Clare Valley Groundwater Resources Progress Report 4 Drilling Phases III and IV

Debbie Clarke, Glenn Harrington and Andrew Love

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Report DWR 2001/001

Department for Water Resources

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Department for Water Resources

REPORT DWR 2001/001

CLARE VALLEY GROUNDWATER RESOURCES PROGRESS REPORT 4 DRILLING PHASES III AND IV

Debbie Clarke, Glenn Harrington and Andrew Love

Two additional phases of the drilling program to assess the groundwater resources in the Clare Valley were undertaken during March 1998 at Wendouree (Phase III), and during July 2000 at Wendouree and Watervale Oval (Phase IV). The Phase III program involved the installation of four new monitoring wells and deepening of an existing well from the Phase II drilling. The deepened well was equipped with a cluster of piezometers to enable monitoring of distinct depth intervals for chemistry and hydraulic head data. The Phase IV program involved the installation of six new wells; three at Watervale Oval and three at Wendouree. Sections of core were recovered from one of the wells at Wendouree to provide mineralogical and pore-water chemistry data on the formation. The new wells at Watervale Oval will be used for aquifer storage and recovery (ASR) trials and investigating the benefits of hydraulic fracturing to improve well yields in fractured rock aquifers. The wells at Wendouree will facilitate future applied tracer tests to determine fracture connectivity and hydrogeologic characteristics at the site. At both Wendouree and Watervale, anisotropy of hydraulic conductivity will be examined by conventional aquifer tests combined with azimuthal resistivity surveys.

INTRODUCTION

Phases III and IV of a drilling program were implemented in March 1998 and July 2000, respectively, as part of the Department for Water Resources (DWR) ongoing assessment of groundwater resources in the Clare Valley. A total of five wells were drilled during Phase III at Wendouree vineyard, including four new wells and the deepening of an existing (Phase II) well. This drilling was undertaken to improve characterisation of the site and facilitate future multi-well investigations of the local hydrogeology.

Six new wells were drilled during Phase IV; three of these were at Watervale Oval and the other three at Wendouree vineyard. The Watervale Oval wells were strategically positioned for the purposes of:

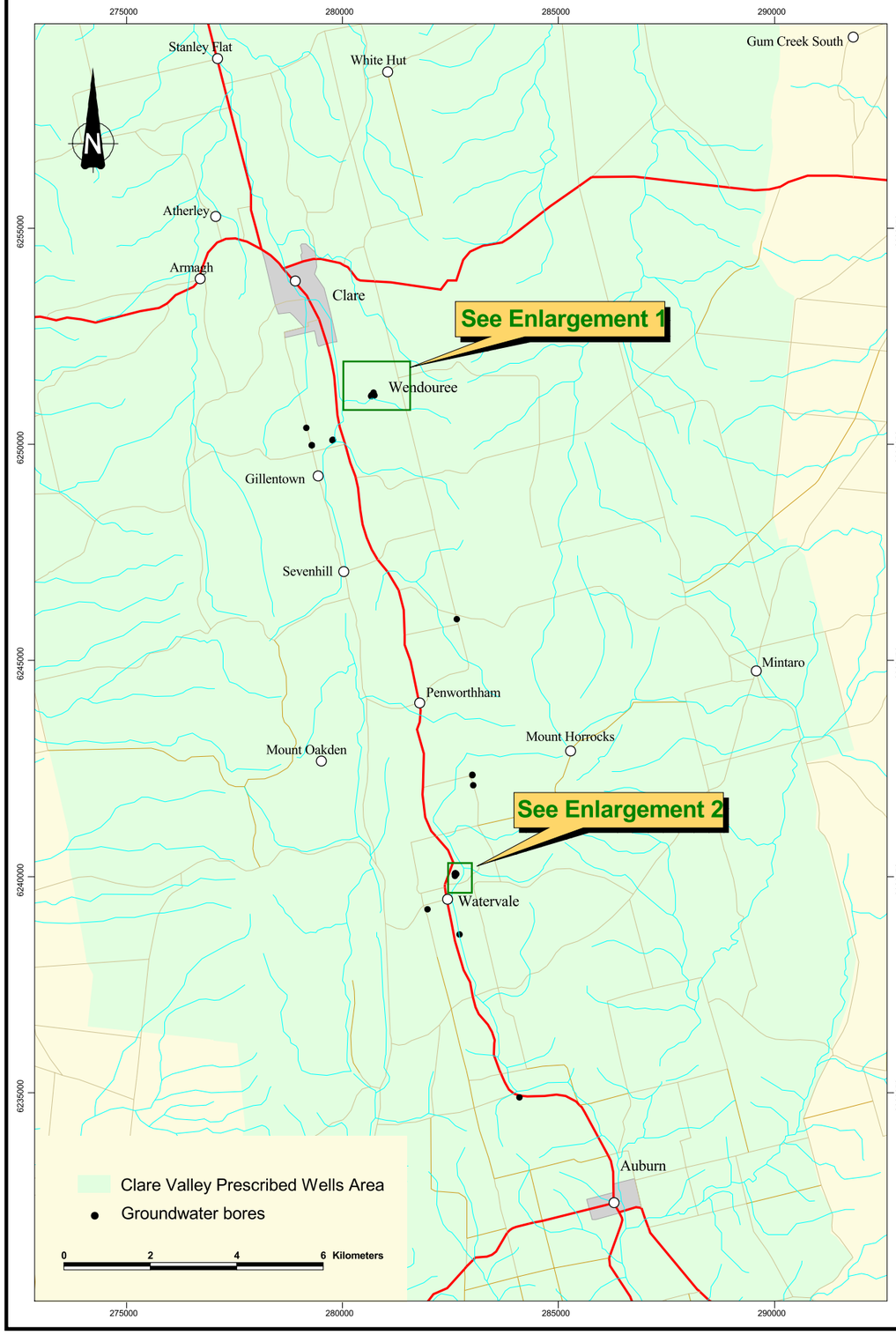
- investigating the benefits of hydraulic fracturing to improve well yields in the fractured rock aquifer
- facilitating an ASR trial
- assessing the anisotropy of hydraulic conductivity at the site.

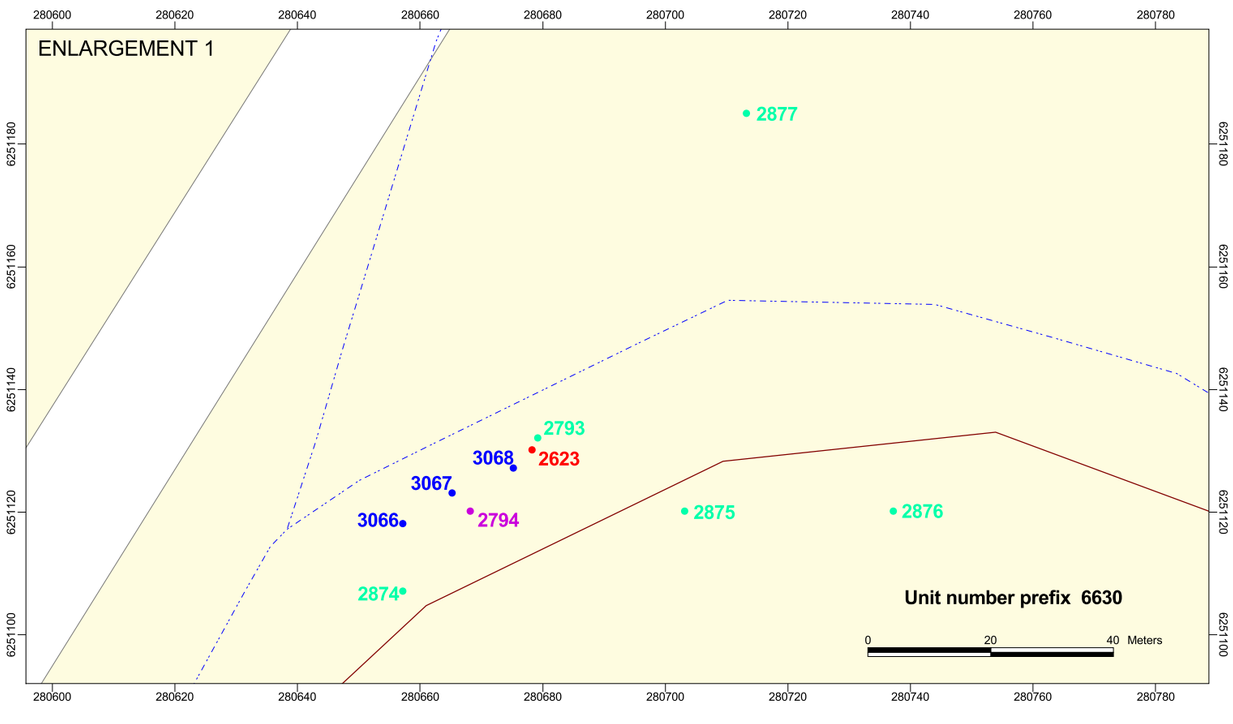
Similarly, the new Wendouree wells were strategically positioned to:

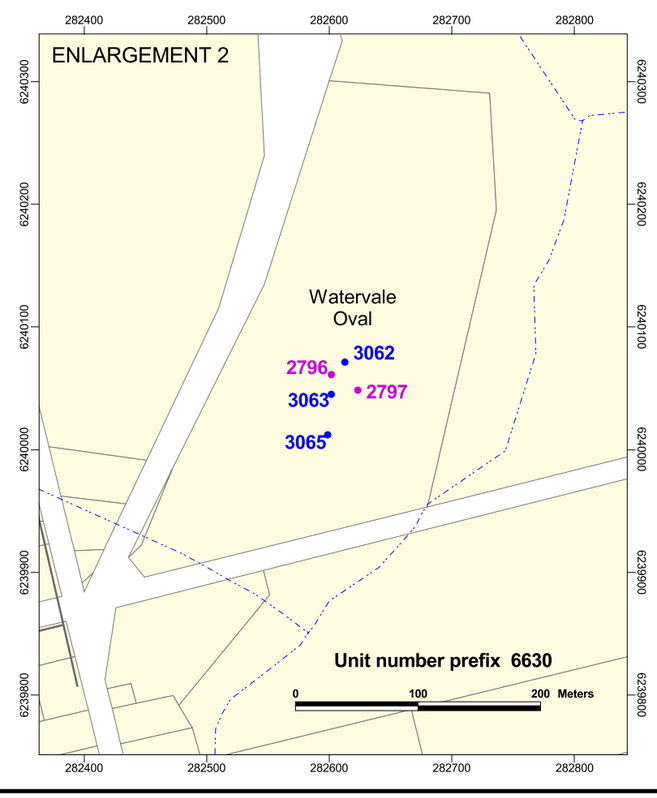
- obtain intact cores for mineralogical assessment and pore-water chemistry analysis
- assess the anisotropy of hydraulic conductivity at the site
- facilitate an applied tracer test for determining fracture connectivity and hydraulic characteristics of the aquifer.

All wells were drilled using a Portadrill® rotary hammer rig with air–water–foam circulation. Sections of intact and fractured core were recovered from one of the new Phase IV wells at Wendouree using a diamond-drill bit and split-tube core barrel.

The locations of new (Phase III and IV) and previously completed (Phase I and II) wells at Wendouree and Watervale Oval are shown on Figure 1. A complete description of the study area, including the physiography, climate, land use, geological setting and hydrogeology, has been published in the Clare Valley Resources Drilling Report I (Morton et al., 1998).







- Phase I
- Phase II
- Phase III
- Phase IV

WELL LOCATIONS FOR PHASES I TO IV DRILLING AT WATERVALE OVAL AND WENDOUREE, CLARE VALLEY

Department for Water Resources

Government of South Australia

Figure 1

PIRSA Publications Services AV:200527_008

DRILLING PROGRAM

PHASE III — WENDOUREE

Phase III drilling commenced at Wendouree vineyard on 10 March and concluded on 24 March 1998. Five wells were drilled; one existing well was deepened and four new wells were completed. Well number 6630–2793 (Phase II) was deepened from its original depth of 39.9 m (Morton and Love, 1998) to a new depth of 60.3 m, and completed as a nest of six PVC piezometers. Each piezometer is 50 mm in diameter, slotted at a different depth (Table 1) and isolated from the others using bentonite and cement plugs. The same approach was used to complete well no. 6630–2623 (P/N 36385) which was drilled at Wendouree during Phase I (Morton et al., 1998). Slotted intervals of the four piezometers installed into this well are also shown in Table 1.

All new wells were completed as an open hole with surface casing installed into the soft sediment until hard rock was encountered. Table 1 provides a summary of the well characteristics and completion details for Phase III drilling. Cuttings were collected and labelled for core library cataloguing; hydrogeological logs are presented in Appendix A.

PHASE IV — WATERVALE OVAL

Phase IV drilling began at Watervale Oval on 14 July and concluded on 21 July 2000. Three new wells were drilled, each to a total depth of 99.2 m, and completed as open holes with PVC surface casing installed into the soft sediment until hard rock was encountered.

PHASE IV — WENDOUREE

Phase IV drilling continued at the Wendouree site from 26 July to 8 August 2000. Three new wells were completed, two of which were drilled to a depth of 100 m; the third (well number 6639–3068) was cored over various intervals during drilling (see discussion below). All wells were completed as open holes as for the Watervale Oval site.

Table 1 provides a summary of wells completed during the Phase IV drilling program; hydrogeological logs are presented in Appendix B.

In the process of surveying the Phase III and IV wells, all Phase I and II wells located within the Wendouree and Watervale Oval research sites were resurveyed. This surveying was undertaken on 27 September 2000 using a Sokkia Locus Differential GPS referenced to the MGA 94 coordinate system.

DIAMOND-DRILLED CORES

Continuous cores of rock strata from the Wendouree well 6630–3068 were extracted in lengths of up to 3 m using a diamond-drill bit and split-tube core barrel. The coring was undertaken to enable:

- Fracture mapping — fracture spacing and orientations were measured to produce a fracture plan. Photographs of selected sections of core are shown on Figure 2, while fracture spacing and orientations are presented in the core description in Appendix C.
- Extraction of pore water from the aquifer matrix material for chemical and isotopic analysis.

Sections of intact core of length 0.1–0.5 m were selected for pore-water chemistry analysis. Once extracted from the core barrel, these cores were quickly sealed in 75 mm diameter PVC pipe to prevent drying out or being contaminated with other water. Molten paraffin wax was used to seal the ends of the pipe and fill the annulus between the core and pipe. Several methods for extracting the porewater for chemical analysis are being investigated. Once obtained, the chemical data will be used to shed light on the origin of solutes in groundwater, as well as provide indication as to whether or not salt dynamics in the aquifer are in a steady state.

DOWN-HOLE SONDE

Each of the three new wells at Wendouree was logged for groundwater temperature, electrical conductivity (EC) and pH using a YSI® down-hole electronic Sonde. Results are presented graphically in Appendix D. The most interesting features of these profiles are the step-like changes in EC down the well (e.g. ~0.6 mS/cm change in EC at ~73 m depth in well 6630–3068). These rapid shifts in salinity with depth have been observed in other wells around the Clare region, and have been interpreted as representing the locations of active fractures where water is entering the well (Love et al., 1999).

Table 1 *Location and construction details for wells completed during Phases III and IV of the drilling program in the Clare Valley*

Drill Phase	**Permit No.**	**Unit No.**	**Location**	**East** (MGA94)	**North** (MGA94)	**Geological unit**	**TD** (m)	**Casing to** (m)	**Slotted interval** (m)	**SWL** (m)	**Yield** (L/s)	**AHD** (m)	**Ref. level**	**GL** (m)	**IC** (m)
1	36385	6630-2623	Wendouree	280677.655	6251130.469	Saddleworth Fm.	117.5	4	N/A	4.5	3	424.271	TOC	0.490	
3	36385–1								95–98						
3	36385–2								80–86						
3	36385–3								71–74						
3	36385–4								63–66						
3	44454	6630-2793	Wendouree	280678.886	6251131.696	Saddleworth Fm.	60.3	2.5 (Phase II)	N/A	4.0	3.0	424.175	TOC	0.383	
3	44454–1								51.5–53.5						
3	44454–2								44–47						
3	44454–3								35–38						
3	44454–4								27–30						
3	44454–5								18–21						
3	44454–6								9–12						
3	44455	6630-2874	Wendouree	280657.023	6251107.533	Saddleworth Fm.	90.1	5.5		4.0	2.5	423.049	TOC	0.151	
3	44456	6630-2875	Wendouree	280702.896	6251120.237	Saddleworth Fm.	90.0	7.5		5.5	5.0	425.122	TOC	0.175	
3	44457	6630-2876	Wendouree	280737.393	6251119.648	Saddleworth Fm.	90.0	5.5		5.5	5–6	426.812	TOC	0.101	
3	44458	6630-2877	Wendouree	280717	6251583	Saddleworth Fm.	222.0	6.0		5.0	6.0		TOC		
4	53287	6630-3062	Watervale Oval	282611.907	6240070.798	Auburn Dolomite	99.2	6.5		6.5	0.5	391.724	TOC	0.827	0.375
4	53293	6630-3063	Watervale Oval	282600.675	6240045.206	Auburn Dolomite	99.2	4.0		7.2	2.0	391.871	TOC	0.721	0.387
4	53294	6630-3065	Watervale Oval	282598.182	6240011.996	Auburn Dolomite	99.2	5.2		5.7	2.5	391.124	TOC	0.777	0.593
4	53289	6630-3066	Wendouree	280657.250	6251118.056	Saddleworth Fm.	100.0	6.5		7.0	3.0	423.257	TOC	0.144	
4	53296	6630-3067	Wendouree	280665.380	6251123.360	Saddleworth Fm.	100.0	6.0		7.0	3–4	423.704	TOC	0.143	
4	53297	6630-3068	Wendouree	280674.526	6251126.875	Saddleworth Fm.	95.5	13.0		7.5	2–3	424.184	TOC	0.227	

TD = Total depth

TOC = Top of casing

GL = GL below TOC

IC = Inner casing below outer

Figure 2 *Selected sections of core obtained from well no. 6630-3068 (Photo Nos 047749, 047750, 047751)*

APPENDIXES

Appendix A

Hydrostratigraphic Logs for Wells Completed During Phase III

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Clare Valley G/water Assess.

PERMIT No. 44454

UNIT No. 6630-2793

Coordinates: 280678.886 mE 6251131.696mN

Hundred: CLARE **Sec:** 395

Location: WENDOUREE El. Surface (m) 424.175 El. Ref. Point (m) Datum: MGA94

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
				Deepening of Phase II drillhole — Permit No. 41497. Drilling and Water Well Log begins at 40 m.					
40	46		DOLOMITIC METASILTSTONE	Dark grey to black dolomitic metasiltstone, subfissile to fissile subangular aggregates. Some soft brown dolomite (3%) evident within the siltstone; pyrite (2–5%) has been deposited along fracture surfaces. Minor deposits of 1–2 mm calcareous white fragments with grey flecks.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				
46	60.3		DOLOMITIC METASILSTONE	As above with abundant fine-grained friable material between 46 and 52 m, decreasing with depth. Minor pyrite deposits and white calcareous fragments present. EOH					

REMARKS:

DRILL TYPE: Rotary **COMPLETED:** 12/3/98

DRILL FLUID: Air **LOGGED BY:** A. Love

DATE: 4/12/00 **SHEET** 1 OF 1

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Clare Valley G/water Assess.

PERMIT No. 44455

UNIT No. 6630-2874

Coordinates: 280657.023mE 6251107.533mN

Location: WENDOUREE El. Surface (m) 423.049 El. Ref. Point (m) Datum: MGA94

Hundred: CLARE **Sec:** 395

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m) From	INTERVAL (m) To	SUPPLY L/sec	SUPPLY Test length	SUPPLY Method	TOTAL DISSOLVED SOLIDS mg/L	TOTAL DISSOLVED SOLIDS Analysis No.
	8 10–12 19–21 36–39				0.25 0.25 0.50 1				

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
0	5.5		SANDY CLAY SILTSTONE	Olive-brown sandy clay with siltstone gravel consisting of mainly weathered light blue-grey to dark grey laminated metasiltstone and a small amount of quartzite, sandstone and siltstone grains, and moderately cohesive olive-brown clay.	Quaternary			0	5.5
5.5	18		WEATHERED DOLOMITIC SILTSTONE	Weathered grey (70%) to black (30%) dolomitic siltstone, subfissile to massive fragments. Some of the larger weathered brown to pale brown dolomitic fragments are slightly soft and friable and covered in the pale grey clay and/or silt on one side of the cleavage surface.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				
18	24		DOLOMITIC METASILTSTONE	Black dolomitic metasiltstone with grey laminae, subfissile to fissile, possible brown oxide staining on some surfaces. Some soft, friable, brown dolomite evident albeit rarely, subfissile to massive. Clay content lower with an increase in silt content. Abundant fine material.					

REMARKS:

DRILL TYPE: Rotary **COMPLETED:** 13/3/98

DRILL FLUID: Air **LOGGED BY:** A.Love

DATE: 3/12/00 **SHEET** 1 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

CONTINUATION SHEET

PROJECT: Clare Valley G/water Assess.

PERMIT No. 44455

UNIT No.

Hundred: CLARE **Sec:** 144

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
34	61		DOLOMITIC METASILTSTONE	Grey to black dolomitic metasiltstone, subfissile to fissile, less friable than above. Some of the larger massive fragments of dark grey dolomitic meta-siltstone have light grey cleavage faces or fracture surfaces. An occasional calcareous fragment to 3 mm was observed between 24 and 30 m. Soft, brown, friable fragments of dolomite become more dominant with depth. Subangular massive quartz fragments to 2 mm in size observed below 33 m. Abundant fines.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				
61	70		DOLOMITIC METASILTSTONE	Same as above. Grey to grey-black dolomitic metasiltstone, fissile to subfissile, with minor pyrite (some crystalline) present on fracture surfaces and increasing slightly with depth.					
70	89		DOLOMITIC METASILTSTONE	As above, with the presence of some organic carbon material between 70 and 73 m depth. Pyrite increased slightly with depth, with the presence of a rare calcareous nodule. EOH					

SHEET 2 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Clare Valley G/water Assess.

PERMIT No. 44456

UNIT No. 6630-2875

Coordinates: 280703mE 6251120mN

Location: WENDOUREE El. Surface (m) El. Ref. Point (m) Datum: MGA94

Hundred: CLARE **Sec:** 395

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m) From	INTERVAL (m) To	SUPPLY L/sec	SUPPLY Test length	SUPPLY Method	TOTAL DISSOLVED SOLIDS mg/L	TOTAL DISSOLVED SOLIDS Analysis No.
	6 17-21 21-26 27.7-28.7 30-30.7				0.25 0.25 0.50 3 3				

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
0	8.4		SANDY CLAY SILTSTONE	Dark olive brown gritty sandy clay with siltstone gravel. Weathered light blue grey to dark grey laminated metasiltstone.	Quaternary			0	
8.4	12.6		WEATHERED DOLOMITIC SILTSTONE	Subfissile to massive fragments of grey to black weathered dolomitic siltstone with light brown clay matrix and minor silt present.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				8.4
12.6	25		DOLOMITIC METASILTSTONE with BROWN CLAY	Grey to black dolomitic siltstone, fissile to subfissile, and massive showing some lamination. Abundant brown clay (20–30%). Minor amounts of soft, brown dolomite with a small amount of silt. The formation is slightly calcareous throughout.					
25	45		DOLOMITIC METASILTSTONE	Fissile to subfissile, grey to black dolomitic metasiltstone, laminated. Abundant fines, minor soft, brown dolomite with small, white, non-calcareous grains. Brown oxide staining and pyrite deposits are present on some fracture surfaces. Minor pyrite grains increasing with depth. Some clay and minor silt present.					

REMARKS:

DRILL TYPE: Rotary **COMPLETED:** 14/3/98

DRILL FLUID: Air **LOGGED BY:** A.Love

DATE: 4/12/00 **SHEET** 1 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER
WATER WELL LOG
CONTINUATION SHEET

PROJECT: Clare Valley G/water Assess.

PERMIT No. 44456

UNIT No. 6630-2875

Hundred: CLARE **Sec:** 395

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
42	76		DOLOMITIC METASILTSTONE	As above, with the absence of brown dolomite to 45 m and reappearing at 48 m. Clumps of orange clay appear at 53–56 m. Absence of white, non-calcareous grains. Pyrite minor.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				
76	90		DOLOMITIC METASILTSTONE	As above, with the presence of a non-calcareous milky coating over the larger fragments and the appearance of white, non-calcareous grains with a chalky texture. Brown dolomite more frequent. Pyrite increasing but still minor. A few fragments of quartz seen at 85 m. EOH					

SHEET 2 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Clare Valley G/water Assess.

PERMIT No. 44457

UNIT No. 6630 2876

Coordinates: 280737mE 6251120mN

Hundred: CLARE **Sec:** 395

Location: WENDOUREE El. Surface (m) El. Ref. Point (m) Datum: MGA94

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	10-11 17-21				0.5 1				

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
0	5.5		SANDY CLAY SILTSTONE	Brown, sandy clay with gravel consisting of mainly weathered light blue-grey to dark grey laminated metasiltstone and small amount of quartzite and sandstone.	Quaternary			0	
5.5	12		WEATHERED DOLOMITIC SILTSTONE	Grey-black and grey weathered dolomitic siltstone, subfissile to massive, coated with a brownish pink coating. Abundant clay content. Soft, weathered, brown dolomite. Some white, non-calcareous fragments flecked with grey become evident with depth.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				5.5
12	21		DOLOMITIC METASILTSTONE	Grey-black and grey dolomitic metasiltstone, subfissile to massive. Some softer fragments brown and purple in colour. Clay, black-grey to pinkish brown, often coating fragments, becomes less abundant with depth and disappears at 18 m. Brown-black silty clay. Iron staining and minor pyrite evident on some fracture surfaces. White, non-calcareous fragments with grey flecks up to 20–30 mm across become more frequent at 15 m deep.					

REMARKS:

DRILL TYPE: Rotary **COMPLETED:** 16/3/98

DRILL FLUID: Air **LOGGED BY:** A. Love

DATE: 5/12/00 **SHEET** 1 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

CONTINUATION SHEET

PROJECT: Clare Valley G/water Assess.

PERMIT No. 44457

UNIT No. 6630 2876

Hundred: CLARE **Sec:** 395

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
21	63		DOLOMITIC METASILTSTONE	As above, black-grey dolomitic siltstone, subfissile to fissile, minor brown dolomite, subangular. Siltier, with minor pyrite on fracture surfaces increasing slightly with depth. Quartz fragments appear rarely throughout, disappearing from 55 m. Abundant fines with small, white, non-calcareous grains. Iron staining on some fragments.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				
63	90		DOLOMITIC METASILTSTONE	As above, with quartz fragments reappearing and pyrite disappearing at 66 m. Purple markings evident on some brown dolomite surfaces. EOH					

SHEET 2 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Clare Valley G/water Assess.

PERMIT No. 44458

UNIT No. 6630 2877

Coordinates: 280713mE 6251185mN

Location: WENDOUREE El. Surface (m) El. Ref. Point (m) Datum: MGA94

Hundred: CLARE **Sec:** 395

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	6-12 17-18 20-21 21-26 30-40				0.25 0.25 0.50 1 2-3				

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
0	6		SANDY CLAY SILTSTONE	Olive-brown sandy clay with siltstone gravel consisting mainly of weathered light blue-grey to dark grey laminated metasiltstone, a small amount of quartzite, sandstone and siltstone grains, and moderately cohesive olive-brown clay.	Quaternary			0	7
9	12		WEATHERED DOLOMITIC SILTSTONE	Grey and black-grey weathered dolomitic siltstone, subfissile to massive. Soft dolomite, light brown to brown. Abundant clay (50%) decreasing with depth. Some of the weathered dolomitic siltstone has stained surfaces, purple-brown in colour. Larger fragments have a clay coating. Subangular. Minor pyrite.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				
12	24		DOLOMITIC METASILTSTONE	Grey and black-grey dolomitic metasiltstone and soft, brown dolomite, subfissile to fissile. Some fragments coated in brown clay, subangular. Silty clay (5–10%). Minor amounts of white calcareous material with grey flecks. Some metasiltstone fragments are coated with a white slither of non-calcareous material. Fines becoming more abundant and clay calcareous with depth.					

REMARKS:

DRILL TYPE: Rotary **COMPLETED:** 23/3/1998

DRILL FLUID: Air **LOGGED BY:** A. Love

DATE: 6/12/00 **SHEET** 1 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

CONTINUATION SHEET

PROJECT: Clare Valley G/water Assess.

PERMIT No. 44458

UNIT No. 6630 2877

Hundred: CLARE **Sec:** 395

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
24	36		DOLOMITIC METASILTSTONE	As above. Iron staining on some dolomite fragments. No white calcareous or non-calcareous materials present. Minor soft, brown dolomite. Minor pyrite increasing slightly with depth.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				
36	63		DOLOMITIC METASILTSTONE	As above. White non-calcareous slithers evident, some coating the dolomitic metasiltstone. 2% pyrite on surfaces increasing with depth. Abundant fines.					
63	139		DOLOMITIC METASILTSTONE	As above, with small clumps of brown clay evident between 63 and 66 m. White, non-calcareous (quartz or quartzite) material coating some of the surfaces or attached to the black-grey dolomite. Some of the dolomite is coated in clay. Pyrite increasing with depth.					
139	222		DOLOMITIC METASILTSTONE	Dolomitic metasiltstone, grey to grey-black, subfissile. Abundant fines — carbonaceous with abundant, very fine shiny material disseminated throughout (<5%). The shiny material is most likely muscovite. Increase in pyrite content both deposited on fracture surfaces and as crystals. EOH					

SHEET 2 OF 2

Appendix B
Hydrostratigraphic Logs for Wells Completed During Phase IV

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Clare Valley G/water Assess.

PERMIT No. 53287

UNIT No. 6630-3062

Hundred: Upper Wakefield **Sec:** 144

Coordinates: 282611.907 mE 6240070.798 mN

Location: WATERVALE OVAL El. Surface (m) 391.724 El. Ref. Point (m) Datum:

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	25.5	6.47		67 99.2			AIRLIFT	783 816	443940 443968

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
0	3		SAND AND CLAY	Dark red, non-calcareous gritty sandy clay. ~10% gravel to 2 mm, subrounded to rounded. Gravel grains mainly sandstone, quartzite, ironstone with some weathered siltstone. ~20% of fine to medium, subangular to subrounded sand-size grains consisting of mainly quartz. Clay and clay–silt ~70%, slight coherence, non-reactive.	Quaternary			0	
3	6.6		SANDY CLAY WITH GRAVEL	A mixture of dark red to light red, sandy, coherent, non-reactive clay with gravel. Contains ~20% weathered gravel grains ranging from 2 to 12 mm, angular to subangular dark ironstone, light brown sandstone and angular, laminated, grey, slightly reactive siltstone up to 20 mm. 40% fine to very fine-grained sand to 0.4 mm, subrounded, mainly quartz. Clay and clay–silt content ~40%, coherent and non-reactive.					6.6
6.6	9		WEATHERED DOLOMITIC SILTSTONE	Pale blue-grey, thinly bedded, slightly reactive, weathered dolomitic metasiltstone. Elongated aggregates showing slaty cleavage and laminated in parts with darker coloured laminae.	Undifferentiated SADDLEWORTH FORMATION (including AUBURN DOLOMITE MEMBER and minor WATERVALE SANDSTONE MEMBER) Torrensian (Burra Group)				

REMARKS:

DRILL TYPE: Rotary Hammer

DRILL FLUID: Air/Foam

DATE 27/8/2000

COMPLETED 16/7/2000

LOGGED BY: D. Clarke and G. Harrington

SHEET 1 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER
WATER WELL LOG
CONTINUATION SHEET

PROJECT: Clare Valley G/water Assess.
PERMIT No. 53287
UNIT No. 6630-3062
Hundred: Upper Wakefield **Sec:** 144

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
9	15		DOLOMITIC METASILSTONE	Pale blue-grey, laminated, slightly reactive metasiltstone as above. Aggregates showed increase occurrence of black laminae and brown-orange oxide staining on surfaces. An occasional vein of white quartz within the siltstone aggregate or a separate quartz fragment was observed. Rounded lumps of soft, pale, white clay begin to appear, possibly well weathered siltstone within the layers of the formation.	Undifferentiated SADDLEWORTH FORMATION (including AUBURN DOLOMITE MEMBER and minor WATERVALE SANDSTONE MEMBER) Torrensian (Burra Group)				
15	18		DOLOMITIC METASILSTONE	As above, with the addition of pyrite on cleavage faces and along laminae. An increase in frequency of massive quartz fragments formed either between cleavages or within fractures. Iron oxide staining on surfaces of cleavages and fracture faces becoming more frequent, producing friable layers between the harder dolomite.					
18	24		DOLOMITIC METASILSTONE	As above, hard, dark blue-grey dolomitic metasiltstone showing fine laminae of darker minerals with slaty cleavage–bedding planes, slightly reactive. Rounded lumps of soft, pale, white, silty, non-reactive clay occur throughout, possibly form layers of weathered siltstone. Occasional brown oxide stained cleavage – bedding plane and pyrite deposit. A layer of dark yellow to light olive coloured silt-clay and weathered glauconitic siltstone appeared between 18 and 20m.					
24	99.2		DOLOMITIC METASILSTONE	As above, with the appearance of small fragments of calcite formed in cleavages, veins or along fracture faces, and continue at very low frequency throughout. EOH					

SHEET 2 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Clare Valley G/water Assess.

PERMIT No. 53293

UNIT No. 6630-3063

Hundred: Upper Wakefield **Sec:** 144

Coordinates: 282600.675 mE 6240045.206 mN

Location: WATERVALE OVAL El. Surface (m) 391.871 El. Ref. Point (m) Datum:

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m) From	INTERVAL (m) To	SUPPLY L/sec	SUPPLY Test length	SUPPLY Method	TOTAL DISSOLVED SOLIDS mg/L	TOTAL DISSOLVED SOLIDS Analysis No.
	11.5 65–72 90–94	7.19			0.5 1 2			882 (to 54 m) 805 (to 90 m) 810 (to 99.2 m)	443969 443970 443971

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
0	4.5		GRAVELLY SANDY CLAY	Dark olive-brown, gritty, gravelly clay. 40–50% gravel of mainly very angular weathered metasiltstone showing iron oxide staining ranging in size from 1 to 12 mm, slightly reactive. Small amount of other gravel types included quartz, sandstone and ironstone. 20% fine sand between 0.1 and 0.4 mm, mainly quartz with a small percentage of other minerals and rock fragments, rounded to subrounded, well weathered. 20% reactive olive-brown clay.	Quaternary			0	4.5
4.5	9		WEATHERED DOLOMITIC SILTSTONE	Dark olive-green to grey weathered gravelly clay. Gravel >80%, ranging in size mainly between 1 and 6 mm, some of the larger aggregates up to 15 mm. The gravel consists mainly of weathered, slightly reactive dolomitic metasiltstone showing some iron oxide staining, laminae evident. Other whiter, very reactive calcite aggregates present. 5–10% very fine sand, mainly quartz <0.1 mm, rounded to subrounded, some dark grains up to 0.4 mm, subrounded to subangular, non-reactive. 5–10% clay–silt, the weathered component of the metasiltstone responsible for the olive–grey colour, slightly reactive, moderately coherent.	Undifferentiated SADDLEWORTH FORMATION (including AUBURN DOLOMITE MEMBER and minor WATERVALE SANDSTONE MEMBER) Torrensian (Burra Group)				

REMARKS:

DRILL TYPE: Rotary Hammer

DRILL FLUID: Air/Foam

DATE: 27/8/2000

COMPLETED: 18/7/2000

LOGGED BY: D. Clarke

SHEET 1 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

CONTINUATION SHEET

PROJECT: Clare Valley G/water Assess.

PERMIT No. 53293

UNIT No. 6630-3063

Hundred: Upper Wakefield **Sec:** 144

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
9	15		DOLOMITIC METASILTSTONE	Hard, dark blue-grey dolomitic metasiltstone showing fine laminae, slaty cleavage–bedding planes, slightly reactive. Some weathering evident, iron oxide staining on the cleavage faces and long laminae on ~20% of the aggregates.	Undifferentiated SADDLEWORTH FORMATION (including AUBURN DOLOMITE MEMBER and minor WATERVALE SANDSTONE MEMBER) Torrensian (Burra Group)				
15	99.2		DOLOMITIC METASILTSTONE	As above, with a decrease in iron oxide staining and the addition of calcite fragments and pyrite deposits crystallised in veins and along cleavages between laminae. Calcite vigorously reactive. From 30 to 33 m, rounded lumps of soft, pale, white silty clay appear, possibly well-weathered siltstone within the layers of the formation, very slightly reactive. Also an occasional lump of soft, light reddish orange silt clay was observed, non-reactive, possibly weathered iron-rich siltstone. EOH					

SHEET 2 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Clare Valley G/water Assess.

PERMIT No. 53294

UNIT No. 6630-3065

Hundred: Upper Wakefield **Sec:** 144

Coordinates: 282598.182 mE 6240011.996 mN

Location: WATERVALE OVAL El. Surface (m) 391.124 El. Ref. Point (m) Datum:

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m) From	INTERVAL (m) To	SUPPLY L/sec	SUPPLY Test length	SUPPLY Method	TOTAL DISSOLVED SOLIDS mg/L	TOTAL DISSOLVED SOLIDS Analysis No.
	12 16.8 25–26	5.70		30.8 57 99.2	2 2.5		AIRLIFT	961 966 950	443934 443935 443936

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
0	6		CLAYEY SAND WITH GRAVEL	Light olive, calcareous, sandy clay, slightly gritty to touch, with medium-grained sandstone river gravel, some rounded but mainly subrounded to subangular. Highly reactive calcite nodules ranging from 0.1 to 8 mm, and light blue-grey dolomitic siltstone aggregates, slightly reactive.	Quaternary				
6	9		WEATHERED SILTSTONE AND CLAY	Dark olive silty clay with some iron oxide staining. Mostly weathered dark blue-grey dolomitic siltstone, slaty cleavage, slightly reactive. Highly reactive white calcite nodules ranging from 0.5 to 1 mm in size.	Undifferentiated SADDLEWORTH FORMATION (including AUBURN DOLOMITE MEMBER and minor WATERVALE SANDSTONE MEMBER) Torrensian (Burra Group)				
9	18		DOLOMITIC METASILTSTONE	Dark grey-blue, laminated, dolomitic metasiltstone, slightly reactive, with iron oxide staining on friable slithers up to 2 mm thick, slaty cleavage. Calcite nodules, highly reactive, 1–5 mm in size become less frequent with depth. Pyrite deposits on fracture walls and in veins parallel to bedding rare from 12 m. Nodules of soft, light reddish orange silty clay, friable, very fine grained, non-reactive, possibly weathered iron-rich siltstone.					

REMARKS:

DRILL TYPE: Rotary Hammer

COMPLETED: 21/7/2000

DRILL FLUID: Air/Foam

LOGGED BY: G. Harrington

DATE: 30/9/2000

SHEET 1 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER
WATER WELL LOG
CONTINUATION SHEET

PROJECT: Clare Valley G/water Assess.
PERMIT No. 53294
UNIT No. 6630-3065
Hundred: Upper Wakefield **Sec:** 144

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
18	24		DOLOMITIC METASILTSTONE	As above. Dark blue-grey laminated metasiltstone, slightly reactive. Soft, siltyclay, reddish brown iron oxide nodules becoming less frequent and calcite nodules rare to absent. Disseminated pyrite on fracture surfaces and in layers parallel to bedding.	Undifferentiated SADDLEWORTH FORMATION (including AUBURN DOLOMITE MEMBER and minor WATERVALE SANDSTONE MEMBER) Torrensian (Burra Group)				
24	27		DOLOMITIC METASILTSTONE	As above, with the appearance of friable, blocky, red-orange-brown, medium-grained clasts, possibly fine sandstone, non-reactive, 5–10 mm. Pyrite common throughout.					
27	33		DOLOMITIC METASILTSTONE	As above, with the absence of the red-orange-brown medium-grained clasts. Dolomitic metasiltstone showing dark blue and pale grey laminae, slightly reactive. Calcite nodules common, with the occasional perfect calcite crystal. Calcite and pyrite deposits on fracture surfaces, and disseminated pyrite throughout. Reappearance of non-reactive light reddish orange nodule of friable silty clay.					
33	72		DOLOMITIC METASILTSTONE	As above, with more frequent occurrence of fine sandstone between layers of metasiltstone. Occasional aggregate of dark olive-brown, fine sandstone observed between 33 and 36 m. Grey-olive-brown fine sandstone more frequently observed between 60 and 72 m showing some iron oxide staining.					
72	99.1		DOLOMITIC METASILTSTONE	As above, with the absence of the sandstone. Dark blue-grey metasiltstone with dark laminae, slaty cleavage, slightly reactive. Calcite and pyrite deposits on fracture structures and veins parallel to bedding, nodules and crystals throughout. Reddish brown, friable, calcareous nodules 2-8 mm occur between 93 and 96 m. EOH					

SHEET 2 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Clare Valley G/water Assess.

PERMIT No. 53289

UNIT No. 6630-3066

Coordinates: 280657.250 mE 6251118.056 mN

Location: WENDOUREE El. Surface (m) 423.257 El. Ref. Point (m) Datum:

Hundred: CLARE **Sec:** 395

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	11	4.13 (on 26/11/00)		19	2			950	443941
				22				955	443965
				37				977	443966
				100				988	443967

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
0	2		SANDY CLAY WITH GRAVEL	Light reddish orange, gravelly, sandy clay. 20–25% gravel consisting mainly of slightly reactive metasiltstone, with iron oxide staining, some weathered dark red-orange sandstone and quartz aggregates. 10–15% fine sand <0.2–0.1 mm, mainly subangular to subrounded quartz. Some dark minerals and fragments present. 50% fine, cohesive, non-reactive clay, light reddish orange.	Quaternary				
2	9		GRAVELLY SILTY CLAY	Light blue-grey, gravelly, silty clay. 50% gravel consisting mainly of weathered dolomitic metasiltstone, dark blue-grey with iron oxide staining, slightly reactive, pyrite present on cleavage faces from 6 m. Small aggregates of red-brown sandstone to 5 mm across and quartz fragments. 40% very fine sand to silt <0.2 mm, non-reactive. Clay 10–15%, very slightly to non-cohesive.					
9	12		WEATHERED DOLMITIC SILTSTONE	Light blue-grey, weathered, hard, dolomitic siltstone with slaty cleavage and iron oxide staining and phyllitic sheen on cleavage faces, slightly reactive. Quartz and pyrite present in veins and on cleavage faces. 10% fine to medium sand, subangular to subrounded. 5% light blue-grey silt weathered from the siltstone. End of weathered zone.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				

REMARKS:

DRILL TYPE: Rotary Hammer

COMPLETED: 28/7/2000

DRILL FLUID: Air/Foam

LOGGED BY: A. Love

DATE: 9/9/2000

SHEET 1 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

CONTINUATION SHEET

PROJECT: Clare Valley G/water Assess.

PERMIT No. 53289

UNIT No. 6630-3066

Hundred: CLARE **Sec:** 395

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
12	15		DOLOMITIC METASILTSTONE	Dark blue-grey, hard, dolomitic metasiltstone with dark laminae, slaty cleavage, very slightly reactive. Some iron oxide staining and pyrite deposits along cleavage and fracture surfaces. Massive quartz deposits in veins and fractures.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				
15	30		DOLOMITIC METASILTSTONE	As above, with dark blue-grey to black dolomitic laminae and grey metasiltstone, some with micaceous phyllitic sheen on cleavage faces with some iron oxide staining. Unconsolidated, soft, friable, light grey micaceous silt–claystone appears within the siltstone layers, non-reactive. Massive quartz deposits in veins and fractures, and a small amount of sandstone aggregates.					
30	100		DOLOMITIC METASILTSTONE	50–80% black dolomite, massive to flinty in appearance. 20–50% dark grey dolomitic siltstone with iron oxide staining on cleavage faces. Translucent white, crystalline, saccharoidal textured fragments most likely dolomitic marble observed at ~30 m depth. Between 54 and 60 m, silt–claystone appears more phyllitic, soft and friable, cleaving easily. Very fine cryptocrystalline structures and minor deposits of talc are observed at >90 m depth. EOH					

SHEET 2 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Clare Valley G/water Assess.

PERMIT No. 53296

UNIT No. 6630-3067

Hundred: CLARE **Sec:** 395

Coordinates: 280665.380 mE 6251123.360 mN

Location: WENDOUREE El. Surface (m) 423.704 El. Ref. Point (m) Datum:

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
		4.50 (on 26/11/00)							

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
0	3		GRAVEY CLAY	Light reddish orange clayey gravel. 70% gravel ranging from 2 to 20 mm consists of massive quartz, blue-grey siltstone and dark brown, weathered sandstone, subangular to subrounded. 5% sand comprising very fine quartz grains >0.1 mm, subrounded. 15% light reddish orange cohesive clay, non-reactive.	Quaternary				
3	6		SANDY CLAY SILSTONE	Olive-brown sandy clay with ~60% siltstone gravel, non-reactive. Gravel consists mainly of weathered light blue-grey to dark grey laminated metasiltstone and a small amount of quartzite, sandstone and siltstone grains, subangular. The light grey metasiltstone aggregates are soft, friable and reactive. The dark grey aggregates are hard and less reactive. 10% very fine sand, mainly quartz <0.2 mm, with some larger dark sand-size particles probable siltstone sand. 30% moderately cohesive olive-brown clay.					
6	9		WEATHERED DOLOMITIC SILTSTONE	Weathered dark blue-grey to light grey dolomitic metasiltstone. Consists mainly of hard, dark blue-grey aggregates with slaty cleavage. Light grey aggregates softer and friable, with phyllitic surfaces. End of weathered zone.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				

REMARKS:

DRILL TYPE: Rotary Hammer

COMPLETED: 29/7/2000

DRILL FLUID: Air/Foam

LOGGED BY: D. Clarke

DATE: 13/9/2000

SHEET 1 OF 2

Department for Water Resources

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

CONTINUATION SHEET

PROJECT: Clare Valley G/water Assess.

PERMIT No. 53296

UNIT No. 6630-3067

Hundred: CLARE **Sec:** 395

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth core sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
9	12		DOLOMITIC METASILTSTONE	As above. Dark blue-grey dolomitic metasiltstone, less friable than above, variation of dark and light laminae, slaty cleavage, phyllitic surfaces, slightly reactive. Massive quartz fragments from vein or fracture deposits.	SADDLEWORTH FORMATION (AUBURN DOLOMITE MEMBER)/ Torrensian (Burra Group)				
12	18		DOLOMITE METASILTSTONE	As above, with the addition of soft, light grey, micaceous, weathered silt aggregates. Iron oxide staining of cleavage faces and fractures. Small amount of pyrite deposited in veins and fractures.					
18	100		DOLOMITE METASILTSTONE	As above. The dolomitic siltstone is becoming harder and less friable with depth. An increase in frequency of soft, light grey, micaceous, weathered silt aggregates and pyrite present in veins and on cleavage faces. Iron oxide staining on cleavage faces and veins evident. Some small calcite fragments seen at ~48m. EOH					

SHEET 2 OF 2

Appendix C

Core Descriptions for Well 6630–3068, Wendouree (P/N 53297)

0–1 m Cuttings red to brown sticky clay, slightly calcareous

Core 1:1.0–2.5 m, 0.4 m recovered (27%) most likely cut from 1 to 1.4 m

1.0–1.25 Brown clay, slightly calcareous, sticky

1.28–1.4 Sandstone, red-pink, fine to medium grained, quartz grains, subangular to subrounded, iron staining, becoming more indurated towards base

Core 2: 2.3–3.1 m, 0.8 m recovered (100%)

2.3–2.4 Siltstone, light to dark grey weathered
2.4–2.5 Siltstone, light to dark grey, slightly calcareous, platy, highly weathered
2.5–2.6 Siltstone, softer than above, more clay, grey clay mineral coating on fracture plane surface
2.6–3.0 Fragmented section, grey clay with indurated dolomite, siltstone chips
3.0–3.1 Siltstone, grey platy, weathered

Core 3: 3.1–5.6 m, 1.1 m recovered (44%)

3.1–4.9 (0.4 m recovered within this zone, exact depth not known) Clay, chocolate brown with silt and sand size particles, slightly calcareous
4.9–5.6 Siltstone, grey friable to indurated, platy, slightly calcareous, some claystone

Core 4: 5.6–7.0 m, 1.4 m recovered (100%)

5.6–6.2 Clay, unconsolidated, light grey, sandy and silty in part, quartz and grey to black dolomite chips, rose quartz grains, black opaques, poorly sorted, subangular to subrounded grains
6.2–6.3 Clay, grey, with minor claystone
6.3–7.0 Claystone, dark grey, minor clay, slightly calcareous, visible bedding at steep angle to core

Core 5: 7.0–10.0 m, 2.1 m recovered (70%), bedding and fracture planes visible

7.0–7.6 Siltstone–claystone, moderately hard (no visible reaction with HCl)
Clay, grey, soft, no visible reaction with HCl
7.6–8.0 Siltstone, dark to light grey
8.0–9.0 0.2 m of squashed, light grey clay recovered in this interval
9.0–9.5 Siltstone, dark grey, massive
9.5–10.0 Dolomite, dark grey to black, saccharodial texture, heavily fractured, iron staining on some fracture walls

Average fracture spacing = 0.46 m

Core 6: 10.0–10.4 m, 0.4 m recovered (100%)

10.0–10.4 Dolomite, dark grey to black

Core 7: 10.4–13.4 m, 2.4 m recovered (80%), 12.4 to 13.0 m section not recovered

10.4–11.97 Dolomite, dark grey to black, indurated, saccharodial texture, black opaques, grey coating on fractures
11.97–12.0 Clay, light to medium grey, dry
12.1–12.4 Dolomite, black
13.0–13.4 Dolomite, black, highly fractured, light grey clay coating with minor iron staining on fracture spacing

Average fracture spacing = 0.17 m, fracture orientation at 10.54 m is 290^{o} 36^{o}W

Core 8: 13.4–15.3 m, 1.9 m recovered (100%)
14.4–14.2 Dolomite, dark grey to black
14.2–14.3 Dolomite, fractured (sheared zone)
15.3–15.2 Dolomite, massive
15.2–15.3 Clay, light to medium grey, platy, iron staining along bedding plane

Average fracture spacing = 0.21 m, bedding plane fracture at 13.6 m

Core 9: 15.3–17.8 m, 2.5 m recovered (100%)
15.3–15.94 Dolomite, dark grey to black, massive cryptocrystalline structure
15.94–16.3 As above with light grey clay coating on bedding plane fracture
16.3–16.9 As above, increase in fracture density, some iron staining on fractured plane surfaces
16.9–17.1 Sheared zone
17.1–17.3 Dolomite, massive
17.3–17.8 Dolomite, increase in fracture density, iron oxide mineral coating along fracture surface
17.7–17.8 Sheared zone

Average fracture spacing = 0.39 m, fracture orientation at 16.8 m is 77^{o} 80^{o}E

Core 10: 17.8–18.9 m, 1.1 m recovered (100%)
17.8–18.8 Dolostone, dark grey to black, laminar bedding, saccharodial to granoblastic texture
18.8–18.9 As above but highly sheared

Average fracture spacing = 0.3 m, fracture orientation at 18.7 m is 345^{o} 81^{o}W (bedding plane fracture)

Core 11: 18.9–21.4 m, 2.5 m recovered (100%)
18.9–19.9 Dolomite, massive, minor iron staining on fractures
19.9–20.5 Clay, medium to dark grey, relatively dry (low moisture content)
20.5–21.4 Dolomite, massive bedding difficult to distinguish

Average fracture spacing = 0.35 m, at least two bedding plane fractures

Core 12: 35–35.6 m, 0.6 m recovered (100%)
35.0–35.6 Dolomite, dark grey to black, microcrystalline structure, minor disseminated and cubic pyrite (n.b. striations on pyrite cubes). White mineral staining as well as minor spotty yellow to brown iron oxide staining

Core 13: 35.6 to 35.9 m, 0.3 m recovered (100%)
As above for Core 12

Core 14: 35.9 to 36.8 m, 0.9 m recovered (100%)
35.9–36.8 Dolomite, dark grey to black, disseminated pyrite along bedding planes, cubic crystals in matrix (up to 0.5 mm), no mineral coating along fracture surface

Average fracture spacing = 0.093 m, fracture orientation at 36.2 m is 222^{o} 30^{o}W; at 36.28 m it is 104^{o} 52^{o}E

Core 15: 44.0–46.1 m, 1.1 m recovered (52%), recovered from 44.0 to 45.1 m
44.0–45.1 Dolomite, highly shattered, most likely due to drilling

Core 16: 46.1–47.2 m, shattered core as above

Core 17: 57.0–60.0 m, 3.0 m recovered (100%)
57.0–58.6 Dolomite, dark grey to black, massive, cryptocrystalline structure, white calcareous interbeds, cubic and disseminated pyrite parallel to bedding, minor iron oxides and opaques
58.6–60.0 Dolomite, as above but more fractured, no visible skins on fracture surfaces

Average fracture spacing = 0.26 m, fracture orientation at 57.9 m is 345° 75°E (bedding plane fracture); 58.1 m 345° 45°E; 58.6 m 291° 25°W; 58.8 m 80° 30°E; 59.5 m 345° 75°E (bedding plane fracture)

Core 18: 60.0–63.3 m, 3.3 m recovered (100%)

60.0-63.3 Dolomite, dark grey to black, bedding clearly visible with white laminated interbeds between grey to black dolomite, disseminated and cubic pyrite, some pyrite cubes have striations. White saccharodial mineral on some fracture surfaces

Average fracture spacing = 0.49 m, fracture orientation at 60.28 m is 285° 32°W

Core 19: 89.5–92.6 m, 3.1 m recovered (100%)

89.5–92.6 Dolomite, dark grey to black, white laminations parallel to bedding, pyrite parallel to bedding. No fractures parallel to bedding

Average fracture spacing = 0.39 m, fracture orientation at 89.96 m is 52° 25°E; 92.4 m 174° 25°E

Core 20: 92.6–93.7 m, 1.1 m recovered (100%)

92.6–93.4 Dark grey to black dolomite as above. Highly shattered core as a result of drilling

Core 21 93.7–95.55 m, 1.85 m recovered (100%)

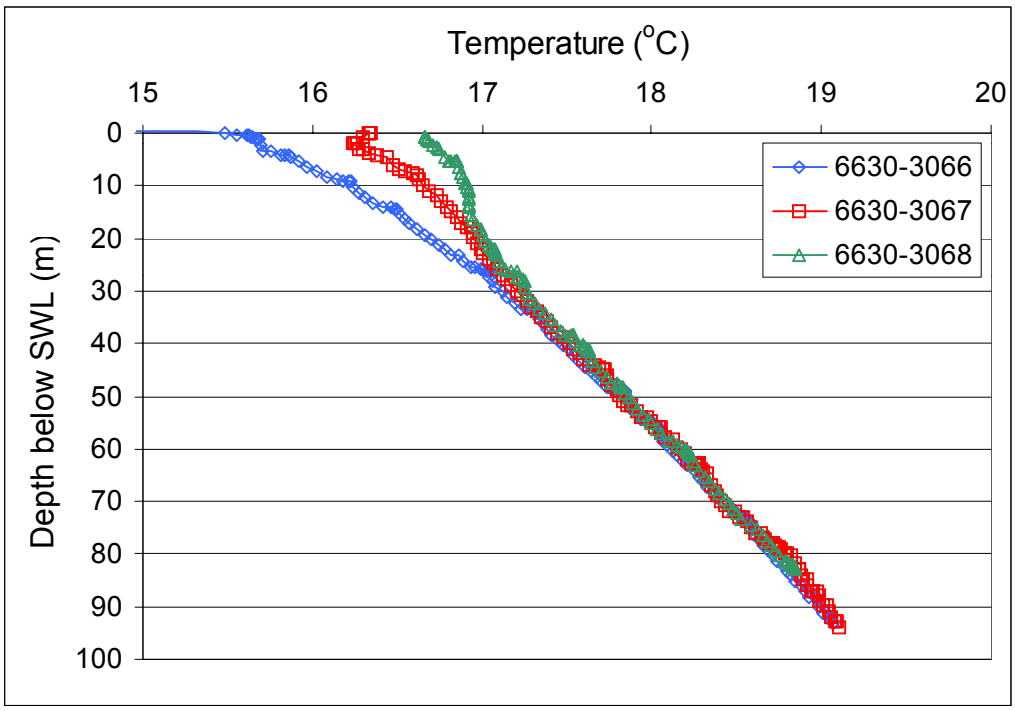
93.7–95.55 Dark grey to black dolomite as above. No fractures, parallel to bedding. White precipitate on fracture surface.

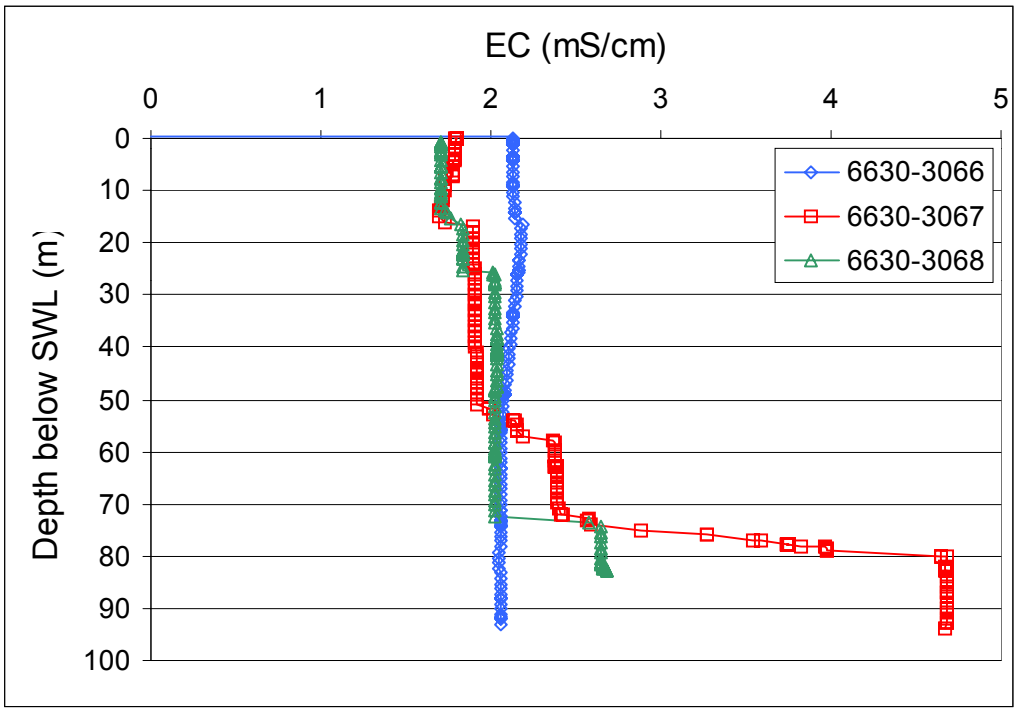
Average fracture spacing = 0.33 m, Fracture orientation @ 93.8 m 273° 55° W; 94.4 m 205° 18° W

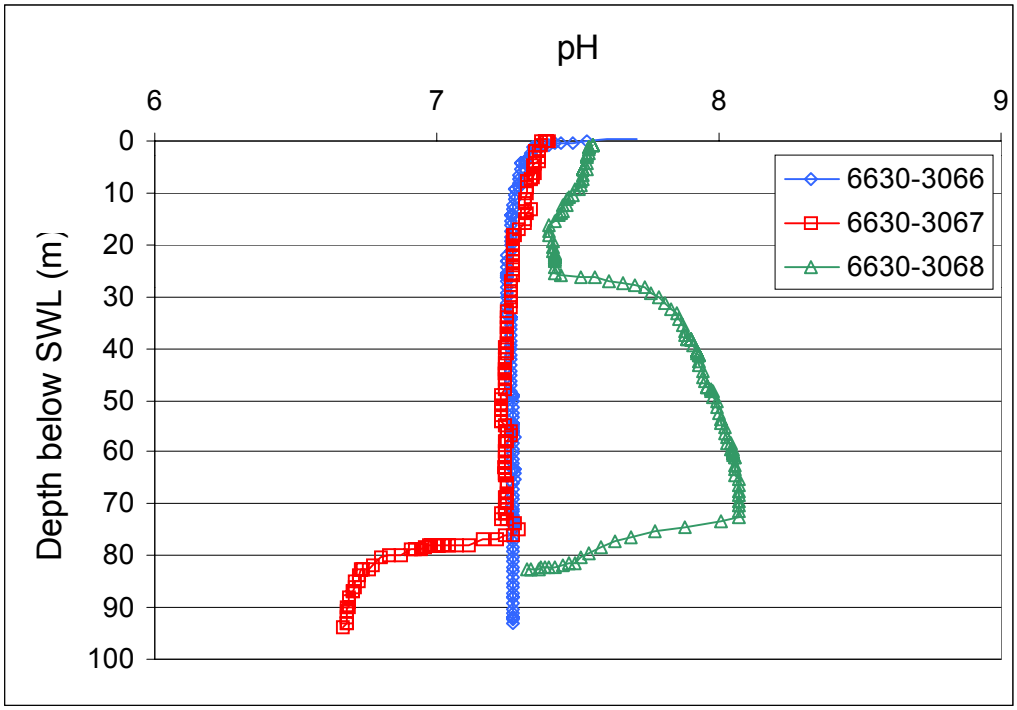
Summary of measured fracture orientations in core obtained from well 6630–3068:

Depth (m)	**Strike** (°)	**Dip** (°)
10.54	290	36W
16.8	77	80W
18.7	345	81W
36.2	222	30W
36.28	104	52E
57.9	345	75E
58.1	35	45E
58.6	291	25W
58.8	80	30E
59.5	345	75E
60.28	285	32W
89.96	52	25W
92.4	174	25E
93.8	273	55W
94.4	205	18W

Appendix D Sonde Profiles for Wells Completed During Phase IV at Wendouree, September 2000






pH
6
7
8
9
0
10
20
30
40
50
60
70
80
90
100
Depth below SWL (m)
6630-3066
6630-3067
6630-3068

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