# APPENDIX F

26 August 2015

610.14072 Euroley drilling and testing program report Final.docx

ProTen Holdings
PO Box 1746
North Sydney NSW 2060

Dear Sir,

# Euroley Poultry Production Complex - Groundwater Drilling and Testing

## 1 Introduction

ProTen Holdings Pty Limited (ProTen) is seeking development consent for the Euroley Poultry Production Complex around 26 km northwest of Narrandera in the Riverina region of New South Wales. The development will require approximately 460 ML/year (1.26 ML/day or 14.6 L/s averaged over a year) of groundwater during operations, which is to be sourced from two production bores proposed to be established within the development site (**Figure 1**). The bores will extract from the deep aquifer source known as the Calivil Formation.

The NSW Office of Water (NOW) submission dated 7 July 2015 raised the following:

> *3. It is recommended that proper pump testing be carried out to confirm bore yields at the proposed sites to confirm water supply security; and*
>
> *5. The assessment of potential impacts of 460 ML extraction on nearby bores is considered inadequate and it is recommended that the analytic model be re-run to assess the impact of extraction using modified aquifer parameters and a longer pumping period (i.e. 2,000 days).*

This letter report presents the results of the drilling and pump testing program of the two groundwater production bores, and presents revised groundwater impact predictions based on the project-specific pump test analysis.

## 2 Drilling Program

ProTen engaged Watson Drilling of Deniliquin to undertake the drilling and bore construction program, and engaged SLR Consulting (SLR) to provide hydrogeological support during the program. Bore drilling and construction was undertaken by a NSW licensed Class 4 driller, and according to the *Minimum Construction Requirements for Water Bores in Australia, Third Edition, February 2012"*.

The drilling program targeted the Calivil Formation aquifer, which lies beneath around 50 m of the Shepparton Formation at the development site. The Shepparton Formation in turn is overlain by 4 to 5 m of topsoil and weathered silty clay, which provides low permeability cover to the Shepparton Formation. The 4m of surficial topsoil and silty clay will provide a significant attenuation barrier to any migration of water from surface operations to both the clayey Shepparton Formation, and the deeper Calivil Formation.

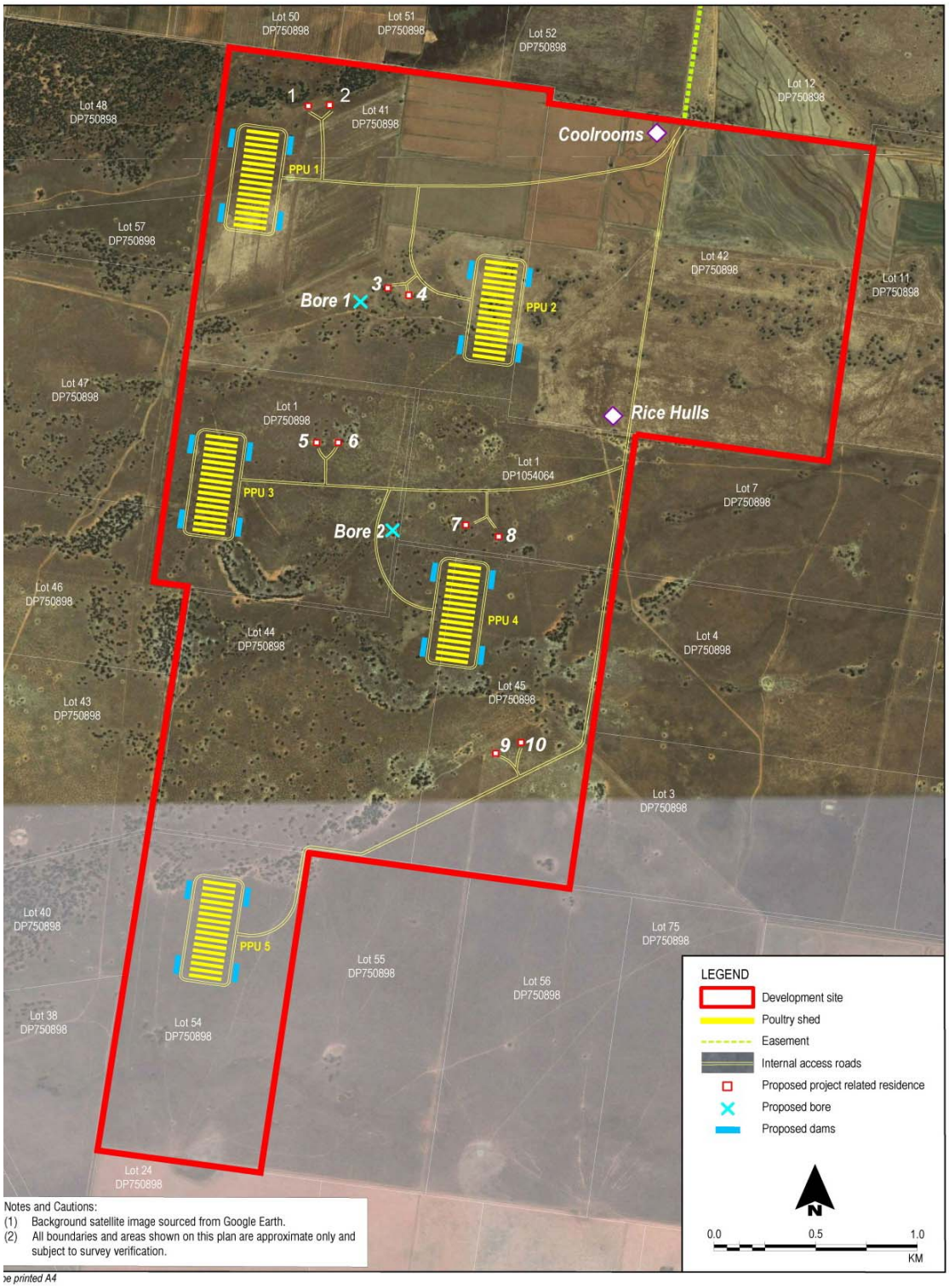



**Figure 1 Development Concept Plan**

Locality information for the two new production bores is provided in **Table 1**.

**Table 1 Drilling locality information**

| Bore ID | Easting (GDA94) | Northing (GDA94) |
|---|---|---|
| Bore 1 | 430623 | 6157517 |
| Bore 2 | 430780 | 6156352 |

In general, the drilling and bore construction process involved:

- Drilling of a pilot hole at 6 inch diameter to intersect the Calivil Formation aquifer using mud-rotary methods
- Design of screen intervals and slot size to suit the lithology encountered
- Reaming of the pilot hole to accept uPVC Cl.18 production casing and 316SS screens, both of 9 inch diameter
- Installation of production casing and screens in an in-line fashion
- Cementing the production casing in place
- Development by jetting with water and airlifting

Lithological drilling logs prepared by SLR are provided in **Appendix A**. A summary of the bore construction information is provided in **Table 2**.

**Table 2 Bore drilling and construction information**

| Bore ID | Total Drilled Depth (mBGL) | Top of Calivil Formation (mBGL) | Base of Calivil Formation (mBGL) | Well Screens (ss wire-wound) | | Standing Water Level (mBGL) |
|---|---|---|---|---|---|---|
| | | | | Aperture | Setting (mBGL) | |
| Bore 1 | 78 | 54 | not drilled | 0.050” | 57-79 | 24.48 |
| | | | | 0.060” | 59-60 | |
| | | | | 0.040” | 64-65 | |
| | | | | 0.050” | 65-66 | |
| | | | | 0.060” | 66-71 | |
| | | | | 0.070” | 71-73 | |
| Bore 2 | 107 | 54 | 100 | 0.060” | 73-75 | 24.22 |
| | | | | 0.070” | 75-77 | |
| | | | | 0.040” | 85-91 | |
| | | | | 0.050” | 91-93 | |

The target Calivil Formation was intersected at 54 m depth/below ground level (BGL) at both drilling locations (located ~1.2 km apart), lying immediately below the Shepparton Formation and noted to be 24 m thick at Bore 1 and 46 m thick at Bore 2, although its entire thickness was not drilled in Bore 1. However at Bore 2, the Renmark Group was intersected below the Calivil Formation at 100 m depth, giving a total formation thickness of 46 m. The interpreted depths of the formation intersections are consistent with depths identified in relevant literature (eg CSIRO, 1997). In the two drilling locations, the Calivil Formation consisted of medium to coarse grained clean white quartzose sands, interbedded with thin clayey horizons.

## 3 Testing Program

ProTen engaged Wayne Kempton Bore Pumps of Deniliquin to undertake the bore testing program (ie pump test) under the guidance of SLR. Testing was undertaken according to *AS 2368-1990 Test Pumping of Water Wells*. Testing comprised:

- A single constant rate test on Bore 1 at a rate of 45 L/s (i.e. well in excess of the long term forecast water demand and licensed extraction of the development) for 48 hours, with drawdown monitored in both Bore 1 and Bore 2 using electronic data loggers and e-tapes. The constant rate test was undertaken with the objective of obtaining reliable estimates of the aquifer hydraulic properties of transmissivity and storativity.
- A short monitored recovery test following the constant rate test, with recovery monitored in Bore 1 using an electronic data logger and an e-tape. The recovery test was undertaken with the objective of obtaining additional data on aquifer hydraulic properties.

The results of the pumping test indicate that the aquifer has sufficient capacity to support the long term licensed pumping demand of 1.26 ML/day and can support significantly higher rates of extraction. The pumped bore recorded a maximum drawdown of only 4.18 m after 2 days of pumping at 45 L/s (3.89 ML/d), with the observation bore located almost 1.2 km away recording a maximum of 0.44 m drawdown.

Analysis of the pumping test data has been undertaken by SLR using the following published solutions (Kruseman & de Ridder, 1994):

- Cooper-Jacob straight-line method (pumping data, pumping bore and observation bore)
- Theis recovery straight-line method (recovery data, pumping bore only)

As an additional means to cross check the results of the above straight-line methods analysis, fitting of the drawdown curve from the observation bore against a theoretical Theis analytical drawdown curve was also undertaken. This curve fitting method provides a means to cross-check that the results obtained from the straight-line analysis methods are valid.

The analyses are presented in **Appendix B** and a summary of the results of the pumping test analysis are provided in **Table 3**.

**Table 3 Aquifer testing analysis results**

| Pumped Bore ID | Observation Bore | Transmissivity ($m^2$/d) | Storativity |
|---|---|---|---|
| Bore 1 | Bore 1 | 3,389 (pumping, Cooper-Jacob) | n/a |
| | | 3,953 (Theis recovery) | n/a |
| | Bore 2 | 3,389 (pumping, Cooper-Jacob) | $3.45 \times 10^{-4}$ |
| | | 3,350 (pumping, Theis curve fitting) | $3.30 \times 10^{-4}$ |
| | **Geometric mean** | **3,512** | **$3.4 \times 10^{-4}$** |

The aquifer test analysis indicates that the transmissivity of the Calivil Formation aquifer is about 3,400 $m^2$/day in the development area, and storativity is around $3.4 \times 10^{-4}$. This compares to theoretical values of 1,500 $m^2$/day for transmissivity and $1 \times 10^{-4}$ for storativity that were used in the EIS for predictive modelling purposes. The difference in these values indicates that in the development area, the Calivil Formation aquifer appears more transmissive than general literature values.

Aquifer test results also show the influence of aquifer boundaries on response to pumping, as evidenced by a change in slope on the log-linear drawdown plot from the pumped bore after around 1,000 minutes of pumping, and the departure from the theoretical Theis analytical drawdown curve for the observation bore after 2,000 minutes of pumping. Such aquifer boundaries are considered to be a result of thinning or pinching out of the screened sand units within the Calivil Formation, given the fluvial depositional environment of the sediments.

## 4 Analytical Modelling

The aquifer parameters obtained from the testing program as outlined in **Section 3** have been input to an analytical model using the Theis distance-drawdown equation to determine likely groundwater drawdown resulting from operation of the development. The modelling assumes the following parameters:

- Pumping rate of 1.26 ML/day, equivalent to the development's proposed extraction of approximately 460 ML/year (see **Section 1**)
- Pumping from only Bore 1 (see **Section 2**), rather than splitting the 1.26 ML/day extraction over two bores, to provide the most conservative estimate of groundwater drawdown
- Transmissivity of 3,512 $m^2$/day and storativity of 3.37 x $10^{-4}$ as per the results of the aquifer testing program (see **Section 3**)
- Pumping duration of 2,000 days, to provide an indication of the long term groundwater drawdown impacts

The results of the analytical model are presented in **Figure 2** below, and show a predicted long term drawdown of maximum 0.8 m in the immediate vicinity of the pumping bore, with the 0.5 m drawdown radius extending only around 110 m from the pumping bore. The results of the pump test indicate that the groundwater abstraction production levels will not significantly affect surrounding bores on adjacent properties or impact groundwater levels in excess of the NSW Aquifer Interference Policy thresholds.

Project: **ProTen**

Calculate Drawdown (s) for known Discharge (Q) — THEIS Analytical Solution (Theis, 1935)

INPUTS

| | | |
|---|---|---|
| Pumping rate of well: | 14.58 | L/s |
| | 1260 | m3/day |
| Storage coefficient (s) of aquifer: | 3.37E-04 | |
| Transmissivity (m2/day): | 3512 | |
| Time since pumping started (days): | 20000 | |

| Distance (m) | u | W(u) | Drawdown (m) |
|---|---|---|---|
| 1.2 | 1.79E-12 | 2.65E+01 | 0.76 |
| 2.4 | 7.15E-12 | 2.51E+01 | 0.72 |
| 4.9 | 2.86E-11 | 2.37E+01 | 0.68 |
| 9.8 | 1.14E-10 | 2.23E+01 | 0.64 |
| 19.5 | 4.58E-10 | 2.09E+01 | 0.60 |
| 39.1 | 1.83E-09 | 1.95E+01 | 0.56 |
| 78.1 | 7.32E-09 | 1.82E+01 | 0.52 |
| 156.3 | 2.93E-08 | 1.68E+01 | 0.48 |
| 312.5 | 1.17E-07 | 1.54E+01 | 0.44 |
| 625.0 | 4.69E-07 | 1.40E+01 | 0.40 |
| 1250.0 | 1.87E-06 | 1.26E+01 | 0.36 |
| 2500.0 | 7.50E-06 | 1.12E+01 | 0.32 |
| 5000.0 | 3.00E-05 | 9.84E+00 | 0.28 |

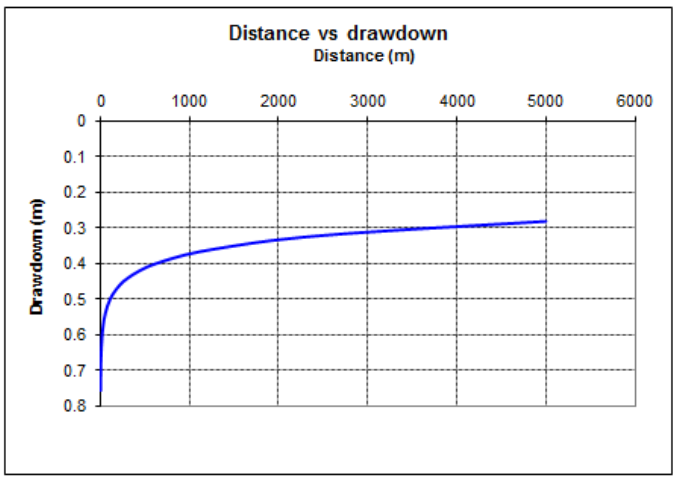



**Figure 2 Analytical Model Predictions**

## 5 Conclusions

The drilling of the wells shows the stratigraphy to include surficial topsoil and silty clay (4-5m thick), above the Shepparton Formation (generally sandy clay, and approximately 50m thick) above the Calivil Formation (generally quartzose sand). The focus of this report is to assess the hydrogeological characteristics of the deeper Calivil Formation, rather than assessing the surface hydrogeology. However, it is noted that the 4 to 5m of surficial topsoil and silty clay will provide a significant attenuation barrier to any migration of water from surface operations to both the clayey Shepparton Formation and the deeper Calivil Formation.

The results of the pumping test indicate that the Calivil Formation aquifer has sufficient capacity to support the development's water supply requirements of approximately 1.26 ML/day and can support significantly higher rates of extraction. The achieved yields indicate the proposed development has demonstrated appropriate water supply security.

The pump test analysis indicates that the groundwater abstraction production levels will not significantly affect surrounding bores on adjacent properties or impact groundwater levels in excess of the NSW Aquifer Interference Policy thresholds. This analysis has also considered longer term impacts of 2,000 days, as discussed with NOW, and has found that the site-specific pump test shows the Calivil Formation to be more transmissive than general hydrogeological literature previously suggests in this area.

Yours sincerely

Derwin Lyons
*Principal – Hydrogeologist*

# 6 References

CSIRO, 1997. Hydrogeology of the Coleambally Irrigation Area: A brief description for use with a groundwater simulation model. Technical Report 3/97, CSIRO Land and Water

Kruseman & de Ridder, 1994. Analysis and Evaluation of Pumping Test Data, Second Edition. International Institute for Land Reclamation and Improvement, the Netherlands.

## Appendix A – Drilling Summary Reports

# Water Bore Drilling Summary Report — Bore 1

| | | | |
|---|---|---|---|
| **Spudded:** | 07-04-2015 | **Report Date:** | 21-07-2015 |
| **TD Reached:** | 07-04-2015 | **Job:** | ProTen - Euroley |
| **Rig Release** | | **Job No:** | 610.14072 |
| **Well Name.:** | Bore 1 | **Co-ordinates (GDA94):** | 430623 e |
| **Tenure:** | n/a | | 6157517 n |
| **Target Formation:** | Calivil Formation | **Elevation:** | |
| **Predicted TD (m GL):** | 90 | **Logging hydrogeologist:** | Derwin Lyons |
| **Drilling Co./Rig:** | Watson Drilling | **TD Reached (m GL):** | 78 |

## Stratigraphy

| Depth (m GL) From | To | Thickness | Unit |
|---|---|---|---|
| 0 | 1 | 1 | Topsoil |
| 1 | 54 | 53 | Shepparton Formation |
| 54 | 78 | 24 | Calivil Formation |

## Cuttings Description

| Depth (m GL) From | To | Thickness | Decription |
|---|---|---|---|
| 0.0 | 1.0 | 1.0 | CLAY, brown; some fine-medium grained sand |
| 1.0 | 3.0 | 2.0 | CLAY, medium grey/brown andorange mottled, firm |
| 3.0 | 4.0 | 1.0 | SILTY CLAY, brown, some sand |
| 4.0 | 7.0 | 3.0 | CLAYEY SAND, red-brown, fine to medium grained |
| 7.0 | 8.0 | 1.0 | SILTY SAND, fine grained, orange-brown |
| 8.0 | 9.0 | 1.0 | CLAY, light grey and orange, firm |
| 9.0 | 11.0 | 2.0 | SAND, medium to coarse grained, moderately well sorted, moderately well rounded, lithic, orange-brown |
| 11.0 | 12.0 | 1.0 | SAND, medium grained, clean, well sorted, orange-brown |
| 12.0 | 13.0 | 1.0 | CLAYEY SAND, fine grained, orange |
| 13.0 | 15.0 | 2.0 | SILTY CLAY, orange and grey mottled, firmer with less silt towards base |
| 15.0 | 16.0 | 1.0 | SAND, fine to coarse grained, poorly sorted, lithic, orange |
| 16.0 | 17.0 | 1.0 | CLAYEY SAND, medium to coarse grained, orange-brown |
| 17.0 | 31.0 | 14.0 | CLAY, firm, orange-brown, some light grey clay. Occasional stiff red clay and siltier clay horizons |
| 31.0 | 35.0 | 4.0 | SILTY CLAY, orange-brown |
| 35.0 | 36.0 | 1.0 | CLAYEY SAND, medium grained, orange |
| 36.0 | 37.0 | 1.0 | GRAVELLY SAND, loose, angular lithic grains |
| 37.0 | 39.0 | 2.0 | SAND, fine to coarse grained, poorly sorted, moderately angular, light brown |
| 39.0 | 41.0 | 2.0 | GRAVELLY CLAY, dark orange-brown with up to 1cm diameter moderately rounded lithics. Gravel decreases with depth |
| 41.0 | 43.0 | 2.0 | SANDY CLAY, coarse grained sand in stiff dark orange-brown clay matrix |
| 43.0 | 44.0 | 1.0 | CLAYEY SAND, firm, orange-brown |
| 44.0 | 46.0 | 2.0 | CLAY, stiff, brown |
| 46.0 | 49.0 | 3.0 | CLAY, stiff, brown, mottled with red & grey clay |
| 49.0 | 51.0 | 2.0 | CLAY, stiff, brown |
| 51.0 | 54.0 | 3.0 | CLAY, stiff, brown, mottled with grey clay, minor sand 52-53m |
| 54.0 | 57.0 | 3.0 | SAND, medium grained, clean, well sorted, angular grains, orange. Coarsening with depth |
| 57.0 | 58.0 | 1.0 | SAND, coarse grained, clean, sub-rounded, moderate sorting, orange and white |
| 58.0 | 60.0 | 2.0 | GRAVELLY SAND, coarse grained, clean, sub-rounded, orange and white |
| 60.0 | 62.0 | 2.0 | GRAVELLY SAND, clayey, sub-angular gravels up to 5mm diameter, orange. Lithic. Gravel decreasing with depth |
| 62.0 | 63.0 | 1.0 | CLAY, gravelly, orange |
| 63.0 | 64.0 | 1.0 | SAND, fine to medium grained, clean, orange |
| 64.0 | 65.0 | 1.0 | SAND, medium to coarse grained, moderately sorted, clean, orange-white |
| 65.0 | 67.0 | 2.0 | SAND, coarse to gravelly, quartz rich, clean, sub-angular, orange |
| 67.0 | 68.0 | 1.0 | SAND and GRAVEL, poorly sorted, clean, sub-rounded gravels, white-orange |
| 68.0 | 69.0 | 1.0 | SAND, medium to coarse grained, quartz rich, moderate sorting, clean, orange-white |
| 69.0 | 70.0 | 1.0 | SAND, coarse to gravelly, clean, sub-angular, white |
| 70.0 | 71.0 | 1.0 | SAND, fine to coarse grained, poorly sorted, some sub-rounded gravels to 5mm diameter, clean, orange |
| 71.0 | 72.0 | 1.0 | SAND, medium to coarse grained, white-orange |
| 72.0 | 73.0 | 1.0 | SANDY GRAVEL, quartz rich, agular, clean, white-orange |
| 73.0 | 75.0 | 2.0 | SAND, medium to coarse grained, some fine quartz gravels, white-orange |
| 75.0 | 76.0 | 1.0 | CLAYEY SAND, medium to coarse grained, orange |
| 76.0 | 78.0 | 2.0 | CLAY, with some rounded gravels, white |

## Bit log

| Depth (m GL) | Type |
|---|---|
| 0-78 | 6" blade |
| 0-73 | 12" blade |

## Mud Log

| Depth (m GL) | Description |
|---|---|
| 0-78 | Bentonite mud (Aus-gel) |

## Well Construction log

| Depth (m GL) | Material/grade | Diameter/size/type | Purpose |
|---|---|---|---|
| 0-57 | uPVC Cl 18 | 225 mm DN | Bore Casing |
| 57-59 | SS wedge-wire | 225mm DN, 0.05" slot | Well Screen |
| 59-60 | SS wedge-wire | 225mm DN, 0.06" slot | Well Screen |
| 60-64 | uPVC Cl 18 | 225 mm DN | Bore Casing |
| 64-65 | SS wedge-wire | 225mm DN, 0.04" slot | Well Screen |
| 65-66 | SS wedge-wire | 225mm DN, 0.05" slot | Well Screen |
| 66-71 | SS wedge-wire | 225mm DN, 0.06" slot | Well Screen |
| 71-73 | SS wedge-wire | 225mm DN, 0.07" slot | Well Screen |
| 52 | Cement basket | 12" | Cement plug |
| 73-78 | Cuttings backfill (natural) | | Rathole backfill |
| 0-52 | Cement | 5% bentonite | Annular seal |
| 52-73 | Natural development | | Filter pack |

## Testing

## Observations

| Water Strike (m GL) | Airlift yield (L/s) | Salinity | SWL (mTOC) | Other observations |
|---|---|---|---|---|
| | | | | |

# Water Bore Drilling Summary Report — Bore 2

| | | | |
|---|---|---|---|
| **Spudded:** | 22-07-2015 | **Report Date:** | 22-07-2015 |
| **TD Reached:** | 29-07-2015 | **Job:** | ProTen - Euroley |
| **Rig Release** | | **Job No:** | 610.14072 |
| **Well Name.:** | Bore 2 | **Co-ordinates (GDA94):** | 430780 e |
| **Tenure:** | n/a | | 6156352 n |
| **Target Formation:** | Calivil Formation | **Elevation:** | |
| **Predicted TD (m GL):** | 90 | **Logging hydrogeologist:** | Derwin Lyons |
| **Drilling Co./Rig:** | Watson Drilling | **TD Reached (m GL):** | 107 |

## Stratigraphy

| Depth (m GL) From | To | Thickness | Unit |
|---|---|---|---|
| 0 | 5 | 5 | Topsoil & weathering |
| 5 | 54 | 49 | Shepparton Formation |
| 54 | 100 | 46 | Calivil Formation |
| 100 | 107 | >7 | Renmark Group |

## Cuttings Description

| Depth (m GL) From | To | Thickness | Decription |
|---|---|---|---|
| 0.0 | 1.0 | 1.0 | SILTY CLAY, dark brown and light grey mottled |
| 1.0 | 2.0 | 1.0 | CLAY, firm, light brown to dark grey |
| 2.0 | 4.0 | 2.0 | SILTY CLAY, light brown to grey |
| 4.0 | 5.0 | 1.0 | SANDY CLAY, fine grained sand in light brown to grey mottled clay matrix |
| 5.0 | 6.0 | 1.0 | SILTY CLAY, light brown to grey |
| 6.0 | 16.0 | 10.0 | CLAY, firm to stiff, grey. Some light brown-orange fine sand and silt with depth |
| 16.0 | 17.0 | 1.0 | SILTY SAND, fine grained, light brown to orange |
| 17.0 | 18.0 | 1.0 | GRAVEL, very coarse. Up to 2cm diameter pebbly lithics, moderately well rounded, poorly sorted. |
| 18.0 | 19.0 | 1.0 | GRAVEL, fine to coarse, lithics up to 1cm diameter, Poorly sorted, well rounded. |
| 19.0 | 20.0 | 1.0 | GRAVEL, medium to coarse lithics, clean, well rounded. |
| 20.0 | 21.0 | 1.0 | CLAY, firm, orange. 50% gravel inclusions likely hole fall-in from above |
| 21.0 | 23.0 | 2.0 | CLAY, firm, orange, with 50% very stiff red clay |
| 23.0 | 24.0 | 1.0 | CLAYEY SAND, coarse grained, well sorted, orange |
| 24.0 | 25.0 | 1.0 | SILTY SAND, coarse grained, well sorted, orange |
| 25.0 | 27.0 | 2.0 | SAND, coarse, clean, orange. Some rounded fine gravel |
| 27.0 | 29.0 | 2.0 | SANDY CLAY, firm, orange-brown and grey |
| 29.0 | 30.0 | 1.0 | SILTY SAND, coarse grained, with some fine to medium gravels. Orange |
| 30.0 | 33.0 | 3.0 | GRAVEL, fine to medium grading to coarse with depth, moderately rounded lithics, poorly sorted. Orange |
| 33.0 | 37.0 | 4.0 | CLAY, firm to stiff, light grey |
| 37.0 | 38.0 | 1.0 | SANDY CLAY, orange-brown |
| 38.0 | 39.0 | 1.0 | CLAYEY SAND, medium to coarse grained, orange-brown |
| 39.0 | 40.0 | 1.0 | SILTY SAND, medium to coarse grained, lithic. Orange-brown |
| 40.0 | 41.0 | 1.0 | GRAVELLY SAND, coarse grained, clean, orange. |
| 41.0 | 43.0 | 2.0 | SILTY SAND, medium to coarse grained, becoming clayey towards base. Light brown |
| 43.0 | 44.0 | 1.0 | SANDY CLAY, coarse grained sand grains, orange-brown |
| 44.0 | 47.0 | 3.0 | CLAY, stiff, red-brown to light brown. Thin hard dark grey to black laminations up to 3mm thick |
| 47.0 | 49.0 | 2.0 | CLAY, stiff, red-brown to light brown. |
| 49.0 | 52.0 | 3.0 | CLAY, firm, light brown & grey |
| 52.0 | 53.0 | 1.0 | CLAYEY SAND, coarse grained, quartzose, well sorted, light brown-orange |
| 53.0 | 54.0 | 1.0 | SAND, very course grained, moderately well sorted, quartzose and lithic, clean, orange-grey |
| 54.0 | 58.0 | 4.0 | SAND, coarse to very course grained, moderately well sorted, quartzose and lithic, clean, light grey to white |
| 58.0 | 59.0 | 1.0 | SANDY CLAY, firm, orange-brown. Coarse well sorted quartzose sand grains. |
| 59.0 | 63.0 | 4.0 | CLAY, firm to stiff, orange to light orange |
| 63.0 | 64.0 | 1.0 | CLAY, soft, orange to light orange |
| 64.0 | 65.0 | 1.0 | CLAY, firm, orange to light orange |
| 65.0 | 66.0 | 1.0 | SILTY SAND, medium grained, dark orange |
| 66.0 | 67.0 | 1.0 | CLAYEY SILTY SAND, medium grained, dark orange |
| 67.0 | 68.0 | 1.0 | CLAYEY SILTY SAND, coarse grained, dark orange |
| 68.0 | 69.0 | 1.0 | SAND, coarse to gravelly, quartzose, poorly sorted, moderately rounded, clean, orange |
| 69.0 | 70.0 | 1.0 | GRAVELLY SAND, quartzose with minor lithics, moderately well sorted, clean, white |
| 70.0 | 71.0 | 1.0 | SAND, medium to coarse grained with minor gravels, quartzose with minor lithics, moderately well sorted, clean, white-orange |
| 71.0 | 73.0 | 2.0 | GRAVELLY SAND, coarse grained, well sorted, moderately well rounded, clean, orange |
| 73.0 | 75.0 | 2.0 | GRAVELLY SAND, coarse grained, well sorted, moderately well rounded, clean, white-orange to white |
| 75.0 | 76.0 | 1.0 | GRAVELLY SAND, very coarse grained, well sorted, moderately well rounded, clean, white |
| 76.0 | 77.0 | 1.0 | GRAVELLY SAND, very coarse grained, well sorted, moderately well rounded, clean, orange |
| 77.0 | 79.0 | 2.0 | CLAYEY GRAVEL, well sorted, well rounded, white-orange |
| 79.0 | 80.0 | 1.0 | SANDY GRAVEL, coarse grained, clean, white-orange |
| 80.0 | 83.0 | 3.0 | CLAYEY SAND, coarse grained, quartzose and lithic, orange-brown |
| 83.0 | 84.0 | 1.0 | SAND, fine to gravelly, poorly sorted, angular, quartzose, clean, white |
| 84.0 | 86.0 | 2.0 | SAND, medium grained, poorly sorted, angular, quartzose, clean, white |
| 86.0 | 89.0 | 3.0 | SAND, medium to coarse grained, poorly sorted, angular, quartzose, clean, white |
| 89.0 | 90.0 | 1.0 | SAND, medium grained, poorly sorted, angular, quartzose with some lithics, clean, orange-white |
| 90.0 | 91.0 | 1.0 | SAND, medium to coarse grained, poorly sorted, angular, quartzose, clean, white |
| 91.0 | 92.0 | 1.0 | SAND, coarse grained, poorly sorted, angular, quartzose, clean, white |
| 92.0 | 93.0 | 1.0 | SAND, coarse grained, poorly sorted, angular, quartzose with some lithics, clean, orange-white |
| 93.0 | 96.0 | 3.0 | CLAYEY SAND, coarse grained, well sorted, well rounded, orange-white |
| 96.0 | 98.0 | 2.0 | CLAYEY SAND, silty, coarse grained, well sorted, well rounded, orange-white |
| 98.0 | 100.0 | 2.0 | CLAYEY SAND, coarse grained, well sorted, well rounded, dark orange-white |
| 100.0 | 101.0 | 1.0 | CLAYEY SAND, fine to medium grained, carbonaceous with some coal flecks, quartzose, well sorted, dark grey |
| 101.0 | 102.0 | 1.0 | SILTY SAND, medium grained, quartzose, well sorted, dark grey |
| 102.0 | 103.0 | 1.0 | SAND, medium grained, well sorted, quartzose, grey |
| 103.0 | 104.0 | 1.0 | SAND, fine to coarse grained, poorly sorted, quartzose, carbonaceous with some coal flecks, dark grey |
| 104.0 | 106.0 | 2.0 | SAND, medium to coarse grained, poorly sorted, quartzose, some carbonaceous flecks, dark grey |
| 106.0 | 107.0 | 1.0 | SAND, coarse grained, quartzose, moderately sorted, grey |

## Bit log

| Depth (m GL) | Type |
|---|---|
| 0-107 | 6" blade |
| 0-93 | 12" blade |

## Mud Log

| Depth (m GL) | Description |
|---|---|
| 0-107 | Bentonite mud (Aus-gel) |

## Well Construction log

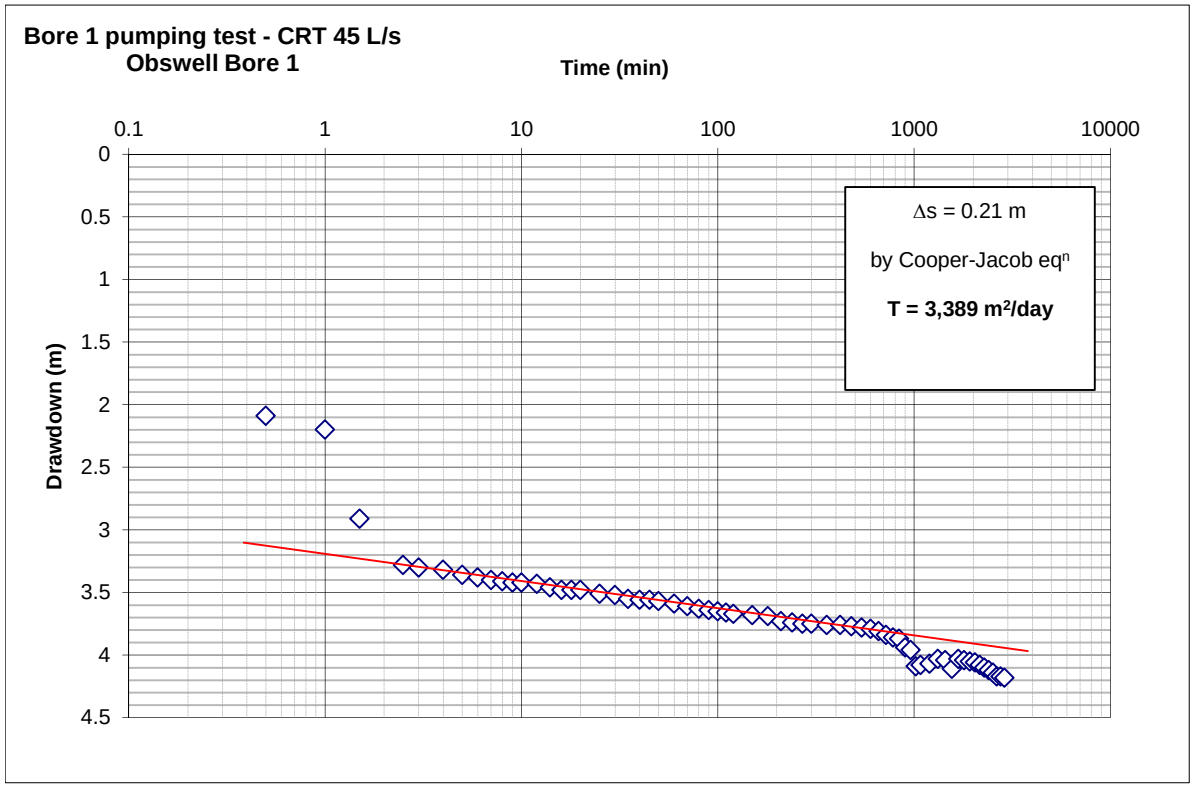
| Depth (m GL) | Material/grade | Diameter/size/type | Purpose |
|---|---|---|---|
| 0-73 | uPVC Cl 18 | 225 mm DN | Bore Casing |
| 73-75 | SS wedge-wire | 225mm DN, 0.06" slot | Well Screen |
| 75-77 | SS wedge-wire | 225mm DN, 0.07" slot | Well Screen |
| 77-85 | uPVC Cl 18 | 225 mm DN | Bore Casing |
| 85-91 | SS wedge-wire | 225mm DN, 0.04" slot | Well Screen |
| 91-93 | SS wedge-wire | 225mm DN, 0.05" slot | Well Screen |
| 68 | Cement basket | 12" | Cement plug |
| 93-107 | Cuttings backfill (natural) | | Rathole backfill |
| 0-68 | Cement | 5% bentonite | Annular seal |
| 68-93 | Natural development | | Filter pack |

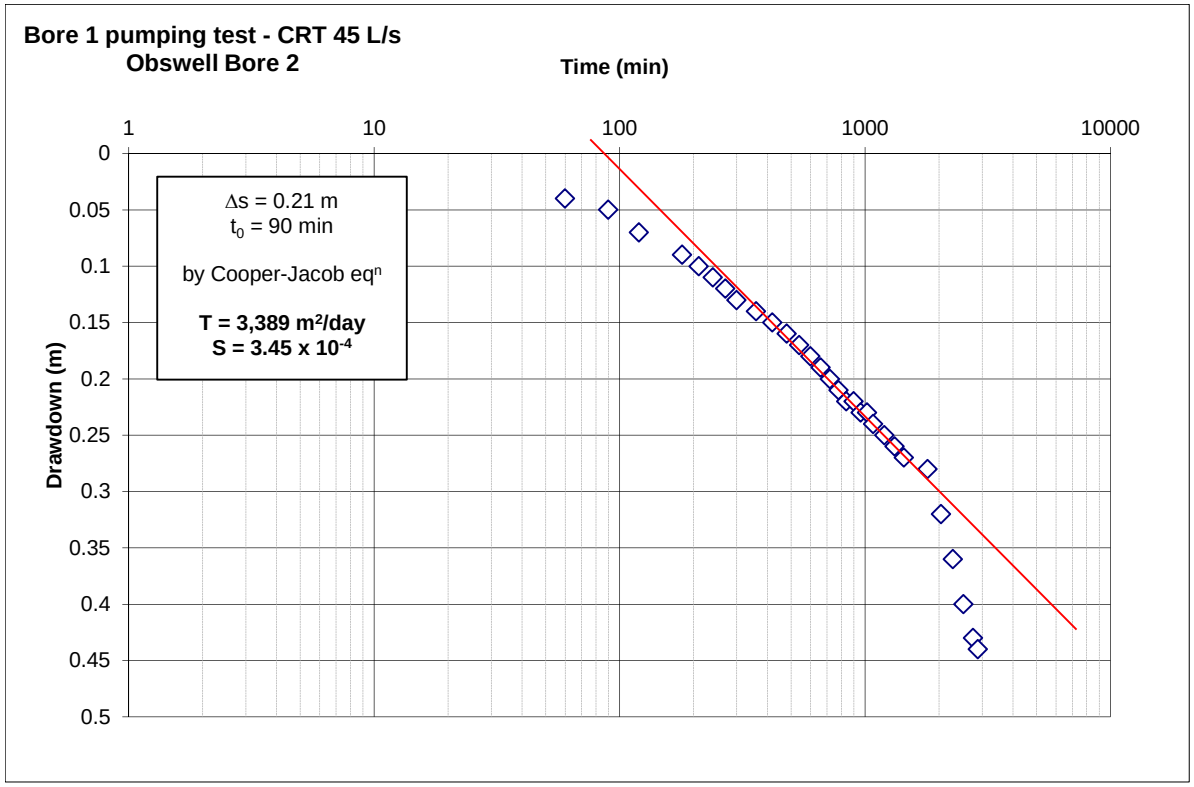
## Testing

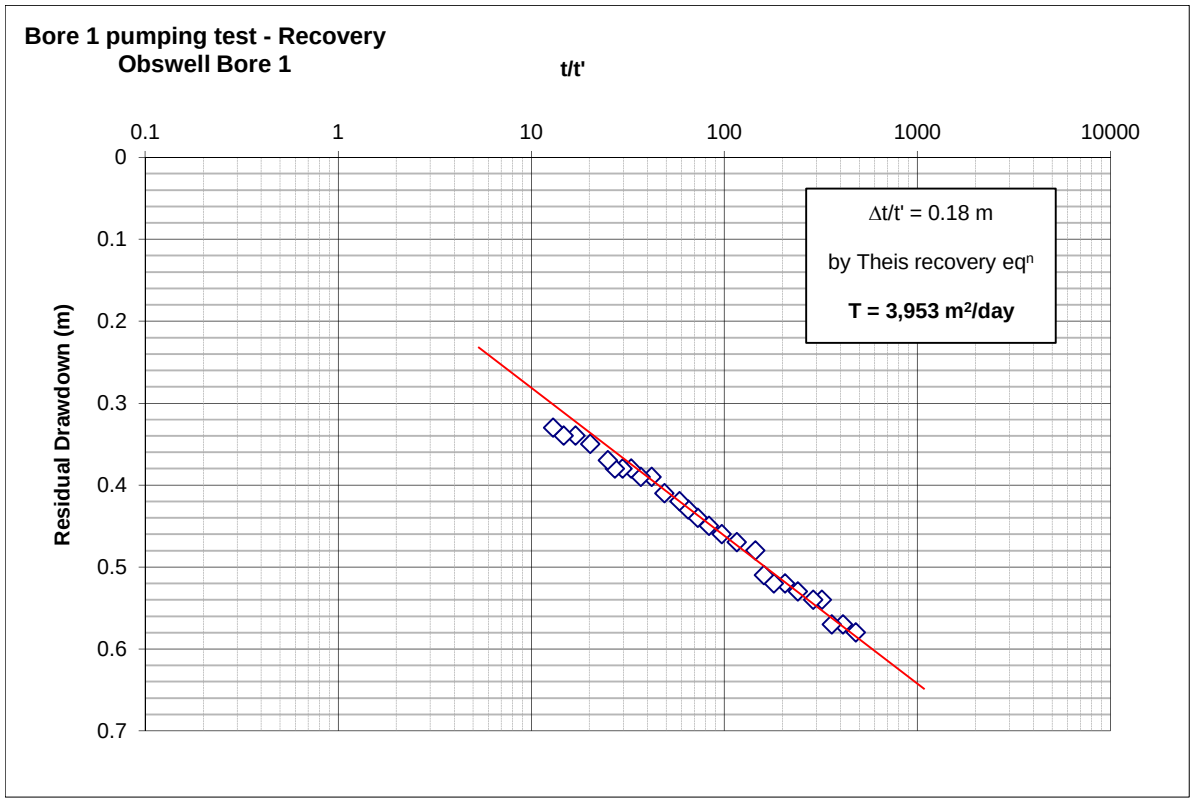
## Observations

| Water Strike (m GL) | Airlift yield (L/s) | Salinity | SWL (mTOC) | Other observations |
|---|---|---|---|---|
| | | | | |

## Appendix B – Aquifer Test Analysis




Bore 1 pumping test - Recovery
Obswell Bore 1
t/t'
0.1
1
10
100
1000
10000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Residual Drawdown (m)
Δt/t' = 0.18 m
by Theis recovery eqn
T = 3,953 m²/day