TECHNICAL NOTE 2011/06

Department for Water

REGIONAL OBSERVATION WELL UPGRADE: BAROOTA PRESCRIBED WELLS AREA, WALLOWAY BASIN, WILLOCHRA BASIN AND ADELAIDE PLAINS

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1.0 INTRODUCTION

The Department for Water (DFW) has lead agency responsibility for ensuring the sustainable management of the State's water resources. Increased dependency on the State's groundwater resources, changing land use, climate variability and ageing groundwater monitoring assets have put pressure on the State's monitoring networks to provide relevant information to support the assessment and management of these resources. Through the Water for Good Actions 45 and 46, the Department has embarked on a program of works to rectify gaps in the networks to ensure that monitoring networks are modern, relevant, flexible and spatially sufficient to provide the level of information required to sustainably manage the resource.

The network modernisation program outlined in this report deals with a number of areas identified as having strategic monitoring gaps that require addressing, specifically Baroota Prescribed Wells Area (PWA), Willochra Basin and Walloway Basin. Also included in this round of drilling were three replacement wells drilled in the Central Adelaide Groundwater area and four wells in the Kangaroo Flat/Angle Vale area of the Northern Adelaide Plains PWA.

2.0 PLANNING AND LOCATING OF WELLS

The planning and locating of the new wells considered deficiencies in the groundwater observation network as identified through the status and condition assessment program for prescribed wells areas and the assessment of non-prescribed wells areas. In almost all cases, sites were located on road verges (crown land) with minimal road traffic allowing ease of access. Drilling on road verges/crown land also negated the need to enter into land access agreements with land owners which reduced the time required for planning.

Kangarilla Drilling Pty Ltd was contracted to carry out the drilling and construction of the wells as it was deemed they had the necessary equipment, expertise and appropriate drillers licences to carry out the program. All drilling was done with an Ingersoll Rand TH60 using a mixture of rotary mud drilling technique or air drilling.

All wells were geophysically logged for Calliper, Gamma, Neutron and Density with the exception of 6532 1653 (RMU 005) which was logged for Gamma and Neutron only. Where required, other logs including Spontaneous Potential, Point Resistivity and Induction were taken to help delineate the strata. The composite log including geophysical logging results are seen in Appendix 5.2.

On completion all wells were sterilised with a solution of 10% chlorine for the volume of each well as required by the *Minimum Construction Requirements for Water Bores in Australia*. Surface completion was carried out with a steel standpipe and lockable steel cap above ground level with the exception of 6628 25371 (RMU 011), which was completed just below ground level in a concrete pit due to its proximity to a road. Each well was labelled with a DFW stainless steel tag displaying the wells unit number. For flowing (artesian) wells, a stainless steel flange and ball valve assembly with a lockable cover/cap were used.

Locations of the wells are summarised in detail in Table 1 and displayed in Figure 1.

Table 1 – Drilling Summary

Area	Unit Nº	Well Name	Date Completed	Permit Nº	Easting	Northing	Completed Depth	SWL (m)	Yield⁺ (L/sec)	TDS (mg/L)	Monitoring Network code	Obs Well Nº
Baroota	6532 1652	RMU 001	13/8/2010	193783	223995	6352521	60	38.54	0.125	2323	Pirie	BTA 28
Baroota	-	RMU 002	Not Drilled	193813	-	-	-	-	-	-	-	-
Baroota	6532 1654	RMU 003	25/10/2010	193785	224473	6348765	155	59.7	1.0	1220*	Pirie	BTA 39
Willochra Basin	6533 914	RMU 004	26/8/2010	190034	234284	6424889	107	13.8 kPa**	0.25	3650*	Willoch	PAM 02
Willochra Basin	6532 1653	RMU 005	8/10/2010	190033	237155	6398454	153.5	9.60	4.0	1513	Willoch	WLR 28
Willochra Basin	6532 1651	RMU 006	19/8/2010	190032	241380	6386166	84.5	5.26	0.25	4048	Willoch	PDA 3
Willochra Basin	6532 1657	RMU 007	1/10/2010	193786	241690	6373006	84	7.43	3.0	1714	Willoch	WLW 10
Walloway Basin	6632 1275	RMU 008	9/9/2010	190030	282432	6397255	169.7	12.8 kPa**	3.0	1608	Walloway	OLD 2
Walloway Basin	6632 1274	RMU 009	23/9/2010	193787	285508	6359001	75	13.17	4.0	2567	Walloway	BRP 1
Kangaroo Flat	6628 25370	RMU 010	20/7/2010	190028	284509	6171979	36	22.80	1.0	1709	NAP-S	MUW 35
Kangaroo Flat	6628 25371	RMU 011	23/7/2010	190026	286806	6172017	38	22.62	1.0	1272	NAP-S	MUW 36
Angle Vale	6628 25372	RMU 012	29/7/2010	193738	287700	6172017	71	26.72	0.5	1850*	NAP-S	MUW 37
Kangaroo Flat	6628 25426	RMU 013	8/11/2010	196834	284664	6171979	80	22.18	1.0	2210*	NAP-S	MUW 38
Adelaide Metro	6628 25427	AApt1 (T2)	24/6/2010	170282	275382	6129188	184	4.50	10.0	973	Metro	ADE 206
Adelaide Metro	6628 25428	AApt2 (T1)	28/6/2010	170283	275393	6129191	108	3.50	5.0	1080	Metro	ADE 207

* Field measurement used, sample lost/damaged in transit to Glenside.

** Well flowing - shut in pressure

⁺ All yield values are field estimations during airlifting

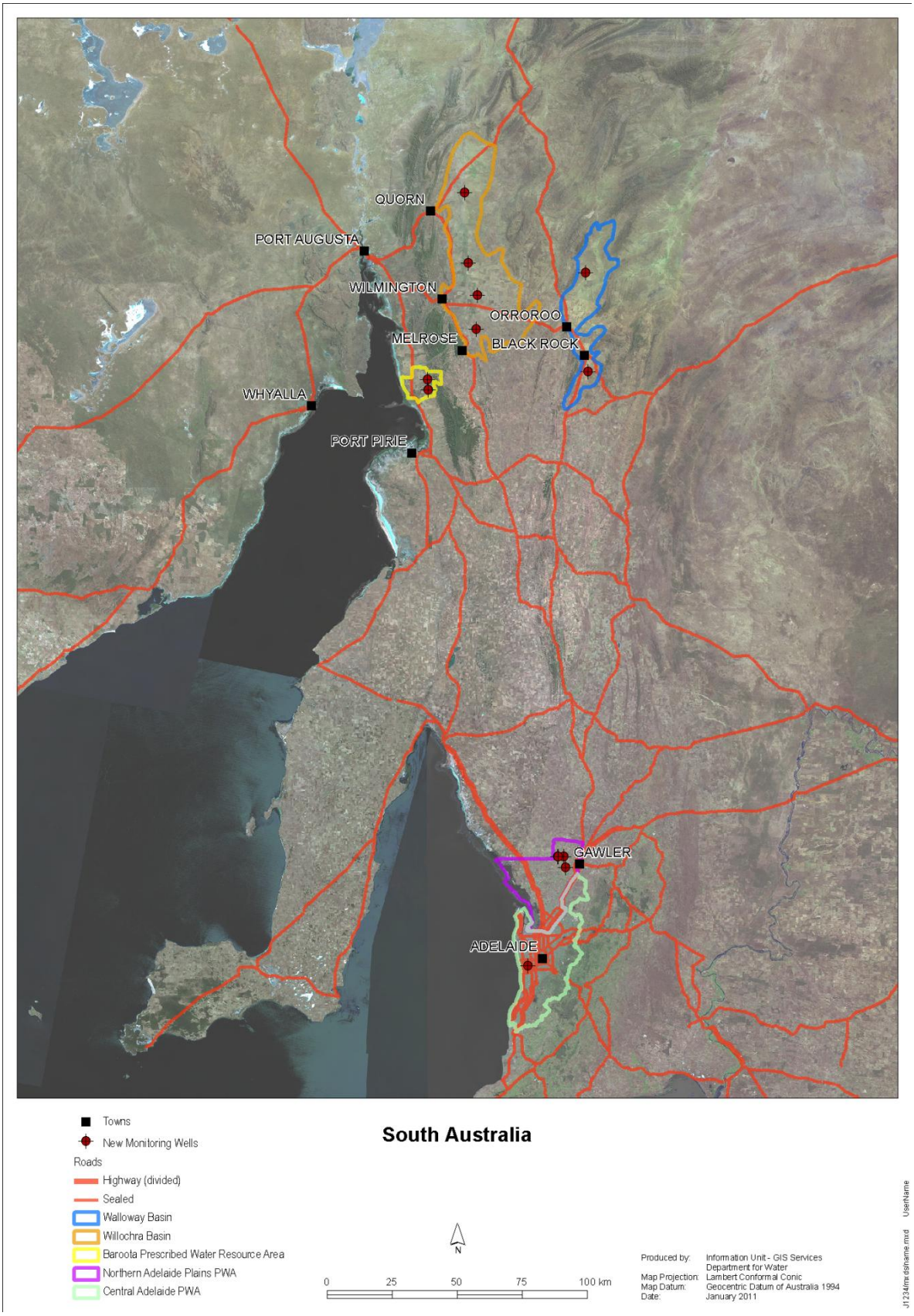


Figure 1 – Well locations within South Australia.

3.0 DRILLING AND CONSTRUCTION

3.1 BAROOTA PRESCRIBED WELLS AREA

3.1.1 Overview

The Baroota PWA is in the vicinity of the Baroota Creek where it leaves the Flinders Ranges to flow out over the Pirie Basin, approximately 10 km northeast of Port Germein and 230 km north west 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 palaeochannels covering a majority of the area and recharge from occasional flows down Baroota Creek.

The Baroota groundwater resource that supports 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 in the Baroota area are generally completed in the Quaternary gravels – often over multiple intervals. These gravel beds are frequently discontinuous and has made the mapping of aquifers and resource assessment challenging. (Evans 2004)

3.1.2 Planning

Initial specifications drawn from DWLBC technical note 2009/27 for drilling in the Baroota PWA called for three wells covering areas where there were no state or privately owned monitoring bores. However, it was decided that only two wells were necessary at this time and one of the proposed wells (Site 2 / RMU 002) was not drilled.

The drilling of both wells proved to be quite difficult, with the upper 30m of each well consisting of unconsolidated Quaternary alluvial sediments containing very coarse gravels and boulders which would collapse when trying to set the surface pre-collar or partly bridge the hole, causing the casing to deviate significantly. This required the first hole to be abandoned and re-drilled 10 metres away.

Refer to Figure 2 for well locations.

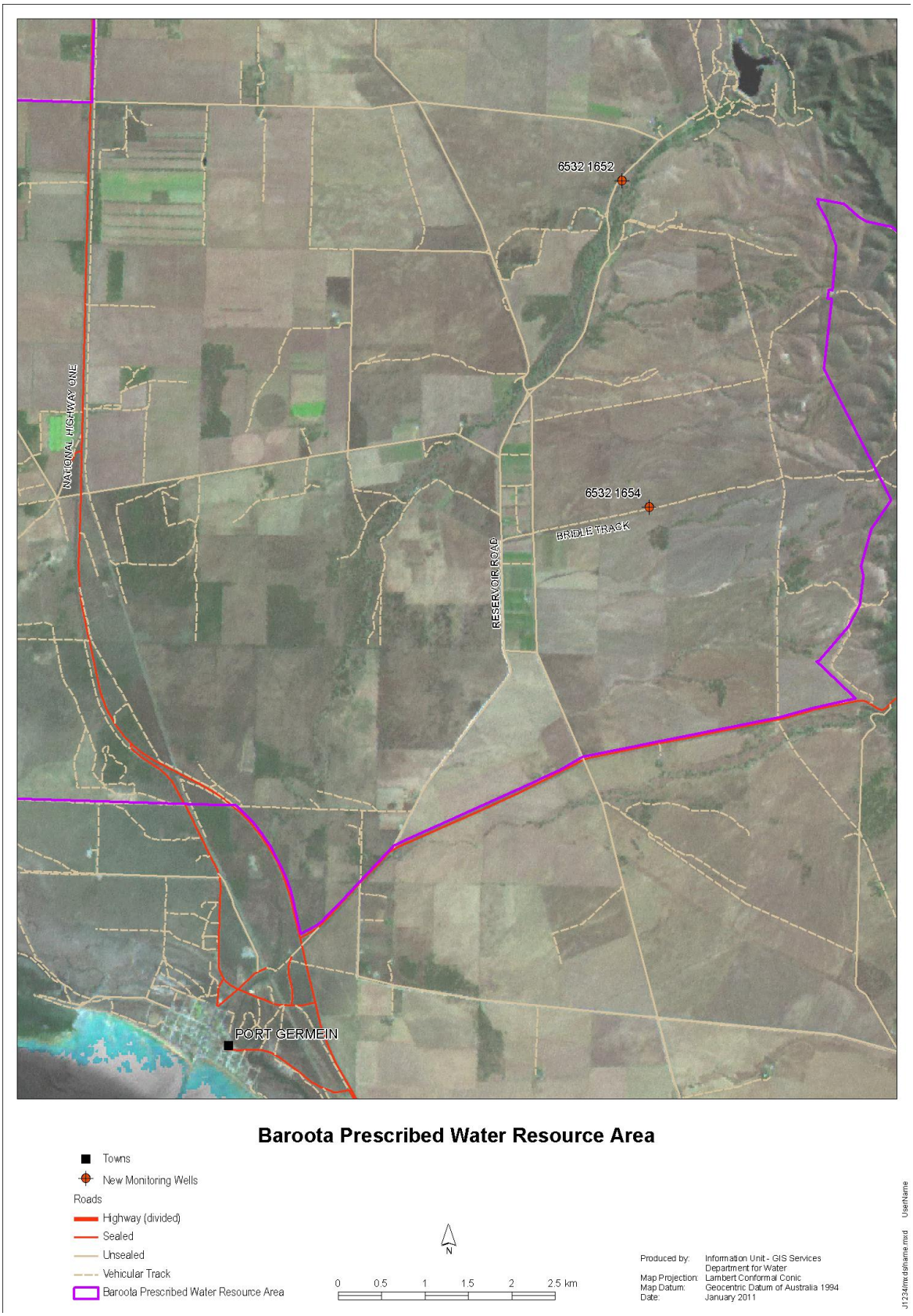


Figure 2 – Well locations in the Baroota Prescribed Wells Area.

3.1.3 Drilling/Completions

6532 1652 - (RMU 001)

Drilling commenced on 4 August 2010 under Permit Number (P/N) 193783 in the Hundred of Baroota on the eastern side of Reservoir Road adjacent to CT 5416/227. The well was drilled to a maximum depth of 87m using a rotary mud drilling technique drilling technique and Strata samples were collected every 2m over the entire length of the drill hole.

The well was completed on 13 August 2010 using 100 mm nominal ID class 12 PVC from 0.3 m above to 42 m below ground level (GL) and an inline section of 0.5 mm aperture slotted casing from 42 m to 54m. A 6 m length of blank casing with end cap was used as a sump from 54 m to 60 m. The bottom of the hole from 60 m to 87 m was backfilled using 7.0mm washed gravel as it was concluded from the geophysical logging data and strata samples that there were no aquifers below that targeted for completion.

The slotted section and sump were 'gravel packed' from 41 m to 60 m using 7.0 mm washed gravel and cementing was carried out by tremmie line from 41 m to surface.

Development by airlifting from 41m was carried out for 1.5 hours at a rate of 0.125 L/sec before well sterilisation and further development for another 1.5 hours. A final water sample was taken for salinity analysis which indicated an electrical conductivity (EC) of 4130 uS/cm, giving an inferred total dissolved solids (TDS) of 2323 mg/L. Due to the low yield of this well it was noted that the final sample still had a 'chlorine smell' indicating that further development may be needed at a later date.

6532 1654 - (RMU 003)

Drilling commenced on 12 October 2010 under P/N 193785 in the Hundred of Baroota on the northern side of the 'Bridal Track' adjacent to CT 5526/241. The well was drilled to a maximum depth of 163.5 m using rotary mud drilling technique and Strata samples were collected every 2 m over the entire length of the hole.

The well was completed on the 25th October 2010 using 100 mm nominal ID class 12 PVC from 0.3 m above to 152 m below ground level, with an inline section of 0.5 mm aperture slotted casing from 152 m to 155 m with a blank end cap. The bottom of the hole from 155 m to 163.5 m was backfilled with 7.0 mm washed gravel as the geophysical logging data and samples did not indicate an aquifer below 155 m.

The slotted interval was then 'gravel packed' using 7.0 mm washed gravel from 151 m to 155 m and cemented via tremmie line from 151 m to surface.

Development by airlifting from 150 m was carried out for 13 hours to achieve a final yield of approximately 1.0 L/sec before well sterilisation. The decision to carry out development for such a long period was based on the poor performance of the previous well in this area and did provide an eventual increase in yield, which had initially started at <0.125 L/sec.

A field measurement of the final water sample was taken for salinity analysis which indicated an EC of 2210 uS/cm, giving an inferred TDS of 1220 mg/L. At the completion of development the well was still producing a small volume of fine sand (<0.5 mm) which has been deemed acceptable for a monitoring well.

3.2 WILLOCHRA BASIN

3.2.1 Overview

The Willochra Basin is a north south-oriented, intermontane (between mountain) basin located approximately 300 km north of Adelaide in the Southern Flinders Ranges. The basin has a length of 80 km, extending from Booleroo Centre in the south to Simmonston area in the north. The width of the basin is between 11 and 25 km. The Plain is bounded on the west by the eastern scarp of an irregular range extending from Mount Remarkable near Melrose, northwards to Mount Ragless (Magarey & Deane 2005).

3.2.2 Planning

Three major areas within the Willochra Basin were identified as requiring new observation wells based on the number of new irrigation and stock/domestic wells that had been constructed since 1985. It was noted that most of these new wells were in isolated groups with few, if any, independent observation wells. The proposed wells (RMU 005, RMU 006 and RMU 007) were sited such that they were in close proximity to the majority of the new wells, while being outside the immediate 'zone of impact' created by these pumping centres.

A fourth well (RMU 004) was planned in the northern end of the basin where very few new wells have been drilled and no independent monitoring wells exist.

The initial targeted aquifer for these wells was an un-named, confined layer of white, commonly clayey sand, that varies from 'pipe clay' through to a fine, well sorted sand. As this formation directly overlies basement rock, this part of the program also aimed to investigate and delineate the underlying stratigraphy and measure depth to basement. In the case of 6532 1657 (RMU 007) this aquifer is separated from basement rock by 55 m of clay and extremely weathered basement material.

This white, clayey sand was found in all wells except 6532 1653 (RMU 005), RMU 005 was completed in the fractured basement rock in common with other irrigation bores in the local area.

Refer to Figure 3 and Figure 4 for well locations

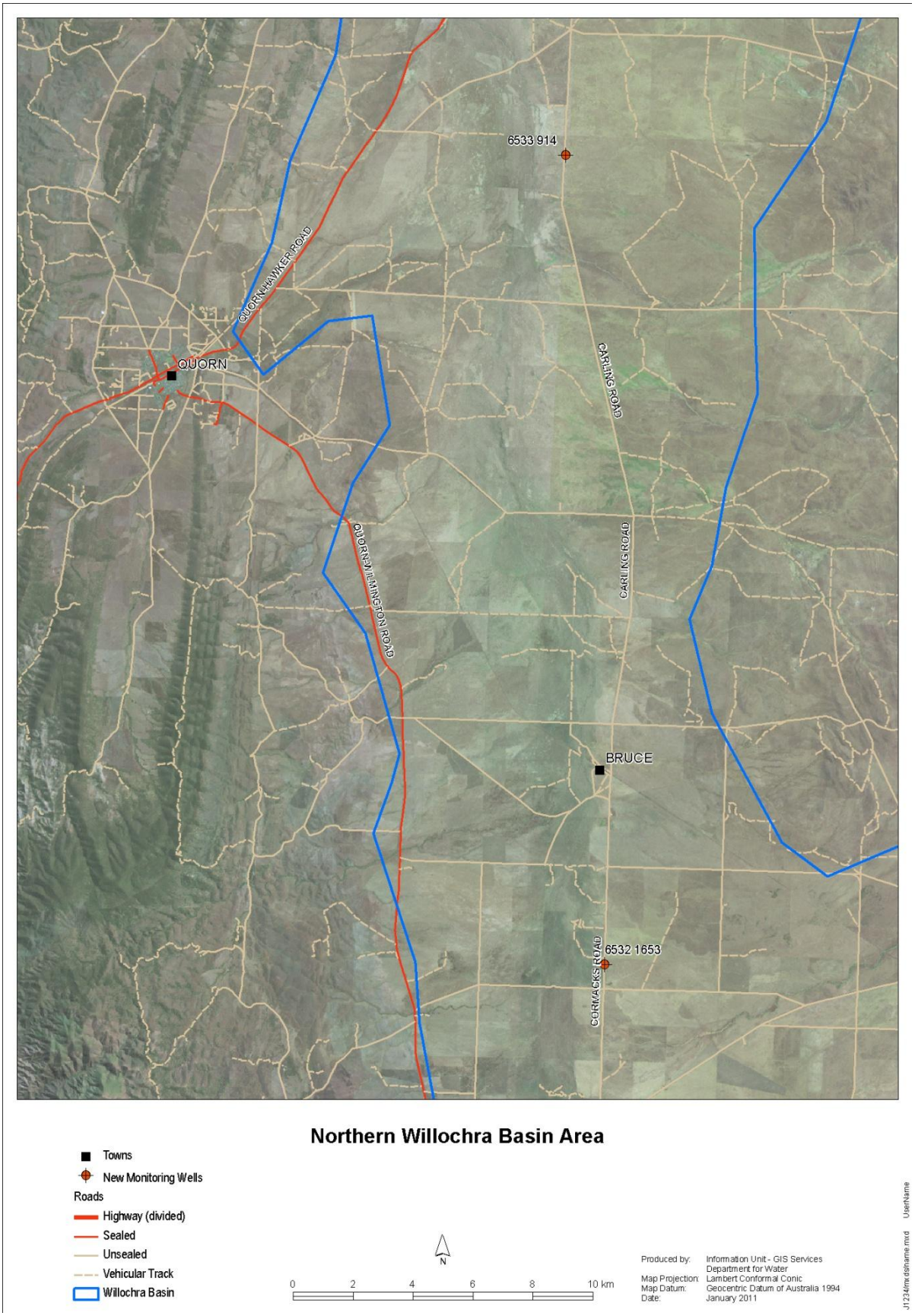


Figure 3 – Well locations in northern Willochra Basin.

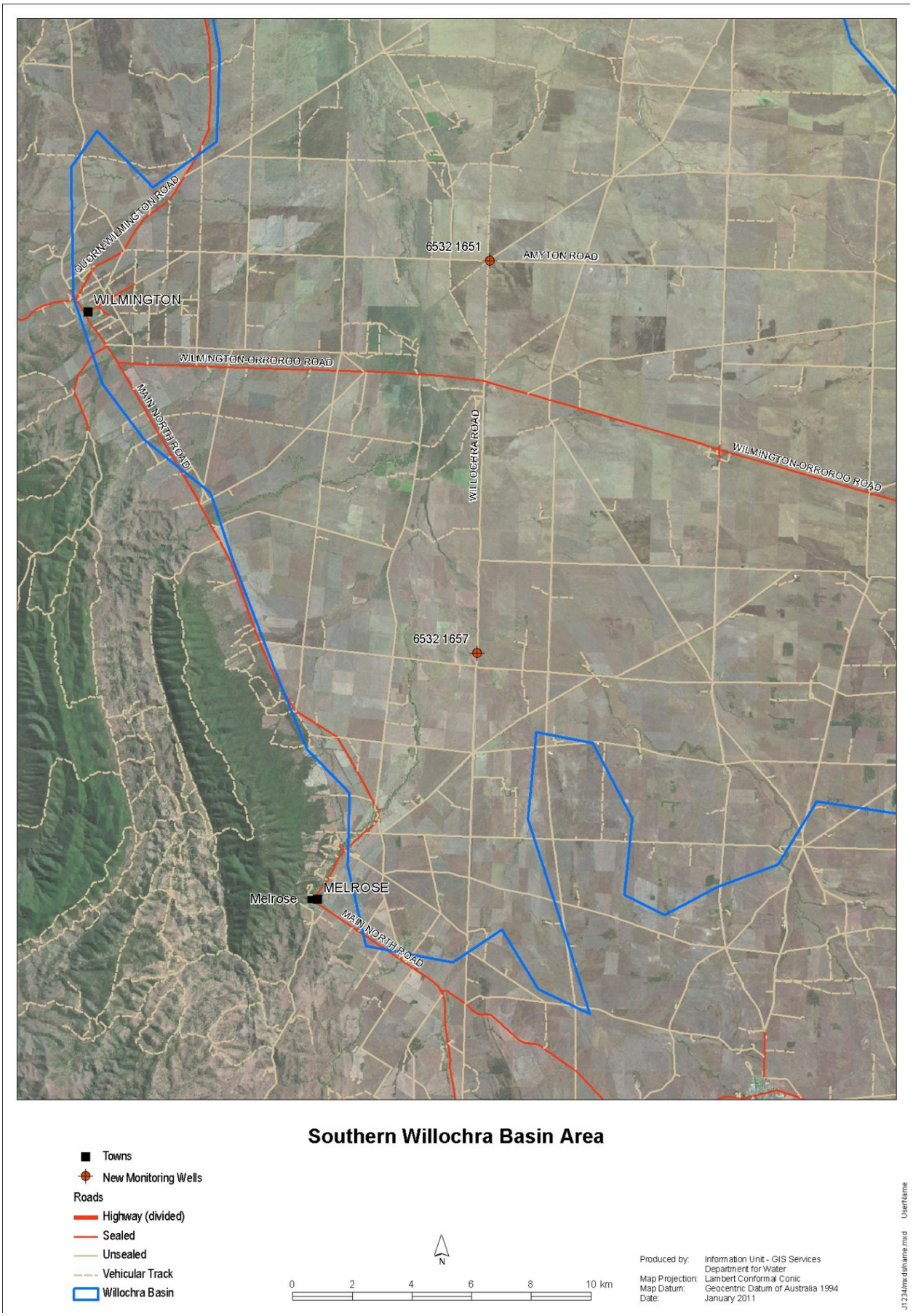


Figure 4 – Well locations in southern Willochra Basin.

3.2.3 Drilling and Completions

6533 914 - (RMU 004)

Drilling commenced on 23 August 2010 under P/N 190034 in the Hundred of Palmer on the eastern side of Carling Road, adjacent to CT 5965/347. The well was drilled to a maximum depth of 108 m using a rotary mud drilling technique and Strata samples were collected every 2 m over the entire length of the hole.

The well was completed on 26 August 2010 using 100 mm nominal ID class 12 PVC from 0.3 m above to 96 m below ground level with an inline section of 0.5 mm aperture slotted casing from 96 m to 107 m completed with a blank end cap.

The slotted interval was gravel packed using 7.0 mm washed gravel from 94 m to 108 m and cemented via tremmie line from 94 m to surface.

Development by airlifting from 90 m was carried out for 6.5 hours to achieve a final yield of approximately 0.125 to 0.25 L/sec before well sterilisation.

A field measurement of the final water sample was taken for salinity analysis which indicated an EC of 6500 uS/cm, giving an inferred TDS of 3650 mg/L.

During the development of this well, initial yields were extremely low and it was discovered by 'jetting' the slotted casing with clean water and surging by filling the well to surface with clean water, then immediately airlifting it out again, it was possible to clean any material out of the slots in the casing and increase the yield very quickly. This process was used successfully on a number of the wells for the rest of this drilling program.

Initially it was thought this well had a standing water level of 12m below ground level, however on returning to the site some two weeks later it was discovered to be flowing and a flange and ball valve assembly was attached. Subsequent measurements indicated a shut in pressure of 13.8 kPa.

6532 1653 – (RMU 005)

Drilling commenced on 5 October 2010 under P/N 190033 in the Hundred of Willochra on the eastern side of Cormack's Road, adjacent to CT 5655/371. The well was drilled to a maximum depth of 154 m with a combination of rotary mud drilling technique and down hole hammer (DHH). The unconsolidated sediments were drilled using rotary mud drilling technique to 149 m and the final 5 m through fractured rock to 154 m was drilled with a DHH. Strata samples were collected every 2 m over the entire length of the hole.

The well was completed on 8 October 2010 using 150 mm nominal ID class 12 PVC from 0.3 m above to 149 m below GL. The casing was pressure cemented through casing to surface and the production zone (149 m to 154 m) left open hole.

Development by airlifting from 145m was carried out for two hours to achieve a final yield of approximately 4.0 L/sec before well sterilisation.

A final water sample was taken for salinity analysis which indicated an EC of 2730 uS/cm, giving an inferred TDS of 1513 mg/L.

After it was discovered the well had collapsed at 150 m, the well was cleaned out on 26 October 2010 and a 'K' packer and telescopic liner of slotted 100 mm nominal ID, 0.5 mm aperture class 12 PVC with blank end cap was inserted from 147.5 m to 153.5 m

6532 1651 – (RMU 006)

Drilling commenced on 16 August 2010 under P/N 190032 in the Hundred of Panda on the southern side of the Ayton Road, near the corner of Conation Road, adjacent to CT 5541/907. The well was drilled to a maximum depth of 108 m using rotary mud drilling technique and Strata samples were collected every 2 m over the entire length of the hole.

The well was completed on 19 August 2010 using 100 mm nominal ID class 12 PVC from 0.3 m above to 81 m below GL, with an inline section of 0.5 mm aperture slotted casing from 81 m to 84.5 m with a blank end cap. The bottom of the hole from 84.5 m to 108 m was backfilled with 7.0 mm washed gravel as the geophysical logging data and strata samples did not indicate an aquifer below 84.5 m.

The slotted interval was then gravel packed using 7.0 mm washed gravel from 80 m to 84.5 m and cemented via tremmie line from 80 m to surface.

Development by airlifting from 77 m was carried out for 6 hours to achieve a final yield of approximately 0.25 L/sec before well sterilisation.

A final water sample was taken for salinity analysis which indicated an EC of 7180 uS/cm, giving an inferred TDS of 4048 mg/L.

6532 1657 – (RMU 007)

Drilling commenced on 27 September 2010 under P/N 193786 in the Hundred of Willowy on the eastern side of the Willochra Road, adjacent to CT 5476/584. The well was drilled to a maximum depth of 129 m using rotary mud drilling technique and Strata samples were collected every 2 m over the entire length of the hole.

The well was completed on 1 October 2010 using 100 mm nominal ID class 12 PVC from 0.3 m above to 72 m below ground level, with an inline section of 0.5 mm aperture slotted casing from 72 m to 84 m with a blank end cap. The bottom of the hole from 84 m to 129 m was backfilled with 7.0 mm washed gravel as the geophysical logging data and strata samples did not indicate an aquifer below 84 m.

The slotted interval was then gravel packed using 7.0 mm washed gravel from 71 m to 84 m and cemented via tremmie line from 71 m to surface.

Development by airlifting from 70m was carried out for five hours to achieve a final yield of approximately 3.0 L/sec before well sterilisation.

A final water sample was taken for salinity analysis which indicated an EC of 3090 uS/cm, giving an inferred TDS of 1714 mg/L.

3.3 WALLOWAY BASIN

3.3.1 Overview

Located approximately 260 km north of Adelaide, the Walloway Basin is a north-south orientated intermontane 'hour glass' shaped basin, approximately 80 km long, with a maximum width of 16 km, and a total area of 650 km². The Basin is an ancient valley, filled with outwash deposits to form a relatively mature and flat land surface (Hillwood 1967).

Sediment at the base includes fine-grained sands, clayey sands and clays with minor lignite, of middle to late Eocene age. The overlying sediments include up to 70 m of clays with coarse gravel beds, often lenticular. These overlying sediments range in age from mid-Tertiary to Quaternary. Obscuring the Quaternary are older deposits of recent alluvium and outwash material, derived from the surrounding Pre-Cambrian rocks (Shepherd, 1978).

Artesian and sub-artesian groundwater is available from various aquifers in the basin. Shallow groundwater occurs less than 30 m deep throughout most of the basin which is contained in the recent outwash and alluvial material and is dependent on local runoff for recharge. Consequently there are wide variations in groundwater salinity (Hillwood, 1967).

The Tertiary Aquifer is more uniform and extends throughout the basin in contrast to the shallow Quaternary unconfined aquifers. Salinity in the Tertiary aquifer is between 1500-1700 mg/L and parts of the mid-section of the basin is artesian.

3.3.2 Planning

The Walloway Basin is currently undergoing a coal exploration and feasibility study for the possible development of an Underground Coal Gasification (UCG) site by Linc Energy. Involved in their program are a series of groundwater observation bores collecting similar data to those installed by the Department for Water. For this reason it was decided to install two more independent observation wells north of Orroroo in what is known to be an area of artesian wells and another south of Black Rock locality in an area that has no wells deeper than 35 m.

The area south of Black Rock being the smaller of the two lobes has a wide spread sandy gravel layer between 10 m and 30 m covering most of the southern lobe of the basin which is primarily used for stock and domestic pumping with high variations in water quality. No deep investigation holes have been drilled to intersect basement in this southern lobe and little was known about deeper water bearing formations that may be connected with those encountered in the northern and larger lobe around Orroroo.

For this reason an investigation well 6632 1274 (RMU 009) was planned to intersect basement rock and complete in the deepest of any favourable aquifers encountered.

Refer to Figure 5 and Figure 6 for well locations.

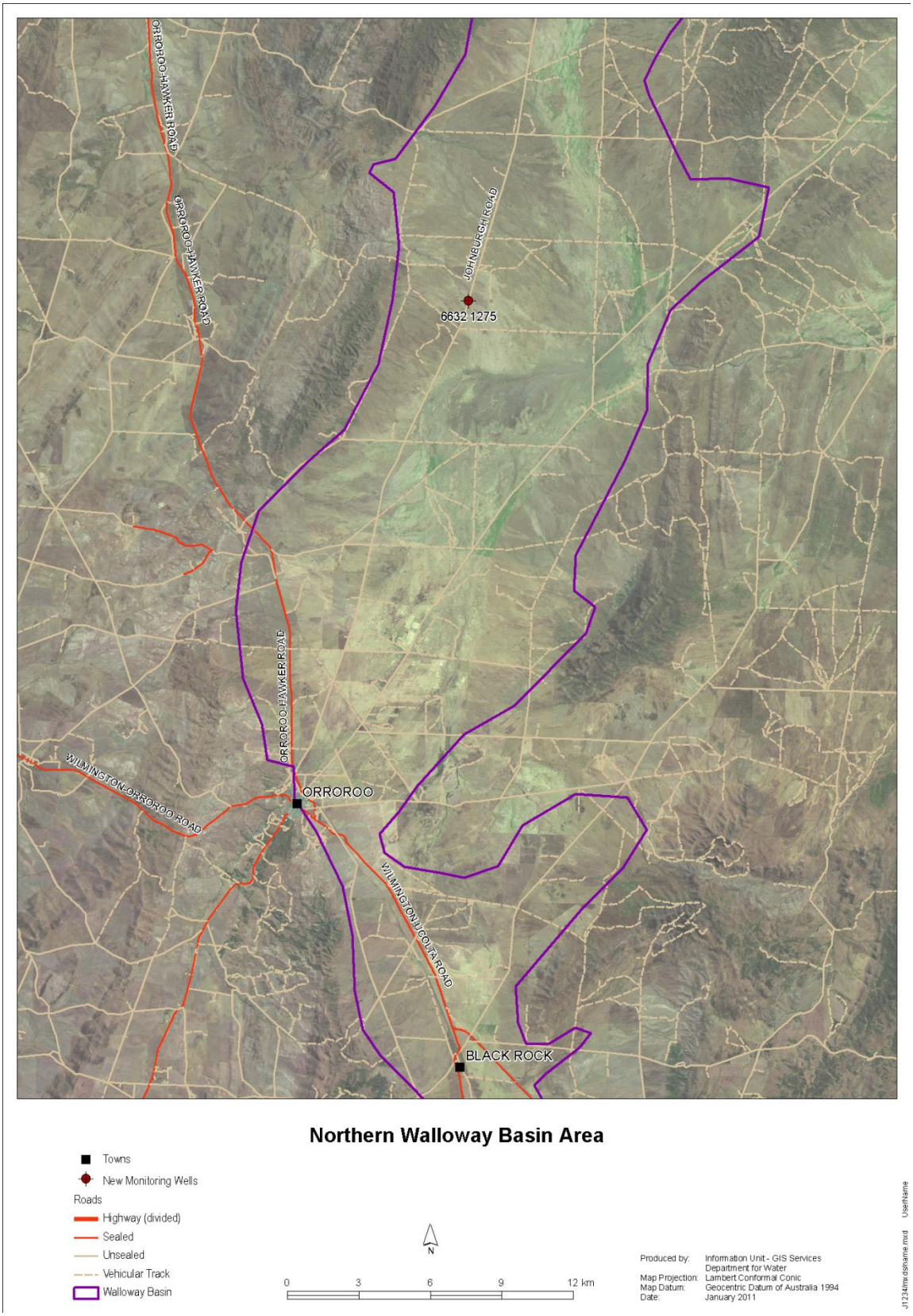


Figure 5 – Well locations in northern Walloway Basin.

Figure 6 – Well location in southern Walloway Basin.

3.3.3 Drilling and Completions

6532 1275 – (RMU 008)

Drilling commenced on 27 August 2010 under P/N 190030 in the Hundred of Oladdie on the eastern side of the Johnburgh Road, adjacent to CT 5444/285. The well was drilled to a maximum depth of 233 m using rotary mud drilling technique. Strata samples were collected every 2 m over the entire length of the hole.

The well was completed on 9 September 2010 using 150 mm nominal ID class 18 PVC from 0.3 m above to 161 m below ground level, and pressure cemented through casing to surface. A 'K' packer and telescopic liner of slotted 100 mm nominal ID, 0.5 mm aperture class 12 PVC with blank end cap was set across the target zone from 157.7 m to 169.7 m.

The geophysical logging data and strata samples indicated that a number of thin aquifers may exist below 170 m directly above and below a layer of lignite that is being targeted by Linc Energy for their UCG operations. For this reason the hole was backfilled with cement from 170 m to 233 m.

Development by airlifting from 150 m was carried out for 2.5 hours to achieve a final yield of approximately 3.0 L/sec before well sterilisation.

A final water sample was taken for salinity analysis which indicated an EC of 2900 uS/cm, giving an inferred TDS of 1608 mg/L. At the completion of development the well was still producing a small volume of fine sand (<0.5 mm) which could be improved with a smaller screen aperture, however it is deemed acceptable for a monitoring well.

After the final airlifting and sterilisation was complete this well was left over night. In the morning it was found to be flowing. A flange and ball valve assembly was attached providing a final shut in pressure of 12.2 kPa.

6632 1274 – (RMU 009)

Drilling commenced on 10 September 2010 under P/N 193787 in the Hundred of Black Rock Plain on the western side of 'Garden Road', adjacent to CT 5529/706. The well was drilled to a maximum depth of 228 m using rotary mud drilling technique. Strata samples were collected every 2 m over the entire length of the hole.

The well was completed on 23 September 2010 using 150 mm nominal ID class 12 PVC from 0.3 m above surface to 67 m below ground level and pressure cemented through casing to surface. The geophysical logging data and strata samples indicated that a number of small aquifers may exist below the target aquifer and the bottom of the well was backfilled with cement from 99 m to 228 m. The remaining 'open hole' section from 75 m to 99 m was filled with 7.0 mm washed gravel as no aquifer was defined at this depth. A 'K' packer and 12 m long telescopic liner of slotted 100 mm nominal ID, 0.5 mm aperture class 12 PVC with blank end cap was set across the target zone having a final seated depth from 63 m to 75 m.

Development by airlifting from 60 m was carried out for two hours to achieve a final yield of approximately 4.0 L/sec before well sterilisation.

A final water sample was taken for salinity analysis which indicated an EC of 4600 uS/cm, giving an inferred TDS of 2567 mg/L.

3.4 KANGAROO FLAT/ANGLE VALE

3.4.1 Overview

The sedimentary sequence in the Kangaroo Flat area includes Quaternary and Tertiary sediments that may extend to a depth of about 200 m below ground surface. These sediments reflect those found in the central Adelaide area, although are much thinner and shallower across much of the area with known discontinuities occurring in some regions. The T2 aquifer (Lower Port Willunga formation) in this area is directly overlain by the Carisbrooke Sand, which is in turn overlain by the Hindmarsh Clay (Barnett, 2010).

3.4.2 Planning

The wells in the Kangaroo Flat area were planned as a response to increasing salinity in the T2 aquifer. It was believed the increase was due to downward leakage from the Carisbrooke Sand which makes up the Q4 aquifer into the deeper T2 aquifer. The drilling was proposed to take place adjacent to two existing monitoring wells already established in the T2 aquifer MUW 29 (unit Nº: 6628 20365) and MUW 30 (unit Nº: 6628 20366) to a depth of 35 m to intersect the Q4 aquifer.

The results of drilling RMU 010 and RMU 011 indicated the Q4 aquifer has a similar salinity to that of the existing data for the T2 aquifer. It was decided that, due to the lack of a significant salinity variation from Q4 to T2 in this area, another well (6628 25426 (RMU 013)) should be completed adjacent to 6628 25370 (RMU 010) in the T3 Aquifer below T2. Very little is known about the T3 aquifer in this area as very few wells have been drilled deep enough to intersect it. As a result, expected salinity values were unknown and the salinity interaction between the two aquifers is also unknown.

A replacement well (RMU 012) was also included in this region to replace monitoring well MPA 48 (Unit Nº: 6628 1375) which has partially collapsed. This well has not been backfilled as part of this program due to limited access to the well and will be backfilled by DFW in the future.

Refer to Figure 7 for well locations.

Figure 7 – Well locations in Kangaroo Flat/Angle Vale area.

3.4.3 Drilling and Completions

6628 25370 – (RMU 010)

Drilling commenced on 19 July 2010 under P/N 190028 in the Hundred of Mudla Wirra on the southern side of Hatcher Road, adjacent to CT 5795/252. The well was drilled to a maximum depth of 37 m using rotary mud drilling technique. Strata samples were collected every 2 m over the entire length of the hole.

The well was completed on 21 July 2010 using 100 mm nominal ID class 12 PVC from 0.3 m above to 27 m below ground level, with an inline section of 0.5 mm aperture slotted casing from 27 m to 36 m with a blank end cap.

The slotted interval was then gravel packed using 7.0 mm washed gravel from 25 m to 37 m and cemented via tremmie line from 25 m to surface.

Development by airlifting from 23m was carried out for 1.5 hours to achieve a final yield of approximately 1.0 L/sec before well sterilisation.

A final water sample was taken for salinity analysis which indicated an EC of 3080 uS/cm, giving an inferred TDS of 1709 mg/L.

6628 25371 – (RMU 011)

Drilling commenced on 22 July 2010 under P/N 190026 in the Hundred of Mudla Wirra on the eastern side of Oates Road, adjacent to CT 5930/960, just south of the Hatcher Road/Oates Road intersection. The well was drilled to a maximum depth of 39 m using rotary mud drilling technique. Strata samples were collected every 2 m over the entire length of the hole.

The well was completed on 23 July 2010 using 100 mm nominal ID class 12 PVC from 0.3 m above to 32 m below GL, with an inline section of 0.5 mm aperture slotted casing from 32 m to 38 m with a blank end cap.

The slotted interval was then gravel packed using 7.0 mm washed gravel from 30 m to 39 m and cemented via tremmie line from 30 m to surface.

Development by airlifting from 29 m was carried out for 2.5 hours to achieve a final yield of approximately 1.0 L/sec before well sterilisation.

A final water sample was taken for salinity analysis which indicated an EC of 2300 uS/cm, giving an inferred TDS of 1272 mg/L.

6628 25372 – (RMU 012)

Drilling commenced on 26 July 2010 under P/N 193738 in the Hundred of Mudla Wirra on the southern side of the Two Wells – Gawler Road, adjacent to CT 5257/136.

The well was drilled to a maximum depth of 79 m using rotary mud drilling technique. Strata samples were collected every 2 m over the entire length of the hole.

The well was completed on 29 July 2010 using 100 mm nominal ID class 12 PVC from 0.3 m above to 69 m below ground level, with an inline section of 0.5 mm aperture slotted casing from 69 m to 71 m with a blank end cap. The geophysical logging data and strata samples indicated that drilling had potentially intersected the T3 aquifer in this well and cement was used to backfill the hole from 71 m to 79 m as a precaution.

The slotted interval was then gravel packed using 7.0 mm washed gravel from 68 m to 71 m and cemented via tremmie line from 68 m to surface.

Development by airlifting from 65 m was carried out for 2.0 hours to achieve a final yield of approximately 0.5 L/sec before well sterilisation.

A field measurement of the final water sample was taken for salinity analysis which indicated an EC of 3330 uS/cm, giving an inferred TDS of 1850 mg/L.

6628 25426 – (RMU 013)

Drilling commenced on 4 November 2010 under P/N 196834 in the Hundred of Mudla Wirra on the southern side of Hatcher Road, adjacent to CT 5795/252. The well was drilled to a maximum depth of 93 m using rotary mud drilling technique. Strata samples were collected every 2 m over the entire length of the hole.

The well was completed on 8 November 2010 using 150 mm nominal ID class 12 PVC from 0.3 m above to 74.5m below ground level, and pressure cemented through casing to surface. The bottom of the well from 80 m to 93 m was backfilled with gravel as this part of the formation was considered to be indurated sand with low porosity/permeability and it was decided to target the sand in the upper section of the formation from 74.5 m to 80 m.

A 'K' packer and telescopic screen of 100 mm nominal ID, 0.35 mm aperture stainless steel was set across the target zone from 74 m to 80 m.

Development by airlifting from 72m was carried out for 2.5 hours to achieve a final yield of approximately 1.0 L/sec before well sterilisation. A final water sample was taken in the field for salinity analysis which indicated an EC of 2210 uS/cm, giving an inferred TDS of 1220 mg/L.

3.5 CENTRAL ADELAIDE PLAINS (ADELAIDE AIRPORT)

3.5.1 Overview

The Central Adelaide Groundwater area occupies about 560 km² of the Adelaide Coastal Plain. It is bounded to the east and southeast by the Adelaide Hills, which consist of Proterozoic basement (meta-sediments) and to the west by Gulf St. Vincent. The plains are formed by Tertiary and Quaternary sediments up to 600 m thick with Quaternary sediments containing up to six thin aquifers, while the Tertiary contains up to four aquifers with groundwater of varying quality occurring in each (Gerges, 2006).

3.5.2 Planning

Due to the extension and redevelopment of the Adelaide International Airport, two existing monitoring wells (Unit numbers 6628-7661 and 6628-7663) were backfilled to allow for the new Airport terminal car park to be built. Due to the security related issues, the replacement wells were drilled outside the Airport boundary in an easement covering Brown Hill Creek, running along the eastern and southern side of the Airport Boundary.

A site was chosen on the southern boundary of the Airport allowing sufficient area to drill and suitable access to the SA Water easement. This site however was immediately east of the *Para fault* putting the targeted aquifers on the up-thrown side and shallower than the original wells being replaced. Although not ideal this was deemed acceptable.

Refer to Figure 8 for well locations.

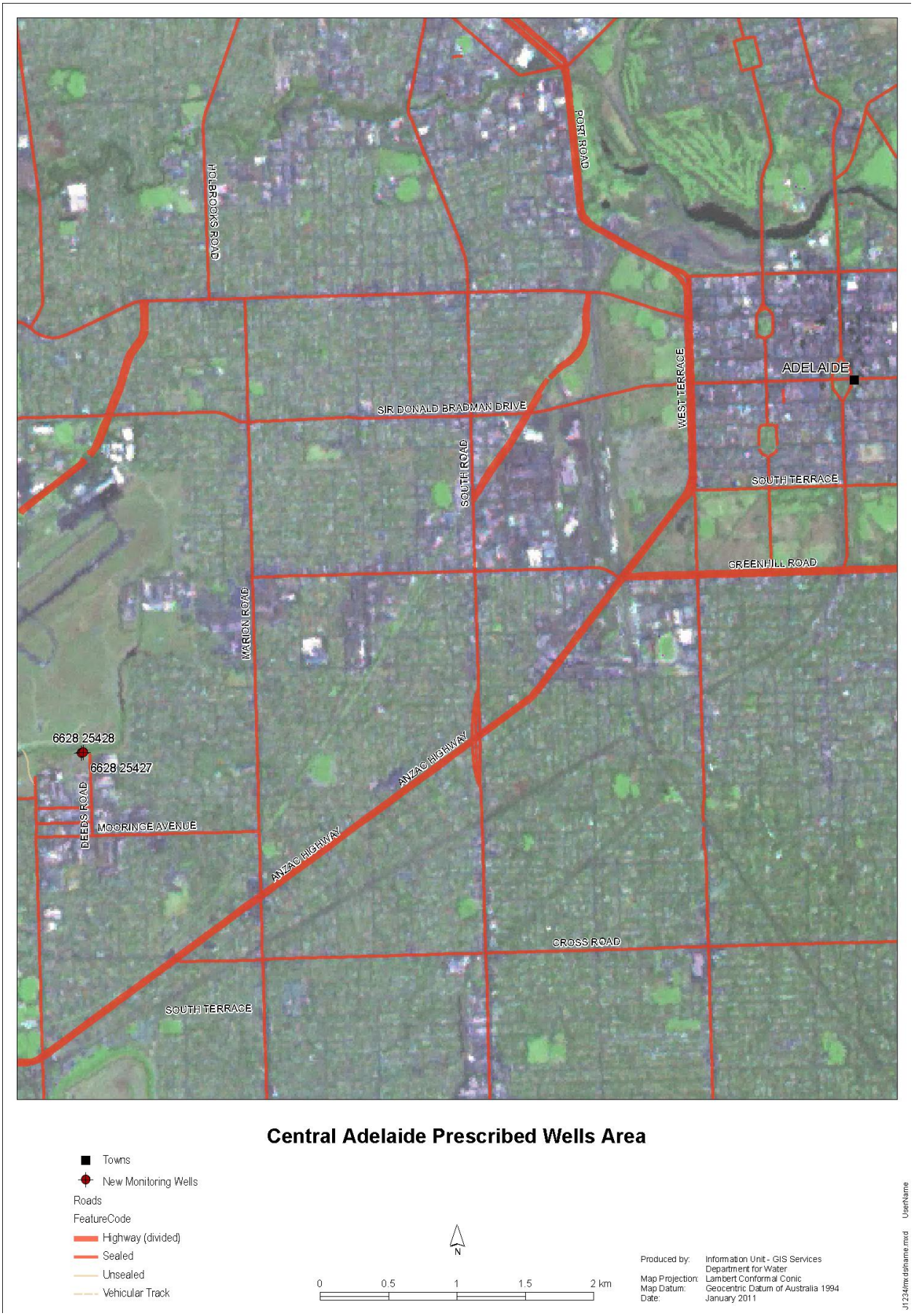


Figure 8 – Well locations in Adelaide Metro area.

3.5.3 Drilling and Completions

6628 25427 – (AApt Site 1 - T2)

Drilling commenced under P/N 170282 in the Hundred of Adelaide on CT 6038/548 in the linear park that covers the southern and eastern side of the Adelaide International Airport, immediately adjacent to the northern end of Deeds Road. The well was drilled to a maximum depth of 227 m using rotary mud drilling technique. Strata samples were collected every two metres to 82 m and then every metre from 82 m onwards.

Completion was carried out using 150 mm nominal ID class 12 PVC from 0.3 m above surface to 137 m below and pressure cemented through casing to the surface. The remaining section (137 m to 227 m) of the hole was left open, however after airlifting the final depth was measured at 184 m due to the well collapsing during airlifting.

Development by airlifting from 130 m was carried out for 4.5 hours to achieve a final yield of approximately 10.0 L/sec before well sterilisation.

A final water sample was taken for salinity analysis which indicated an electrical conductivity EC of 1762 uS/cm, giving an inferred TDS of 973 mg/L.

6628 25428 – (AApt Site 2 – T1)

Drilling commenced under P/N 170283 in the Hundred of Adelaide on CT 6038/548 immediately adjacent to the T2 well. This well was drilled to a maximum depth of 117 m using rotary mud drilling technique. Strata samples were collected every two metres to 64 m and then every metre through the T1 aquifer to 117 m.

Completion was carried out using 150 mm nominal ID class 12 PVC from 0.3 m above surface to 89 m below and pressure cemented through casing to the surface. The remaining section (89 m to 117 m) of the hole was left open, however after airlifting the final depth was measured at 108 m due to the well collapsing during air lifting.

Development by airlifting from 83 m was carried out for 2.5 hours to achieve a final yield of approximately 5.0 L/sec before well sterilisation.

A final water sample was taken for salinity analysis which indicated an EC of 1954 uS/cm, giving an inferred TDS of 1080 mg/L.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 BAROOTA

Baroota proved to be quite difficult for drilling and the discontinuity of the aquifers in the area made targeting aquifers extremely hard to determine and expected depths almost impossible to determine.

RMU 001 was completed in the deepest and most favourable aquifer encountered, but still led to very poor yields. This could be due to limited thickness and connectivity of the aquifer.

RMU 003 proved easier in drilling, although deeper compared to most wells in the area. The well was completed in sandstone at the base of the drill hole and provided quite a good yield. It is noted that a formation displaying similar properties outcrops at the western end Pt Germein Gorge some two kilometres to the south-east of the site. Approximate field measurements indicate this formation strikes in a north/north-east direction and dips at approximately 60 degrees to the west putting an estimated continuation of this formation in the vicinity of the point at which the well intersected the sandstone formation.

4.2 WILLOCHRA

All wells in the Willochra Basin region were successfully drilled and are suitable for both standing water level and salinity monitoring.

Wells RMU 005 and RMU 007 proved to have very good yields and it may be of benefit to carry out pumping tests on these wells, particularly RMU 005, which is the only monitoring well completed in basement fractured rock in this region. RMU 004 and RMU 006 returned very low yields, but are considered adequate for the purpose of groundwater monitoring.

4.3 WALLOWAY

Both wells RMU 008 and RMU 009 produced acceptable yields and qualities. Of particular interest is the RMU 009 which is the deepest known monitoring well in the southern lobe of the Walloway Basin. This well was completed in an aquifer at a depth previously unknown to landowners in the region and could be utilised as a useful alternative aquifer for the supply of stock quality groundwater.

4.4 KANGAROO FLAT/ANGLE VALE

All drilling at these sites was problem free, however, the salinity results were much lower than expected, which may warrant further investigation and testing for a hydraulic connection between aquifers.

4.5 ADELAIDE METRO

On completion of drilling and development at these two sites it was discovered that both wells had partially collapsed due to their ‘open hole’ design. At the time is was not possible to clean back to their total depth, as it was becoming increasingly difficult to contain development water from entering Brown Hill Creek or flooding neighbouring business access roads.

The current depths and level of development were the best that could be achieved under the circumstances; it may be beneficial in the future to clean out the wells to total depth, undertake further development of the wells and install a slotted liner.

5.0 APPENDIXES

5.1 A. WELL COMPLETION LOGS

6532 1652 – Well Completion log

Permit Number:	**193783**	Backfilled (Y/N):	**N**
Date Completed:	**13/8/10**	Total Depth (m):	**87**
Unit No:	**6532 1652**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**RMU 001**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Stephen Tuckwell**

Coordinates

Easting:	**223995**	Ground Elevation (mAHD):	**TBD**
Northing:	**6352521**	Reference Elevation (mAHD):	**TBD**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Backfilled with gravel from 54 m to 87m

Well coordinates and a ground elevation of 74 m have been determined using a hand held GPS which provides an approximate ground elevation value only.

Reference Elevation has been calculated at 74.3 m by adding the casing height to the current approximate ground elevation.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	4	Gravel	Slightly clayey, poorly sorted, water washed gravel up to boulders.	
4	16	Clay	Gravelly, Tan/pale brown, medium/soft, with thin bands of sub-angular to sub-rounded, poorly sorted gravels.	
16	22	Clay	Sandy, Medium/firm, pale brown/tan clay. Sand = sub-angular to sub-rounded medium/coarse, clear to grey quartz sand.	
22	30	Clay	Gravelly, mottled tan and mustard yellow/brown clay. Gravel = poorly sorted, rounded, quartz, siltstone and sandstone fragments (5.0 – 15.0 mm).	
30	38	Clay	Gravelly, mottled mustard yellow/brown and grey/off white, soft clay. Gravel = coarse sub-angular to sub-rounded quartz, sandstone and siltstone fragments.	
38	40	Clay	Sandy, mottled Mustard yellow/brown and pale grey/white, medium/soft clay. Sand = fine to medium, medium sorted, rounded clear to grey quartz (0.1 – 0.5 mm).	
40	44	Clay	Sandy, Mottled red/brown - mustard yellow - and light	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
			grey. Sand = fine, well sorted, sub-rounded clear quartz sand (0.1 – 0.3 mm).	
44	46	Clay	Sandy, Mottled tan/off white and grey medium/firm clay. Sand = fine sub-angular to sub-rounded clear quartz sand (0.1 – 0.3 mm).	
46	48	Gravel	Sandy, poorly sorted gravel and sand. Sub-rounded to sub-angular, quartz/siltstone and sandstone fragments ranging from (0.2 mm – 15.0 mm) Occasional black/reddish brown grains.	
48	52	Sand	Clayey, pale yellowish brown, fine to medium, clear to grey sand, (0.1 – 0.6 mm)	
52	54	Clay	Sandy, Mottled tan/off white and orange/yellow, medium/firm clay. Sand = fine, clear to opaque yellow, quartz sand (0.1 – 0.3 mm).	
54	62	Clay	Mottled red/brown and white, medium/firm clay Occasional micaceous grains.	
62	66	Sand	Clayey, mottled tan/white and reddish pink, medium/firm clay. Sand = fine, sub-angular clear to grey quartz sand (0.1 – 0.3 mm).	
66	76	Sand	Clayey, Tan and grey sand, Sand = very fine, sub-rounded to rounded, well sorted clear quartz sand (0.1 – 0.2 mm).	
76	87	Sand	Clayey, tan/white sand with occasional red/pink silty clay bands. Sand = fine to medium, medium/well sorted, rounded clear quartz sand (0.1 – 0.4 mm). Rare hard reddish/black limonitic (?) grains.	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length (hrs)	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
42	54	38.4	<0.125	3	Airlift	1789874	2323	mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Casing	0	23	200	Steel	-	N	-	-
Casing	0	42	100	PVC 12	-	Y	0	40
Slotted Casing	42	54	100	PVC 12	0.5	N	-	-
Sump	54	60	100	PVC 12	-	N	-	-

6532 1654 – Well Completion Log

Permit Number:	**193785**	Backfilled (Y/N):	**N**
Date Completed:	**25/10/2010**	Total Depth (m):	**164**
Unit No:	**6532 1654**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**RMU003**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Angus Forbes**

Coordinates

Easting:	**224473**	Ground Elevation (mAHD):	**TBD**
Northing:	**6348765**	Reference Elevation (mAHD):	**TBD**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Backfilled with gravel 155 m – 164 m

Well coordinates and a ground elevation of 85 m have been determined using a hand held GPS which provides an approximate ground elevation value only.

Reference Elevation of 85.3 m has been calculated by adding the casing height to the current approximate ground elevation.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	2	Clay	Pale brown to brown, soft silty/gravelly clay/topsoil. Gravel = rounded to angular poorly sorted very course gravel to boulders (10 – 75 mm). Highly calcareous.	
2	8	Clay	Mottled brown and tan/white, medium/soft, calcareous silty/gravelly clay. Gravel = small to medium black and white 'marble like' quartz.	
8	10	Clay	Light brown – brown, medium/firm, weakly calcareous silty clay. Rare hard white limestone fragments.	
10	12	Clay	Pale brown to brown, calcareous, sandy clay. Sand = fine to coarse, poorly sorted, Sub-angular to sub-rounded clear to black coarse grains. Rare soft white limestone nodules throughout.	
12	14	Gravel	Slightly clayey, black and white, coarse marble like quartz gravel. Sub-angular to angular (10 – 25 mm) Occasional very large dark red/brown quartz fragments.	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
14	22	Clay	Pale brown, firm/medium gravelly clay. Gravel = medium/coarse, poorly sorted, angular mixture of quartz, sandstone and marble. Weakly calcareous.	
22	24	Gravel	Poorly sorted mixture of angular to sub-angular gravel, sandstone, siltstone and marble.	
24	30	Clay	Brown to pale brown, medium/soft weakly calcareous gravelly clay. Common soft white limey nodules throughout Gravel = poorly sorted mixture of angular to sub-angular marble, sandstone, siltstone and quartz (up to 10 mm).	
30	38	Clay	Pale brown to brown, soft to medium, weakly calcareous clay. Rare soft limestone nodules towards top of unit.	
38	44	Clay	Pale brown, soft to medium, calcareous, gravelly clay. Gravel = angular mixture of black/white marble, quartz and sandstone.	
44	74	Clay	Brown to pale brown, soft, weakly calcareous, silty clay. Notable thin sandy bands between 56 and 60m Common soft white, limestone nodules towards middle of unit.	
74	80	Clay	Mottled grey and pale brown, firm, sandy clay. Becoming sandier towards base of unit. Sand = fine sub-rounded to sub-angular, clear to grey quartz.	
80	88	Clay	Pale brown to brown, soft, gravelly clay. Gravel = Angular to sub-angular, milky to grey quartz.	
88	94	Clay	Pale brown to brown, soft, silty clay.	
94	112	Clay	Mottled pale yellow and grey, medium/firm, sandy clay. Sand = fine to medium, sub-rounded to rounded, clear to grey quartz sand.	
112	124	Clay	Pale yellowish grey, medium/firm sandy clay. Sand = fine to coarse, poorly sorted, sub-angular to rounded clear to grey quartz. Becoming sandier towards base of unit. Rare small, very soft, black nodules (carbonaceous matter?) at base of unit.	
124	128	Clay	Orange/brown, soft, gravelly clay. Gravel = medium to coarse sub-angular siltstone, sandstone, and quartz mixture.	
128	132	Gravel	Clayey, medium to coarse, sub-angular to angular	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
			mixture of quartz, siltstone and sandstone. Rare limonitic fragments.	
132	152	Clay	Mottled orange/brown, mustard yellow and pale grey, medium/soft, sandy clay. Sand = fine, sub-angular to sub-rounded clear to grey quartz.	
152	156	Sand stone	Weathered, mottled pale greyish white and yellow medium/hard, fine, sub-rounded to sub-angular, clear to grey quartz (0.1 mm – 0.4 mm) in white non-calcareous cement.	
156	164	Sandstone	Fresh, pale yellowish white, medium/hard, fine to coarse (0.1 mm – 1.8 mm), sub-rounded to rounded, clear to grey quartz in white non-calcareous cement. Becoming extremely hard towards base of unit.	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length (hrs)	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
152	155	59.8	~1.5	13	Airlift	Field measurement	3400	Mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Casing	0	13	200	Steel	-	N	-	-
Casing	0	152	100	PVC 12	-	Y	0	152
Slotted Casing	152	155	100	PVC 12	0.5	N	-	-

6533 914 – Well Completion Log

Permit Number:	**190034**	Backfilled (Y/N):	**N**
Date Completed:	**26/8/2010**	Total Depth (m):	**108**
Unit No:	**6533 914**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**RMU 004**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Angus Forbes**

Coordinates

Easting:	**234284**	Ground Elevation (mAHD):	**TBD**
Northing:	**6424889**	Reference Elevation (mAHD):	**TBD**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Well coordinates and a ground elevation of 212 m have been determined using a hand held GPS which provides an approximate ground elevation value only.

Reference Elevation has been calculated at 212.3 m by adding the casing height to the current approximate ground elevation.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	2	Clay	Clay /top soil, medium/firm , brown limey clay	
2	12	Clay	Mottled yellow/brown and grey, medium/soft, slightly sandy, non calcareous clay. Rare limey nodules towards top of unit.	
12	20	Clay	Mottled red/purple and grey, medium/soft, slightly silty, non calcareous clay.	
20	28	Clay	Mottled red/brown and grey, medium/soft, slightly silty clay.	
28	40	Clay	Mottled red/purple and grey, medium/soft, slightly silty clay.	
40	42	Clay	Mottled brown/yellow and grey, soft, silty clay.	
42	52	Clay	Mottled red/brown and grey, medium, silty clay. Very thin sandy bands throughout.	
52	58	Clay	Mottled red/brown and grey, medium/firm silty clay. Driller indicated a thin, very hard band at 58 m.	
58	60	Clay	Grey (slight purplish tint), very firm/brittle.	
60	62	Clay	Grey, very firm/brittle, Slight yellowish tint.	
62	70	Clay	Grey/purplish-grey, very firm/brittle clay.	
70	76	Clay	Mottled yellow and grey, very stiff/brittle clay.	
76	84	Clay	Off white/pale grey, soft, pipe clay. “Soapy” feel when dried. Rare streaks of purple/pink.	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
84	92	Clay	Mottled mustard yellow and dark grey, slightly silty, soft/sticky clay. Occasional purple/grey nodules.	
92	96	Clay	Mottled pale brown/mustard yellow, silty soft/medium clay. Rare soft yellow silt stone fragments.	
96	100	Slate	Blue/grey, medium/soft weathered slate. Rare pale yellowish green clay nodules Rare pale yellow siltstone fragments.	
100	108	Slate	Blue/grey, very hard, fresh slate. Basement rock.	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length (hrs)	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
96	107	Flowing (12.8 kPa)	0.125	2	Air lift	Field measurement	3650	Mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Case	0	11	200	Steel	-	N	-	-
Case	0	96	100	PVC12	-	Y	0	96
Slotted Casing	96	107	100	PVC 12	0.5	N	-	-

6532 1653 – Well Completion Log

Permit Number:	**190033**	Backfilled (Y/N):	**N**
Date Completed:	**8/12/2010**	Total Depth (m):	**154**
Unit No:	**6532 1653**	Drill Method:	**Rotary mud drilling technique/Rotary Air**
Drillhole Name:	**RMU 005**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Angus Forbes**

Coordinates

Easting:	**237155**	Ground Elevation (mAHD):	**TBD**
Northing:	**6398454**	Reference Elevation (mAHD):	**TBD**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Well coordinates and a ground elevation of 252 m have been determined using a hand held GPS which provides an approximate ground elevation value only.

Reference Elevation has been calculated at 252.3 m by adding the casing height to the current approximate ground elevation.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	6	Clay	Brown/Dark brown, medium/firm highly calcareous clay. Little if any topsoil.	
6	16	Clay	Mottled grey and tan, medium/firm silty clay with rare soft white lime stone fragments throughout. Small black nodules/streaks appearing towards base of unit (carbonaceous material?).	
16	24	Clay	Mottled light grey and mustard yellow, medium/soft sandy clay. Rare black carbonaceous (?) streaks. Sand = fine clear sub-angular quartz.	
24	56	Clay	Mottled grey and reddish/brown, very stiff/brittle clay. Red portion very silty.	
56	66	Clay	Mottled pale grey and yellowish tan/mustard yellow, firm/stiff clay. Rare pinkish grey nodules.	
66	68	Clay	Pale grey to white, firm/stiff slightly sandy clay. Rare purple/red nodules.	
68	80	Sand stone	Grey/pale grey, very fine well cemented, hard sand stone.	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
			Occasional very hard bands encountered while drilling.	
80	98	Clay	Grey/pale grey, very soft sandy clay, becoming sandier towards base of unit. Sand = fine, sub-rounded to sub angular, clear to grey quartz sand (0.1 mm - 0.3 mm). (Possible weathered shale?).	
98	100	Clay	Mottled Pinkish brown and grey, medium/soft, slightly sandy clay. (Possible weathered shale?).	
100	110	Shale	Weathered Brownish pink, Medium/soft, sandy shale. Rare hard bands encountered.	
110	142	Shale	Weathered Purple/brown, medium/soft, sandy shale. Occasional very soft layers.	
142	148	Shale	Purplish /grey, medium/hard shale inter-bedded with blue slate like layers. Becoming very hard towards 148 m.	
148	154	Slate	Purplish blue/blue very hard slate. Abundant pyrite crystals.	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length (hrs)	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
149	154	9.9	~5.0	3.5	Air lift	1808743	1513	Mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Casing	0	11	250	Steel	-	Y	0	18
Casing	0	149	157	PVC 12	-	Y	0	149
Slotted Casing	147.5	153.5	100	PVC 12	0.5	N	-	-

6532 1651 – Well Completion Log

Permit Number:	**190032**	Backfilled (Y/N):	**N**
Date Completed:	**19/8/2010**	Total Depth (m):	**106**
Unit No:	**6532 1651**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**RMU 006**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Angus Forbes**

Coordinates

Easting:	**241380**	Ground Elevation (mAHD):	**270**
Northing:	**6386166**	Reference Elevation (mAHD):	**270.3**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Back fill with gravel from 84.5 to 106

Well coordinates and a ground elevation of 270 m have been determined using a hand held GPS which provides an approximate ground elevation value only.

Reference Elevation has been calculated at 270.3 m by adding the casing height to the current approximate ground elevation.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	2	Clay	Top soil, plant material, occasional irregular limestone fragments (probably from road works).	
2	6	Clay	Medium/soft, reddish/brown, silty clay.	
6	10	Clay	Mottled red/brown and grey silty clay.	
10	26	Clay	Slightly sandy, medium to firm mottled brown/yellow and grey clay. Grey portion very firm/brittle.	
26	34	Clay	Mottled red/brown and grey, medium/soft, slightly silty clay. Very sticky.	
34	56	Clay	Mottled Grey and yellowish brown, medium/firm silty clay.	
56	68	Clay	Mottled reddish/brown and grey, firm/medium silty clay.	
68	70	Clay	Slightly sandy, White, soft/sticky clay, (pipe clay). When dried has a “soapy” talc like feel. Sand = very fine, rounded, well sorted clear quartz (0.1 mm – 0.2 mm). Non-calcareous.	
70	84	Clay	Pinkish grey, very soft/sticky clay with occasional purple/red mottling. Has same “soapy” feel as above	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
			when dried. Non-calcareous.	
84	96	Clay	Mottled tan/pale brown and grey, medium/soft clay	
96	102	Clay	Sandy, mottled pale brown/grey and dark grey/black, medium/soft, very sticky clay. Sand = fine, well rounded, clear quartz (0.1 mm - 0.3 mm) Possible top of weathered basement?	
102	106	Slate	Black/dark grey, very hard/fresh slate. Occasional pyrite grains visible in larger fragments.	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
81	84.5	12	0.25 – 0.5	5.5 hrs	Airlift	1808744	4048	mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Casing	0	11	200	Steel	-	N	-	-
Casing	0	81	100	PVC 12	-	Y	0	81
Slotted Casing	81	84.5	100	PVC 12	0.5	N	-	-

6532 1657 – Well Completion Log

Permit Number:	**193786**	Backfilled (Y/N):	**N**
Date Completed:	**1/10/2010**	Total Depth (m):	**129**
Unit No:	**6532 1657**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**RMU 007**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Angus Frobes**

Coordinates

Easting:	**241690**	Ground Elevation (mAHD):	**287**
Northing:	**6373006**	Reference Elevation (mAHD):	**287.3**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Back filled from 84 to 129

Well coordinates and a ground elevation of 287 m have been determined using a hand held GPS which provides an approximate ground elevation value only. Reference Elevation has been calculated at 287.3 m by adding the casing height to the current approximate ground elevation.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	2	Clay/Topsoil	Very Stiff dark brown silty clay/loam.	
2	12	Clay	Mottled Orange/brown and grey, very firm/stiff weakly calcareous clay. Orange/brown portion non-calcareous. Notable gravel layer at 10 – 11m. Gravel = Coarse sub-rounded to rounded mix of quartz, silt stone and sandstone.	
12	28	Clay	Mottled pale brown/tan and grey, firm to stiff slightly sandy clay. Occasional small black nodules/streaks of carbonaceous matter (?).	
28	34	Clay	Mottled orange/yellow and grey, medium strength sandy clay. Sand = fine to medium, sub-angular clear to grey quartz (0.1 mm – 0.8 mm).	
34	42	Clay	Mottled yellow/tan and grey, medium/firm sandy clay Occasional dark red/brown clay nodules. Sand = fine, clear to grey sub-angular quartz.	
42	44	Clay	Mottled red/brown and greyish yellow, medium firm slightly sandy clay.	
44	66	Clay	Mottled Grey and tan/yellow, firm sandy clay.	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
			Sand = sub-rounded to sub angular medium/coarse clear to grey quartz sand (0.5 mm – 1.5 mm).	
66	70	Clay	Grey, Very firm/brittle clay.	
70	78	Clay	Pale tan/off white soft/medium sandy clay. Non calcareous. Sand = fine sub-angular to sub-rounded clear to grey quartz sand. Driller indicated a very thin very hard band at 71.5m.	
78	80	Clay	Mottled yellow/orange and grey, soft to medium very sandy clay. Sand = fine clear to grey quartz sand.	
80	84	Clay	Grey/pale grey, soft, very sandy clay. Sand = fine sub-angular clear quartz.	
84	88	Clay	Mottled yellow/orange and grey, medium/firm clay. Rare red/brown silty nodules.	
88	96	Clay	Mottled orange/yellow and brown/red, medium strength silty clay.	
96	114	Clay	Mottled orange/yellow and purple/red, firm/stiff silty clay.	
114	122	Clay	Mottle red/brown and yellowish brown, firm/medium silty clay. Medium/soft tan/pale greenish grey siltstone fragments becoming more abundant towards base of unit (Possibly weathered slate?).	
122	126	Slate	Weathered pale yellowish/green soft slate fragments. Becoming harder towards base of unit.	
126	129	Slate	Fresh very hard greenish/blue laminated slate. Common pyrite grains.	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length (hrs)	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
72	84	7.43	~2.0	5	Air lift	Field measurement	1450	Mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Case	0	18	200	Steel	-	N	-	-

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Case	0	72	100	PVC 12	-	Y	0	72
Slotted Casing	72	84	100	PVC 12	0.5	N	-	-

6632 1275 – Well Completion Log

Permit Number:	**190030**	Backfilled (Y/N):	**N**
Date Completed:	**9/9/2010**	Total Depth (m):	**233.5**
Unit No:	**6632 1275**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**RMU 008**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Angus Forbes**

Coordinates

Easting:	**282432**	Ground Elevation (mAHD):	**TBD**
Northing:	**6397255**	Reference Elevation (mAHD):	**TBD**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Well coordinates and a ground elevation of 371 m have been determined using a hand held GPS which provides an approximate ground elevation value only.

Reference Elevation has been calculated at 371.3 m by adding the casing height to the current approximate ground elevation.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	2	Clay	Pale brown, medium/soft, clay. Little if any topsoil.	
2	26	Clay	Brown/reddish brown, soft/puggy, gravelly clay. Highly calcareous. Gravel= poorly sorted, rounded, siltstone, sandstone and quartz up to 10.0 mm. Common, medium/soft white limestone fragments.	
26	34	Clay	Pale brown/brown sandy clay. Highly calcareous. Sand = fine, sub-rounded to rounded clear quartz. Common hard/very hard, sandy limestone fragments.	
34	44	Clay	Mottled pale gray and brown medium/firm, sandy clay. Sand = fine sub-rounded to rounded clear quartz.	
44	62	Clay	Mottled pale yellow and pale brownish grey, medium/soft silty clay.	
62	80	Clay	Mottled pale brown and light grey, medium/soft sandy clay. Sand = fine to medium, well rounded, red/brown to black limonitic siltstone fragments.	
80	106	Clay	Mottled grey and pale yellow, medium/firm, silty clay. Grey portion very brittle.	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
106	110	Clay	Mottled red/brown and light grey, medium/soft silty clay.	
110	142	Clay	Mottled off white and purple/brown, medium/soft silty clay. 'Soapy' feel when dried.	
142	188	Clay	Mottled purple/red and pale grey/white, medium-soft inter-bedded sandy clay. Sand = fine to medium, medium sorting, well rounded clear quartz (0.1 – 1.2 mm. approx 60% <0.5 mm).	
188	212	Carbonaceous clay	Mottled pale brown and brownish grey carbonaceous clay. Common fibrous, carbonaceous wood fragments (xyloid?) becoming more abundant towards base of uni. Strong sulphurous smell increasing towards base of unit. Occasional pyritic sandy nodules throughout.	
212	218	Lignite	Dark brown to black, medium/hard lignite. Large fragments recovered displaying laminations and 'cleating' when dried. Becoming clayey (inter-bedded with clay?) towards base of unit.	
218	222	Clay	Greenish grey, medium/firm, silty clay.	
222	228	Carbonaceous clay	Blackish brown/dark brown, medium/soft carbonaceous clay. Common small fibrous, carbonaceous woody fragments (xyloid?).	
228	233.5	Carbonaceous clay	Dark brown, medium/soft, sandy carbonaceous clay. Sand = very fine, well rounded, well sorted clear quartz.	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length (hrs)	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
161	169	Flowing (13.3 kPa)	~2.5	2.5	Air Lift	1789873	1680	mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Casing	0	23	250	Steel	-	Y	0	23

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Casing	0	161	149	PVC 18	-	Y	0	161
Slotted Casing	157.7	169.7	100	PVC 12	0.5	N	-	-

6632 1274 – Well Completion Log

Permit Number:	**193787**	Backfilled (Y/N):	**N**
Date Completed:	**23/9/2010**	Total Depth (m):	**227**
Unit No:	**6632 1274**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**RMU 009**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Angus Forbes**

Coordinates

Easting:	**285508**	Ground Elevation (mAHD):	**Unknown**
Northing:	**6359001**	Reference Elevation (mAHD):	
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Back filled with cement to 90m

Back willed with gravel from 75 to 90m

Well coordinates and a ground elevation of 456 m have been determined using a hand held GPS which provides an approximate ground elevation value only. Reference Elevation has been calculated at 456.3 m by adding the casing height to the current approximate ground elevation.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	2	Clay	Top soil, Dark brown/brown, Medium/firm clay. Plant matter throughout.	
2	6	Clay	Brown, medium/soft gravelly clay. Gravel = poorly sorted, sub-rounded to rounded mix of milky quartz, sandstone, and siltstone.	
6	12	Clay	Pale brown, soft/medium sandy clay. Sand = fine to medium, sub-rounded to rounded quartz, siltstone and sandstone.	
12	14	Gravel	Very coarse, vari-coloured water washed gravel. Sub-rounded to rounded mixture of milky quartz, siltstone and sandstone (10 mm – 25 mm).	
14	42	Clay	Mottled grey and mustard yellow/brown, medium/soft clay. Common thin soft sandy bands. Grey portion extremely brittle. Sand = fine to medium clear to grey quartz with rare siltstone and sandstone grains (up to 0.8 mm).	
42	52	Clay	Mottled yellow/grey and purplish/red, medium/firm slightly sandy clay. Sand = fine to medium, sub-angular to sub-rounded	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
			clear to grey quartz.	
52	56	Clay	Mottled grey and yellow, soft/puggy sandy clay. Sand = medium to well sorted fine to medium, milky/grey quartz.	
56	60	Clay	Mottled purple/brown and mustard yellow slightly sandy clay.	
60	66	Clay	Mottled pale grey/off white and purple/brown, soft/sticky, slightly silty clay. "soapy" feel when dried.	
66	80	Sand	Pale grey to off white, soft/puggy, clayey sand. Medium/coarse, rounded, well sorted clear to grey quartz. Notable very sandy layer at 72 – 74m (~75 % sand).	
80	120	Clay	Mottled grey and off white, soft sandy clay. Sand = sub-rounded to rounded, fine, well sorted clear to grey quartz.	
120	124	Sand	Grey to off white, soft, clayey sand (weakly cemented?). Sub rounded to rounded, fine well sorted, clear to grey quartz.	
120	124	Sand	Grey to off white, soft, clayey sand (weakly cemented?). Sub Angular to Angular, poorly sorted, fine to very coarse, clear to grey quartz. Rare coarse silt stone fragments.	
124	144	Sand	Grey to off white, soft, clayey sand (weakly cemented?). Fine to coarse, sub-rounded to rounded, pale green/grey to clear quartz sand.	
144	162	Clay	Pale grey, soft, sandy clay. Sand = fine to coarse clear to grey, sub-rounded quartz sand with common micaceous grains (0.1 mm – 0.8 mm) Common black 'slatey' fragments with rare very fine pyrite(?) crystals Common thin Hard bars throughout.	
162	172	Clay	Mottled pale grey and dark grey/black, soft/medium, sandy clay. Sand = fine to coarse, Sub-rounded to Angular, clear to grey quartz. Common black 'slatey' fragments with rare very fine pyrite (?) crystals.	
172	190	Clay	Pale grey to tan/grey, soft sandy clay. Sand = poorly sorted, fine to coarse, clear to grey	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
			quartz. Common pinkish tan, soft, cemented sandy nodules (weathered granite?). Abundant fine micaceous grains.	
190	218	Granitic Material	Extremely weathered pale green/grey soft (sandy, clay like) granite material. Sand = sub-angular to sub-rounded, clear to grey coarse quartz. Abundant micaceous grains. Medium/hard small 'gravel like' granite fragments with feldspars, mica and quartz visible under 10x lens becoming more common towards base of unit.	
218	228	Granitic Material	Weathered greenish/grey soft granitic material. Common large very hard granite fragments with easily visible feldspars, quartz and biotite up to 5 mm. Abundant clear to grey 'loose' quartz grains up to 5 mm in size. Larger 'fresh' fragments at 227 m.	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length (hrs)	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
67	75	12.9	~4.0	2.0	Airlift	1808741	2567	mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Case	0	23	254	Steel	-	Y	0	24
Case	0	67	157	PVC 12	-	Y	0	67
Slotted Casing	63	75	100	PVC 12	0.5	N	-	-

6628 25370 – Well Completion Log

Permit Number:	**190028**	Backfilled (Y/N):	**N**
Date Completed:	**20/7/2010**	Total Depth (m):	**37**
Unit No:	**6628 25370**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**RMU010**	Drilling Company:	**Kangarilla drilling**
Logged By:	**M Williams**	Driller:	**Stephen Tuckwell**

Coordinates

Easting:	**284509**	Ground Elevation (mAHD):	**TBD**
Northing:	**6171979**	Reference Elevation (mAHD):	**TBD**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Adjacent monitoring well 6628 20365

Well coordinates and a ground elevation of 35 m have been determined using a hand held GPS which provides an approximate ground elevation value only. Reference Elevation has been calculated at 35.3 m by adding the casing height to the current approximate ground elevation.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	2	Clay/loam	Top soil, dark brown/brown, clay loam Abundant plant matter.	
2	6	Clay	Mottled brown/reddish brown and grey, slightly silty, very stiff to brittle.	
6	8	Clay	Sandy, Soft/puggy, mottled red/brown and grey. Common light grey sandy fragments. Sand = clear to grey medium/well sorted sub-angular quartz.	
8	10	Sand	Clayey, orange/red medium well sorted sub-rounded milky to grey fine quartz sand (0.1 mm – 0.4 mm).	
10	16	Clay	Mottled red/orange and pale brown.	
16	29	Clay	Mottled mustard yellow/brown and grey, medium to firm/stiff. Occasional grey brittle layers. Notable sandy layers towards base of unit at 25m and 28m. Sand = well rounded, well sorted, fine, milky to grey quartz sand (0.1 mm – 0.3 mm).	
29	31	Sand	Poorly sorted fine to coarse sub-angular to sub-rounded, clear to grey and milky orange quartz sand (0.1 mm to 1.5 mm).	
31	32	Gravel	Sandy poorly sorted sub-angular to sub-rounded quartz gravel. 80% gravel, 20% sand. Gravel = pale milky orange to grey washed quartz	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
			gravel up to 15 mm. Sand = clear to milky orange/yellow fine to coarse quartz sand (0.1 mm – 1.5 mm). Common fine black micaceous (?) grains.	
32	33	Clay	Mottled red/brown and light grey to grey/white. Soft/puggy sandy clay. Sand = fine sub-angular quartz grains with occasional milky orange fragments (0.1 mm – 0.4 mm).	
33	34	Sand	Light brown to pale orange, fine, clayey clear quartz sand (0.1 mm – 0.3 mm).	
34	36	Clay	Mottled light brown/orange and grey sandy medium/soft clay. Sand = fine sub-angular to sub rounded clear quartz sand (0.1 mm – 0.3 mm).	
36	37	Sand	Light yellow/light orange poorly sorted gravelly sand. 80% gravel, to 20% sand. Gravel = milky to grey sub-angular quartz gravel up to 15 mm. Sand = fine clear sub-rounded to sub-angular quartz with occasional milky orange/yellow grains (0.1 mm – 0.4 mm).	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
27	36	22.8	~1.0	1.5	Air lift	1799768	1709	Mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Casing	0	12	255	Steel	-	N	-	-
Casing	0	27	100	PVC 12	-	Y	0	27
Slotted casing	27	36	100	PVC 12	0.5	N	-	-

6628 25371 – Well Completion Log

Permit Number:	**190026**	Backfilled (Y/N):	**N**
Date Completed:	**23/7/2010**	Total Depth (m):	**39**
Unit No:	**6628 25371**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**RMU011**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Stephen Tuckwell**

Coordinates

Easting:	**286806**	Ground Elevation (mAHD):	**TBD**
Northing:	**6172017**	Reference Elevation (mAHD):	**TBD**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Well coordinates and a ground elevation of 40 m have been determined using a hand held GPS which provides an approximate ground elevation value only. Reference Elevation has been calculated at 39.9 m as this well is completed in a concrete pit just below ground level.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	2	Clay	Top soil very thin, Mottled grey and light brown, medium to firm slightly sandy clay.	
2	8	Clay	Mottled orange/red, brown and grey, firm to stiff/brittle.	
8	10	Sand	White to off white, soft, well sorted sub-angular to rounded, fine, milky white to grey and clear quartz sand (0.1 mm to 0.4 mm). Rare black micaceous grains.	
10	18	Clay	Silty, Mottled red/brown, mustard yellow/brown and grey, medium to firm.	
18	20	Clay	Sandy, mottled light grey and pale orange/brown, soft/puggy. Sand = clear to grey fine quartz sand (0.1 mm - 0.4 mm).	
20	22	Clay	Sandy, mottled grey and mustard yellow/brown firm/brittle clay. Sand predominantly in yellow/brown portion. Sand = well sorted grey to clear quartz sand (0.2 mm – 0.3 mm). Grey clay portion very brittle.	
22	26	Clay	Poor sample recovery – properties taken as above.	
26	33	Clay	Slightly sandy, Mottled yellow and mustard yellow and grey, very firm/brittle clay.	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
			Sand = well/medium sorted clear to grey, fine, sub-angular to rounded quartz sand (0.1 mm – 0.4 mm).	
33	34	Clay	Very sandy, mottled grey and mustard yellow medium/soft clay. Sand = well/medium sorted, fine, sub-angular to rounded clear to grey quartz (0.1 mm – 0.4 mm).	
34	35	Sand	Slightly clayey, Mottled mustard yellow/and pale grey. Sand = very fine, clear to milky white, sub-angular to sub-rounded quartz sand. (0.1 mm – 0.3 mm) rare fine black micaceous (?) grains.	
35	39	Sand	Mottled pale grey, mustard yellow and violet purple. Sand = sub-rounded, fine, clear quart sand in varying coloured matrix (0.1 mm – 0.3 mm). EOH.	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length (hrs)	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
32	39	22.62	~1.0	3.25	Airlift	1799769	1272	mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Casing	0	12	200	Steel	-	N	-	-
Casing	0	32	100	PVC 12	-	Y	0	32
Slotted Casing	32	38	100	PVC 12	0.5	N	-	-

6628 25372 – Well Completion Log

Permit Number:	**193738**	Backfilled (Y/N):	**N**
Date Completed:	**29/7/2010**	Total Depth (m):	**79**
Unit No:	**6628 25372**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**RMU 012**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Stephen Tuckwell**

Coordinates

Easting:	**287700**	Ground Elevation (mAHD):	**TBD**
Northing:	**6172017**	Reference Elevation (mAHD):	**TBD**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Back fill with cement from 72 to 79

Well coordinates and a ground elevation of 43 m have been determined using a hand held GPS which provides an approximate ground elevation value only. Reference Elevation has been calculated at 43.3 m by adding the casing height to the current approximate ground elevation.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	2	Clay	Sandy clay/topsoil, dark brown, abundant plant matter.	
2	6	Clay	Mottled Orange – Red/brown and grey, medium/firm, sandy clay.	
6	8	Clay	Mottled pale brown and grey, soft/puggy, sandy clay.	
8	12	Sand	Light grey overall, sub-rounded/rounded, fine, clear to grey quartz sand (0.2 mm – 0.4 mm). Rare fine black micaceous (?) grains.	
12	34	Clay	Mottled red/brown – yellow and grey, medium/firm clay. Grey portion notably brittle towards top of unit. Thin sandy band noted at 16m while drilling (fine, medium/well sorted clear to grey quartz sand (0.3 mm – 0.5 mm).	
34	36	Clay	Gravelly, mottled yellow/brown and grey, soft/puggy. Gravel = sub-rounded to sub-angular milky white to grey quartz gravel ranging from 5.0 mm - 15.0 mm.	
36	46	Clay	Sandy, Mottled light brown and grey, medium/firm clay. Sand = fine, sub-rounded to rounded, clear to grey quartz sand (0.1 mm – 0.3 mm). Abundant fine black micaceous (?) grains.	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
46	50	Gravel	Poorly sorted, sandy gravel. Gravel = sub-rounded to sub-angular yellowish grey quartz up to 15 mm. Sand = medium/coarse milky white to grey sub-rounded quartz sand from (0.1 mm to 0.5 mm).	
50	58	Sand	Clayey – fine to medium clear to grey quartz sand, (0.1 mm-0.5 mm) occasional milky/yellow grains.	
58	61	Clay	Mustard yellow, medium/soft sandy clay.	
61	63	Limestone	Pale yellow/brown/tan slightly sandy hard limestone.	T1 (?)
63	68	Clay	Dark grey – greenish grey, medium/soft (sticky), slightly silty clay. Very hard thin lime stone band at 65 m.	
68	73	Limestone	Medium/hard, pale brown/tan slightly sandy limestone.	T2
73	79	Sand	Clayey, black/dark grey, calcareous sand. Thin, sticky black lignite clay band at 75m. Rare shell fragments at 79m	Chinaman gully formation.

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length (hrs)	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
66	71	26.72	~0.5	2.0	Airlift	Field Measurement	1850	Mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Casing	0	11	200	Steel	-	N	-	-
Casing	0	66	100	PVC 12	-	Y	0	66
Prod Zone	66	71	100	PVC 12	0.5	N	-	-

6628 25426 – Well Completion Log

Permit Number:	**196834**	Backfilled (Y/N):	**N**
Date Completed:	**8/11/2010**	Total Depth (m):	**89.5**
Unit No:	**6628 25426**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**RMU 013**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Stephen Tuckwell**

Coordinates

Easting:	**284664**	Ground Elevation (mAHD):	**TBD**
Northing:	**6171979**	Reference Elevation (mAHD):	**TBD**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

- Well coordinates and a ground elevation of 35 m have been determined using a hand held GPS which provides an approximate ground elevation value only. Reference Elevation has been calculated at 35.3 m by adding the casing height to the current approximate ground elevation.
- Circulation and samples lost between 46 and 56m. Attempt made to cement off zone which contributed to heavy sample contamination between 56 and 74m
- It is assumed base of limestone is at 52m based on geophysics.
- Backfilled with gravel from 80 to 89.5m

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	4	Clay	Brown, Very firm/stiff silty clay.	
4	10	Clay	Mottled red/orange and pale grey, medium to firm sandy clay. Sand = very fine clear to milky sub-angular quartz. Occasional soft sandy layers throughout.	
10	18	Clay	Mottled pale grey and orange/red and mustard yellow medium to fine silty clay.	
18	30	Clay	Mottled Pale grey and mustard yellow/brown with occasional orange nodules. Firm to medium becoming softer/sandier towards base of unit.	
30	32	Sand	Mottled mustard yellow and pale grey soft/friable sand. Fine to very fine, sub-angular to sub-rounded quartz.	
32	40	Sand	Mottled dark yellow and pale grey fine sub-angular to rounded clear to grey quartz.	
40	42	Sand	Dark yellow with rare pale grey nodules. Weakly calcareous, fine sub-angular to sub-rounded clear to opaque yellow quartz.	
42	46	Limestone	Pale yellow/cream, common small shell fragments, highly calcareous, slightly sandy limestone.	
46	56	Sample Loss	Complete loss of circulation - no samples.	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
56	60	Sand	Tan, fine to very fine, clear sub-angular to sub-rounded quartz. *Heavily contaminated sample.	
60	64	Sand	Tan/orange fine to very fine, clear, sub-angular to sub-rounded quartz with common small shell fragments. Weakly calcareous. *Heavily contaminated sample.	
64	68	Sand	Tanish green, fine to very fine clear, sub-angular to sub-rounded quartz. Abundant small shell fragments. Weakly calcareous. *Heavily contaminated sample.	
68	70	Gravel (?)	Orange/tan yellow, medium/coarse sub-rounded to rounded gravel with sandstone nodules throughout. Weakly calcareous. *Sample 80% cement contamination? Interpretation very difficult.	
70	82	Sand	Pale greyish green, poorly sorted, sub-angular to sub rounded, fine to coarse, calcareous silty sand. Common medium coarse black fragments and orange/brown silty sandstone nodules. Abundant large shell fragments.	
82	86	Sand	Greyish green, fine to very fine, sub-angular clear to grey silty quartz sand. Common large shell fragments. Common small soft black lignite/carbonaceous (?) nodules. Occasional cherty fragments. *medium contamination through samples.	
86	89.5	Sand	Dark greyish green, very fine, sub-angular to sub-rounded clear silty quartz sand. Common grey cherty fragments. Common small shell fragments. Occasional black lignite/carbonaceous (?) nodules.	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
73.5	89.5	22.18	~1.0	2.5	Air lift	1	~1200	Mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Case	0	11	250	Steel	-	N	-	-
Case	0	74.5	150	PVC 12	-	Y	0	72.5

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Screen	74	80	100	Stainless steel	0.35	N	-	-

6628 25428 – Well Completion Log

Permit Number:	**170283**	Backfilled (Y/N):	**N**
Date Completed:	**28/6/2010**	Total Depth (m):	**117m**
Unit No:	**6628 25428**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**T1**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Stephen Tuckwell**

Coordinates

Easting:	**275393**	Ground Elevation (mAHD):	**TBD**
Northing:	**6129191**	Reference Elevation (mAHD):	**TBD**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Well coordinates and a ground elevation of 11 m have been determined using a hand held GPS which provides an approximate ground elevation value only. Reference Elevation has been calculated at 11.3 m by adding the casing height to the current approximate ground elevation.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	30	Clay	Mottled orange/brown and Grey, very firm/brittle clay. Notable thin gravel layers at 9m & 20m (consist of poorly sorted sub-angular to sub-rounded pale orange and milky white quartz.	Hindmarsh Clay
30	32	Gravel	Medium to well sorted sub-angular to angular grey to pale yellow quartz.	
32	74	Clay	Firm/plastic, very brittle in parts, mottled yellow/orange/brown and grey. Occasional sandy layers. Becoming soft towards base of unit.	
74	80	Limestone	Soft/weathered, white to off white sandy limestone. Occasional hard bands encountered while drilling.	
80	86	Sand stone	Dark grey to grey, soft sand stone, medium to large shell fragments throughout (very abundant towards top of unit). Slightly silty in parts.	
86	117	Limestone	Light brown/tan, hard limestone, occasional very hard bands encountered while drilling. Top of Munno-Para clay tagged at 117 m.	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length (hrs)	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
90	117	3.5	~3.0	2.5	Air lift	1779762	1080	Mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Casing	0	18	250	Steel	-	N	-	-
Casing	0	89	150	PVC 16	-	Y	0	89
Slotted Casing	89	117	150	Open Hole	-	-	-	-

6628 25427 – Well Completion Log

Permit Number:	**170282**	Backfilled (Y/N):	**N**
Date Completed:	**24/6/2010**	Total Depth (m):	**226m**
Unit No:	**6628 25427**	Drill Method:	**Rotary mud drilling technique**
Drillhole Name:	**T2**	Drilling Company:	**Kangarilla Drilling**
Logged By:	**M Williams**	Driller:	**Angus Forbes**

Coordinates

Easting:	**275382**	Ground Elevation (mAHD):	**11**
Northing:	**6129188**	Reference Elevation (mAHD):	**11.3**
Zone:	**54H**	Reference Point Type:	**Top of PVC casing (TOC)**
Datum:	**WGS84**		

General Comments:

Well coordinates and a ground elevation of 11 m have been determined using a hand held GPS which provides an approximate ground elevation value only. Reference Elevation has been calculated at 11.3 m by adding the casing height to the current approximate ground elevation.

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	30	Clay	Mottled orange/brown and Grey, very firm/brittle clay. Notable thin gravel layers at 9m & 20m (consist of poorly sorted sub-angular to sub-rounded pale orange and milky white quartz.	Hindmarsh Clay
30	32	Gravel	Medium to well sorted sub-angular to angular grey to pale yellow quartz.	
32	74	Clay	Firm/plastic, very brittle in parts, mottled yellow/orange/brown and grey. Occasional sandy layers. Becoming soft towards base of unit.	
74	80	Limestone	Soft/weathered, white to off white sandy limestone. Occasional hard bands encountered while drilling.	
80	86	Sand stone	Dark grey to grey, soft sand stone, medium to large shell fragments throughout (very abundant towards top of unit). Slightly silty in parts.	
86	117	Limestone	Light brown/tan, hard limestone. Occasional very hard bands encountered while drilling.	
117	121	Clay	Dark grey to Grey/blue, very firm/sticky, non calcareous clay.	Munno-Para Clay

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
			Notable thin Hard limestone band at 119 m.	
121	172	Limestone	Tan/ cream - off white, rare shell fragments, occasional soft sandy layers encountered, medium/hard throughout. Occasional very hard white limestone (calcarenite ?) bands encountered	
172	227	Limestone	Medium/soft greenish grey, sandy limestone. Rare small shell fragments (may be 'up-hole' contamination) . Abundant pale grey "Cherty" fragments throughout. Occasional very hard white limestone (calcarenite?) layers. EOH	

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length (hrs)	Method	Sample No	Salinity	Salinity Unit (mg/L / EC)
130	226	4.50	~10.0	4.5	Air lift	1779761	973	Mg/L

Casing and Production Zone Information

Case or Prod Zone	Depth (m)		Nominal Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Case	0	12	250	Steel	-	N	-	-
Case	0	137	150	PVC 12	-	Y	0	137
Slotted Casing	137	191	227	Open Hole	-	-	-	-

5.2 B. WELL CONSTRUCTION DIAGRAMS AND GEOPHYSICAL LOGS

2010 Regional Observation Well Upgrade - Well Schematic Diagram

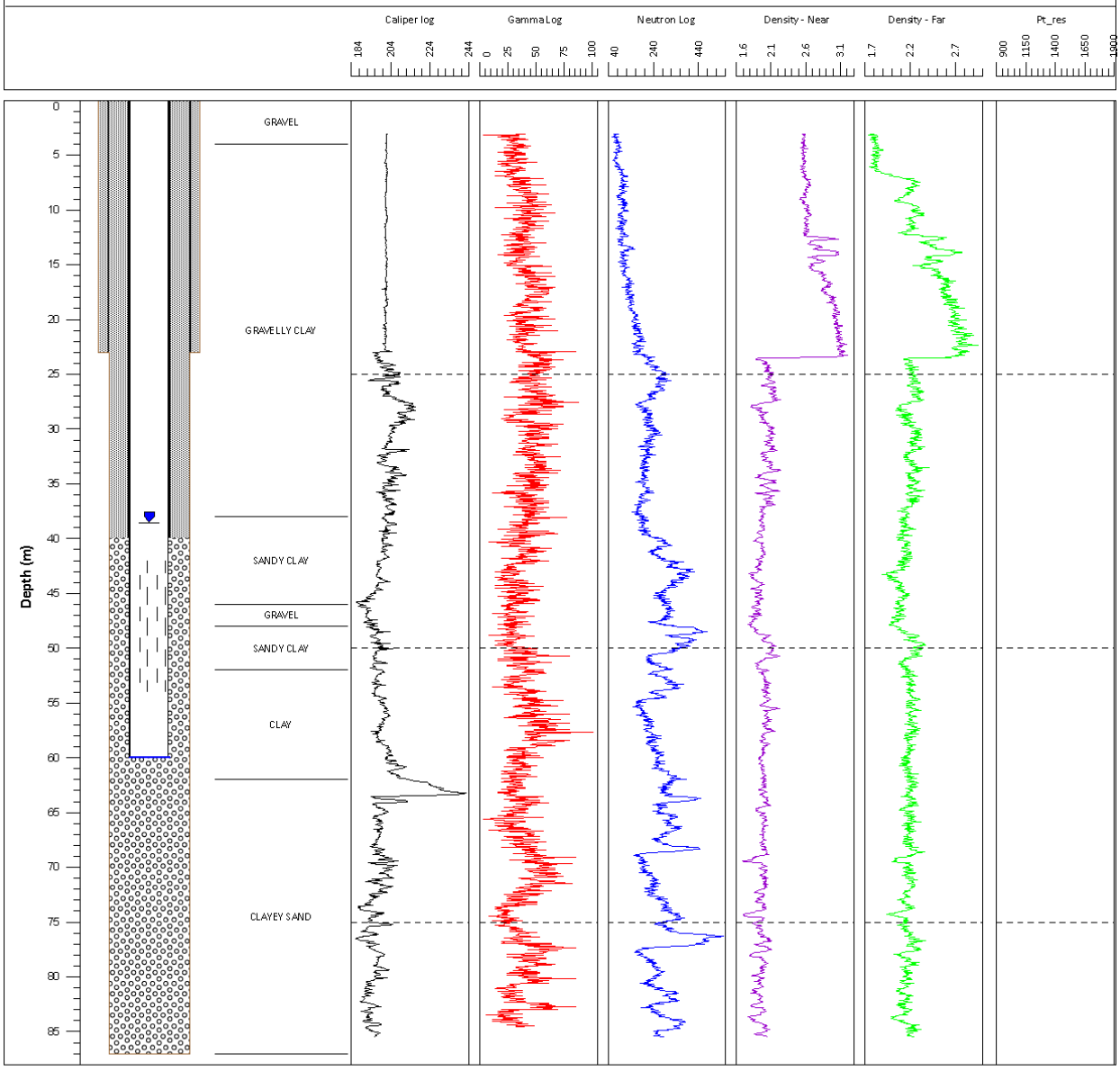
Unit Number: 6532-1652 **Permit Number:** 193783 **Region:** Baroota PWA

Completion Date: 13/08/2010 **Total Depth (m):** 87 **Final Depth (m):** 60

Government of South Australia
Department for Water

Coordinates

Easting: 223995 **Northing:** 6352521 **Zone:** 54H **Well Name:** RMU 001 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	203 mm	0 - 23 m	-
Class 12 UPVC	102 mm	0 - 42 m	0 - 40 m

Production Zone Details

Type	Interval	Diam
In-line slotted casing	42 - 54 m	102 mm
Sump	54 - 60 m	102 mm

Well Construction Symbols

- Cement
- Casing
- Slotted Casing
- Open hole
- Gravel Pack
- Packer
- Stainless Steel Screen
- Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper & Dens short/long. - Glenside job # 8522
- All coordinates in WGS 84 Datum

2010 Regional Observation Well Upgrade - Well Schematic Diagram

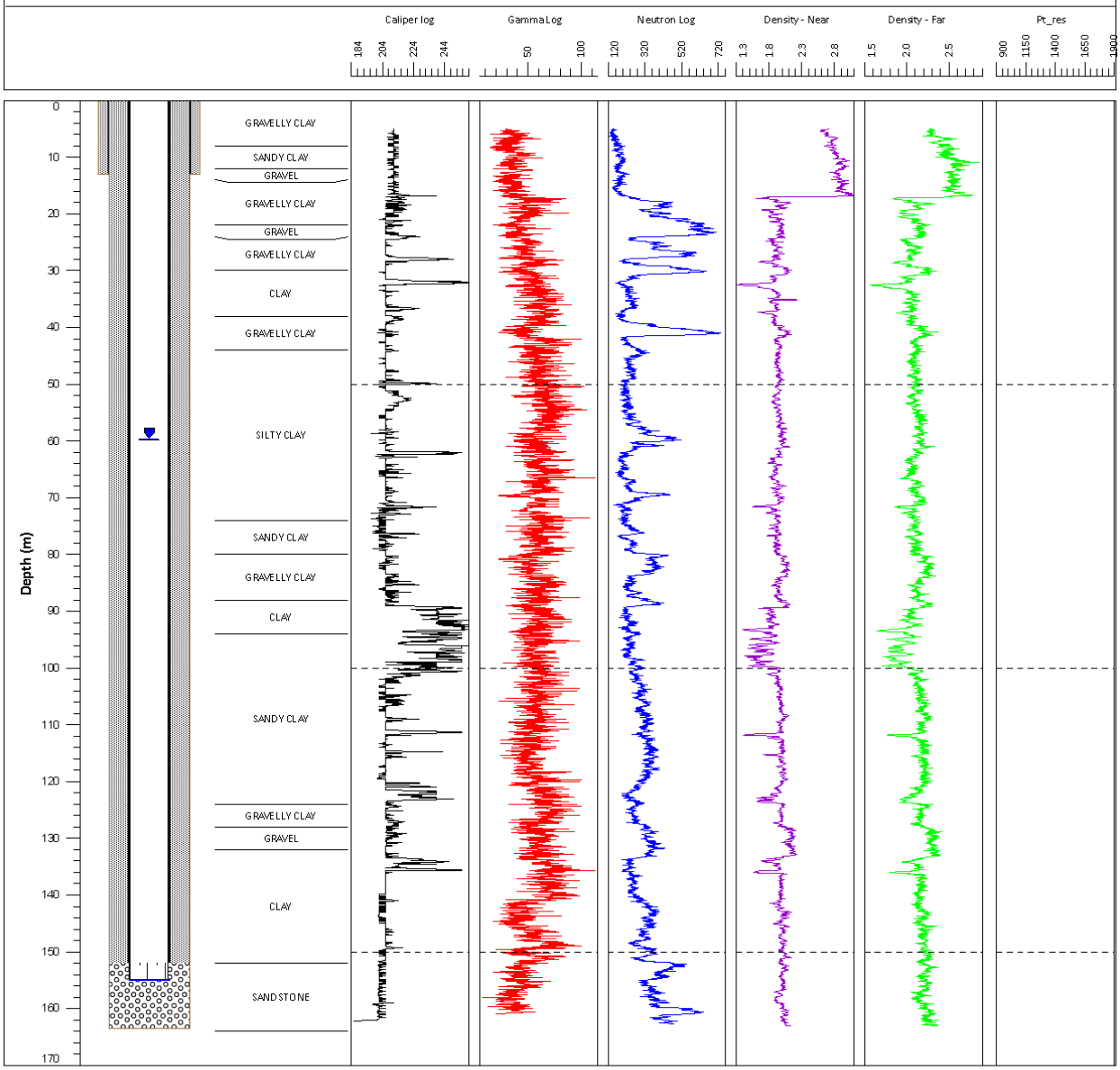
Unit Number: 6532-1654 **Permit Number:** 193785 **Region:** Baroota PWA

Completion Date: 25/10/2010 **Total Depth (m):** 163.5 **Final Depth (m):** 155

Government of South Australia
Department for Water

Coordinates

Easting: 224473 **Northing:** 6348765 **Zone:** 54H **Well Name:** RMU 003 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	203 mm	0 - 17 m	-
Class 12 UPVC	102 mm	0 - 152	0 - 150 m

Production Zone Details

Type	Interval	Diam
In-line slotted casing	152 - 155m	102 mm

Well Construction Symbols

- Cement
- Casing
- Slotted Casing
- Open hole
- Gravel Pack
- Packer
- Stainless Steel Screen
- Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper, Dens short/long, SP. - Glenside job # 8582
- All coordinates in WGS 84 Datum

2010 Regional Observation Well Upgrade - Well Schematic Diagram

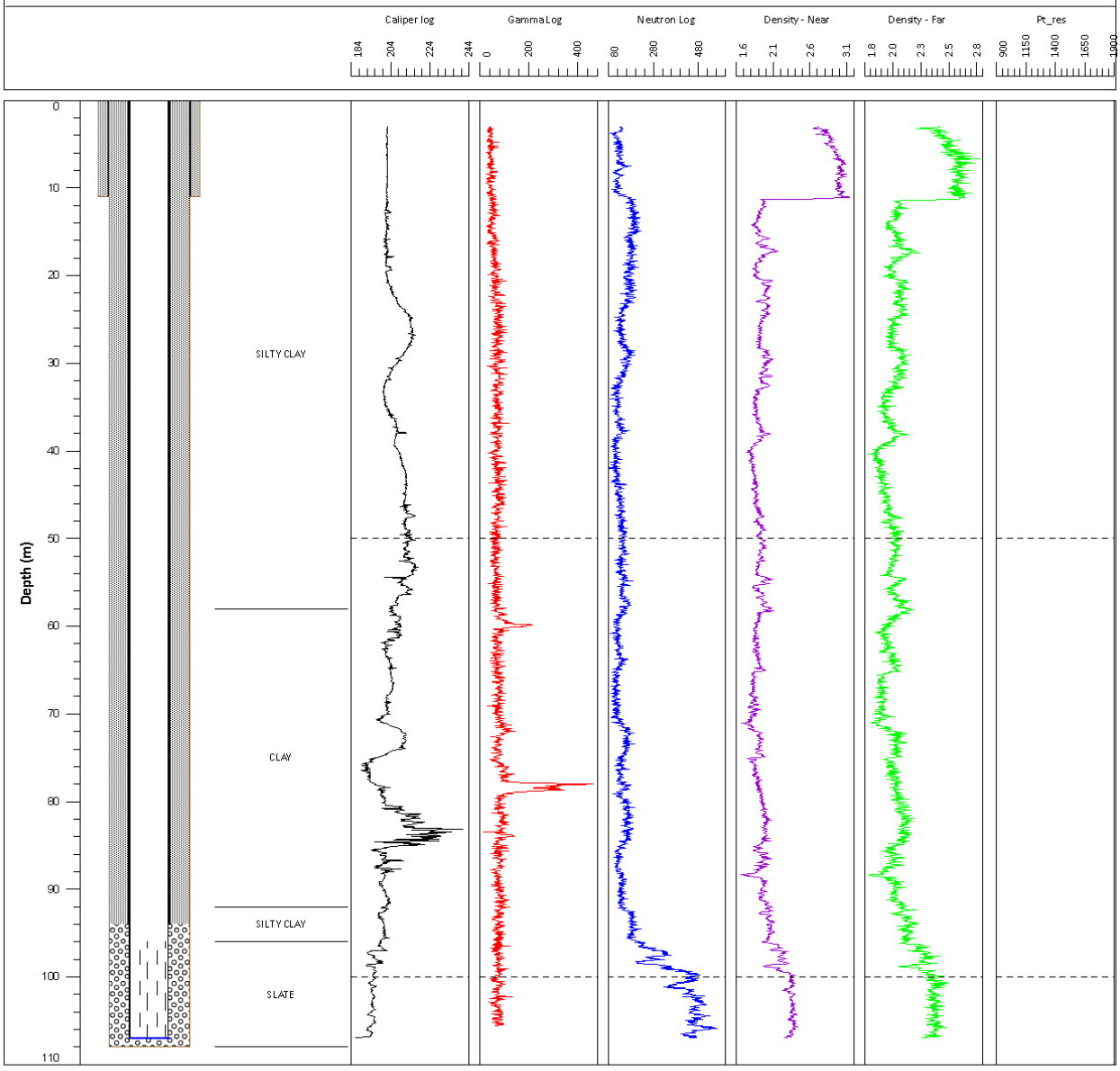
Unit Number: 6533-914 **Permit Number:** 190034 **Region:** Willochra Basin

Completion Date: 26/08/2010 **Total Depth (m):** 108 **Final Depth (m):** 107

Government of South Australia
Department for Water

Coordinates

Easting: 234284 **Northing:** 6424889 **Zone:** 54H **Well Name:** RMU 004 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	203 mm	0 - 11 m	-
Class 12 UPVC	102 mm	0 - 96 m	0 - 64 m

Production Zone Details

Type	Interval	Diam
In-line slotted casing	96 - 107 m	102 mm

Well Construction Symbols

- Cement
- Casing
- Slotted Casing
- Open hole
- Gravel Pack
- Packer
- Stainless Steel Screen
- Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper, Dens short/long, Pt Res & SP. - Glenside job # 8525
- All coordinates in WGS 84 Datum
- Well flowing - shut in pressure 12.8 kPa

2010 Regional Observation Well Upgrade - Well Schematic Diagram

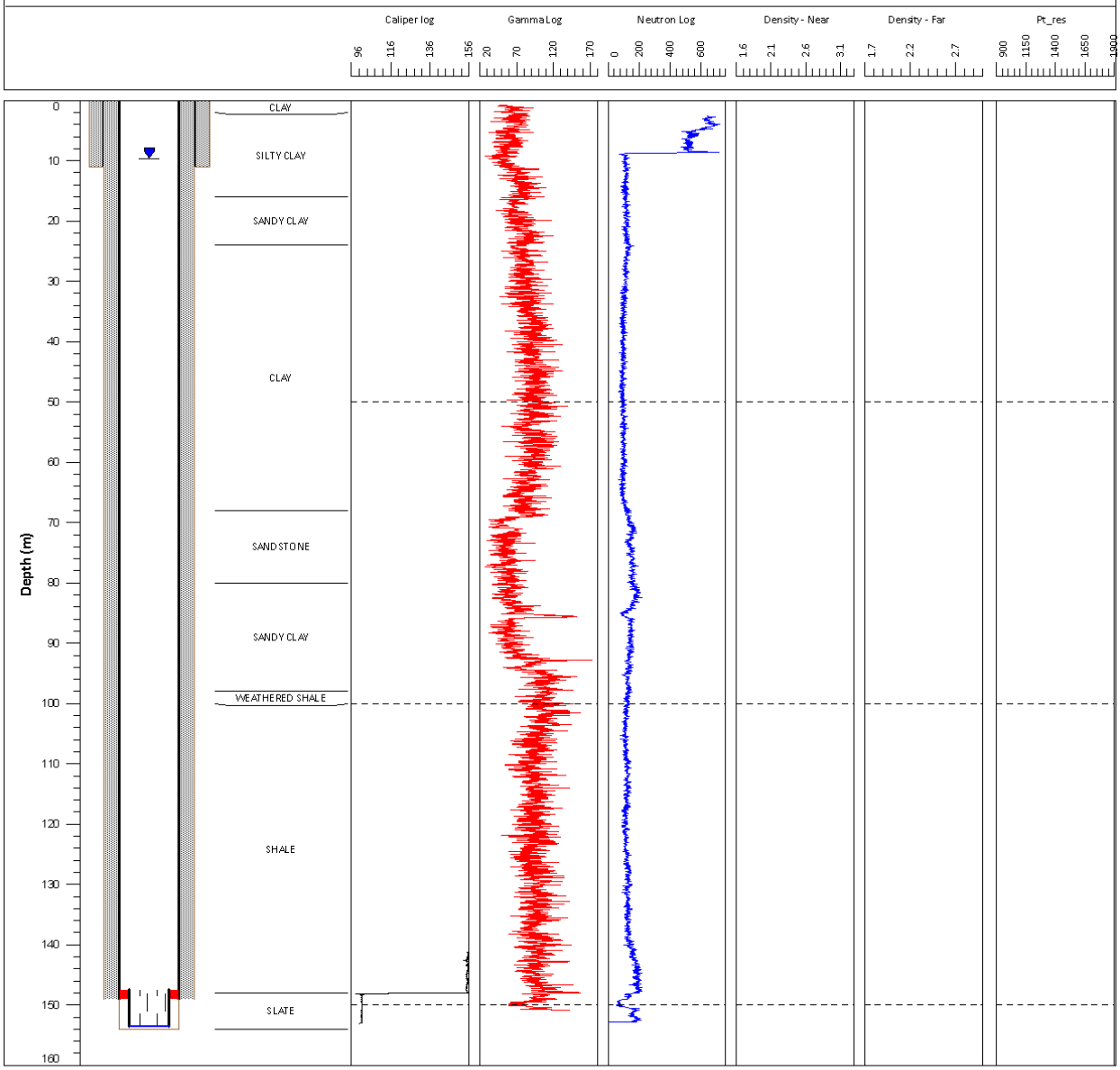
Unit Number: 6532-1653 **Permit Number:** 190033 **Region:** Willochra Basin

Completion Date: 08/10/2010 **Total Depth (m):** 154 **Final Depth (m):** 153.5

Government of South Australia
Department for Water

Coordinates

Easting: 237155 **Northing:** 6398454 **Zone:** 54H **Well Name:** RMU 005 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	260 mm	0 - 11 m	0 - 11 m
Class 12 UPVC	157 mm	0 - 154 m	0 - 154 m

Production Zone Details

Type	Interval	Diam
Telescopic slotted casing	147.5 - 153.5 m	102 mm

Well Construction Symbols

Cement
Casing
Slotted Casing
Open hole
Gravel Pack
Packer
Stainless Steel Screen
Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper **Logged through casing. - Glenside job # 8583
- All coordinates in WGS 84 Datum

2010 Regional Observation Well Upgrade - Well Schematic Diagram

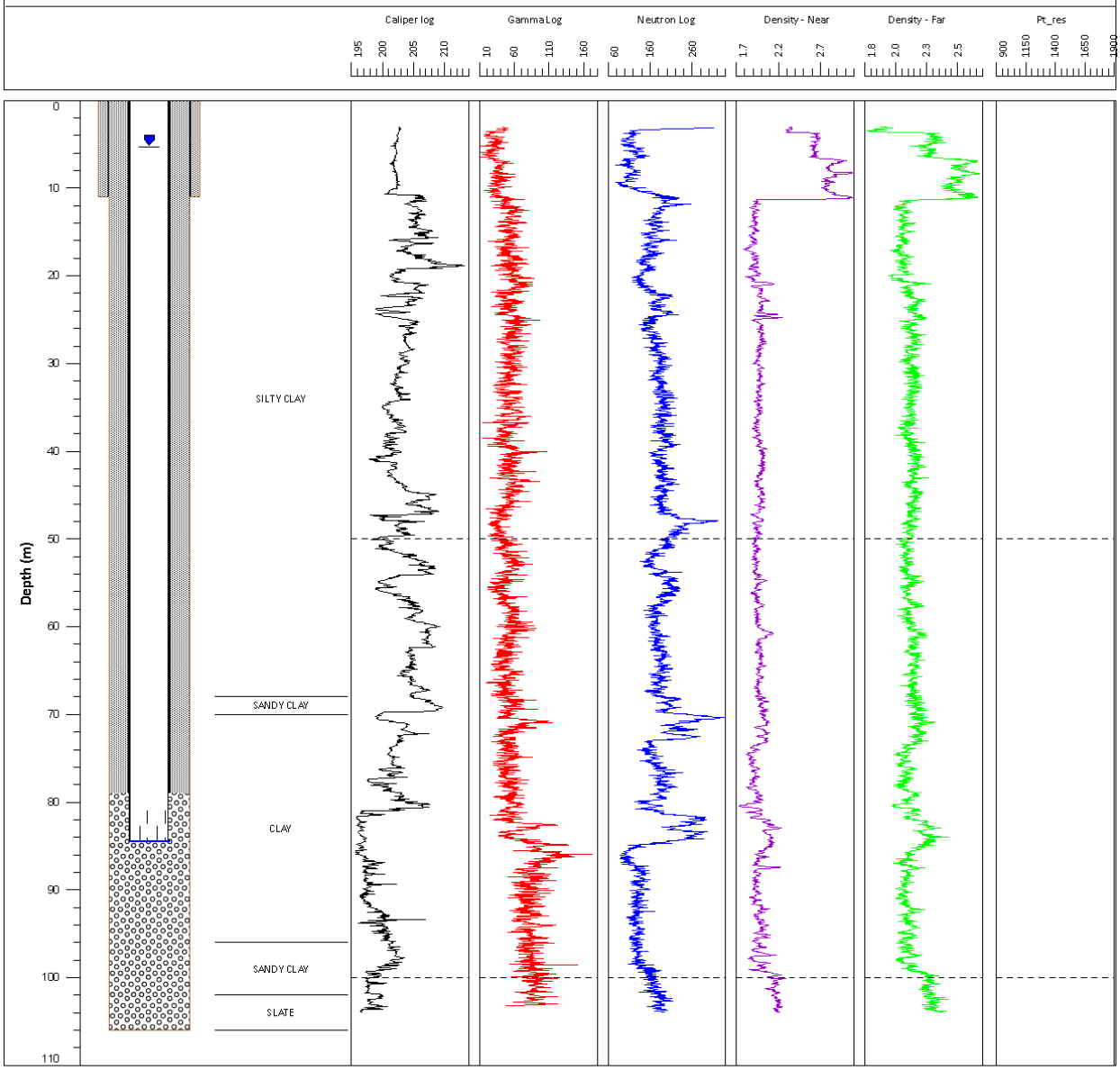
Unit Number: 6532-1651 **Permit Number:** 190032 **Region:** Willochra Basin

Completion Date: 19/08/2010 **Total Depth (m):** 106 **Final Depth (m):** 84.5

Government of South Australia
Department for Water

Coordinates

Easting: 241380 **Northing:** 6386166 **Zone:** 54H **Well Name:** RMU 006 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	203 mm	0 - 11 m	-
Class 12 UPVC	102 mm	0 - 81 m	0 - 79 m

Production Zone Details

Type	Interval	Diam
In-line slotted casing	81 - 84.5 m	102 mm

Well Construction Symbols

Cement
Slotted Casing
Gravel Pack
Stainless Steel Screen
Casing
Open hole
Packer
Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper, Dens short/long & Pt Res. - Glenside job # 8524
- All coordinates in WGS 84 Datum

2010 Regional Observation Well Upgrade - Well Schematic Diagram

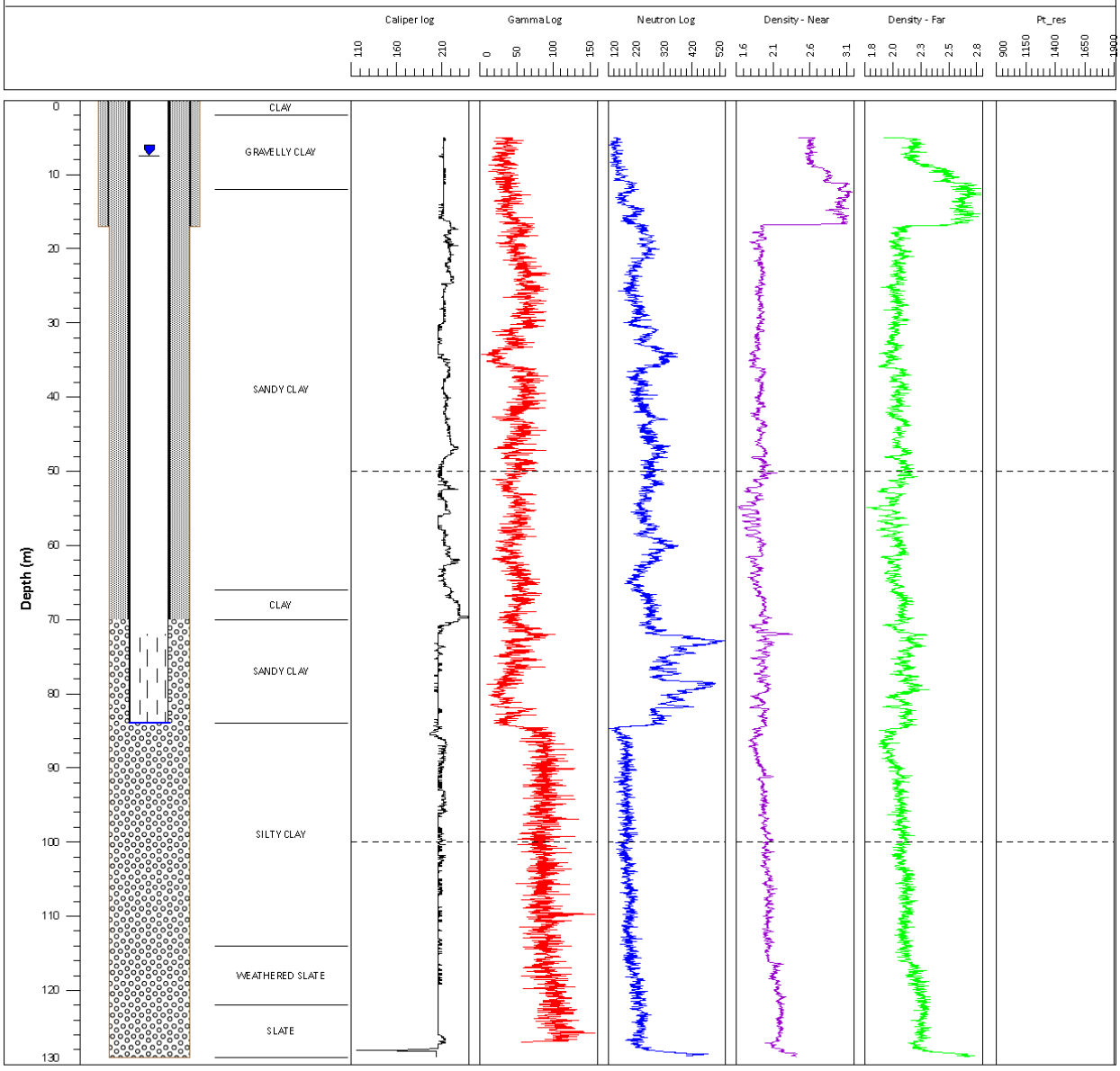
Unit Number: 6532-1657 **Permit Number:** 193786 **Region:** Willochra Basin

Completion Date: 01/10/2010 **Total Depth (m):** 129 **Final Depth (m):** 84

Government of South Australia
Department for Water

Coordinates

Easting: 241690 **Northing:** 6373006 **Zone:** 54H **Well Name:** RMU 007 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	203 mm	0 - 17 m	-
Class 12 UPVC	102 mm	0 - 72 m	0 - 70 m

Production Zone Details

Type	Interval	Diam
In-line slotted casing	72 - 84 m	102 mm

Well Construction Symbols

Cement
Slotted Casing
Gravel Pack
Stainless Steel Screen
Casing
Open hole
Packer
Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper, Dens short/long, Pt Res & SP. - Glenside job # 8565
- All coordinates in WGS 84 Datum

2010 Regional Observation Well Upgrade - Well Schematic Diagram

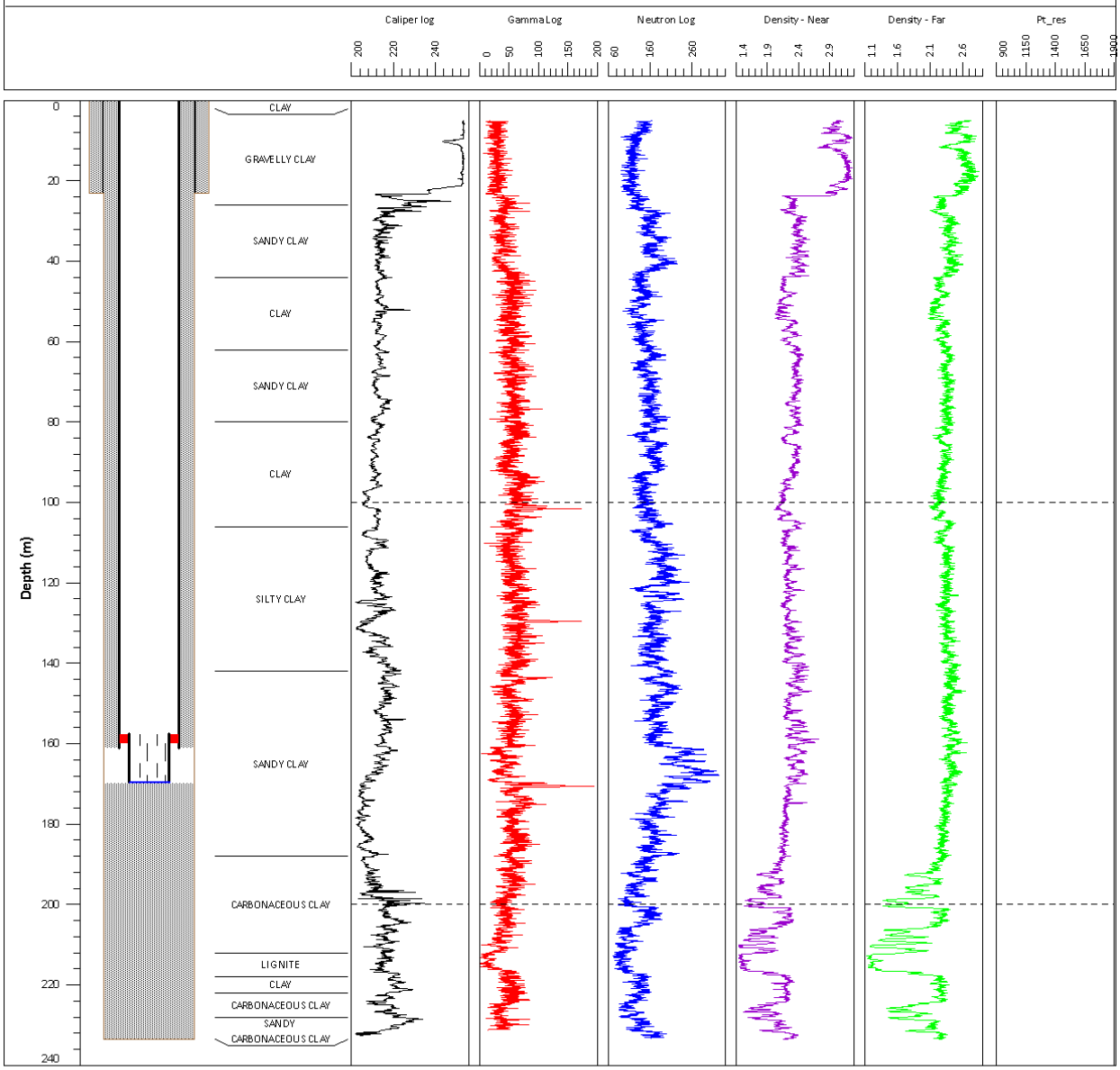
Unit Number: 6632-1275 **Permit Number:** 190030 **Region:** Walloway Basin

Completion Date: 09/09/2010 **Total Depth (m):** 233.5 **Final Depth (m):** 169.7

Government of South Australia
Department for Water

Coordinates

Easting: 282432 **Northing:** 6397255 **Zone:** 54H **Well Name:** RMU 008 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	260 mm	0 - 23 m	0 - 23 m
Class 18 UPVC	149 mm	0 - 161 m	0 - 161m

Production Zone Details

Type	Interval	Diam
Telescopic slotted casing	157.7 - 169.7 m	102 mm

Well Construction Symbols

Cement
Slotted Casing
Gravel Pack
Stainless Steel Screen
Casing
Open hole
Packer
Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper, Dens short/long, Pt Res & SP. - Glenside job # 8526
- All coordinates in WGS 84 Datum
- Well flowing - shut in pressure 13.3 kPa

2010 Regional Observation Well Upgrade - Well Schematic Diagram

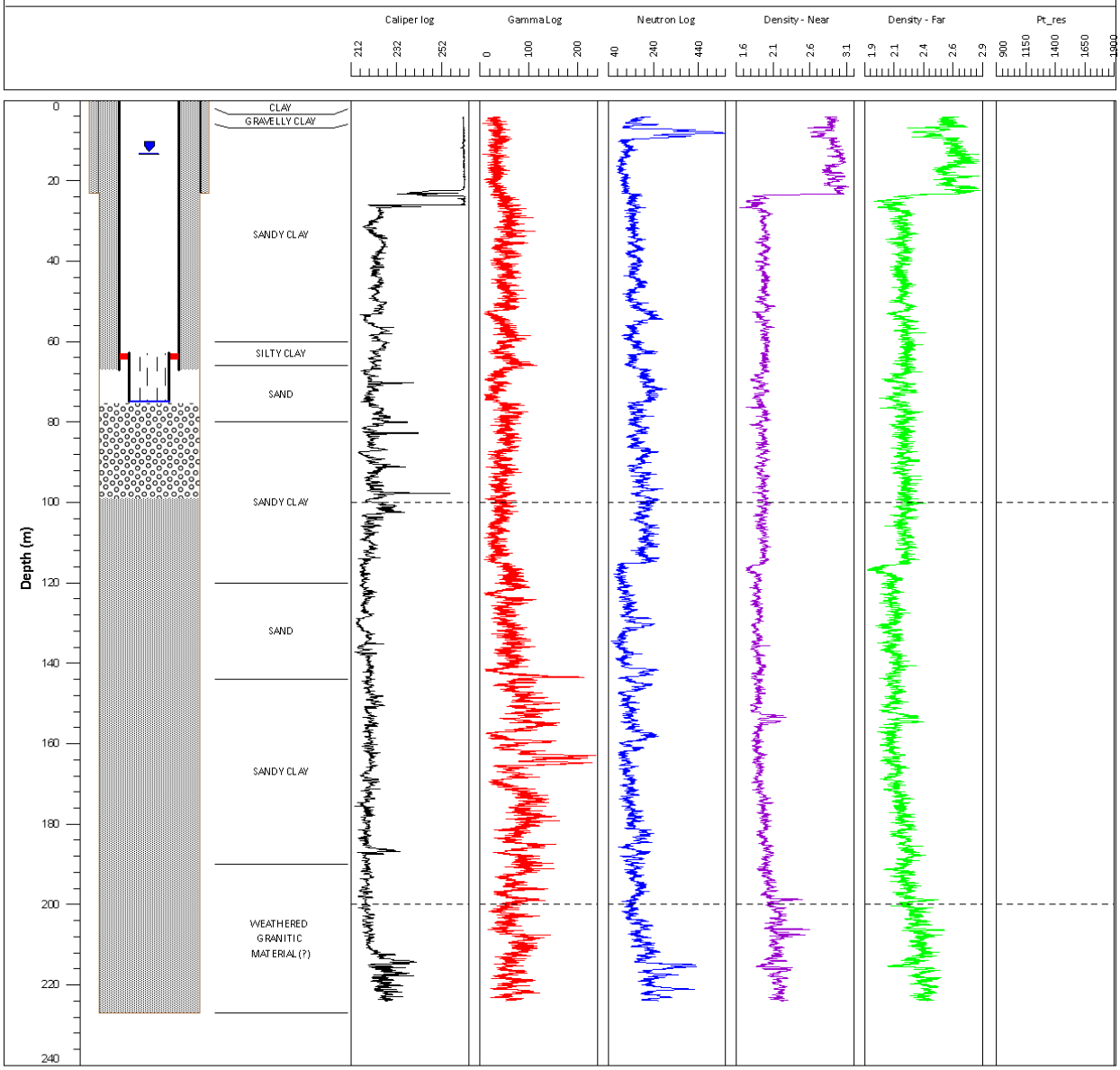
Unit Number: 6632-1274 **Permit Number:** 193787 **Region:** Walloway Basin

Completion Date: 23/09/2010 **Total Depth (m):** 227 **Final Depth (m):** 75

Government of South Australia
Department for Water

Coordinates

Easting: 285508 **Northing:** 6359001 **Zone:** 54H **Well Name:** RMU 009 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	260 mm	0 - 23 m	0 - 23 m
Class 12 UPVC	157 mm	0 - 67 m	0 - 67 m

Production Zone Details

Type	Interval	Diam
Telescopic slotted casing	63 - 75 m	102 mm

Well Construction Symbols

Cement
Slotted Casing
Gravel Pack
Stainless Steel Screen
Casing
Open hole
Packer
Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper & Dens short/long. - Glenside job # L8465
- All coordinates in WGS 84 Datum

2010 Regional Observation Well Upgrade - Well Schematic Diagram

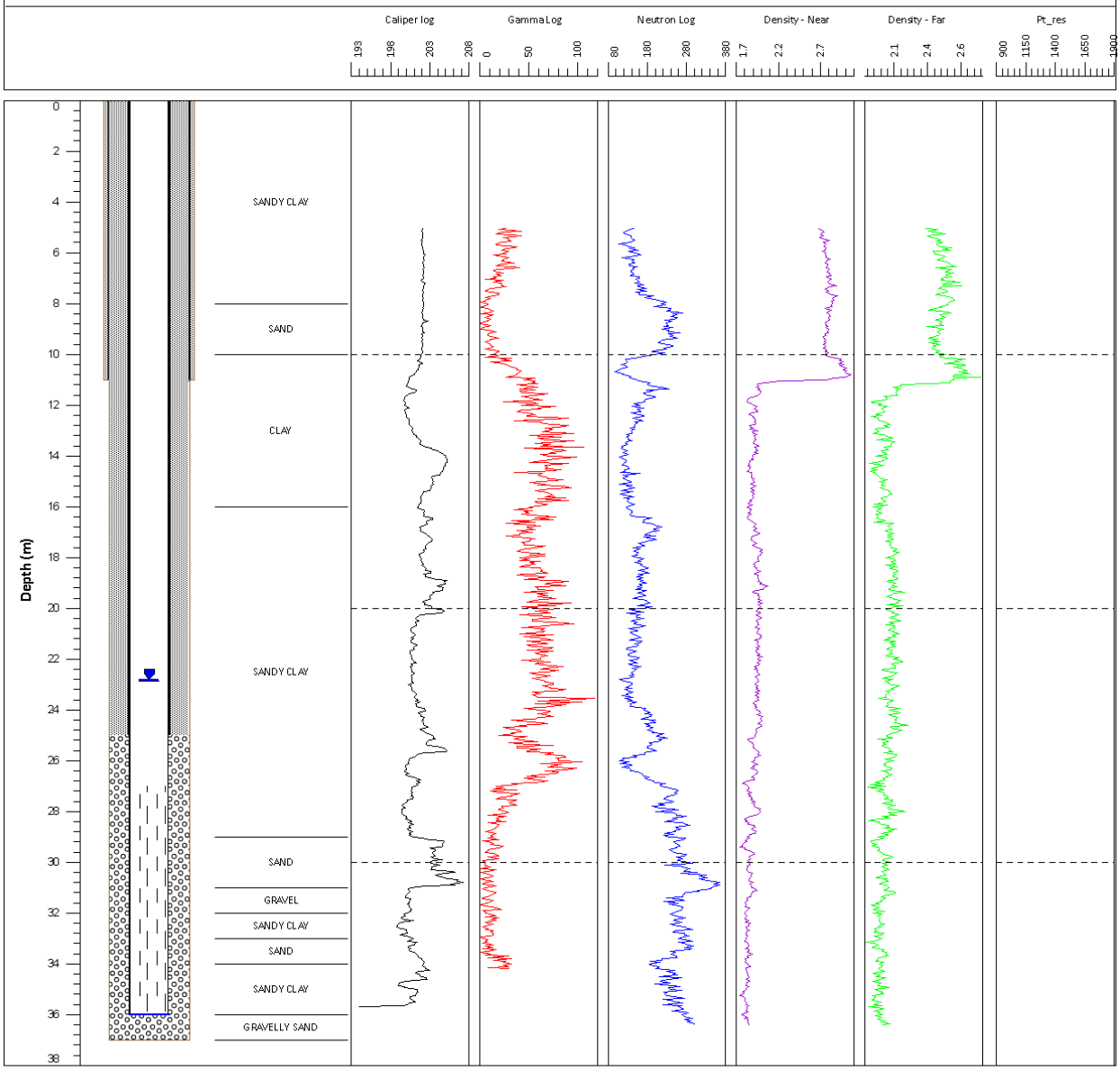
Unit Number: 6628-25370 **Permit Number:** 190028 **Region:** Kangaroo Flat

Completion Date: 21/07/2010 **Total Depth (m):** 37 **Final Depth (m):** 36

Government of South Australia
Department for Water

Coordinates

Easting: 284509 **Northing:** 6171979 **Zone:** 54H **Well Name:** RMU 010 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	203 mm	0 - 11 m	-
Class 12 UPVC	102 mm	0 - 27 m	0 - 25 m

Production Zone Details

Type	Interval	Diam
In-line slotted casing	27 - 36 m	102 mm

Well Construction Symbols

- Cement
- Casing
- Slotted Casing
- Open hole
- Gravel Pack
- Packer
- Stainless Steel Screen
- Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper & Dens short/long. - Glenside job # 8513
- All coordinates in WGS 84 Datum

2010 Regional Observation Well Upgrade - Well Schematic Diagram

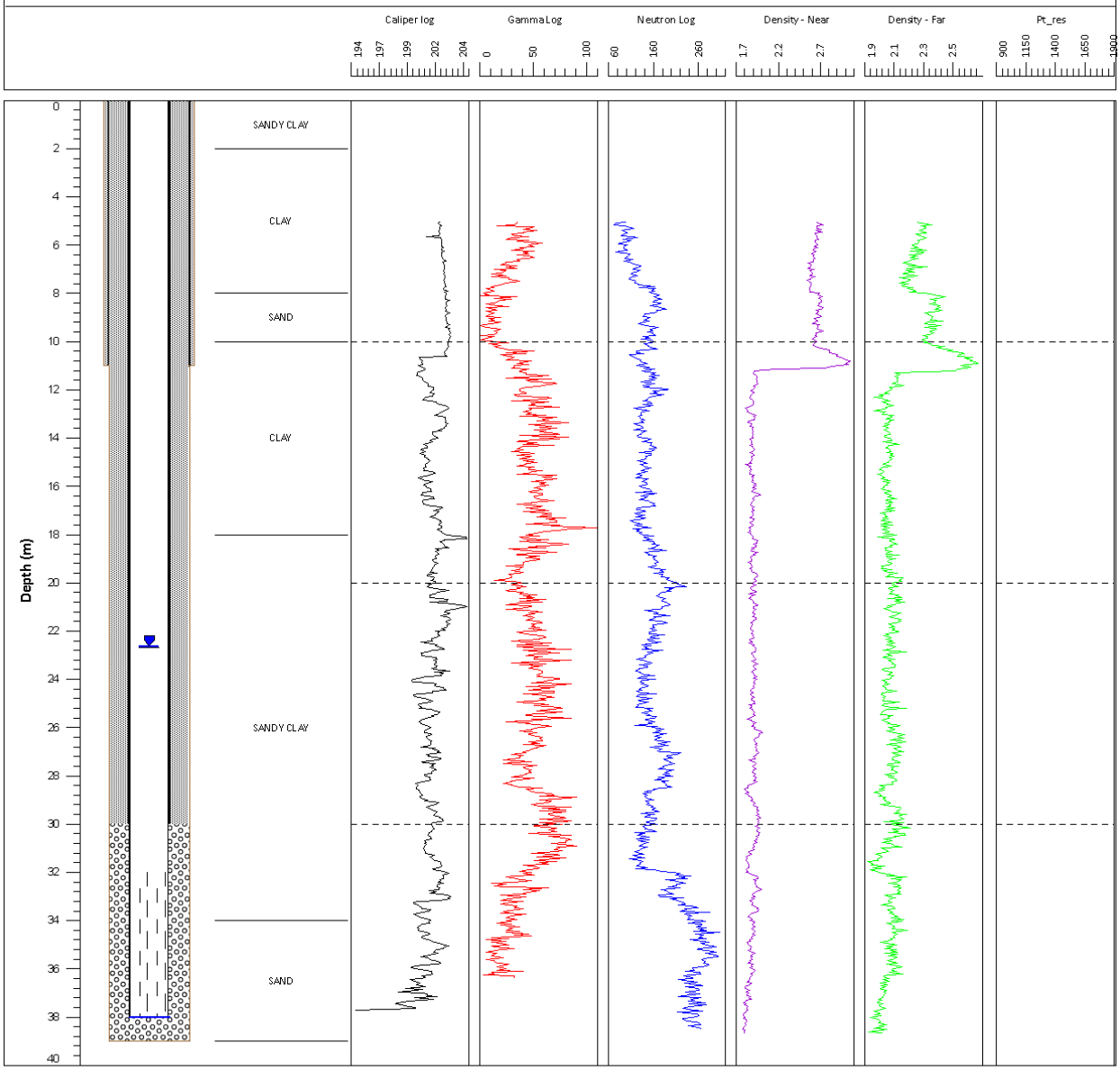
Unit Number: 6628-25371 **Permit Number:** 190026 **Region:** Kangaroo Flat

Completion Date: 23/07/2010 **Total Depth (m):** 39 **Final Depth (m):** 38

Government of South Australia
Department for Water

Coordinates

Easting: 286806 **Northing:** 6172017 **Zone:** 54H **Well Name:** RMU 011 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	203 mm	0 - 11 m	-
Class 12 UPVC	102 mm	0 - 32 m	0 - 30 m

Production Zone Details

Type	Interval	Diam
In-line slotted casing	32 - 38 m	102 mm

Well Construction Symbols

- Cement
- Slotted Casing
- Gravel Pack
- Stainless Steel Screen
- Casing
- Open hole
- Packer
- Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper & Dens short/long. - Glenside job # 8514
- All coordinates in WGS 84 Datum

2010 Regional Observation Well Upgrade - Well Schematic Diagram

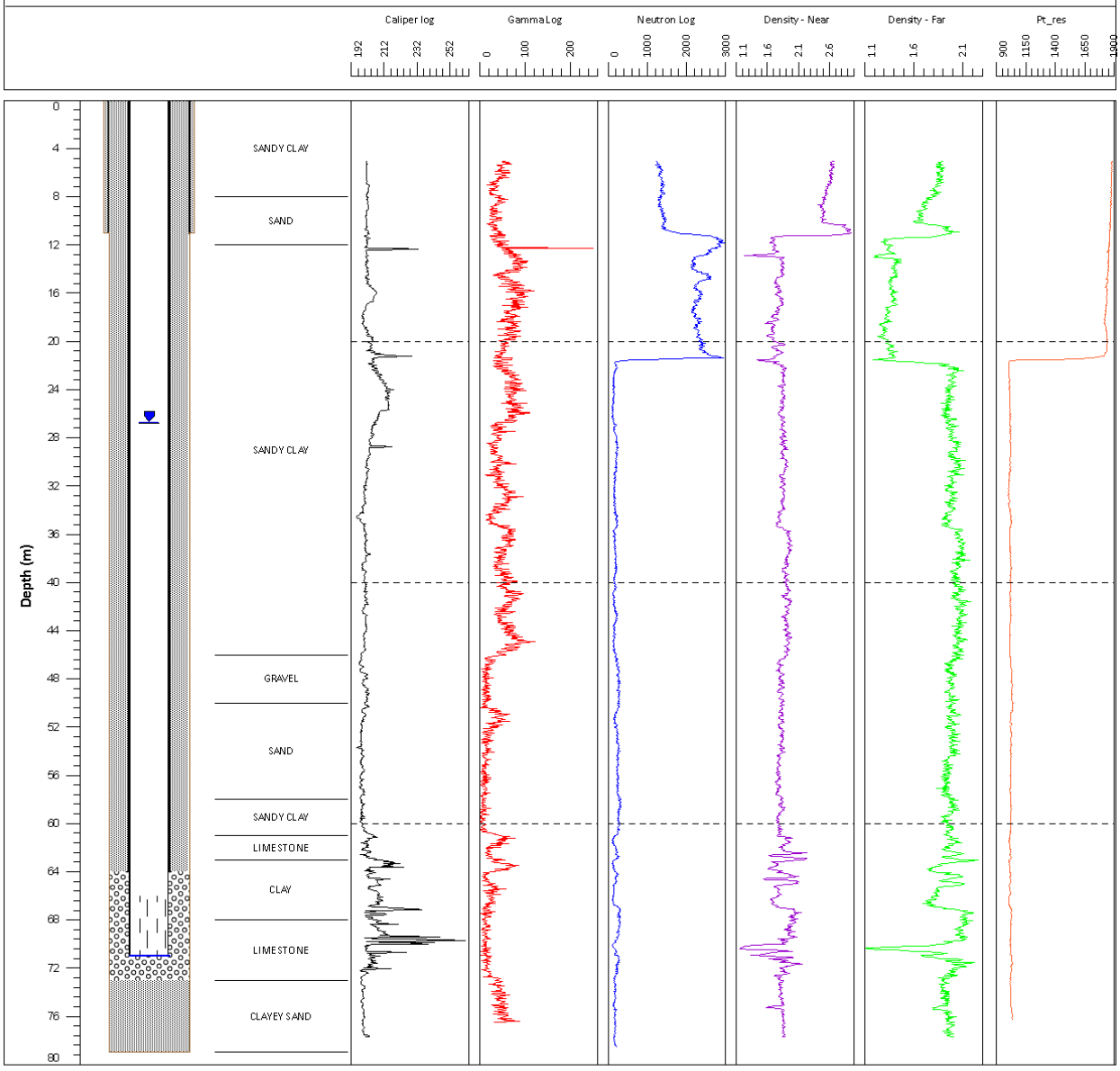
Unit Number: 6628-25372 **Permit Number:** 193738 **Region:** Angle Vale

Completion Date: 29/07/2010 **Total Depth (m):** 79 **Final Depth (m):** 71

Government of South Australia
Department for Water

Coordinates

Easting: 287700 **Northing:** 6172017 **Zone:** 54H **Well Name:** RMU 012 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	203 mm	0 - 11 m	-
Class 12 UPVC	102 mm	0 - 66 m	0 - 64 m

Production Zone Details

Type	Interval	Diam
In-line slotted casing	66 - 71 m	102 mm

Well Construction Symbols

- Cement
- Casing
- Slotted Casing
- Open hole
- Gravel Pack
- Packer
- Stainless Steel Screen
- Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper, Dens short/long, Pt Res, SP & Ind. - Glenside job # 8516
- All coordinates in WGS 84 Datum

2010 Regional Observation Well Upgrade - Well Schematic Diagram

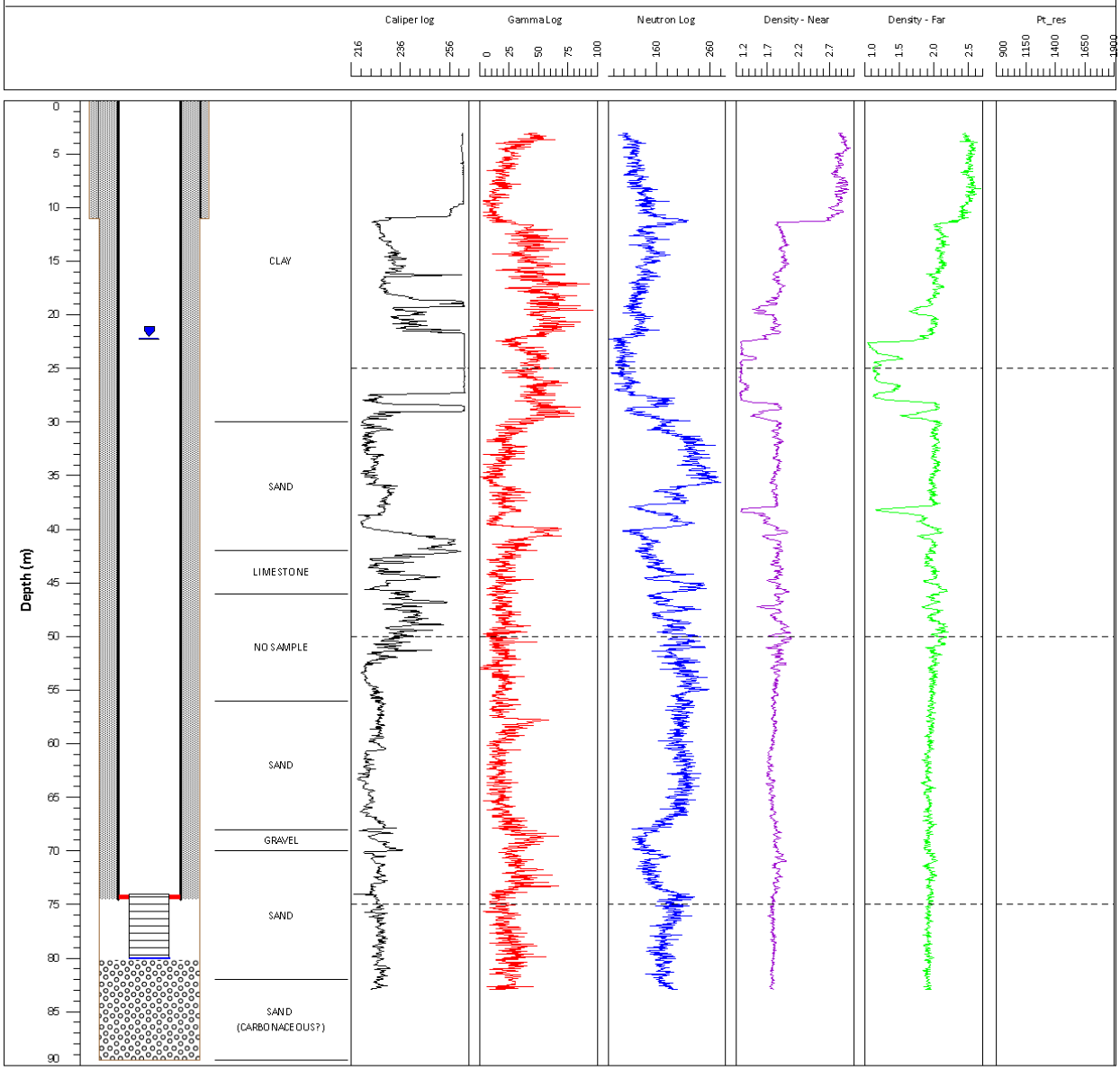
Unit Number: 6628-25426 **Permit Number:** 196834 **Region:** Kangaroo Flat

Completion Date: 09/11/2010 **Total Depth (m):** 89.5 **Final Depth (m):** 80

Government of South Australia
Department for Water

Coordinates

Easting: 284664 **Northing:** 6171979 **Zone:** 54H **Well Name:** RMU 013 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	260 mm	0 - 11 m	-
Class 12 UPVC	157 mm	0 - 74.5 m	0 - 74.5

Production Zone Details

Type	Interval	Diam
Telescopic Screen	74 - 80 m	102 mm

Well Construction Symbols

- Cement
- Casing
- Slotted Casing
- Open hole
- Gravel Pack
- Packer
- Stainless Steel Screen
- Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper, Dens short/long, & Ind med/deep. - Glenside job # 8594
- All coordinates in WGS 84 Datum
- Sample loss from 46 to 56m - Heavy sample contamination from 56 to 74m

2010 Regional Observation Well Upgrade - Well Schematic Diagram

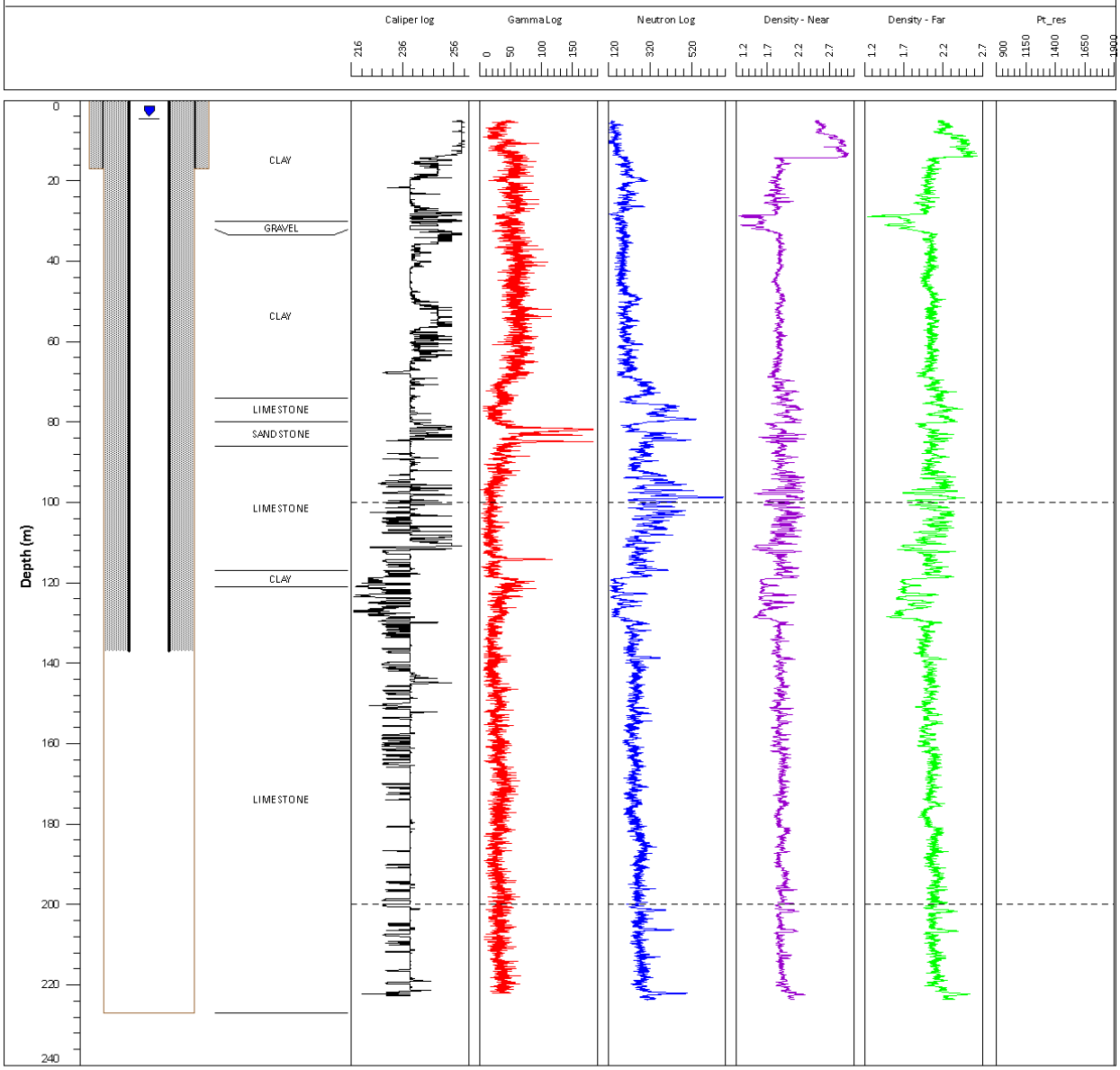
Unit Number: 6628-25427 **Permit Number:** 170282 **Region:** Adelaide Airport

Completion Date: 24/06/2010 **Total Depth (m):** 227 **Final Depth (m):** 184

Government of South Australia
Department for Water

Coordinates

Easting: 275382 **Northing:** 6129188 **Zone:** 54H **Well Name:** Aapt 1 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	260 mm	0 - 17 m	0 - 17 m
Class 12 UPVC	157 mm	0 - 137 m	0 - 137 m

Production Zone Details

Type	Interval	Diam
Open Hole	137 - 227 m	227mm

Well Construction Symbols

Cement
Slotted Casing
Gravel Pack
Stainless Steel Screen
Casing
Open hole
Packer
Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper, Dens short/long, Pt Res, SP & Ind. - Glenside Job # 8569
- All coordinates in WGS 84 Datum

2010 Regional Observation Well Upgrade - Well Schematic Diagram

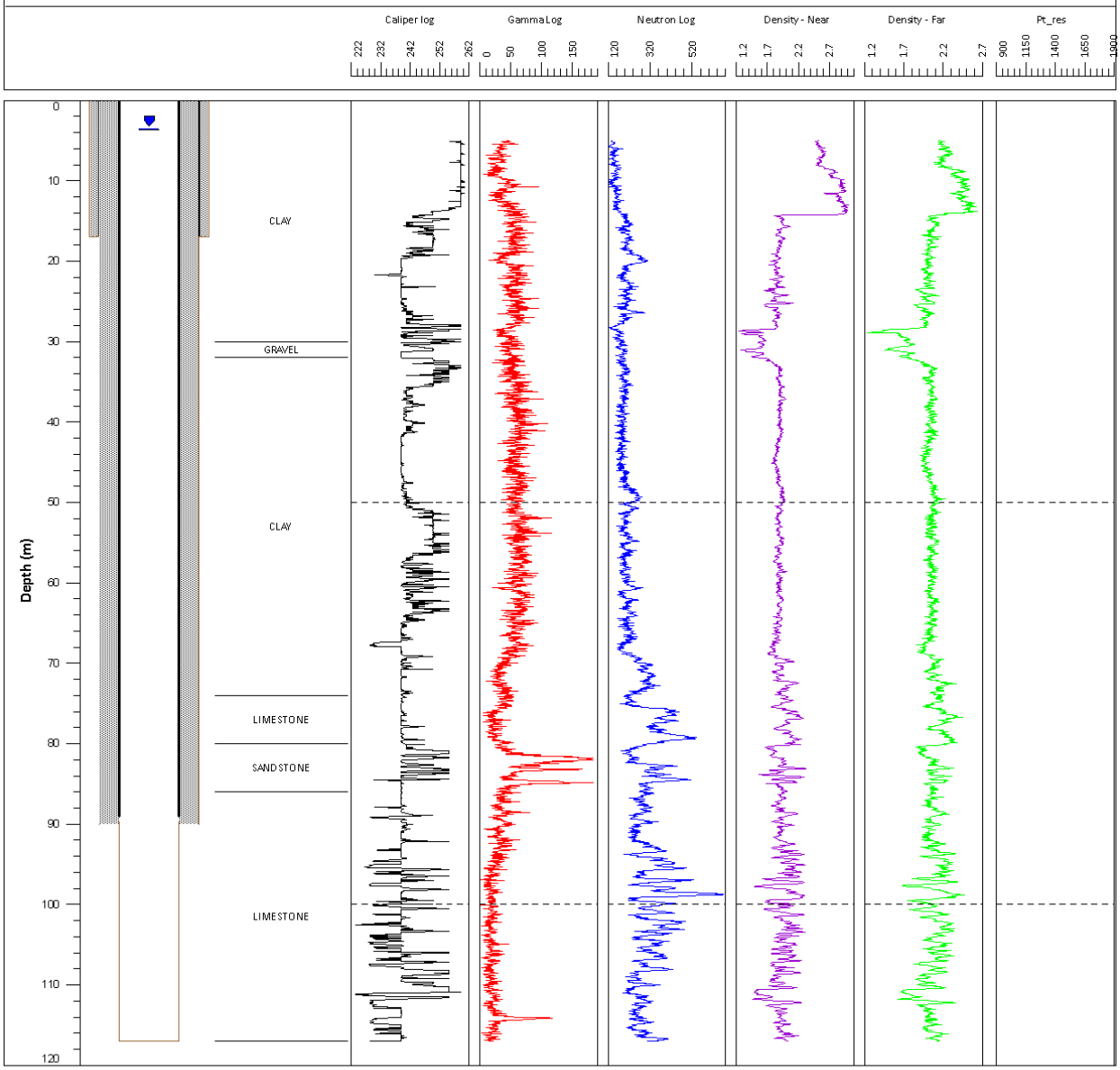
Unit Number: 6628-25428 **Permit Number:** 170283 **Region:** Adelaide Airport

Completion Date: 28/06/2010 **Total Depth (m):** 117 **Final Depth (m):** 108

Government of South Australia
Department for Water

Coordinates

Easting: 275393 **Northing:** 6129191 **Zone:** 54H **Well Name:** Aapt 2 **Current at:** 14-Dec-10



Casing Details

Details	Diameter	Interval	Pressure Cement
Steel	260 mm	0 - 17 m	0 - 17 m
Class 12 UPVC	157 mm	0 - 89 m	0 - 89 m

Production Zone Details

Type	Interval	Diam
Open Hole	89 - 117 m	227mm

Well Construction Symbols

Cement
Slotted Casing
Gravel Pack
Stainless Steel Screen
Casing
Open hole
Packer
Casing end cap

Notes: -

- Geophys available: Gamma Neutron, Caliper, Dens short/long, Pt Res, SP & Ind. - Glenside job # 8569
- All coordinates in WGS 84 Datum

6.0 UNITS OF MEASUREMENT

Units of measurement commonly used (SI and non-SI Australian legal)

Name of unit	Symbol	Definition in terms of other metric units	Quantity
day	d	24 h	time interval
gigalitre	GL	10^6 m^3	volume
gram	g	10^{-3} kg	mass
hectare	ha	10^4 m^2	area
hour	h	60 min	time interval
kilogram	kg	base unit	mass
kilolitre	kL	1 m^3	volume
kilometre	km	10^3 m	length
litre	L	10^{-3} m^3	volume
megalitre	ML	10^3 m^3	volume
metre	m	base unit	length
microgram	µg	10^{-6} g	mass
microlitre	µL	10^{-9} m^3	volume
milligram	mg	10^{-3} g	mass
millilitre	mL	10^{-6} m^3	volume
millimetre	mm	10^{-3} m	length
minute	min	60 s	time interval
second	s	base unit	time interval
tonne	t	1000 kg	mass
year	y	365 or 366 days	time interval

6.1.1.1 Shortened forms

~	approximately equal to
bgs	below ground surface
EC	electrical conductivity (µS/cm)
pH	acidity
ppm	parts per million

7.0 GLOSSARY

Act (the) — In this document, refers to the *Natural Resources Management (SA) Act 2004,* which supercedes the *Water Resources (SA) Act 1997*

Alluvial Material — material which is transported and deposited by streams or rivers. Commonly composed of sand or gravel

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

Aquifer, confined — Aquifer in which the upper surface is impervious (see 'confining layer') and the water is held at greater than atmospheric pressure; water in a penetrating well will rise above the surface of the aquifer

Aperture – Opening or hole.

Aquifer test — A hydrological test performed on a well, aimed to increase the understanding of the aquifer properties, including any interference between wells, and to more accurately estimate the sustainable use of the water resources available for development from the well

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

Artesian — An aquifer in which the water surface is bounded by an impervious rock formation; the water surface is at greater than atmospheric pressure, and hence rises in any well which penetrates the overlying confining aquifer

Basin — The area drained by a major river and its tributaries

Bore — See 'well'

Cone of depression — An inverted cone-shaped space within an aquifer caused by a rate of groundwater extraction that exceeds the rate of recharge; continuing extraction of water can extend the area and may affect the viability of adjacent wells, due to declining water levels or water quality

Confining layer — A rock unit impervious to water, which forms the upper bound of a confined aquifer; a body of

DFW — Department for Water (Government of South Australia)

Domestic purpose — The taking of water for ordinary household purposes; includes the watering of land in conjunction with a dwelling not exceeding 0.4 hectares

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 as a measure of water salinity as it is quicker and easier than measurement by TDS

EPA — Environment Protection Authority (Government of South Australia)

GIS — Geographic Information System; computer software linking geographic data (for example land parcels) to textual data (soil type, land value, ownership). It allows for a range of features, from simple map production to complex data analysis

Hydrogeology — The study of groundwater, which includes its occurrence, recharge and discharge processes, and the properties of aquifers; see also 'hydrology'

Infrastructure — Artificial lakes; dams or reservoirs; embankments, walls, channels or other works; buildings or structures; or pipes, machinery or other equipment

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

Land — Whether under water or not, and includes an interest in land and any building or structure fixed to the land

K Packer — A rubber seal attached to the top of the telescopic screen/liner used to prevent the ingress of sand through the conduit between the casing and screen.

m AHD — Defines elevation in metres (m) according to the Australian Height Datum (AHD)

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

NAP — Northern Adelaide Plains

NRM — Natural Resources Management; all activities that involve the use or development of natural resources and/or that impact on the state and condition of natural resources, whether positively or negatively

Observation well — A narrow well or piezometer whose sole function is to permit water level measurements

Obswell — Observation Well Network

Open Hole — The portion of a well/bore production zone left uncased or screened/lined allowing direct access to the aquifer

Permeability — A measure of the ease with which water flows through an aquifer or aquitard, measured in m^2/d

Prescribed water resource — A water resource declared by the Governor to be prescribed under the Act, and includes underground water to which access is obtained by prescribed wells. Prescription of a water resource requires that future management of the resource be regulated via a licensing system.

Prescribed well — A well declared to be a prescribed well under the Act

Production well — The pumped well in an aquifer test, as opposed to observation wells; a wide-hole well, fully developed and screened for water supply, drilled on the basis of previous exploration wells

Production Zone — The section of a well/bore that allows water into the well.

Recharge area — The area of land from which water from the surface (rainfall, streamflow, irrigation, etc.)

Strata — Rock layers or layer

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

TBD — To Be Determined.

TDS — Total Dissolved Solids

Telescopic liner/screen — A screen or liner of a smaller diameter than the well casing that can be run inside the well casing to prevent the collapse of the targeted aquifer

TOC — Top of Casing

Watercourse — A river, creek or other natural watercourse (whether modified or not) and includes: a dam or reservoir that collects water flowing in a watercourse; a lake through which water flows; a channel (but not a channel declared by regulation to be excluded from the this definition) into which the water of a watercourse has been diverted; and part of a watercourse

Water-dependent ecosystems — Those parts of the environment, the species composition and natural ecological processes, that are determined by the permanent or temporary presence of flowing or standing water, above or below ground; the in-stream areas of rivers, riparian vegetation, springs, wetlands, floodplains, estuaries and lakes are all water-dependent ecosystems

Water resource monitoring — An integrated activity for evaluating the physical, chemical, and biological character of water resources, including (1) surface waters, groundwaters, estuaries, and near-coastal waters; and (2) associated aquatic communities and physical habitats, which include wetlands

Well — (1) An opening in the ground excavated for the purpose of obtaining access to underground water. (2) An opening in the ground excavated for some other purpose but that gives access to underground water. (3) A natural opening in the ground that gives access to underground water

Xyloid — A term used to describe the 'wood like' nature of the early stages of lignite or brown coal.

Yield — level of production

8.0 REFERENCES

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