	
6431 2		Qpah(1)	5.70	5.70	09/74	Telowie	A 232	4.13	09/74	0.70	03/82	3684	09/74					Y	Stk
6431 55		N	354.00	0.00	03/82	Telowie	S 154	-5.00	03/82	0.63	10/49	3704	03/82						Exp
6432 44		Qpah(3)	31.39	9.70	09/74	Telowie	A 3		09/74			2721	05/63	31.39	152	Y	Y	Y	
6432 46		Qpah(1)	6.40	6.40	10/49	Telowie	A 6	6.10	10/49	0.00	10/49	6307	10/49			Y		Y	
6432 47		Qpah(1)	5.35	5.35	09/74	Telowie		4.60	09/74	0.13	10/49	2370	09/74			Y		Y	Stk
6432 102		Qpah(4)	47.24	47.00	08/74	Baroota	A 107	10.40	08/74			1272	08/74	47.24	152	Y		Y	
6432 105					09/74	Baroota	A 100					18205	09/74						
6432 106		Qpah(2)	18.29	18.29	01/00	Baroota	S 68N												
6432 107		TpQag	85.34	85.34	10/49	Baroota	S 67	3.96	10/49			5082	10/49	73.15	127	Y	Y	Y	
6432 108		Qpah(2)	24.38	24.38	01/00	Baroota	S 67			0.13	10/49	6232	01/00				Y	Y	
6432 109		Qpah(1)	9.85	9.85	09/74	Baroota	S 63	6.60	09/74			5050	09/74				Y	Y	
6432 110		Qpah(1)	18.00	18.00	09/74	Baroota	S 63	6.85	09/74			7720	03/53		152			Y	
6432 111		Qpah(1)	18.29	18.29	01/00	Baroota	S 64											Y	
6432 112		Teoa	137.77	100.58	10/49	Baroota	S 65	3.66	10/49	0.13	10/49	2970	10/49		127	Y	Y	Y	
6432 113		Qpah(2)	19.81	19.81	10/49	Baroota	S 62	14.63	10/49	1.26	05/56	4688	10/49					Y	
6432 114		Tomm	110.64	110.64	05/56	Baroota	S 62	0.00	05/56			2821	05/56	107.59	127		Y	Y	Irr
6432 115		Qpah(5)	58.17	58.17	08/74	Baroota	S 62	12.00	08/74	0.13	10/49	2086	08/74		152			Y	
6432 116		Qpah(3)	30.78	30.78	08/74	Baroota	S 61N			0.38	10/49	2795	08/74					Y	Stk
6432 117		Qpah(1)	16.76	16.76	10/49	Baroota	A 282	10.67	10/49	0.91	06/75	9870	10/49					Y	
6432 118	BTA 01	Tomm	130.15	130.10	06/75	Baroota	A 282	0.00	06/75			2147	12/79	104.55	127	Y	Y	Y	Irr; Stk; Obs
6432 119	BTA 12	Qpah(4)	46.25	45.51	03/85	Baroota	A 283	13.65	11/04			783	07/74					Y	Obs
6432 120		Tomm	101.50	101.50	10/49	Baroota	S 48	0.00	10/49	0.06	10/49	6535	10/49	100.58	127	Y	Y	Y	
6432 121		Tomm	100.58	100.58	10/49	Baroota	S 49	0.00	08/74			5768	08/74	91.44	102	Y			
6432 122		TpQag	100.58	0.00	07/74	Baroota	S 50W	2.44	10/49	0.13	10/49	3690	10/49	82.30	127	Y		Y	
6432 123		Qpah(1)	12.80	12.80	10/49	Baroota	A 1	9.45	10/49	0.51	10/49	11429	10/49					Y	
6432 124	BTA 06	Qpah(1)	18.35	18.35	07/74	Baroota	A 1	9.89	11/04			3252	08/74						
6432 125		Tomm	165.00	100.10	07/74	Baroota	A 1	0.00	12/77	0.03	12/77	2295	12/77						
6432 126		Qpah(2)	24.38	24.38	10/49	Baroota	A 105												
6432 127		Qpah(3)	40.23	39.00	08/74	Baroota	A 105			0.38	10/49	8035	10/49	24.38	152				Irr

WELL NUMBER	OBS. WELL NAME	AQUIFER COMPLETION	MAXIMUM DRILLED DEPTH	CURRENT DEPTH		LOCATION		STANDING WATER LEVEL		WELL YIELD		GROUNDWATER SALINITY (TDS)		CASED TO	MIN. INT. DIA	CHEM ANAL	LOGS		PURPOSE
			(m)	(m)	Date	H'd	Lot	(m)	Date	(L/s)	Date	(mg/L)	Date	(m)	(mm)		D	G	
6432 128		Tomm	97.84	97.84	08/58	Baroota	S 46			7.50	08/74	4407	08/74	37.80	152		Y	Y	Irr
6432 129		Teoa+Tomm	121.31	111.25	10/58	Baroota	S 46	2.13	08/58	2.53	08/58	3453	08/58	97.54	127	Y			Stk
6432 130		TpQag	91.44	5.00	08/74	Baroota	S 46		10/58	0.63	10/58	6108	10/58	111.25	127	Y	Y	Y	
6432 131		Teoa	122.00	11.10	07/74	Baroota	S 45	3.30	08/74						127				
6432 132	BTA 05	Qpah(4)	46.94	29.82	08/89	Baroota	A 103	8.45	07/74			1692	07/74						
6432 133		Qpah(6)	62.18	32.87	08/74	Baroota	A 103	14.64	11/04	0.13	10/49	882	08/74			Y		Y	Obs
6432 134		Qpah(1)	20.42	20.42	10/49	Baroota	A 99	23.00	08/74	2.53	09/54	1581	08/74	60.96	152		Y	Y	Irr; Stk
6432 135	BTA 11	Qpah(3)	33.00	30.41	08/89	Baroota	A 99	13.11	10/49	0.38	10/49	5988	10/49					Y	
6432 136		Qpah(3)	35.36	34.20	08/74	Baroota	A 300	15.25	03/94			2574	06/00					Y	Obs
6432 137		Qpah(2)	24.38	24.38	01/27	Baroota	S 200	19.30	08/74	6.32	10/49	2454	08/74	30.48	152	Y	Y	Y	Stk
6432 138		Qpah(1)	15.85	15.85	11/52	Baroota	S 28S											Y	
6432 139		Qpah(3)	37.00	37.00	08/74	Baroota	S 28N	8.40	09/74	1.26	10/49	4991	09/74					Y	Stk
6432 140		Qpah(1)	18.29	18.29	10/49	Baroota	A 7	9.65	08/74									Y	
6432 141		TpQag	94.49	91.00	08/74	Baroota	A 7	4.57	10/49	1.26	10/49	5757	10/49					Y	
6432 142		Qpah(3)	33.22	22.50	09/74	Baroota	S 91	10.60	08/74	1.00	08/74	3143	10/59	91.44	152		Y	Y	Irr; Stk
6432 143		Qpah(4)	48.16	44.20	09/66	Baroota	A 3	13.50	09/74	1.26	06/48	3224	09/74	32.92	152	Y	Y	Y	Stk
6432 144		Qpah(5)	61.00	0.00	09/97	Baroota	A 3	23.77	09/66	7.58	01/47	1715	09/66	45.72	203	Y	Y	Y	Irr
6432 145		Qpah(5)	59.44	0.00	07/97	Baroota	A 3	30.33	08/74	7.58	01/47	2241	10/87			Y	Y		Obs
6432 146		Tomm	85.34	0.00	09/66	Baroota	A 3	27.00	04/96	37.88	10/49	1380	10/87			Y	Y	Y	Irr
6432 147		Qpah(1)	19.81	0.00	09/66	Baroota	A 3									Y	Y	Y	
6432 148		Qpah(1)	16.46	0.00	09/66	Baroota	A 3	16.15	10/49	12.63	10/49	6194	10/49			Y			
6432 149	BTA 16	Qpah(4)	68.00	29.10	02/87	Baroota	A 3	15.24	10/49	5.05	10/49	4320	10/49			Y			Stk
6432 150		Qpah(4)	60.90	60.90	08/74	Baroota	A 3	28.12	02/87	7.50	08/74	2830	11/67		152	Y			Irr; Obs
6432 151		Qpah(3)	30.48	30.48	01/00	Baroota	A 3	30.00	08/74	15.00	08/74				152			Y	Irr
6432 152		Qpah(4)	59.74	59.74	01/69	Baroota	A 3	27.43	01/69	44.20	01/69	2355	01/69	36.58	203				Irr
6432 153		Qpah(4)	44.20	44.20	06/63	Baroota	A 3	21.34	06/63	9.47	06/63	2115	06/63						Irr
6432 154		Qpah(2)	21.34	21.34	10/49	Baroota	S 198												
6432 155		Qpah(1)	7.62	7.62	01/00	Baroota	S 198	7.62	01/30			6255	01/30						
6432 156		Qpah(1)	9.45	9.45	10/49	Baroota	S 23	7.01	10/49	0.13	10/49	8514	10/49						
6432 157		Qpah(2,3+4)	65.53	52.12	07/48	Baroota	S 85	10.97	10/49	31.58	10/49	2584	07/48	19.30	203	Y	Y	Y	Irr
6432 158		N	131.67	131.67	09/48	Baroota	S 85	15.85	10/49	12.60	08/48	3314	09/48	131.67	152	Y	Y	Y	Irr
6432 159		Qpah	9.75	0.00	03/48	Baroota	S 85		03/48								Y	Y	
6432 160		Qpah(1)	15.96	15.96	09/74	Baroota	S 85	14.23	09/74			4147	09/74						

WELL NUMBER	OBS. WELL NAME	AQUIFER COMPLETION	MAXIMUM DRILLED DEPTH	CURRENT DEPTH		LOCATION		STANDING WATER LEVEL		WELL YIELD		GROUNDWATER SALINITY (TDS)		CASED TO	MIN. INT. DIA	CHEM ANAL	LOGS		PURPOSE
			(m)	(m)	Date	H'd	Lot	(m)	Date	(L/s)	Date	(mg/L)	Date	(m)	(mm)		D	G	
6432 161		Qpah(1)	14.63	14.63	10/49	Baroota	S 85	11.28	10/49	12.63	10/49	9870	10/49			Y			
6432 162			16.76	16.76	10/49	Baroota	A 94	16.15	10/49	0.13	10/49	4814	10/49			Y			Stk
6432 163		Qpah(1)	10.06	10.06	10/49	Baroota	S 25	3.96	10/49	0.51	10/49	4880	10/49		127	Y			Stk
6432 164		Qpah(1)	7.62	7.62	01/00	Baroota	S 25					5068	01/00						
6432 165		Qpah(1)	6.10	6.10	01/00	Baroota	S 3					5076	01/00						
6432 166		Qpah(1)	7.01	7.01	10/49	Baroota	S 3	6.71	10/49			3082	10/49						Stk
6432 167		Qpah(1)	15.24	12.75	08/74	Baroota	A 899	10.00	08/74	0.13	10/49	6281	10/49						
6432 168		Qpah			08/74	Baroota	A 93	11.18	08/74			3080	08/74		152				Stk
6432 169		Qpah(3)	61.00	61.00	09/74	Baroota	Q 91	26.82	01/60	20.00	10/74	1413	09/74	53.01	203	Y	Y	Y	Irr
6432 170		Qpah(1)	14.02	0.00	09/74	Baroota	Q 91	7.62	10/49	0.13	10/49								
6432 171		Qpah(1)	18.29	0.00	09/74	Baroota	Q 91	12.19	03/47	15.16	03/47	2882	03/47			Y			
6432 172		Qpah(1)	19.81	19.81	04/53	Baroota	Q 91	9.14	04/53	0.95	04/53	3324	04/53	17.68	152		Y		Stk
6432 174		Qpah			09/44	Baroota	Q 91					2685	09/44			Y			
6432 175			7.20	7.20	08/74	Baroota	S 2		08/74										
6432 176		Qpah(1+2)	24.38	14.25	09/74	Baroota	S 5	14.25	09/74	1.52	10/49	1720	09/74	24.38	127	Y	Y	Y	Irr; Stk
6432 177		Qpah(2)	41.15	41.15	02/60	Baroota	S 71	27.13	02/60			1268	02/60	41.15	152	Y	Y	Y	Irr
6432 479			82.00	0.00	04/82	Baroota	Q 91			1.50	04/82	1378	04/82				Y	Y	Irr
6432 480		Qpah(3)	47.00	47.00	04/82	Baroota	Q 91		08/04	7.50	04/82	1413	04/82	47.00	152		Y	Y	Irr
6432 482		Qpah(1)	20.00	20.00	06/84	Baroota	S 211			0.30	06/84	2717	06/84	18.50	140		Y	Y	Stk
6432 486		Qpah(3)	78.00	0.00	09/97	Baroota	A 899	12.99	11/87	15.15	07/84	3943	05/85	26.00	203		Y	Y	Irr
6432 490			38.00	0.00	10/84	Baroota	S 63			0.90	10/84	6590	10/84				Y	Y	Irr
6432 491			15.00	0.00	10/84	Baroota	S 63			0.75	10/84	4160	10/84				Y	Y	Irr
6432 492			32.00	32.00	10/84	Baroota	S 91			1.00	10/84	3385	10/84	32.00	152		Y	Y	Dom; Stk
6432 494			105.40	73.70	06/88	Telowie	A 2	5.02	06/88	0.25	01/86	31145	06/88				Y	Y	Irr
6432 495		Qpah(3)	36.00		11/87	Baroota	A 899	12.00	01/86	6.25	01/86	2535	01/86	27.00	203		Y	Y	Irr
6432 496			42.70	42.70	06/86	Baroota	A 105			1.88	06/86	999	06/86	42.00	195		Y	Y	Irr; Stk
6432 526			36.00	30.80	03/85	Baroota	S 2	5.70	03/85	0.30	03/85	7084	03/85	30.80	150	Y	Y	Y	Stk
6432 535		Qpah(3+4)	45.00	45.00	09/86	Baroota	S 194	7.60	09/86	1.26	09/86	2210	09/86	45.00	203		Y	Y	Irr
6432 550		Qpah(4)	48.00	48.00	05/90	Baroota	S 25	18.00	05/90	1.25	05/90	3195	05/90	45.40	203		Y	Y	Stk
6432 551			356.00	356.00	03/82	Telowie	A 2												
6432 553		TpQag	105.50	104.00	05/90	Telowie	S 58	0.00	05/90	0.13	05/90	3471	05/90	101.00	100				
6432 886		Qpah(1)	21.00	19.30	05/93	Baroota	S 23	12.20	06/93	2.53	05/93	3443	05/93	19.30	152		Y	Y	Stk
6432 909		Qpah(5)	66.00	58.00	04/96	Baroota	A 3	27.00	04/96	3.50	04/96	1468	04/96	54.00	203		Y	Y	Irr

WELL NUMBER	OBS. WELL NAME	AQUIFER COMPLETION	MAXIMUM DRILLED DEPTH	CURRENT DEPTH		LOCATION		STANDING WATER LEVEL		WELL YIELD		GROUNDWATER SALINITY (TDS)		CASED TO	MIN. INT. DIA	CHEM ANAL	LOGS		PURPOSE
			(m)	(m)	Date	H'd	Lot	(m)	Date	(L/s)	Date	(mg/L)	Date	(m)	(mm)		D	G	
6432 910			36.00	0.00	05/96	Baroota	A 91	14.00	05/96	3.00	05/96						Y	Y	Dom
6432 912		TpQag	105.00	105.00	06/97	Baroota	A 3	33.00	06/97	5.00	06/97	5817	06/97	101.00	152		Y	Y	Irr
6432 914		Qpah(3)	31.00	30.00	10/97	Baroota	A 899	12.70	10/97	5.00	10/97	3407	10/97	27.00	152		Y	Y	Irr
6432 915			54.00	0.00	04/02	Baroota	S 31	26.00	09/97	14.00	09/97	2025	09/97				Y	Y	Irr
6432 916		Qpah(3)	30.00	30.00	09/97	Baroota	A 899					4246	02/98	30.00	203		Y	Y	Irr
6432 961			75.00	75.00	07/99	Baroota	A 3	26.00	07/99	8.00	07/99	1995	09/99	75.00	140		Y	Y	Irr
6432 962			76.00	76.00	07/99	Baroota	A 3	26.00	07/99	10.00	07/99	2182	09/99	69.00	152		Y	Y	Irr
6432 963			5.79	5.79	10/49	Telowie	S 165	5.18	10/49	0.13	10/49	4119	10/49						Irr; Stk
6432 971			96.00	0.00	03/00	Baroota	A 3										Y	Y	Irr
6432 972		Qpah(4)	90.00	48.00	03/00	Baroota	A 3	26.48	08/03	7.00	03/00	2301	03/00	41.00	152		Y	Y	Irr; Obs
6432 973		Qpah(6)	84.00	75.00	03/00	Baroota	A 3	24.70	03/00	8.00	03/00	2126	03/00	64.00	152		Y	Y	Irr
6432 986		Qpah(6)	81.00	78.00	11/02	Baroota	A 94	30.00	11/02	10.00	11/02	1038	11/02	66.00	152		Y		Irr
6531 883			18.89	18.89	07/47	Telowie	A 240	5.48	07/47	1.77	07/47	2485	11/49	14.63	152	Y		Y	
6531 884						Telowie	A 240								152				
6531 885			11.58	11.58	10/49	Telowie	A 105	3.55	09/74	0.10	10/49	5788	09/74						
6531 886			9.14	9.14	10/60	Telowie	S 260	5.49	10/60	0.10	10/60	476	11/49						Stk
6531 887			11.89	11.89	10/49	Telowie	S 264	7.01	10/49			3242	11/49						
6531 888			13.72	13.72	10/49	Telowie	S 331	10.67	10/49			3727	11/49						
6531 889			59.13	59.13	11/49	Telowie	A 2	17.07	11/49			2213	11/49						
6531 890	TEL 05		31.10	31.10		Telowie	S 328	11.00	11/04			2160	11/88		152		Y		Obs
6531 891			47.00	47.00	07/47	Telowie	A 3	14.50	09/74			1418	09/74	35.05	152	Y			
6531 892			41.85	41.85		Telowie	A 3	13.25	09/74			2340	09/74					Y	
6531 893						Telowie	S 47S												
6531 894			36.60	36.60	10/49	Telowie	S 429	29.00	10/49	0.10	10/49								
6531 1613			8.00	8.00	07/97	Telowie	A 38	4.89	07/97					2.00	50			Y	Obs
6531 1614			8.00	8.00	07/97	Telowie		4.87	07/97					2.00	50			Y	Obs
6531 1615			8.00	8.00	07/97	Telowie	A 40	4.85	07/97					2.00	50			Y	Obs
6531 1616			8.00	8.00	07/97	Telowie	A 40	4.57	07/97					2.40	50			Y	Obs
6531 1617			8.00	8.00	07/97	Telowie		3.66	07/97					2.20	50			Y	Obs
6532 37	BTA 25					Baroota	S 214					844	08/03						Obs
6532 627			9.14	9.14	10/49	Telowie	S 55	8.23	10/49	0.13	10/49	4798	10/49						
6532 628			78.94	78.94	03/48	Telowie	A 538	29.87	03/48	0.02	03/48	4213	03/48			Y		Y	
6532 629			168.55		02/23	Telowie	S 474			0.06								Y	

WELL NUMBER	OBS. WELL NAME	AQUIFER COMPLETION	MAXIMUM DRILLED DEPTH	CURRENT DEPTH		LOCATION		STANDING WATER LEVEL		WELL YIELD		GROUNDWATER SALINITY (TDS)		CASED TO	MIN. INT. DIA	CHEM ANAL	LOGS		PURPOSE
			(m)	(m)	Date	H'd	Lot	(m)	Date	(L/s)	Date	(mg/L)	Date	(m)	(mm)		D	G	
6532 630			198.12	198.12		Telowie	S 430												
6532 637	BTA 07		47.55	47.55	10/49	Baroota	S 58N	19.08	01/83	0.51	10/49	2477	09/74	45.72	152	Y			
6532 638			133.50	133.50	10/49	Baroota	Q 92	27.43	10/49			1901	06/99		127				
6532 639			22.86	22.86		Baroota	S 53	21.95		2.53		4884				Y			Irr
6532 640						Baroota	S 41N	21.30	08/74	20.20	08/74	2372	10/73						
6532 641			36.58	31.85	08/74	Baroota	S 89	31.20	08/74	3.79	01/49	2607	08/74			Y			Stk
6532 642			39.62	39.62	10/49	Baroota	S 39	32.92	10/49	0.13	10/49	1756	10/49	39.62	102	Y			
6532 643	BTA 04	Qpah(6)	61.96	44.81	08/89	Baroota	S 39	37.57	11/04			2284	08/74		152				Obs
6532 644		Qpah(3)	30.48	30.48	10/49	Baroota	A 301	24.38	10/49	0.51	10/49	3270	10/49			Y			Stk
6532 645		Qpah(6)	60.96	60.96	07/48	Baroota	A 301	29.57	08/74	2.53	07/48	666	08/74	53.95	203	Y	Y		Irr
6532 646		Qpah(3,4,6)+Tomm	80.77	80.77	09/58	Baroota	A 302	29.67	09/58	5.05	09/58	1970	09/58	80.77	203	Y	Y	Y	
6532 647	BTA 21	Tomm	86.26	86.26	12/58	Baroota	A 301	33.53	12/58	11.50	01/74	2092	05/98	79.25	152			Y	Irr
6532 648		Qpah(3,4,5,6)+TpQag	81.69	70.70	04/02	Baroota	S 31	32.00	04/02	11.00	04/02	1625	08/74	70.70	152	Y	Y		Dom; Stk
6532 649			69.49	69.49	01/60	Baroota	S 31	27.74	02/63	1.01	08/04	1428	02/63			Y		Y	Irr
6532 650			74.37	74.37	03/47	Baroota	S 31	22.86	10/49	1.89	10/49	1385	03/47	59.74	203			Y	Irr
6532 651			30.15	30.15	08/74	Baroota	S 31		08/04	0.51	01/49	2146	08/74			Y		Y	
6532 652	BTA 10		48.77		08/89	Baroota	S 175		11/04	0.63	01/49	1185	12/47			Y			Obs
6532 653			83.82	34.18	09/74	Baroota	S 81	29.00	09/74	5.00	09/74	240	09/74	83.82	152			Y	Stk
6532 654			77.72	55.61	09/74	Baroota	S 81	30.50	09/74	5.00	09/74	1099	09/74	77.72	152				Irr; Stk
6532 655			76.00	76.00	09/74	Baroota	S 81	30.50	09/74	5.00	09/74	1334	09/74	76.00	152				Irr
6532 656			32.31	32.31	10/49	Baroota	S 20	28.65	10/49	1.26	10/49	2028	10/49			Y			
6532 657			53.64	53.64	07/54	Baroota	S 20					1214	07/54						
6532 658			48.16	48.16	03/47	Baroota	S 17	27.43	10/49	1.26	10/49	1185	03/47		127	Y		Y	Stk
6532 659		Qpah(3,4+6)	65.53	65.53	07/58	Baroota	A 306	27.43	07/58	2.53	07/58	745	12/86	62.69	152	Y	Y	Y	
6532 660	BTA 26	Qpah(2)	26.82	26.82	04/47	Baroota	S 19	27.70	11/04	4.00	09/74	1060	12/91	23.47	127	Y	Y	Y	Irr; Stk; Obs
6532 661		Qpah			09/74	Baroota	S 5	26.09	03/03			1005	03/03		127				Irr
6532 662		Qpah(3)	41.15	41.15	09/47	Baroota	S 6	18.60	10/49	1.89	10/49	1114	11/49	38.71	127	Y	Y	Y	
6532 663		Qpah(2)	22.86	18.00	09/74	Baroota	S 6	14.55	09/74	3.03	05/58	938	09/74	22.86	152	Y	Y	Y	Stk
6532 664		Qpah	72.00	72.00	09/74	Baroota	S 7E	20.70	09/74	12.50	09/74	944	09/74	72.00	152				Irr
6532 665	BTA 22	Qpah(3)	44.50	38.71	08/48	Baroota	A 294	26.41	08/48	3.16	08/48	1029	02/89	37.80	203	Y	Y	Y	Irr
6532 666	BTA 15					Baroota	A 294	32.39	11/04			742	03/01			Y			Irr; Obs
6532 667		Qpah(2,3,4,5+6)	67.06	67.06	07/58	Baroota	A 294	28.96	07/86	4.67	07/58	760	12/86	66.95	203	Y	Y	Y	
6532 668		Qpah(3+5)	55.17	55.00	09/74	Baroota	A 293	27.30	09/74	12.50	09/74	762	12/86			Y		Y	Irr

WELL NUMBER	OBS. WELL NAME	AQUIFER COMPLETION	MAXIMUM DRILLED DEPTH	CURRENT DEPTH		LOCATION		STANDING WATER LEVEL		WELL YIELD		GROUNDWATER SALINITY (TDS)		CASED TO	MIN. INT. DIA	CHEM ANAL	LOGS		PURPOSE
			(m)	(m)	Date	H'd	Lot	(m)	Date	(L/s)	Date	(mg/L)	Date	(m)	(mm)		D	G	
6532 669		Qpah(2)	48.16	48.16	05/58	Baroota	A 307	24.38	05/58	1.52	05/58	985	05/58	40.31	152	Y	Y	Y	
6532 670		Qpah(2)	40.84	40.84	05/58	Baroota	A 307	21.34	05/58	1.82	05/58	971	05/58	40.84	127	Y	Y	Y	Irr
6532 671		Qpah(6)	78.64	78.64	11/63	Baroota	S 152	25.91	11/63	2.27	11/63	885	11/63	69.06	152	Y	Y	Y	
6532 672		Qpah(4)	38.10	38.10	02/48	Baroota	S 161	32.92	10/49	1.26	02/48	1028	02/48	36.13	152	Y	Y	Y	Irr
6532 673	BTA 02	Qpah(4)	89.92	44.11	08/89	Baroota	S 162	32.27	09/92	2.50	05/58	542	08/74	84.43	152	Y	Y	Y	Obs
6532 674			36.88		08/74	Baroota	S 162	34.14	05/47	1.89	05/47	1200	05/47			Y		Y	
6532 675			80.77		10/49	Baroota	S 162	32.61	10/49	2.53	10/49	899	04/49			Y		Y	
6532 676		Qpah(4)	68.58	38.50	08/74	Baroota	S 162	34.15	08/74	2.50	08/74	910	08/74			Y	Y	Y	
6532 677	BTA 24	Qpah(3,4,5+6)	79.86	55.00	08/74	Baroota	S 162	25.91	08/58	9.00	08/74	1183	03/91	72.67	203	Y	Y	Y	Irr
6532 678			64.01	64.01	02/48	Baroota	S 164	33.22	10/49	1.77	10/49	785	02/48	61.95	203	Y		Y	
6532 679	BTA 23		70.10	70.10	06/58	Baroota	S 164	30.48	06/58	3.70	01/74	1032	10/87	68.70	152	Y		Y	Irr
6532 680	BTA 14		70.10	70.10	06/58	Baroota	S 164	38.67	11/04	14.52	06/58	1160	02/03		203	Y		Y	Irr
6532 681			50.00	50.00	08/76	Baroota	A 13			2.50	08/76	1810	08/76						
6532 682			48.20	48.20	08/76	Baroota	A 13	26.20	08/76	5.00	08/76	1328	04/03	48.00	152			Y	Irr
6532 683			41.76	41.76	05/58	Baroota	S 170	27.43	02/63	6.50	08/74	1077	08/74	41.76	152	Y		Y	Irr
6532 684			137.00	137.00	08/74	Baroota	S 171			7.50	01/74								
6532 685			72.24		08/74	Baroota	S 172	33.60	08/74	1.14	01/49	1286	12/86			Y		Y	
6532 686			70.10		01/77	Baroota	S 172	15.24	10/75	2.53	10/75	1231	12/86			Y		Y	
6532 692						Baroota	S 263					2256	08/62						
6532 693						Baroota	S 260					2185	10/49			Y			
6532 694			103.63	103.63	10/49	Baroota	S 75												
6532 695						Baroota	S 201					2241	05/36			Y			
6532 696						Baroota	S 201					428	10/49			Y			
6532 697						Baroota	S 201					828	05/36			Y			
6532 698						Baroota	S 201					798	08/43			Y			
6532 699						Baroota	S 201					685	08/42			Y			
6532 700						Baroota	S 201					914	10/49			Y			
6532 701						Baroota	S 201					1156	01/58			Y			
6532 702						Baroota	S 201					871	08/42			Y			
6532 703						Baroota	S 201					828	01/42			Y			
6532 704		Qpah	22.25	22.25	09/48	Baroota	S 87		09/48								Y	Y	
6532 705	BTA 03	Qpah(3)	67.36	33.22	08/89	Baroota	S 87	26.28	08/03	0.76	10/48	495	09/74	35.36	203	Y	Y	Y	Obs
6532 706			69.00	69.00		Baroota	A 294	18.00	07/58			499	01/48			Y		Y	

WELL NUMBER	OBS. WELL NAME	AQUIFER COMPLETION	MAXIMUM DRILLED DEPTH	CURRENT DEPTH		LOCATION		STANDING WATER LEVEL		WELL YIELD		GROUNDWATER SALINITY (TDS)		CASED TO	MIN. INT. DIA	CHEM ANAL	LOGS		PURPOSE
			(m)	(m)	Date	H'd	Lot	(m)	Date	(L/s)	Date	(mg/L)	Date	(m)	(mm)		D	G	
6532 707		Qpah(3)	39.00	39.00	08/74	Baroota	A 297	2.03	08/74	5.00	08/74	880	08/74		203	Y			
6532 708	BTA 17	Qpah	5.18	4.40	08/89	Baroota	S 33	3.13	11/89	2.53	01/49	832	03/87	5.18	1600	Y			Irr
6532 709	BTA 19	Qpah(1)	10.97	8.05	10/87	Baroota	S 33		04/90	0.76	01/49	614	08/74			Y			Obs
6532 710		Qpah	6.15	6.15	09/74	Baroota	S 33	3.85	09/74			567	09/74						
6532 711		Qpah(1)	18.29	18.29	10/49	Baroota	A 50		10/49	0.51	10/49	1142	10/49						
6532 712		Qpah(4)	67.67	0.00	09/58	Baroota	A 5	21.34	09/58	1.89	09/58	885	09/58			Y	Y	Y	
6532 713		Qpah(2,3+6)	68.88	68.88	03/60	Baroota	A 50	22.25	05/60			1014	05/60	67.23	152	Y	Y	Y	
6532 714		Qpah(1,2,3,5+6)	112.78	112.78	05/60	Baroota	A 50	12.80	05/60	4.90	08/74	1099	05/60	104.09	152	Y	Y	Y	
6532 715		Qpah	7.60	7.60	08/74	Baroota	A 50	3.65	08/74			827	08/74						Stk
6532 716		TpQag	116.00	116.00	08/74	Baroota	A 50	11.75	08/74	1.80	08/74	871	08/74						
6532 717		Qpah	3.05	3.05	04/63	Baroota	S 214			3.79	01/63	885	04/63			Y			
6532 718						Baroota	S 214					785	08/42			Y			
6532 719		Qpah	0.50	0.50	10/73	Baroota	S 257					885	10/73						Irr
6532 720						Baroota	S 214					871	08/42			Y			
6532 721						Baroota	S 214					713	08/42			Y			
6532 722						Baroota	S 257					868	10/62			Y			
6532 723		Qpah(1)	29.87	14.02	06/58	Baroota		5.49	06/58	4.42	06/58	1228	06/58	11.91	203	Y	Y	Y	
6532 724		Qpah(1)	6.71	6.71	10/49	Baroota	A 94	5.49	10/49	0.63	10/49	1200	10/49						
6532 725		N	159.41	152.00	08/74	Baroota	A 95	11.50	08/74	6.00	08/74	1418	08/74	124.84	152		Y	Y	Irr
6532 726		Qpah	6.45	6.45	08/74	Baroota	A 94	3.00	08/74			1183	08/74						
6532 727		Qpah(1)	51.21	51.21	11/48	Baroota	A 3	12.19	10/49	0.51	10/49	1528	10/48		203	Y	Y		
6532 728		Qpah(2)	30.48	0.00	12/48	Baroota	A 3	21.03	11/48	0.00	11/48	1428	11/48				Y	Y	
6532 729		N	96.01	0.00	05/49	Baroota	A 312	47.24	10/49	0.00	05/49	1504	05/49			Y	Y	Y	
6532 730		Qpah	10.25	10.25	08/74	Baroota	S 157	4.30	08/74			1664	08/74						
6532 731		Qpah(5)	64.01	64.01	07/49	Baroota	S 156	21.95	07/49	0.82	07/49	965	07/49	47.24	203	Y	Y	Y	
6532 1285		Qpah(5)	59.40	54.00	08/83	Baroota	A 307	30.00	08/83	2.25	08/83	26489	08/83	48.00	114		Y		Irr
6532 1291		Qpah(5)	56.00	56.00	07/83	Baroota	A 307	29.89	08/03	9.00	07/83	838	04/03	52.40	145		Y		Irr
6532 1293	BTA 20	Qpah(2+3)	46.33	46.33	12/83	Baroota	S 19	38.95	09/04	7.58	12/83	1216	04/97	46.33	203		Y	Y	Irr
6532 1298			60.00	0.00	10/01	Baroota	A 294	27.00	12/83	11.37	12/83	744	10/01				Y		Irr
6532 1318			103.00	0.00	07/84	Baroota	A 297										Y		
6532 1319	BTA 09	Qpah(3)	33.00	33.00	12/84	Baroota	S 152	28.31	11/04						150				Obs
6532 1320			7.60	7.60	03/85	Telowie	A 245												
6532 1338		Qpah(2)	25.49	25.49	11/87	Baroota	S 19		11/87						133				

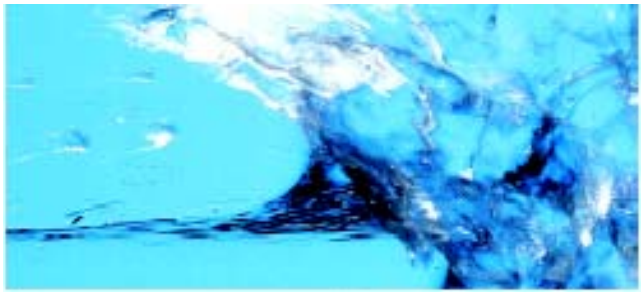
WELL NUMBER	OBS. WELL NAME	AQUIFER COMPLETION	MAXIMUM DRILLED DEPTH	CURRENT DEPTH		LOCATION		STANDING WATER LEVEL		WELL YIELD		GROUNDWATER SALINITY (TDS)		CASED TO	MIN. INT. DIA	CHEM ANAL	LOGS		PURPOSE
			(m)	(m)	Date	H'd	Lot	(m)	Date	(L/s)	Date	(mg/L)	Date	(m)	(mm)		D	G	
6532 1340	BTA 13					Baroota	A 91	38.39	11/04			1022	08/03		152	Y			Obs
6532 1345	BTA 18	Qpah(1)	8.07	8.07	08/89	Baroota	A 50		05/90						203				Obs
6532 1347		Qpah	9.10	9.10	03/87	Baroota	S 155							5.00					
6532 1417		Qpah(1,2,3,4+5)	62.50	62.50	11/96	Baroota	A 298	32.19	06/03	3.70	11/96	888	08/03	62.50	152		Y	Y	Irr
6532 1418		Qpah	60.00	60.00	11/96	Baroota	A 95		11/96					18.00			Y	Y	Stk
6532 1419	BTA 27	Qpah(6)	65.50	65.50	09/97	Baroota	S 161	38.77	11/04	3.75	08/00	780	03/03	65.50	170		Y	Y	Irr
6532 1420		Qpah(1)	24.00	24.00	09/97	Baroota	A 297	10.00	09/97	3.00	09/97	1295	09/97	24.00	148		Y	Y	Irr
6532 1491			42.00	41.60	01/99	Baroota	S 31	30.60	01/99			1692	01/99	39.00	152		Y	Y	Irr
6532 1492			73.60	73.60	04/02	Baroota	S 31	32.98	08/03	1.80	04/02	1233	04/02				Y	Y	Irr
6532 1494			79.00	79.00	08/99	Baroota	S 81	42.00	08/99	1.00	08/99	916	09/99	75.00	152		Y	Y	Irr
6532 1495		Qpah(1)+Qpah(3)	40.00	40.00	08/99	Baroota	A 297	15.25	08/03	2.00	08/99	888	09/99	18.00	140		Y	Y	Irr
6532 1496		Qpah(1)	10.06	10.06	10/49	Telowie	A 3	9.45	10/49			2924	10/49			Y			
6532 1510		Qpah(6)	84.00	84.00	03/00	Baroota	A 5	32.50	03/00	0.03	03/00	561	03/00	76.00	152		Y	Y	Stk
6532 1513		Qpah(2,3,4,5)+TpQag	75.00	69.00	07/99	Baroota	A 297	15.00	07/99	1.50	07/99	1020	09/02	69.00	152		Y	Y	Irr
6532 1514			72.00	0.00	09/00	Baroota	S 170	35.00	09/00	0.70	09/00	1351	09/00				Y	Y	Irr
6532 1515			50.00	50.00	10/00	Baroota	S 171	33.80	10/00	3.02	10/00	1906	10/00	32.00			Y		Irr
6532 1519			54.00	53.00	05/01	Baroota	A 302	32.00	05/01	2.40	05/01	1384	05/01	53.00	152		Y		Irr
6532 1530		Qpah(4+5)	62.00	60.00	10/01	Baroota	A 294	34.00	10/01	4.50	10/01	772	10/01	36.00	152		Y		Irr
6532 1531		Qpah(4+5)	63.00	59.00	09/01	Baroota	A 294	34.00	09/01	2.50	09/01	772	09/01	37.00	152		Y		Irr
6532 1541					07/02	Baroota	S 175	34.76	08/03	1.26	08/04			29.00	203				
6532 1542			41.30	41.30	01/76	Baroota	S 31	32.65	01/76										
6532 1546		Qpah(4)	63.00	47.50	11/00	Baroota	S 5	15.00	11/00	2.00	11/00	1132	11/00	42.00	152		Y		Stk
6532 1553	BTA 28		120.00	0.00	09/03	Baroota											Y	Y	Obs
6532 1556	BTA 32	Tomm	129.00	129.00	10/03	Baroota	S 5	9.64	11/04	20.00	10/03	3706	10/03	125.00	158		Y		Irr; Inv
6532 1562	BTA 29	Tomm	132.00	132.00	09/03	Baroota		33.69	11/04	20.00	09/03			127.00	127		Y		Obs
6532 1563	BTA 31	Qpah(2)	24.00	24.00	10/03	Baroota			11/04					11.00	127		Y		Obs
6532 1564	BTA 30	Qpah(6)	66.50	66.50	10/03	Baroota		26.62	11/04	0.63	10/04			54.00	127		Y		Obs

Summary of Latest Water Well Information Table Explanation Notes:

Well Number:	DWLBC unique well number.
Obs. Well Name:	Observation Well Name.
Aquifer Completion:	Hydrogeological Unit Well is completed in: Qpah: Quaternary Hindmarsh Clay Formation; Qpah(1): Groundwater bearing zone between 10 to 20 m depth; Qpah(2): Groundwater bearing zone between 20 to 30 m depth; Qpah(3): Groundwater bearing zone between 30 to 40 m depth; Qpah(4): Groundwater bearing zone between 40 to 50 m depth; Qpah(5): Groundwater bearing zone between 50 to 60 m depth; Qpah(6): Groundwater bearing zone greater than 60 m depth; TpQag: Tertiary Gibbon Beds Formation; Tomm: Tertiary Melton Limestone Formation; N: Neoproterozoic fractured rock aquifer system.
Maximum Drilled Depth:	The maximum depth to which the well was drilled in metres.
Current Depth:	Latest recorded total depth in metres and date taken.
Location:	Lists the Hundred (H'd) and Allotment (Lot) for the assumed well location.
Standing Water Level:	The depth to groundwater level (standing water level) in metres and date taken.
Supply:	The yield of the well in L/sec and date taken.
Groundwater Salinity:	Salinity (TDS) in mg/L (same as ppm) of the latest sample recorded for that well.
Cased To:	Depth to with records indicate well is cased to.
Min. Int. Dia:	Minimum Internal Diameter of the well in millimetres.
Chem Anal:	Whether there is a chemical analysis of groundwater from that well.
Logs:	Whether Driller (D) or Geological (G) log information is on SA Geodata record.
Purpose:	The purpose (if listed) of the well: Irr Irrigation; Inv Investigation; Stk Stock; Dom Domestic; Obs Observation.

APPENDIX B





Summary of Observation Wells in the Baroota Irrigation Area

Table 6: Summary of Observation Well Information – Baroota Irrigation Area

WELL NUMBER	OBS. WELL NAME	AQUIFER COMPLETION	MAXIMUM DRILLED DEPTH	CURRENT DEPTH		LOCATION		STANDING WATER LEVEL			GROUNDWATER SALINITY (TDS)			MIN. INT. DIA	CHEM ANAL	LOGS		PURPOSE
			(m)	(m)	Date	H'd	Lot	freq.	from	to	freq.	from	to	(mm)		D	G	
6432 118	BTA 01	Tomm	130.15	130.10	06/75	Baroota	A 282	N			N			127	Y	Y	Y	Irr; Stk; Obs
6532 673	BTA 02	Qpah(4)	89.92	44.11	08/89	Baroota	S 162	H	4/77	4/93	N			152	Y	Y	Y	Obs
6532 705	BTA 03	Qpah(3)	67.36	33.22	08/89	Baroota	S 87	C 3	4/77	8/03	N			203	Y	Y	Y	Obs
6532 643	BTA 04	Qpah(6)	61.96	44.81	08/89	Baroota	S 39	C 3	4/77	11/04	N			152				Obs
6432 132	BTA 05	Qpah(4)	46.94	29.82	08/89	Baroota	A 103	C 3	4/77	11/04	N							
6432 124	BTA 06	Qpah(1)	18.35	18.35	07/74	Baroota	A 1	C 3	5/77	11/04	N							
6532 637	BTA 07		47.55	47.55	10/49	Baroota	S 58N	H	4/77	1/83	N			152	Y			
6532 1319	BTA 09	Qpah(3)	33.00	33.00	12/84	Baroota	S 152	C 3	12/84	11/04	N			150				Obs
6532 652	BTA 10		48.77		08/89	Baroota	S 175	C 3	3/85	11/04	N				Y			Obs
6432 135	BTA 11	Qpah(3)	33.00	30.41	08/89	Baroota	A 99	H 6	3/85	10/94	C 6	2/90	6/00				Y	
6432 119	BTA 12	Qpah(4)	46.25	45.51	03/85	Baroota	A 283	C 3	3/85	11/04	N						Y	Obs
6532 1340	BTA 13					Baroota	A 91	C 3	6/86	11/04	N	1/02	8/03	152	Y			Obs
6532 680	BTA 14		70.10	70.10	06/58	Baroota	S 164	C 3	6/86	11/04	C R	7/58	2/03	203	Y		Y	Irr
6532 666	BTA 15					Baroota	A 294	C 3	7/86	11/04	H R	7/58	1/02		Y			Irr; Obs
6432 149	BTA 16	Qpah(4)	68.00	29.10	02/87	Baroota	A 3	N			N				Y			Stk
6532 708	BTA 17	Qpah	5.18	4.40	08/89	Baroota	S 33	H	9/74	11/89	N	3/87	3/87	1600	Y			Irr
6532 1345	BTA 18	Qpah(1)	8.07	8.07	08/89	Baroota	A 50	H	3/87	5/90	N			203				Obs
6532 709	BTA 19	Qpah(1)	10.97	8.05	10/87	Baroota	S 33	H	4/87	4/90	N				Y			Obs
6532 1293	BTA 20	Qpah(2+3)	46.33	46.33	12/83	Baroota	S 19	N	9/04	9/04	C 6	10/87	4/97	203		Y	Y	Irr
6532 647	BTA 21	Tomm	86.26	86.26	12/58	Baroota	A 301	N			C 6	10/87	5/98	152			Y	Irr
6532 665	BTA 22	Qpah(3)	44.50	38.71	08/48	Baroota	A 294	N			H R	10/87	2/89	203	Y	Y	Y	Irr
6532 679	BTA 23		70.10	70.10	06/58	Baroota	S 164	N			H R	6/58	10/87	152	Y		Y	Irr
6532 677	BTA 24	Qpah(3,4,5+6)	79.86	55.00	08/74	Baroota	S 162	N			H R	12/86	3/91	203	Y	Y	Y	Irr
6532 37	BTA 25					Baroota	S 214	N			C R	7/88	8/03					Obs
6532 660	BTA 26	Qpah(2)	26.82	26.82	04/47	Baroota	S 19	C 3	11/87	11/04	C R	12/91	12/91	127	Y	Y	Y	Irr; Stk; Obs
6532 1419	BTA 27	Qpah(6)	65.50	65.50	09/97	Baroota	S 161	C 3	8/00	11/04	C R	8/00	3/03	170		Y	Y	Irr
6532 1553	BTA 28		120.00	0.00	09/03	Baroota		N			N					Y	Y	Obs
6532 1562	BTA 29	Tomm	132.00	132.00	09/03	Baroota		C 3	11/03	11/04	N			127		Y		Obs
6532 1564	BTA 30	Qpah(6)	66.50	66.50	10/03	Baroota		C 3	11/03	11/04	N			127		Y		Obs
6532 1563	BTA 31	Qpah(2)	24.00	24.00	10/03	Baroota		C 3	11/03	11/04	N			127		Y		Obs
6532 1556	BTA 32	Tomm	129.00	129.00	10/03	Baroota	S 5	C 3	11/03	11/04	N			158		Y		Irr; Inv
6531 890	TEL 05		31.10	31.10		Telowie	S 328	C 3	5/77	11/04	N			152		Y		Obs

Summary of Latest Water Well Information Table Explanation Notes:

Well Number: DWLBC unique well number.

Obs. Well Name: Observation Well Name.

Aquifer Completion: Hydrogeological Unit Well is completed in:

Qpah: Quaternary Hindmarsh Clay Formation;
Qpah(1): Groundwater bearing zone between 10 to 20 m depth;
Qpah(2): Groundwater bearing zone between 20 to 30 m depth;
Qpah(3): Groundwater bearing zone between 30 to 40 m depth;
Qpah(4): Groundwater bearing zone between 40 to 50 m depth;
Qpah(5): Groundwater bearing zone between 50 to 60 m depth;
Qpah(6): Groundwater bearing zone greater than 60 m depth;
TpQag: Tertiary Gibbon Beds Formation;
Tomm: Tertiary Melton Limestone Formation;
N: Neoproterozoic fractured rock aquifer system.

Maximum Drilled Depth: The maximum depth to which the well was drilled in metres.

Current Depth: Latest recorded total depth in metres and date taken.

Location: Lists the Hundred (H'd) and Allotment (Lot) for the assumed well location.

Standing Water Level: The depth to groundwater level (standing water level) in metres and date taken.

Freq.: Monitoring frequency; C 3 – current, 3 monthly
H 6 – historic; 6 monthly
N – not monitored for SWL

from: date of initial monitoring
to: date of latest monitoring

Groundwater Salinity: Salinity (TDS) in mg/L (same as ppm) of the latest sample recorded for that well.

Freq.: Monitoring frequency; C 6 – current, 6 monthly
C R – current; randomly
H R – historic; randomly
N – not monitored for TDS

from: date of initial monitoring
to: date of latest monitoring

Min. Int. Dia: Minimum Internal Diameter of the well in millimetres.

Chem Anal: Whether there is a chemical analysis of groundwater from that well.

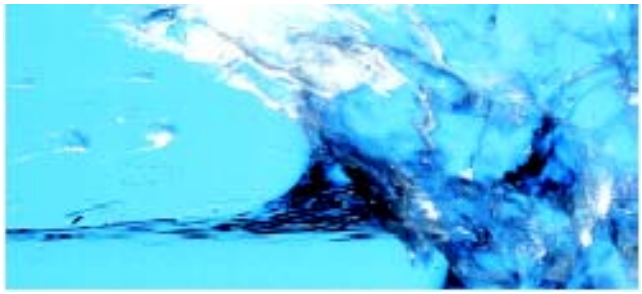
Logs: Whether Driller (D) or Geological (G) log information is on SA Geodata record.

Purpose: The purpose (if listed) of the well:

Irr Irrigation;
Inv Investigation;
Stk Stock;
Dom Domestic;
Obs Observation.

APPENDIX C





Composite Well Log

Government of South Australia
Department of Water, Land and Biodiversity Conservation

COMPOSITE WATER WELL LOG
Well Unit No. 6532-01562 : Observation Well Name BTA 29

IDENTIFICATION DATA	
Permit No.	63285
Unit No.	6532 2215
Obs. Name	BTA 029
Purpose	Observation

LOCATION DATA	
Hundred	Baroota
Allotment Type & No.	Adj. S 188
Easting (m AMG)	221695
Northing (m AMG)	6351155
Zone	54
Datum	GDA 94

ELEVATION DATA (m AHD)	
Ground Surface	60.00
Ref. Point above Ground	0.40
Ref. Point	60.40
Top of Production Zone	-63.0
Base of Production Zone	-72.0

DRILLING DATA	
Start Date	24 Sept 2003
Finish Date	31 Sept 2003
Driller	Olympic Boring
Drilling Method	Rotary
Circulation	Mud
Max. Drilled Depth (m)	132.0
Final Total Depth (m)	132.0
Samples Logged By	S.L. Evans

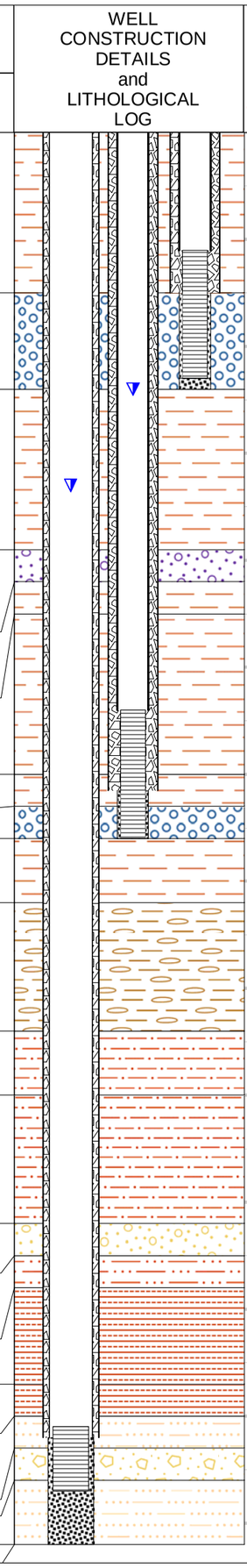
POST-DEVELOPMENT DATA	
Date	5 October 2003
DTW (m below Ref. Point)	34.0
SWL (m below Ground Level)	33.6
RSWL (m AHD)	23.4
TDS (mg/L - Lab)	
EC (μS/cm - Lab)	
Yield (L/s)	
Sample Method	

COMPLETION DATA	mm	From (m)	To (m)	Type/Material
Borehole Diameter	203	0.0	132.0	Blade Bit
Backfilled/Plugged		127.0	132.0	cuttings
Casing Diameter	152	0.0	123.0	PVC
Production Zone	127	123.0	127.0	Slotted PVC
Aquifer Monitored				TpQag
Grout		0.0	123.0	Cement
Bentonite Seal				
Gravel Pack	0.5 to 1.0	123.0	127.0	Gravel

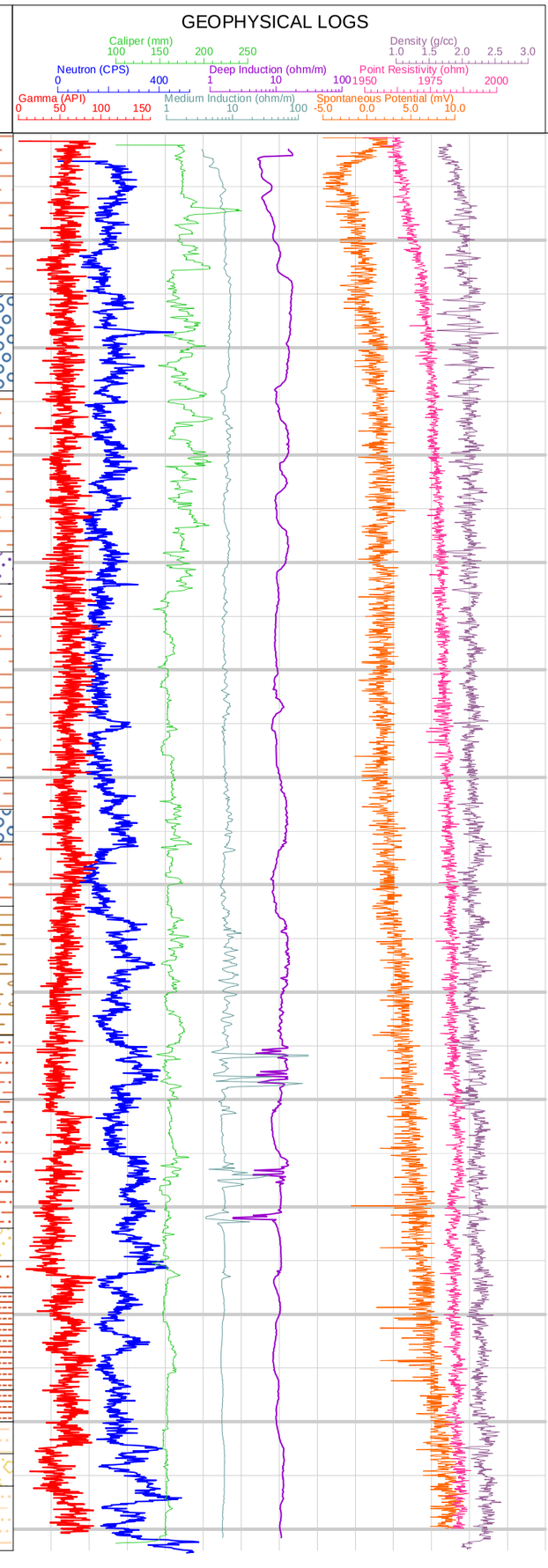
CHEMISTRY DATA	Units
pH	
TDS by EC	mg/L
EC	μS/cm
TDS by calc.	mg/L
Ca	mg/L
Mg	mg/L
K	mg/L
Na	mg/L
HCO_3	mg/L
CO_3	mg/L
Cl	mg/L
SO_4	mg/L
$NO_{2/3}$ as N	mg/L
$NO_{2/3}$ as NO_3	mg/L
Boron	mg/L
GEOPHYSICS JOB No.	6673

Depth (m)	Elevation (m AHD)	UNIT	Hydrostratigraphy	LITHOLOGY Description
0	60	Quaternary		0-15m CLAY brown, non- to slightly calcareous, rare v fine, clear quartz grains, rare fine - coarse, rounded Gravel (slate).
10	50		Qpah(PT2)	15-24m GRAVEL pink grey, red brown, green, coarse to v coarse, sub-angular to sub-rounded, pred non-calcareous grains, slate, quartzite, occ quartz grains.
20	40			24-39m CLAY green grey, orange, red brown, non-calcareous, no grit, matrix supported vv fine quartz and occ clastic grains, stiff but malleable, increase in Gravel with depth.
30	30		Qpah(PT4)	39-42m GRAVEL fine-coarse, sub-angular to rounded, quartzite & clastic grains, common SAND, v fine to medium, poorly sorted, sub-angular to sub-rounded, non calcareous, some Grit.
40	20			42-45m CLAY red, grey, slightly orange, gritty, stiff, non calcareous, occ vv fine, clear, rounded Quartz grains, rare rounded to sub-rounded Gravel, matrix supported.
50	10			45-60m CLAY red to red brown, stiff, non calcareous, rare vv fine Quartz and Clastic grains, occ Gravel a/a, matrix supported.
60	0		Qpah(PT5)	60-63m CLAY a/a, slight increase in Gravel and Quartz grains.
70	-10			63-66m GRAVEL a/a, minor Clay a/a.
80	-20		*Qpah(PT6)*	66-72m CLAY a/a, pred red brown, minor Gravel a/a.
90	-30			72-84m GRAVEL poorly sorted, quartzite and clastic grains, sub-angular to sub-rounded, non calcareous, CLAY red brown to yellow brown, gritty.
100	-40			84-90m CLAY a/a, GRAVEL a/a.
110	-50			90-102m CLAY yellow brown, red, grey, orange, sandy, non calcareous, common vv fine, claer, rounded Quartz, grain supported, GRAVEL fine to coarse, poorly sorted, quartzite, quartz and clastic grains.
120	-60	Tertiary		102-105m SAND orange, clayey, v fine to fine, mod well sorted, sub-rounded, clear, non calcareous, GRAVEL a/a.
130				105-108m SAND a/a, CLAY red, white grey, non calcareous, stiff, common vv fine, poorly sortrd, sub-angular to sub-rounded Quartz, grain supported near top.
				108-117m CLAY a/a.
				117-120m CLAY white grey, occ red and orange, v stiff, minor vv fine Quartz a/a, non calcareous.
			TpQag	120-123m CLAY a/a, SANDSTONE white, red, vv fine grained, rare fine grains, mod well sorted, weak silica cement, v clayey, sub-angular to sub-rounded.
				123-126m SANDSTONE a/a.
				126-132m CLAY white, red, v sticky, soft, minor Quartz grains, non calcareous, SANDSTONE a/a.

WELL CONSTRUCTION DETAILS and LITHOLOGICAL LOG



GEOPHYSICAL LOGS



TOTAL DEPTH 132 m