TECHNICAL NOTE 2012/06

Department for Environment, Water and Natural Resources

SOUTH EAST TOWN WATER SUPPLY – NARACOORTE TWS 13 – NARACOORTE, SOUTH AUSTRALIA

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Government of South Australia

Department of Environment, Water and Natural Resources

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INTRODUCTION

In early 2011 the former Department for Water (DFW)), now the Department for Environment, Water and Natural Resources (DEWNR), was contracted by the South Australian Water Corporation (SA Water) to drill and construct a production well for the township of Naracoorte in the South East region of South Australia, also known as the Limestone Coast. The well was part of a program of work undertaken during the first half of 2012 which also included the drilling and construction of wells at Millicent, Mount Burr, Lucindale and Kalangadoo. This report discusses the drilling and construction of production well Naracoorte TWS 13 which was drilled as replacement well for the existing production well Naracoorte TWS 8.

The original well was drilled by the Department of Mines in 1968 and used steel casing to support shallow unconsolidated sediments. Casing integrity checks indicated corrosion of the steel casing which was considered a risk to the long-term viability of the well.

Diverse Resources Group Pty Ltd was contracted to drill and construct the new well. Drilling of a pilot hole and installation of the fibreglass well casing occurred in March 2012 with the screen assembly later installed in May 2012.

DFW Groundwater Technical Services conducted aquifer testing in June 2012.

NARACOORTE TOWN WATER SUPPLY

Naracoorte is located about 100 kilometres north of the regional centre of Mount Gambier and is reliant on groundwater from the Dilwyn Formation confined aquifer to supply a population of about 5700 (2011 census).

The groundwater salinity in the vicinity of Naracoorte TWS 13 in the Dilwyn Formation is approximately 1300 mg/L.

SA Water wanted to increase the output from Naracoorte TWS 13 to 40 L/s, double the output from TWS 8 at 20 L/s.

Details of the Naracoorte production wells (historic and current) are given in Table 1. The location of the new and pre-existing wells is given in Fig. 1.

Table 1. Naracoorte production well details

Well name	Unit number	Drill date	Depth (m)	Obs date	DTW (m)	Obs date	TDS (mg/L)	Obs date	Yield (L/s)
Naracoorte TWS 1	7024-1630	1939	148.7	1939	13.41	1939	1360	2010	56
Naracoorte TWS 2	7024-1631	1940	163.7	1940	4.12	1950	1300	1987	20
Naracoorte TWS 3	7024-1632	1950	62.5	1950	3.05	1950	1385	1970	20
Naracoorte TWS 4	7024-1668	1958	175.3	1958	34.8	1992	895	1992	16
Naracoorte TWS 5	7024-1553	1961	152	1961	16.75	1993	1270	1970	41
Naracoorte TWS 6	7024-1780	1968	186	1968	n/a	n/a	1270	1970	25
Naracoorte TWS 7	7024-1781	1968	152.4	1968	n/a	n/a	1235	1970	44
Naracoorte TWS 8	7024-1670	1969	180.4	1969	37.19	1969	1245	2011	15
Naracoorte TWS 9	7024-1598	1975	160.3	1975	10.37	1975	1255	2011	41
Naracoorte TWS 10	7024-2698	1978	181	1978	n/a	n/a	1280	1986	38
Naracoorte TWS 11	7024-4128	1987	149	1987	15	1987	1250	2011	75
Naracoorte TWS 12	7024-4509	1991	178	1991	28.5	1991	1270	2011	
Naracoorte TWS 13	7024-6113	2012	176	2012	38	2012	1225	2012	40

Note:

* Dilwyn Fm completions except TWS 3 which is Gambier Limestone

Figure 1. Location of Naracoorte productions wells

WELL DESIGN AND CONSTRUCTION

Diverse Resources Group Pty Ltd was engaged by DWR to drill and construct the production well. The drilling rig employed for the drilling operations was an Atlas Copco T3W. This rig is capable of rotary air and rotary mud drilling methods.

The technical specification for the rig is given in Appendix A, along with some photographs of site operations).

The site of Naracoorte TWS 13 (Fig. 1) was jointly chosen by SA Water and DWR Hydrogeologists to target the sands of the Dilwyn Formation confined aquifer.

Drilling occurred in two separate phases, the initial drilling strata sample collection and setting of casing, followed by running the screen at a later date after strata sample analysis. The drilling contractor undertook other work for SA Water in the intervening period.

Naracooorte TWS 13 was drilled as a production well under permit number 206965 (well unit number 7024-6113) and was completed on 24 May 2012.

The final design of Naracoorte TWS 13 was based on information gathered during drilling. Strata samples were initially collected every two metres whch increased to every one metre through the aquifer zone. The well construction diagram (Fig. 2) shows the lithology encountered during drilling.

The well was drilled and constructed according to the following steps:

- The pilot drillhole was mud drilled to total depth at 191.2 m using a 230 mm (9.1 inch) blade bit to collect strata samples for use in the well design
- The top 6 m of the pilot drillhole was reamed using a 600 mm (23.6 inch) blade bit
- Steel surface control casing 450 mm (17.7 inch) ID was run into the drillhole to a depth of 6 m
- The first reaming run was undertaken to 150 m (near the casing point) using a 440 mm (17.3 inch) blade bit
- A second reaming run was undertaken to 180 m using a 300 mm (11.8 inch) blade bit
- A HETRON 922 Vinyl Ester Resin FRP 300 mm (11.8 inch) ID casing string with a 15.5 mm wall thickness was run into the drillhole to a depth of 145 m
- The casing was pressure displacement cemented to surface
- Following the return to site, the cement had set, the pilot drillhole was re-opened to 176 m using a 245 mm (9.6 inch) blade bit
- A stainless steel (316 grade) telescopic wire-wound screen 200 mm (8.7 inch) ID, 1.5 mm aperture, was set over the interval 162–174 m
- The screen was run with a Figure-K Packer and using a J-latch
- A riser pipe of 200 mm (8.7 inch) ID stainless steel (316 grade) zero-wound screen was set over the interval 140–162 m. This long length of riser pipe resulted from the initial decision to set casing to 145 m, which was followed by the analysis of the strata samples and the later decision to set the screen from 162 m.
- A sump of 200 mm (8.7 inch) ID stainless steel (316grade) zero-wound screen was set over the interval 174–176 m
- Development of the well was undertaken by airlifting from a number of depths in the well above the screen. A large amount of fine sand requiring removal from the screen. After three days of development the groundwater being produced was still turbid but the drilling rig was released from the work site. Further well development was undertaken prior to and during the pumping testing

- Development was slow due to very fine sand (90% passing through a 0.147 mm sieve) being produced. This fine sand was unexpected as the aquifer zone strata samples presented as very coarse sand with much of the sequence having 50% greater than 1.5 mm and one section having 50% greater than 2.5 mm. This fine sand was not observed in the cuttings. Removal of the cuttings during drilling required high mud flow and it appears the fine sand was trapped in suspension dropping out across the shale shaker
- The original TWS 8 required five days of development. If future drilling is required in this area, additional time for aquifer development should be allowed for, at least up to five days.

Sterilisation of the well was achieved by adding chlorine to the drilling fluid and maintaining this throughout the drilling process.

A final depth to water of approximately 38 m and an airlift yield of 60 L/s were recorded at the conclusion of drilling.

Groundwater salinity was 1200 mg/L (2250 uScm) based on the result of laboratory water chemistry analysis.

The Drillers Well construction Report (Schedule 8) is given in Appendix B and a water well log (including lithological / stratigraphic description) is given in Appendix C. Sieve analysis curves are given in Appendix D.

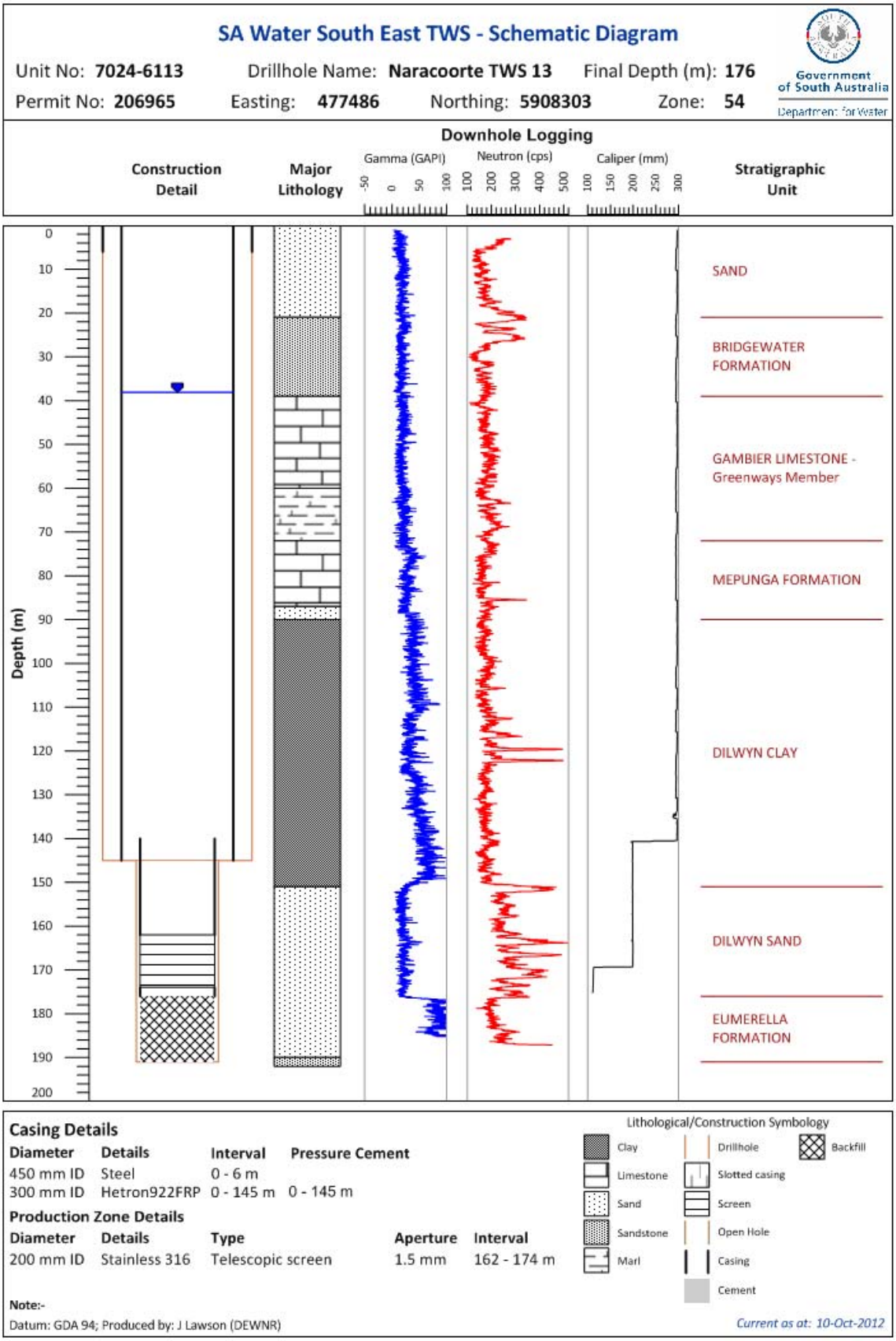


Figure 2. Well construction and lithological sequence Naracoorte TWS 13

GEOLOGY - HYDROGEOLOGY

Naracoorte is theoretically located on the up thrown side of the Kanawinka fault. The result of this is that relatively thin sequences of both the unconfined Gambier Limestone and confined Dilwyn Formation occur (33 m and 100 m in thickness respectively).

The aquitard between the Dilwyn Formation (the target aquifer) and the Gambier Limestone has a significant thickness of approximately 60 m. It can be described as soft, pliable clay with little fine sand.

The head difference between the unconfined and confined aquifers is approximately 4 m with the unconfined aquifer above the confined aquifer. Both aquifers have similar groundwater salinities of around 1200–1300 mg/L with the elevated salinity in the confined aquifer resulting from:

- Slow leakage from the unconfined aquifer to the confined aquifer via leakage through the 60 m thick aquitard driven by the head difference
- Downward leakage via the Kanawinka fault.

Higher salinity groundwater in the unconfined aquifer occurs in and around Naracoorte. The Australian Drinking Water Guideline suggests municipal supplies should aim to supply water below 1000 mg/L and ideally closer to 500 mg/L. Neither aquifer can provide groundwater meeting this standard.

Table 2. Stratigraphic sequence for Naracoorte TWS 13

Depth (m)	Lithological Description	Stratigraphic Description
0 – 21	Sand	Padthaway Sand
21 – 39	Sandstone	Bridgewater Formation
39 – 72	Limestone and Marl	Gambier Limestone
72 – 90	Sand	Mepunga Formation
90 – 150	Clay	Dilwyn Formation
150 – 177	Sand	Dilwyn Formation
177 – 192.5	Sandstone and mica	Eumeralla Formation

PUMPING TESTS

PUMPING TEST DESIGN

A pumping test (aquifer test) is conducted by pumping a well and observing the aquifer 'response' or drawdown in the well and / or neighbouring observation wells. Pumping tests are carried out on wells to determine one or more of the following:

- The aquifer and aquitard hydraulic parameters used to determine the ability of the aquifer to store and transmit water and which can be used in analytical and numerical groundwater modelling
- The existence and potentially location of sub-surface hydraulic boundaries which may affect, beneficially or adversely, the long-term hydraulic behaviour and pumping performance of the well
- The long-term pumping rate of the well
- The design efficiency of the well
- The performance of the groundwater basin.

In this case, pumping tests were required to determine:

- The maximum sustainable pumping rate for a range of pumping times
- The pump setting
- Whether dewatering of the aquifer was occurring.

The pumping tests that were conducted consisted of a step drawdown test and a constant rate discharge test.

STEP DRAWDOWN TEST

The step drawdown test allows determination of the hydraulic behaviour of the well under pumping stress. The step drawdown test usually consists of three or more steps at increasing pumping rates, but with the rate ramaining constant throughout each step.

The objective of step drawdown testing is to determine the well equation (Equation 1) which reflects the efficiency of the well design and relates drawdown, pumping rate and time. This equation (ideally) allows prediction of the hydraulic performance of production wells for a design pumping rate and generation of yield drawdown curves for any given time.

The well equation allows determination of the maximum sustainable pumping rate of the well and consequently the selection of a suitable pumping rate for the constant rate discharge test.

$$\mathbf{s(t) = (a\,Q + c\,Q^2) + b\,\log(t)\,Q} \qquad \textbf{Equation (1)}$$

Where:

s(t)	=	drawdown (m)
Q	=	pumping rate (m^3/min)
t	=	time (min)
a	=	constant related to well loss for laminar flow
c	=	constant related to well loss for turbulent flow
b	=	constant related to aquifer loss for laminar flow

and,

Well loss (m)	=	$a Q + c Q^2$
Aquifer loss (m)	=	b log(t) Q
Well efficiency	=	(aquifer loss as a percentage of S(t)

The specific capacity is defined as:

SC = Q/S	=	(L/s)/m of drawdown

CONSTANT RATE DISCHARGE TEST

The constant rate discharge test allows determination of the hydraulic behaviour of the aquifer system under pumping stress. The constant rate discharge test is conducted at a constant pumping rate for a duration commensurate with the intended use of the well, however this is often compromised by the cost of running long-term tests.

The water level data collected from the constant rate discharge test allows determination of:

- Aquifer and aquitard hydraulic parameters
- Presence of hydraulic boundaries which may have an effect on pumping sustainability under long-term operational pumping
- Dewatering of the aquifer system, which may have an effect on pumping sustainability under long-term operational pumping
- Interference of neighbouring production wells.

The constant rate discharge test should ideally be followed by a period of groundwater level monitoring during the recovery of he well, although this is frequently not undertaken to reduce cost. Recovery is ideally monitored until 95% of the drawdown has been recovered. The residual drawdown data can be used to determine whether interference effects are present from either recharge boundaries, or conversely from impermeable boundaries or dewatering of the aquifer:

- If no interference is present, the extrapolated residual drawdown should intersect the zero residual drawdown line at $t/t_1 = 1$
- If a recharge boundary has been encountered, the line will intersect the zero residual drawdown line at a value of $t/t_1 > 1$
- If dewatering has occurred or an impermeable boundary has been encountered, the line will intersect the zero residual drawdown line at a value of $t/t_1 < 1$.

Observations from monitoring during pumping provide important data for gaining a better understanding of the broader aquifer system. Data are more reliable than those measured in the production well where turbulence may exist due to the pump. The data indicate the extent of the hydraulic influence of the production well and allow accurate determination of aquifer and aquitard hydraulic parameters.

GROUNDWATER QUALITY TEST

Preliminary groundwater sampling for a town water supply production well with domestic application should be tested for the following suite of chemical parameters (G Dworak and J West (SA Water) 2011, pers. comm., 5 May):

- basic chemistry: TDS, Na, Ca, Mg, K, CO3, HCO3, Cl, F, SO4, hardness and alkalinity
- pH, colour and turbidity
- nutrients: NH3, NO3, NO2, soluble P and DOC
- metals (total and soluble): Al, Cd, Sb, Ni, Cu, Zn, Pb, Cr, Mn, Fe, As, Ba, Mo, Se, Hg, B, Ag, Be, I, CN, Sn, Zn, Br and U
- radioactivity.

PUMPING TEST RESULTS

CONDUCT OF TEST

The pumping tests conducted on Naracoorte TWS 13 consisted of a step drawdown test and a constant rate discharge test and recovery test over the period 12–14 June 2012. Test details are given in Table 3 and the results are given in Appendix E.

DFW Groundwater Technical Services conducted the testing. The well required further development prior to testing due to high turbidity water being pumped from the well. One day of pumping with continual pump stops and starts occurred prior to testing. The groundwater was clear after this further development. During this work pumping rates and groundwater levels were monitored and rates selected for the step drawdown test.

Groundwater samples were analysed at the Australian Water Quality Centre (AWQC) (Appendix F).

Table 3. Pumping test details Naracoorte TWS 13

Test type	Test date	Step	Duration (min)	Pumping Rate (L/s)
Step drawdown	12 June 2012	1	60	40
		2	60	45
		3	60	50
Constant rate discharge	13–14 June 2012	1	1440	40
Recovery	14 June 2012	–	90	0

STEP DRAWDOWN TEST

Analysis of the step drawdown results for Naracoorte TWS 13 (Fig. 3) leads to the following well equation:

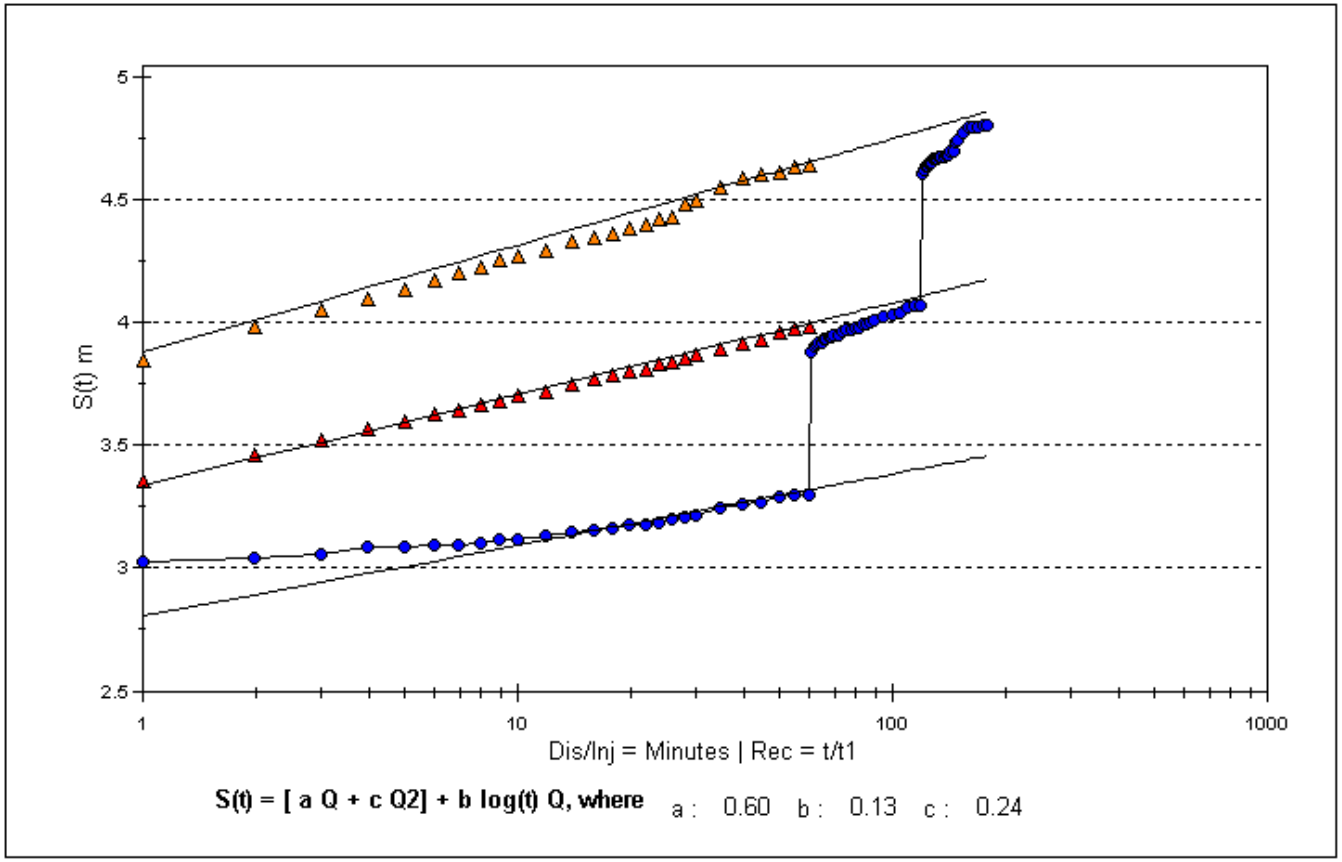
$$s(t) = 0.06\,Q + 0.24\,Q^2 + 0.13 \log (t)\,Q \qquad \text{Equation (2)}$$

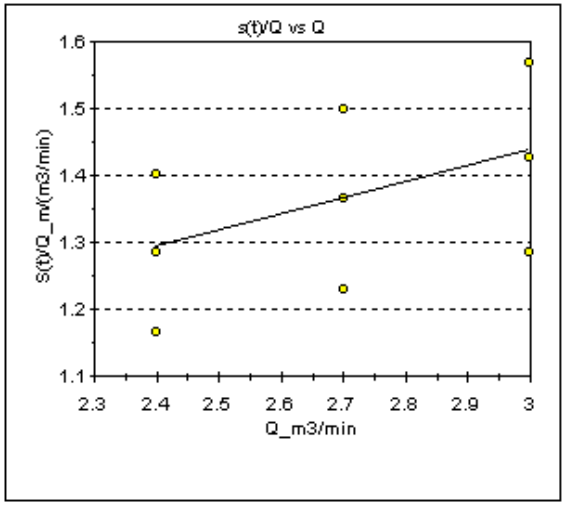
The well equation can be used as a predictive tool. Table 4 gives predicted drawdown after 1 000 000 minutes (approximately 2 years) of continuous pumping at a range of pumping rates. While the theoretical available drawdown is 107 m, drawdowns are very small and this would obviously never be utilised.

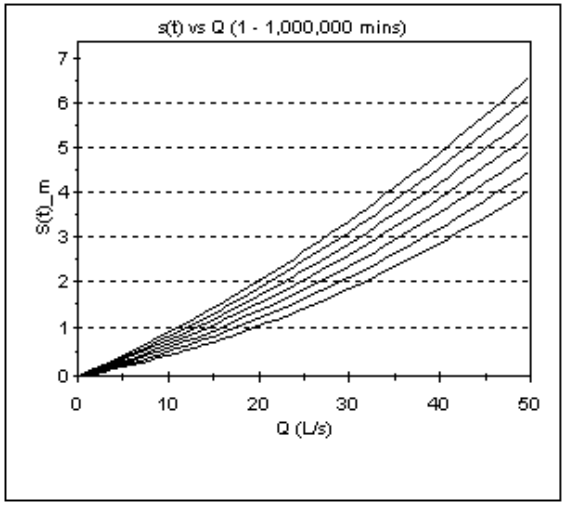
Table 4. Predicted drawdown Naracoorte TWS 13

Pumping rate (L/s)	DTW (m)*	Casing length (m)	Theoretical Available DD (m)	Duration (min)	Predicted DD (m)
40	38	145	107	1 000 000	4.69
45	38	145	107	1 000 000	5.47
50	38	145	107	1 000 000	6.29
55	38	145	107	1 000 000	7.15

* Measurement taken at start of step drawdown test and rounded to a whole number







TheStep	Q_L/s	Q_m3/min	Duration_min	St1	St1/Q	St10	St10/Q	St100	St100/Q	dS	dS/Q	T_m2/day
1	40.00	2.40	60	2.81	1.17	3.09	1.29	3.37	1.41	0.28	0.12	2227
2	45.00	2.70	60	3.33	1.23	3.69	1.37	4.06	1.50	0.37	0.14	1949
3	50.00	3.00	60	3.86	1.29	4.29	1.43	4.71	1.57	0.43	0.14	1860
maintest	40.00	2.40	1440									

Figure 3. Step drawdown test analysis of drawdown using Hazel method Naracoorte TWS 13

CONSTANT RATE DISCHARGE TEST

Production Well

Drawdown (residual drawdown) were recorded during the constant rate discharge test and recovery (Fig 4).

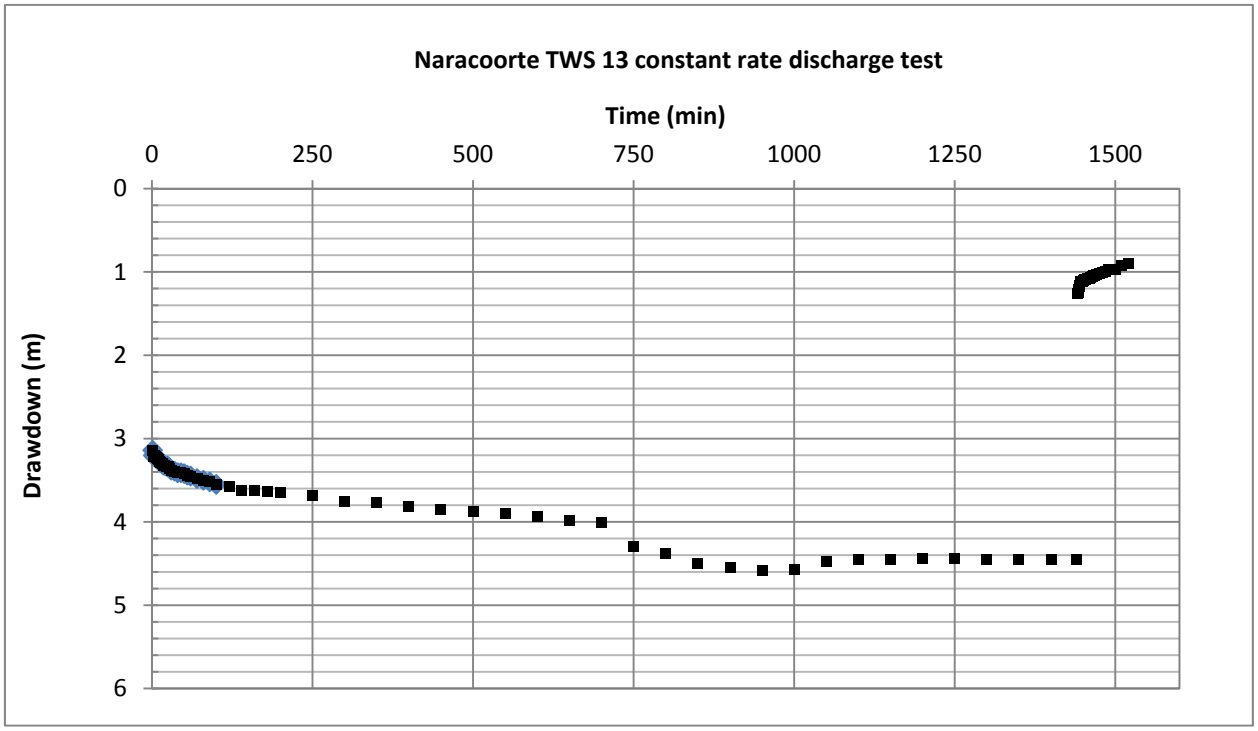


Figure 4. Linear- linear plot of drawdown Naracoorte TWS 13 constant rate discharge test

Drawdown versus time and residual drawdown versus t/t_1 (where t is the time since pumping began and t_1 is the time since pumping stopped) are given in Fig 5.

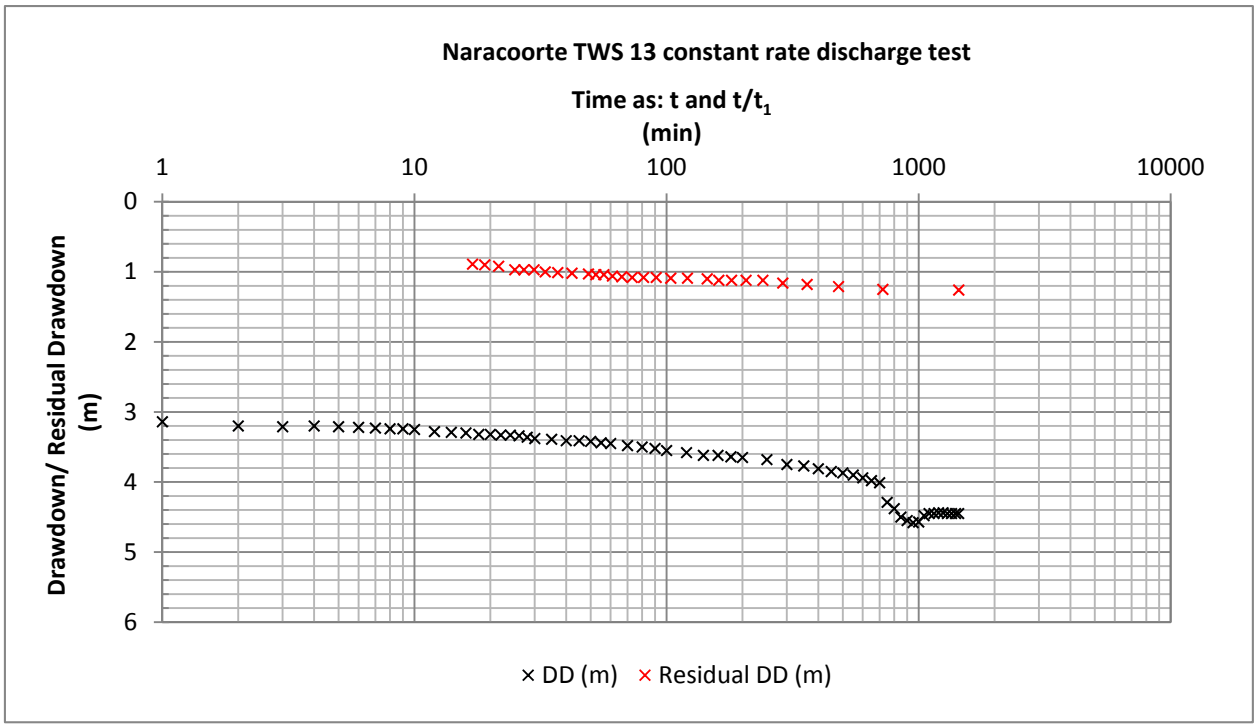


Figure 5. Log- linear plot of drawdown / residual drawdown Naracoorte TWS 13 constant rate discharge test

The following general comments can be made:

- A drawdown of 4.45 m developed during the test
- The drawdown is anomalous, i.e. does not plot as a straight line on a log-linear graph. Due to the significant development that had occurred, it is believed that this response is due to rearrangement of the aquifer particles close to the screen and due to some further development of the well. Alternatively there may be some hydraulic boundaries close to the well which are likely to be changes in hydraulic conductivity resulting from reduced grain size.
- The step drawdown test provided results that enabled a satisfactory analysis and derivation of the well equation, however the well equation cannot predict the observed drawdown from the constant rate discharge test due to the anomalous nature of the results (Fig. 6). Once the hydraulic behaviour of the well has been observed further the relationshjip between the well equation prediction of drawdown and actual drawdown can be revised.
- The specific capacity at 100 minutes was 11.27 L/s per metre of drawdown
- Well loss was approximately 73% of drawdown at the end of the test
- Recovery was monitored until residual drawdown was within 20% of the total drawdown developed. Monitoring of recovery was terminated after 90 minutes and the data are insufficient to make any conclusive comments in relation to the aquifer. It should be noted that that Dilwyn Formation is an extensive regional confined aquifer and its capacity to meet demand does not present a problem.

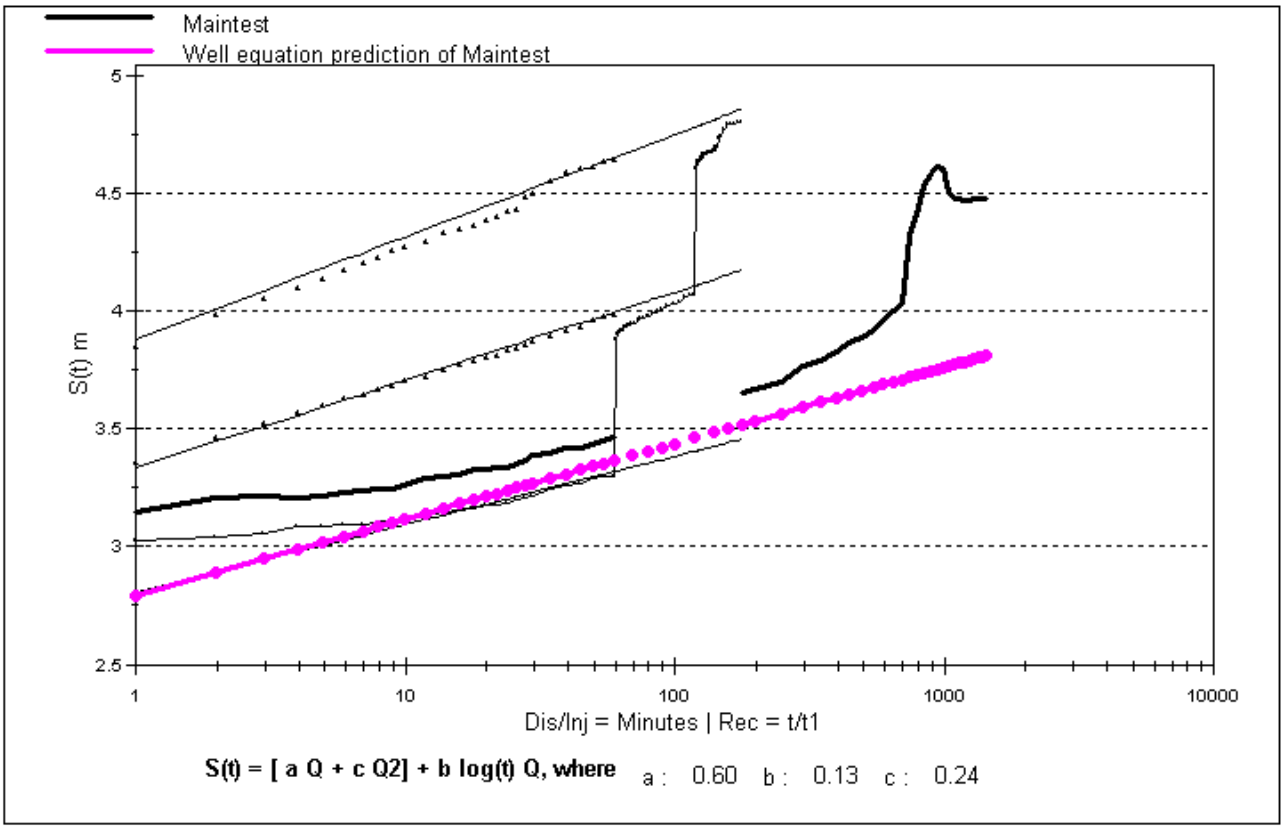


Figure 6. Well equation prediction of constant rate discharge test Naracoorte TWS 13

GROUNDWATER SALINITY

Groundwater salinity (Fig. 7) was continuously recorded in the field during the constant rate discharge test. Groundwater salinity decreased slightly (<25 mg/L) during the test ending at around 1225 mg/L. Groundwater salinity was 1200 mg/L (2250 uScm) based on the result of laboratory water chemistry analysis.

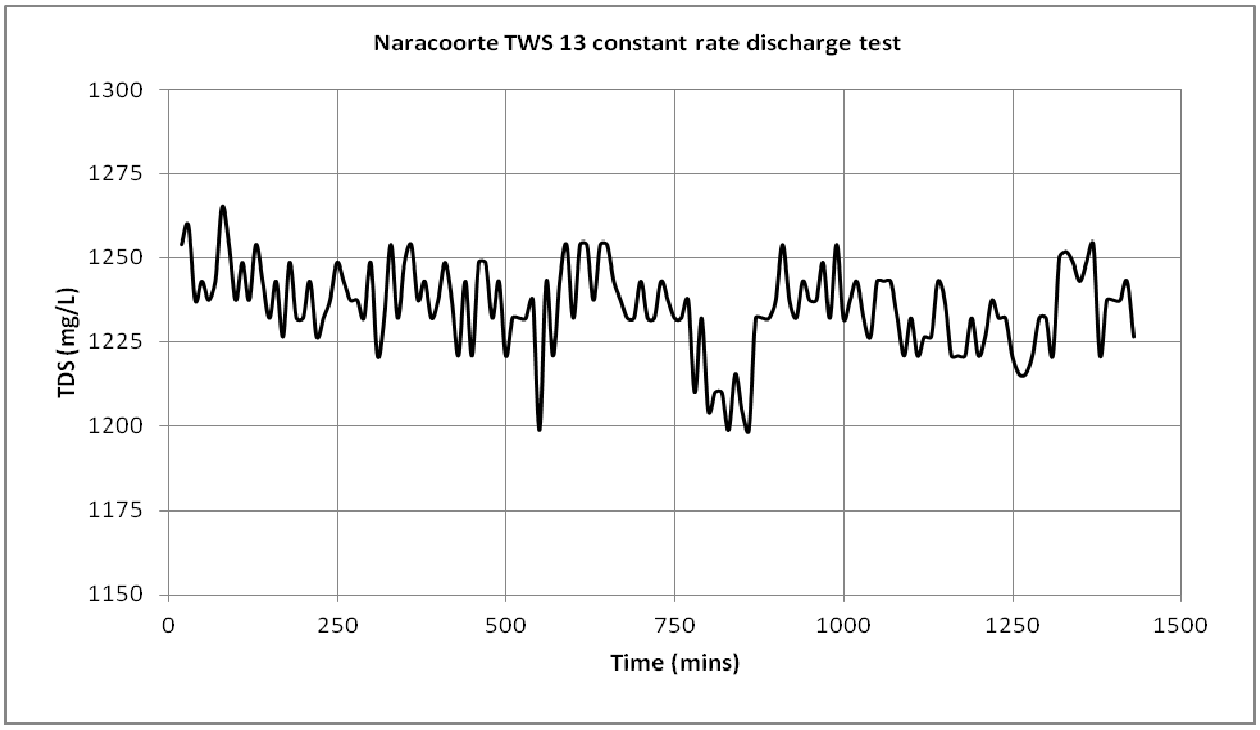


Figure 7. Groundwater salinity Naracoorte TWS 13 constant rate discharge test

RECOMMENDATIONS

It is recommended Naracoorte TWS 13 be pumped operationally and monitored for a full 12 months to confirm the long-term hydraulic behaviour of the well. The recommended pumping rate and pump depth are given in Table 5.

Due to the unusual signature of the drawdown obtained from the constant rate discharge test it would be useful to repeat it once the well has been in operation for some months.

The current program of work included the design, implementation and testing of the production well. The report includes a brief analysis and interpretation of the constant rate discharge test. This analysis and interpretation can be futher explored in a future program of work dealing with regional aquifer and aquitard assesment.

Table 5. Well completion details and pumping test summary Naracoorte TWS 13

	Parameter Description	Naracoorte TWS 13
Well Design	Target aquifer	Dilwyn Formation
	Assumed depth to water (m)	39 [1]
	Nominal casing inner diameter (mm)	300
	Casing length (m)	145
	Available drawdown (m)	106
SA Water Specification	Required pumping rate (L/s)	40
	Required pumping duration	4 h per day
	Modelled pumping rate (L/s)	40
	Modelled pumping duration	4 h (240 min)
	Predicted drawdown (m)	3.6
DFW Recommendation	Pumping rate (L/s)	40
	Pumping duration	6 h (360 min)
	Predicted drawdown (m)	3.6
	Pump intake depth (m)	54 [2]
	Resultant available drawdown safety factor (m)	11.4

Note:

[1] Measurement taken at start of constant rate discharge test and consertaviley rounded to next whole number

[2] Pump intake depth based on 3 metre pump column

APPENDIXES

A. ATLAS COPCO T3W SPECIFICATION

Atlas Copco

T3W Water Well Drill Specifications

U.S. UNITS

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GENERAL

The **T3W** is a hydraulic, top-head-drive drill rig designed for waterwell and other applications requiring air or mud rotary, as well as down-hole hammer drilling methods. The drill is suitable for drilling 5 – 12 in. holes but can drill up to 20 in. and handle up to 19 in. diameter casing. The rig is factory mounted on a ***Navistar 7600*** or ***Peterbilt 365*** truck, but is also available as a deck module (less truck) for mounting on a suitable chassis of your choice.

POWER PACK - 900 CFM / 350 PSI

Deck Engine

Make: Caterpillar C15 – 475 hp @ 1800 RPM
Fuel Tank: 160 gal. made of aluminum

Compressor

Make: Ingersoll-Rand HR2.5
Type: Over/under screw
Volume: 900 CFM
Pressure Range: 120 to 350 psi
Power Source: Direct coupled to deck engine
Manifold: The air regulation system enables the operator to adjust air volume and air pressure.

POWER PACK – 1070 CFM / 350 PSI

Deck Engine

Make: Caterpillar C15 – 575 hp @ 1800 RPM
Fuel Tank: 160 gal. made of aluminum

Compressor

Make: Ingersoll-Rand HR2.5
Type: Over/under screw
Volume: 1070 CFM
Pressure Range: 120 to 350 psi
Power Source: Drive from deck engine through standard in/out box
Manifold: The air regulation system enables the operator to adjust air volume and air pressure.

Deck Engine Starting Aid (Optional)

Diesel-fired coolant pre-heater with ether injection

HYDRAULIC SYSTEM

Tank Capacity: 100 gal.
Filtration: Hydraulic oil filtered through 3-micron elements

Axial Piston Pumps

Main pump: 96 GPM @ 4,750 psi
Fan pump: 40 GPM @ 3,000 psi
Auxiliary pump: 50 GPM @ 4,750 psi
Mud pump: 50 GPM @ 4,750 psi

Functions: Leveling jacks, retractable table, derrick raising cylinders, water injection, carousel, breakout wrench, fast feed, drawworks, hydraulic cooling fan, drill feed (pullback/pulldown), jib boom, auxiliary hoist

Axial Piston Pump, Top-head Rotation

Standard Rotary Head: 79 GPM @ 4,500 psi

COOLING PACKAGE

The 5-section cooling package is designed to cool the hydraulic oil, compressor oil, engine fuel, engine coolant and turbo-charged air.

Hydraulic Fan Drive: On-demand technology to run fan at minimum speed to maintain optimum temperature on all fluids.
Fan Size: 54 in. diameter, suction type
Cooling Capacity: Rated at 125°F ambient at sea level

DERRICK

Construction: Welded cold-finished rectangular-steel tubing
Structural Capacity: 45,000 lbs.
Main Cord Length: 35 ft. 6 in.
Width: 36 in.
Depth: 28 in.
Head Travel: 27 ft. 4 in.
Maximum Working Clearance: 37 ft. 5 in. from hoist line hook to top of table; 29 ft. 2 in. from bottom of rotary head spindle to the table with the head at the top of the derrick.

FEED SYSTEM

The **T3W** uses a single-cylinder, cable-feed system. The feed cylinder is connected to the head with pre-stretched cables to transmit pullback and pulldown. Long cable and sheave life is ensured by using 24 ½ in. nylon-composite sheaves with a D:d ratio of 28:1 between sheave and 7/8 in. cable.

Hydraulic Cylinder: Single 5 in. x 3 ½ in. bore; 165 in. stroke
Cable diameter: 7/8 in.
Sheave diameter: 24 ½ in.
Drill Feed Rate: 20 ft./min.
Fast Feed Rate Down: 150 ft./min.
Fast Feed Rate Up: 150 ft./min.
Pulldown Capacity: 25,000 lbs. depending on truck weight
Pullback Capacity: 40,000 lbs.

ROTARY HEAD OPTIONS

Type: Four-motor, spur-gear, rotary top-head
Piping/Swivel: 3 in. air piping with 3 in. ID spindle

a) 5,500 ft.-lbs. @ 145 RPM single-speed rotary head - standard
b) 5,500 ft.-lbs. @ 145 RPM and 4,000 ft.-lbs. @ 195 RPM two-speed rotary head
c) 6,250 ft.-lbs. @ 134 RPM single-speed rotary head
d) 6,250 ft.-lbs. @ 134 RPM and 4,650 ft.-lbs. @ 180 RPM two-speed rotary head
e) 8,000 ft.-lbs. @ 105 RPM single-speed rotary head
f) 8,000 ft.-lbs. @ 105 RPM and 5,500 ft.-lbs. @ 145 RPM two-speed rotary head

TORQUE LIMIT CONTROL

Standard console-mounted control to adjust rotary head torque.

RETRACTABLE TABLE

Retracted by one 3 ½ in. bore x 10 in. stroke hydraulic cylinder.

Table Opening: Full 20 in. diameter in the closed position with bushings removed. Depending on carousel option, either 15 in. or 20 in. clearance up the derrick.
Table Base: Consists of two half plates. The rear half retracts and the front half is hinged to swing out to enable handling of large tools or casing.
Holding Wrench: An air-operated wrench that fits the drill pipe flats is standard.

CAROUSEL

Contained in the derrick in a fixed position; rotated by hydraulic motor in both directions from the console. Rotary head retracts to load/unload the drill pipe. Depending on carousel diameter either 15 in. or 20 in. opening along the tower is available.

Capacity: Nine – 3 ½ in. x 20 ft. pipe – at max 14 in. casing
***Seven –** 3 ½ in. x 20 ft. pipe – at max 19 in. casing
Seven – 4 ½ in. x 20 ft. pipe – at max 14 in. casing
***Six –** 4 ½ in. x 20 ft. pipe – at max 19 in. casing
*Allows access to full 20 in. opening up derrick

Dual Wall Carousel: Six 4 ⅝ in. x 20 ft. pipe / 4 ½ in. spindle

PIPE RACK

Mounted on the left side of the deck, this storage rack holds sixteen 3 ½ in. x 20 ft. drill pipe or twelve 4 ½ in. x 20 ft. drill pipe. A pipe slide is included as standard equipment. Standoff ribs at the end of the pipe rack allow for convenient use of the sling and hook.

BREAKOUT WRENCH

Hydraulic Cylinder: 3 ½ in. bore x 10 in. stroke; 1 ½ in. rod diameter hydraulic cylinder.
The cylinder operates a self-adjusting, cam-action breakout wrench that is included with the standard rig and is suitable for 3 ½ in. and 4 ½ in. OD diameter drill pipe.

DRILL PIPE

a) 4 ½ in. OD x 20 ft. long
2 ⅞ in. API IF box up/pin down connections (standard)
3 ½ in. API regular box up/pin down connections (optional)
3 ½ in. wrench flats on box end
Weight is approximately 345 lbs.

b) 3 ½ in. OD x 20 ft. long
2 ⅜ in. API IF box up/pin down connections
2 ¾ in. wrench flats on box end

Pipe Spinner (Optional)

For attaching/detaching drill pipe. Hydraulic motor/pneumatic cylinder design.

Pipe Size: 3 ½ in.	4 ½ in.
Torque: 80 ft.-lbs.	80 ft.-lbs.
Speed: 395 RPM	395 RPM
Range: 3 ⅛ – 3 ½ in.	4 ⅛ – 4 ½ in.

Single Pipe Loader (Optional)

For loading 3 ½ in. x 20 ft. or 4 ½ in. x 20 ft. pipe.
Facilitates pipe handling after the carousel is empty.

Floating Spindle Sub (Optional)

This sub has the function of reducing the DTH hammer shock and vibration.
The floating spindle sub offers 2 ½ in. float (extension).

DRAWWORKS

Standard Drawworks

Lifting Capacity: 18,000 lbs. single line, bare drum (over centerline only)
Speed Up/Down: 165 ft./min. single line, bare drum
Jib Boom: Swings and extends hydraulically so that it can be positioned over the hole or over the pipe rack.
Supplied with 150 ft. of 5/8 in. rotation resistant cable and a 20-ton rod hook.
Controls on operator's and helper's sides. Simultaneous drawworks and fast feed operation is possible.

Optional Drawworks

Lifting Capacity: 30,000 lbs. single line, bare drum (over centerline only)
Speed Up/Down: 120 ft./min. single line, bare drum
Jib Boom: Swings and extends hydraulically so that it can be positioned over the hole or over the pipe rack.
Supplied with 150 ft. of 7/8 in. rotation resistant cable and a 20-ton rod hook.
Controls on operator's and helper's sides. Simultaneous drawworks and fast feed operation is possible.

OPTIONAL HOIST SELECTIONS

Auxiliary Hoist

Lifting Capacity: 3,900 lbs. average capacity
Speed Up/Down: 220 ft./min. – average speed, no free fall
Cable Capacity: 120 ft. x 3/8 in.
Mounted on back of derrick for handling casing, drill pipe and tools. This option includes a reel control on the helper's side. (**The auxiliary hoist is not available with sand reel.)**

Sand Reel

Lifting Capacity: 3,000 lbs. average capacity (2,250 lbs. full drum capacity)
Speed Up/Down: 300 ft./min. – average speed, no free fall
Cable Capacity: 1,500 ft. x 5/16 in.
Mounted on the lower rear of the derrick for handling of survey tools, casing, drill pipe and tools.
Carries more cable for bailing or setting screens. This option includes a control on the helper's side.
(The sand reel is not available with auxiliary hoist.)

CONSOLE AND PLATFORM

All drilling operations are controlled from the operator's console located at the right rear of the rig. The slim profile and quick-opening side panels provide easy access for maintenance and service. An aluminum console cover is standard. The operator and helper work on large, heavy-duty steel mesh platforms that fold up for transport. A steel insert drops in between the two platforms, converting the separate platforms into one continuous surface. An optional aluminum platform is available.

LEVELING JACKS

All truck-mounted or modular T3W's are supported with four hydraulic jacks
Drill End: Two 5 ¾ in. bore x 36 in. stroke jacks with 18 in. jack pads
Non Drill End: Two 5 ¾ in. bore x 48 in. stroke jacks with 18 in. jack pads, mounted behind the cab

WATER INJECTION SYSTEMS

The **T3W** can be configured with various water injection packages, all operating at 550 psi maximum pressure.
The following options are available:

1. **Cat Piston Pump Capacity:** 0 to 12 GPM (supplied with pulse pump for foam injection)
2. **Bean Piston Pump Capacity:** 0 to 18 GPM
3. **Cat Piston Pump Capacity:** 0 to 25 GPM (supplied with pulse pump for foam injection)
4. **Bean Piston Pump Capacity:** 0 to 25 GPM
5. **FMC Piston Pump Capacity:** 0 to 35 GPM (with capacity to operate at up to 1,000 psi)

6

MUD PUMPS

The **T3W** can be configured with various on-board mud pump packages, all of which are supplied with suction hose and foot valve/strainer. The following options are available:

a) Hydraulic components, controls and piping to operate an off-board hydraulic powered 5 in. x 6 in. or 5 ½ in. x 8 in. mud pump.
A quick disconnect manifold with hydraulic filter is included on the rig.

b) 3 in. x 4 in. Mission centrifugal mud pump mounted in vertical position near the mid jack, driller's side
Flow and pressure: 150 GPM @ 310 psi

c) 5 in. x 6 in. Gardner Denver duplex piston pump, mounted between cab and deck
Flow and pressure: 300 GPM @ 145 psi

d) 7 ½ in. x 10 in. Centerline mono pump mounted between cab and deck
Flow and pressure: 150 GPM @ 350 psi

e) 7 ½ in. x 10 in. Centerline duplex pump, mounted between cab and deck
Flow and pressure: 300 GPM @ 350 psi

Options c, d and e require extended chassis, 254 in. wheelbase

AIR PIPING SELECTION

a) Standard Air Piping – 3 in. with piping on top head 3 in. hanging and pivot hoses 2 in. stand pipe on deck
b) Optional – 2 ½ in. hanging and pivot hoses
c) Hi-Pressure Air Piping (option) – 3 in. with piping rated at 1500 psi
This option includes a manifold with outlet for the on-board air to facilitate connection of external booster air as well as an electric blow-down valve.

Down Hole Hammer Lube Injection (Optional)

Capacity: 7 gal.
Flow Adjustment: Manually adjustable
The injection lubricator is mounted under the deck in front of the toolbox.

AUXILIARY AIR MANIFOLD

A 3 in. @ 1500 psi high pressure circulation piping system for use with an auxiliary compressor and/or booster compressor.
The high pressure (1500 psi) circulation piping option must be ordered to use this option.

STANDARD TOOLS AND ACCESSORIES INCLUDED WITH RIG

- Rod wiper
- Drill pipe centralizer bushings
- Road hazard kit
- Two maintenance/operator's manuals
- Hoist plug for drill pipe
- Feed cable adjusting tool
- Pipe handling sling
- Two printed parts books, two parts books on CD

SHIPPING DIMENSIONS

***Weight:** 56,500 lbs.
Width: 96 in.
Length, Derrick Down: 37 ft. 8 in.
Height, Derrick Down: 13.5 ft.
Height, Derrick Up: 43 ft. 1 in.
Derrick Dimensions: 28 in. x 36 in. x 34 ft.

*Weight for T3W mounted on *Navistar 7600* 6 x 4 with 1070 Compressor, no mud pump or rods, rig and truck fuel levels at half of tank and hydraulic fuel level at full tank.

TRUCK SPECIFICATIONS - NAVISTAR 7600, 6 x 4 (STANDARD)

Manufacturer: International Truck and Engine Corporation

GVWR: 68,000 lbs.

Chassis Weight: 17,000 lbs.

Dimensions:	**Standard W.B. 232"**	**Extended W.B. 254"**
Wheelbase:	232 in.	254 in.
Overall Length:	372 in.	382 in.
Cab to Rear Axle:	169 in.	191 in.
Rear Axle to End of Frame:	59 in.	59 in.

Engine: Caterpillar C13, 380 hp @ 2,100 RPM, electronic controls, 1,450 ft-lbs. torque, 50-state diesel engine fitted with Jacobs Brake

Frame: 10 ¼ in. C channel, heat-treated alloy steel

Cab: All-welded steel cab

Control System: International Diamond Logic electrical system – allows engine, transmission and panelto communicate electronically

Transmission: Fuller FRO-14210C, 10-speed with overdrive and air shift

Brakes: Dual air brake system, air cam operated, 16 ½ in. x 6 in. front, 16 ½ in. x 7 in. rear

Wheel Control: Air brake ABS, full vehicle wheel control system

Rear Axles: 46,000 lbs. Meritor RT-46-164EH, 4.89 gear ratio

Rear Suspension: Steel walking beam, Hendrickson RT2-460

Front Axle: 22,000 lbs. steel

Front Suspension: Parabolic tapered leaf springs with rubber auxiliary springs and shock absorbers

Front Wheels: Polished aluminum disk 22 ½ in., 10-stud, hub-piloted

Front Tires: 425/65R22.5 20-ply radial

Rear Wheels: Dual, 22.5 x 8.25 polished aluminum 10-stud, hub-piloted

Rear Tires: 11R22.5 14-ply radial

Fuel Tank: 80 gal., D-style steel, LH under cab

Tandems: Driver-controlled, locking main differentials in both rear axles

Cab: Atlas Copco yellow paint, tilting fiberglass hood with 3-piece construction, conventional steel, tinted windows, digital display gauge cluster, air suspension high-back driver seat, breakaway mirrors, AM/FM radio with weather band, air conditioning

Cold Weather Start: 110-120V block heater

Dress-up Upgrade (Standard)

- Motorized right hand mirror
- Chrome exhaust
- Chrome bumper
- Aluminum wheels

Premium Cab Upgrade (Options)

- CD player
- Engine oil temp. gauge
- Heated chrome breakaway mirrors
- Power windows
- Eagle trim
- Power locks
- Rear axle temp. gauge
- Keyless remote entry
- Transmission oil temp. gauge

UPGRADES FOR STANDARD 7600

Fuller 908 LL transmission, 410 hp Paystar, 52,000 rear axles with DiffLock™ both rear axles - No spin Detroit lockers option available in forward rear axle

TRUCK SPECIFICATIONS - NAVISTAR PAYSTAR 5600i, 6 x 4 (STANDARD)

Manufacturer: International Truck and Engine Corporation

GVWR: 68,000 lbs.

Chassis Weight: 18,800 lbs.

Dimensions:

Wheelbase: 21 ft. 2 in.
Overall Length: 31 ft. 2 in.
Cab to Rear Axle: 16 ft.
Rear Axle to End of Frame: 68 in.

Engine: Caterpillar C13, 380 hp @ 2,100 RPM, electronic controls, 1,450 ft-lbs. torque, 50-state diesel engine fitted with Jacobs Brake

Frame: 12 ¼ in. full outer channel frame reinforcement

Cab: Riveted aluminum cab
Transmission: Fuller FRO-14210C, manual 10-speed
Brakes: Air brakes with 13 CFM compressor minimum
Rear Axles: 46,000 lbs., Meritor RT 46-160, 4.89 gear ratio
Rear Suspension: Hendrickson RT2-460
Front Axle: 22,000 lbs.
Front Suspension: Multi-leaf
Front Wheels: Disk style
Front Tires: 425/65R22.5 20-ply radial
Rear Wheels: Disk style
Rear Tires: 11R22.5 14-ply radial
Fuel Tank: 100 gal., mounted on passenger side
Tandems: Driver-controlled, locking main differentials in both rear axles
Braking Assist: Jacobs Brake
Bumper: Chrome, heavy-gauge steel with integral jack and heavy-duty tow hook
Cold Weather Start: 110-120V block heater

UPGRADES ON NAVISTAR PAYSTAR 5600I

Fuller 908 LL transmission, 410 hp Paystar, 52,000 rear axles. DiffLock™ in rear-rear axle and no-spin Detroit lockers in the front-rear axle

Dress-up Upgrade (Standard)

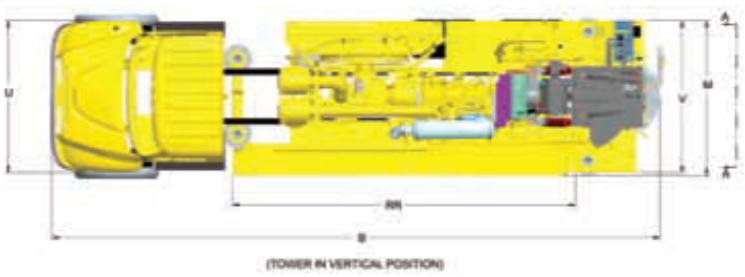
- Motorized right hand mirror
- Chrome exhaust
- Chrome bumper
- Aluminum wheels

Premium Cab Upgrade (Options)

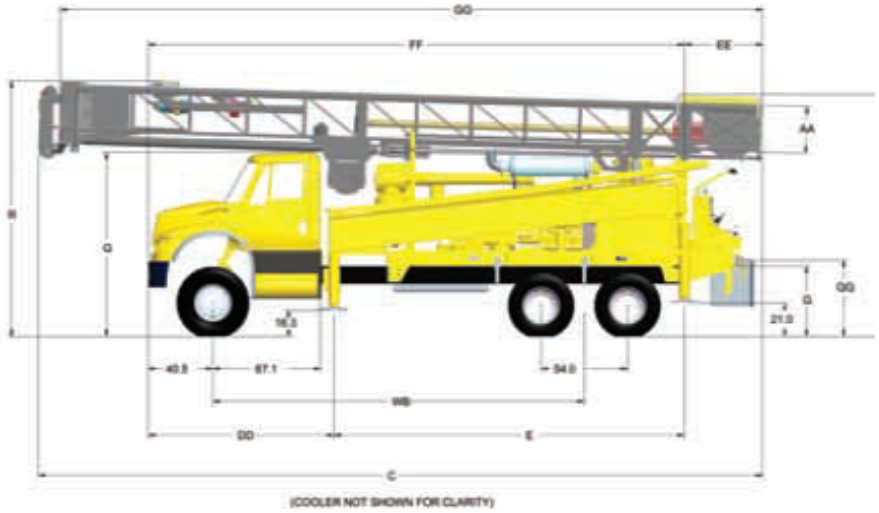
- CD player
- Engine oil temp. gauge
- Heated chrome breakaway power mirrors
- Power windows
- Eagle trim
- Power locks
- Rear axle temp. gauge
- Keyless remote entry
- Transmission oil temp. gauge

TRUCK SPECIFICATIONS - PETERBILT 365, 6 x 4 (OPTIONAL)

Manufacturer: Peterbilt Truck Corporation
GVWR: 68,000 lbs.
Dimensions:
Wheelbase: 19 ft.4 in.
Overall Length: 31 ft.
Cab to Rear Axle: 15 ft. 5 in.
Rear Axle to End of Frame: 59 in.
Engine: Caterpillar C-13, 350 hp @ 2,100 RPM, 420 hp @ 1,600 RPM
Frame: 11 5/8 in. steel rails, steel crossmembers and 3/8 in. rail thickness
Transmission: Fuller FRO-15210C, 10-speed
Brakes: CAT compression brake or C-Brake by Jacobs-ISM
Rear Axles: 46,000 lbs., Dana Spicer, D46-170P, 4.78 gear ratio
Rear Suspension: Hendrickson RT-463 46,000 lbs.
Front Axle: 22,000 lbs. Dana Spicer
Front Suspension: 23,000 lb. taper leaf with shocks
Front Wheels: 22.5x13 Alcoa aluminum
Front Tires: 425/65R22.5 20-ply
Rear Wheels: 22.5x8.25 Steel Wheels
Rear Tires: 11R22.5 M711, 14-ply
Fuel Tank: 100 gal. aluminum
Brake Assist: Jacobs Brake
Cab: Tinted glass, interior noise reduction package and A/C
Tandems: Differential lock, both axles
Cold Weather Start: 110 - 120V 1500 Watts Phillips block heater



(TOWER IN VERTICAL POSITION)



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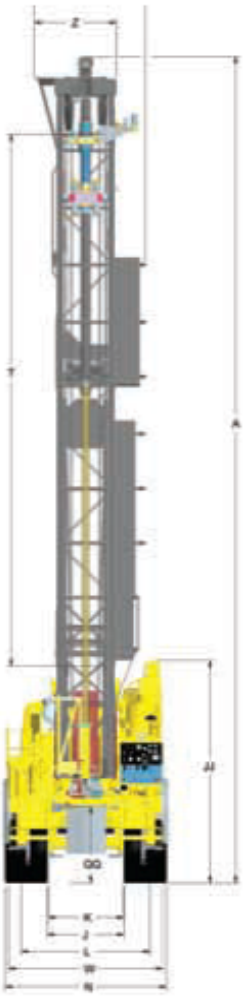
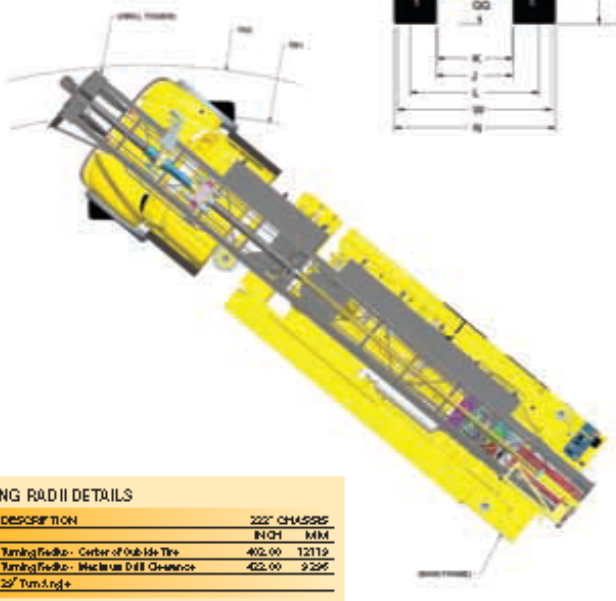




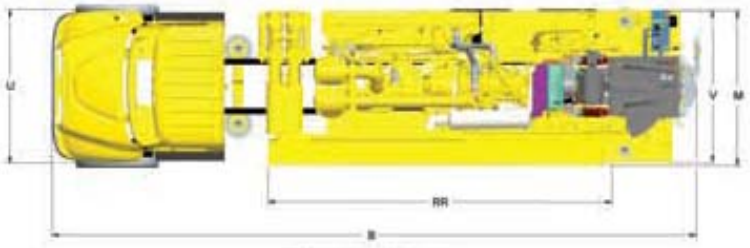
T3W - 232" CHASSIS WITH TRUCK
SPECIFICATIONS

	DESCRIPTION	INCH	MM
A	Height - Overall, Tower Up	51.630	12119
B	Length - Overall, Tower Up	366.00	9296
C	Length - Overall, Tower Down	452.00	11481
D	Width - Across Outside of Front Tire	94.00	2388
E	Length - Jack Center to Jack Center	219.00	5562
F	Height - Jack to Ground, Drill End	21.00	533
G	Height - Mainframe to Ground	44.00	1118
H	Height - Overall, Tower Down, Drill End	151.50	3848
J	Width - Wheel Inside to Wheel Inside	46.00	1168
K	Width - Mid-Jack Centers	47.00	1194
L	Width - Rear Jacks Centers	80.50	2045
M	Width - Overall	96.00	2438
N	Width - Wheel	24.00	610
O	Height - Ground to Cabin Top	111.50	2834
R	Height - Overall, Tower Down, Monodrill End	160.00	4064
T	Rotary Head Travel	220.00	5588
U	Cabin Width	96.00	2438
V	Width - Mainframe, Drill End	95.00	2412
W	Width - Across Outside of Rear Tires	94.00	2388
Y	Length - Mainframe	216.00	5486
Z	Width - Tower, Crown	51.50	1308
AA	Depth - Tower Side View	29.50	749
BB	Height - Mid-Jack to Ground	16.50	419
DD	Length - Front Bumper to Mid-Jack	112.00	2870
EE	Length - Tower Support Cleats to Tower Rear Edge	48.50	1232
FF	Length - Front Bumper to Tower Support Cleats	222.00	5642
GG	Length - Tower, Side View	429.50	11162
JJ	Height - Ground to Cooler	129.00	3521
PP	Width - Tower Edge to Hose Tray	66.00	1676
QQ	Height - Ground to Drill Table	48.50	1232
RR	Length - Rod Box	214.50	5448
SS	Length - Between Centers of Rear Wheels	54.00	1372
WB	Length - Wheelbase	222.00	5592

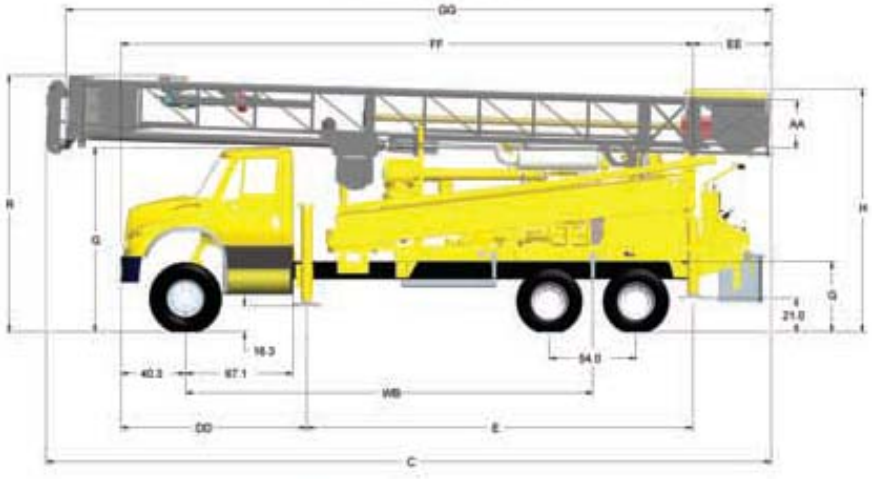
TURNING RADII DETAILS

	DESCRIPTION	222" CHASSIS	
		INCH	MM
TR1	Turning Radius - Center of Outside Tire	402.00	12119
TR2	Turning Radius - Maximum Drill Clearance	422.00	9296
A	25° Turning		

10



(TOWER IN VERTICAL POSITION)



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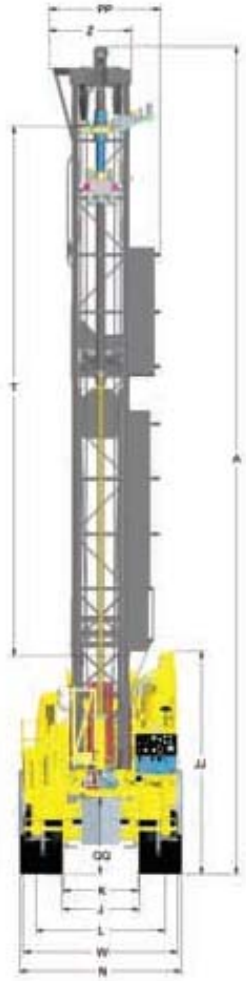
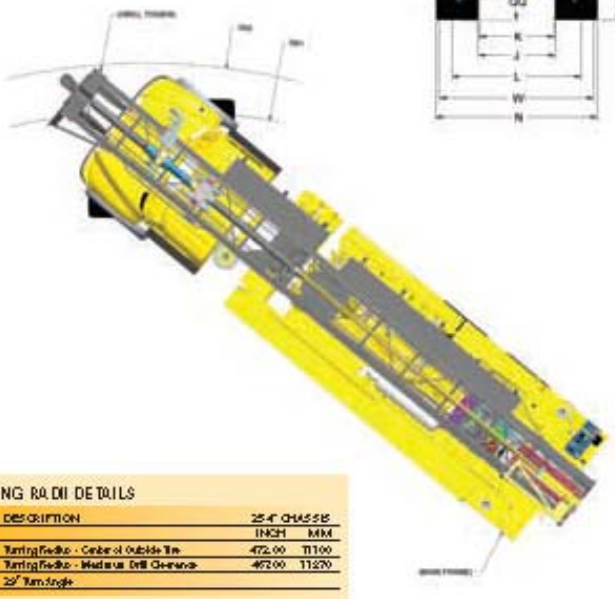


T3W - 254" CHASSIS WITH TRUCK

SPECIFICATIONS

	DESCRIPTION	INCH	MM
A	Height - Overall, Tower Up	516.50	12119
B	Length - Overall, Tower Up	401.70	10202
C	Length - Overall, Tower Down	422.20	11422
E	Length - Axle Center to Axle Center	240.40	6719
Q	Height - Mid Frame to Ground	44.00	1118
H	Height - Overall, Tower Down, Drill End	151.20	3840
J	Width - Inside Rear Tire	47.80	1217
K	Width - Mid Axle Centers	47.00	1194
L	Width - Rear Axle Centers	80.50	2045
M	Width - Overall	97.10	2466
N	Width - Outside Front Tires	100.80	2562
Q	Height - Ground to Top of Cab	115.20	2929
R	Height - Overall, Tower Down, at Crown	159.80	4059
T	Rotary Head Travel	220.00	5588
U	Cabin Width	96.00	2438
V	Width - Mainframe, Drill End	95.00	2412
W	Width - Outside Rear Tires	96.20	2442
X	Width - Tower, Crown	51.50	1202
AA	Depth - Tower Side View	29.50	749
DD	Length - Front Bumper to Mid Axle	116.00	2946
EE	Length - Tower Pin to Bottom of Tower	48.20	1240
FF	Length - Bumper to Tower Pin	256.20	6052
GG	Length - Tower, Side View	440.00	11176
JJ	Height - Ground to Cooler	129.00	3521
PP	Width - Tower Edge to Hose Tray	69.40	1762
QQ	Height - Ground to Drill Table	47.80	1214
RR	Length - Rod Box	214.50	5448
WB	Length - Wheelbase	254.00	6452



TURNING RADII DETAILS

	DESCRIPTION	254" CHASSIS	
		INCH	MM
TR1	Turning Radius - Center of Outside Tire	472.00	11100
TR2	Turning Radius - Maximum Drill Clearance	462.00	11270
A	25° Turn Angle		

T3W

GENERAL SPECIFICATIONS

	T3W	
Pullback Options	Pullback – 40,000 lb Pulldown – 25,000 lb	
Feed System	Single Cylinder, Cable Feed D:d Ratio 28:1, 24 ½ in. sheaves w/ ⅞ in. cable Drill Feed Rate: 20 ft./min. Past Feed Up/Down: 150 ft./min.	
Derrick	Capacity: 45,000 lb. Main Cord Length: 35 ft. 6 in. Head Travel: 27 ft. 4 in. Width: 36 in. Depth: 28 in.	
Standard Carrier	Standard – Navistar 7600, 6 x 4 Caterpillar C13 Diesel Engine 380 hp @ 2100 RPM 21 ft. 2 in. wheelbase 68,000 lbs. GVWR Optional – 410 hp, 9 speed Transmission	Optional – Peterbilt 365, 6 x 4 Caterpillar C13 Diesel Engine 350 hp @ 2100 RPM 21 ft. 9 in. wheelbase 68,000 lbs. GVWR
Drawworks Single Line Bare Drum	Standard – 18,000 lbs. 165 ft./min.	Optional – 30,000 lbs. 150 ft./min.
Rotary Head	Standard – 5,500 ft.-lbs. @ 145 RPM Single-Speed Rotary Head Optional – 5,500 ft.-lbs. @ 145 RPM Two-Speed Rotary Head (Second Speed) 4,000 ft.-lbs. @ 195 RPM Optional – 6,250 ft.-lbs. @ 134 RPM Single-Speed Rotary Head Optional – 6,250 ft.-lbs. @ 134 RPM Two-Speed Rotary Head (Second Speed) 4,650 ft.-lbs. @ 180 RPM Optional – 8,000 ft.-lbs. @ 105 RPM Single-Speed Rotary Head Optional – 8,000 ft.-lbs. @ 105 RPM Two-Speed Rotary Head (Second Speed) 5,500 ft.-lbs. @ 145 RPM	
Powerpack	Option 1 – 900 CFM @ 350 psi – Caterpillar C15 diesel engine, 475 hp @ 1800 RPM IR HR2.5 over-under screw compressor, 900 CFM flow, direct coupled 120 to 350 psi, optional in/out compressor disconnect Option 2 – 1070 CFM @ 350 psi – Caterpillar C15 diesel engine, 575 hp @ 1800 RPM IR HR2.5 over-under screw compressor, 1070 CFM flow with standard in/out box 8.3 to 24.1 bar	
Options	Mud pumps Floating-spindle hub 6 x 6 Heavy-duty trucks	Pipe spinner Sand reel Water injection Single-pipe loader Service hoist DHD lube injection High-pressure air piping Drop-down axle Deck engine starting aid

These machine specifications are those in effect at the time of this printing. However, Atlas Copco Drilling Solutions Inc. is constantly striving for product improvements and enhancements. Accordingly, the right is reserved to make such changes in specifications and design that the Company considers in conformity with this policy or are due to unavailability of materials or assemblies. Final confirmation of current specifications should be made by contacting Atlas Copco Drilling Solutions, Garland, Texas, USA.

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Part No. 5782719 Printed in USA

B. WELL CONSTRUCTION REPORT

GOVERNMENT OF SOUTH AUSTRALIA
DRILLERS WELL CONSTRUCTION REPORT
Natural Resource Management Act 2004
DETAILS OF ALL WORK UNDERTAKEN MUST BE REFLECTED IN THIS REPORT

1. PERMIT NO: 20695 Site

NAME OF DRILLER Paul Justyn Licence No 3.123
Contact Phone/Mobile No.: 0427 900 761
Name of plant operator if under supervision: Duncan Neill

PERMIT HOLDER or land occupier SA Water Corp
Postal Address: PO Box 603
Mount Gambier Post Code 5290

2. LOCATION OF WELL
Date of Survey 21/3 Surveyed by PJ Method GPS
GPS COORDINATES AND DATUM USED
☐ GDA 94/WGS84 ☐ AGD 66/84
S 36° 58.264' E 140° 45.027'
☐ ZONE 52 ☐ ZONE 53 ☐ ZONE 54

3. WELL NAME Naracoorte #13
4. LAND IDENTIFICATION
Pastoral Lease or Hundred:
Title or Plan and Parcel
Name of Property

5. SUMMARY *(Please tick appropriate boxes and complete all relevant details)*
Date work Commenced 21/3/12 Date work Completed 24/5/12
Work carried out: New Well ☑ Deepen ☐ Enlarge ☐ Rehabilitate ☐ Backfill ☐
Is this a Replacement well? YES (NO) if yes please quote replaced well number
Is this an Existing well? YES (NO) **if yes please quote well number or GPS coordinates**
Was well Abandoned? YES (NO) if so please state reason and method of backfill
Maximum Depth Drilled 191.2 (m) Final Depth 176 (m) Final Standing Water Level 22.4 (m) Final Yield 60 (L/sec)

6. DRILLING DETAILS If not a drilled well, please complete Sections: 6.2, 9, 10, 11, 12 and 13 as necessary

6.1 Construction Details

From (m)	To (m)	Diam (mm)	Drilling Method Cable Tool, Rotary Auger, Down Hole Hammer, etc.	Fluid Used (Air, Water, Mud Type)
0	6	600	Blade	MUD
6	150	440	Blade	MUD
150	180	390	Blade	MUD
180	191.2	220	Blade	MUD

6.2 Water Cut Details (measurements from natural surface to nearest 0.1 m)

Date	Water Cut From (m)	Water Cut To (m)	Standing Water Level (m)	Estimated Yield (L/sec)	Hole Depth at Test (m)	Casing at Test (m)	Test Method	Salinity (mg/L) or Taste
	138	188	22.4	60+	176	176	Air	1525

7. CASING LEFT IN WELL

7.1 Dimensions / 7.2 Type / 7.3 Casing Cemented

From (m)	To (m)	Internal Diam. (mm)	Swell Joint, Welded Collar, Steel, FRP, PVC, etc.	Yes	No	From (m)	To (m)	Cement (bags)	Water (litres)	Other Additives	Cementing Method Used	Comments
0	6	450	Steel	☑	☐	0	6	28	540	-	Tremmied	
6	145	300	FRP	☑	☐	0	145	190	4860	5% Bent	Pumped	

7.4 COLLAR CASING (must be cemented to surface) ☐ ☐

8. CONSTRUCTION AT PRODUCTION LEVEL

8.1 Method
☐ Open Hole
☐ Slotted Casing
☑ Screen(s)
☐ Other, give details:

8.2 Screen or Casing (*If variable aperture screen used give limits)

Type	From (m)	To (m)	Aperture* (mm)	Inner Diam (mm)	Outer Diam (mm)	Material	Trade Name	Completion of Base
Slotted	162	174	1.5	200	220	SS/Steel	Johnson	End Plate
Plain 316 SS/FP	146	162	Plain					
	174 - 176 Plain Sump							

8.3 Liner Seal (Packer)

Material	Depth (m)	Internal Diam (mm)

8.4 Gravel Packing

Method of Placement	Gravel Passing Mesh Size	From (m)	To (m)

9. IF NOT A DRILLED WELL

Method	Depth (m)	Length (m)	Width (m)	Diam (m)	Lining Material	From (m)	To (m)

10. DEVELOPMENT (State methods and time taken)

Method	Hours	Minutes
ASR	19	

11. PUMPING TEST (measurements from natural surface to nearest 0.1m)

Interval Tested From (m)	Interval Tested To (m)	Water Level (m)	Test Method	Pump Depth (m)	Discharge Rate (L/sec)	Method of Measuring Discharge	Hours Pumped	Draw Down (m)

12. SAMPLES
The Natural Resource Management Act 2004 and Regulations require that strata and water samples must be obtained. If any samples have not been obtained state reasons:
No Strata Rec'd.
As the person responsible I advise that the work has been completed as described above.

Signature of Licensed Driller [signature] Date 25/5/12

Driller to deliver this copy together with water samples collected and well location map within 14 days of completion to any of the locations below:
Department of Water Land and Biodiversity Conservation
Science Monitoring & Information, GPO Box 2834 Adelaide SA 5001 (reports only)
Water Laboratory and Geophysical Services, 23 Conyngham Street GLENSIDE SA 5065 or
Mount Gambier Regional Office, 11 Helen Street MOUNT GAMBIER SA 5290 or
Naracoorte Regional Office, 101 Cedar Avenue, NARACOORTE SA 5271

13. FORMATION LOG

From (m)	To (m)	Description of Material
0	1	Topsoil
1	20	Yellow Sand
20	138	Limestone / Clay Layers
138	188	Coarse Sandstone
188	191.2	Clay / Marl.
		* Data for Water Logged
		Nil Geo Log Done.
		Re - J. Lawson 0428842517

UNIT NUMBER

C. WATER WELL LOG

Project**: Naracoorte 13 Town Water Supply Well**

Permit Number: **206965**
Date Completed: **24/5/2012**
Unit No: **702406113** Drill Method: **Rotary Mud**
Drillhole Name: **Naracoorte TWS 13**
Logged By: **Jeff Lawson**

Backfilled (Y/N): **N**
Total Depth (m): **192**

Drilling Company: **Diverse Resources Group**
Driller: **Paul Juett**

Coordinates
Easting: **477486**
Northing: **5908303**
Zone: **54**
Datum: **GDA94**

Ground Elevation (mAHD): **80.8 DEM**
Reference Elevation (mAHD): **TBD**
Reference Point Type: **TOC**

General Comments:

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	3	SAND	Light brown, fine unconsolidated sand. Clear, frosted to iron stained grains.	HOLOCENE
3	6		Grey unconsolidated. Clear, frosted to iron stained grains.	
6	9		Orange, unconsolidated fine sand. Clear to frosted, sub rounded to rounded grains – strongly iron stained.	
9	21		Sand becoming coarser. Generally rounded sand grains. Strongly iron stained.	
21	24	SANDSTONE	Light brown to pale orange. Weakly to strongly cemented fragments. Sand and indistinguishable fossil material cemented together. Minor uncemented sand.	BRIDGEWATER FORMATION
24	30		Smaller fragments. High percentage unconsolidated sand with coarse sand grains.	
30	39		Larger fragments. Slightly finer grained. Sandstone is sugary like with sand washing of the faces.	
39	42	LIMESTONE	Pale brown/ pale orange. Weakly cemented, fine grained fragments (smaller than previous sample). Minor unconsolidated sand.	GAMBIER LIMESTONE Greenways
42	45		Occasional well preserved fossils.	
45	48		Becoming lighter in colour to off white. Occasional well preserved bryozoa.	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
48	51		Off white, strongly cemented fine grained fragments. Minor marly fraction.	Member
51	57		Fine calcite and fossil content.	
57	60		Marl content increasing.	
60	63	MARLY LIMESTONE	Pale grey, moderately well bounded marl. Strongly cemented fine grained limestone fragments.	
63	72	MARL	Pale grey with some white mottling. Moderately bounded marl, soft, pliable. Approximately 20% strongly cemented fragments.	
72	78	LIMESTONE	Very pale orange. Fine grained strongly cemented fragments and partially silicified chips. Minor fossil content – partially iron stained. Minor marl content.	
78	87		White rounded, well rolled, and strongly cemented fine grained limestone. Seems to have been a former water course. Grey partially silicified flint chips. Rounded limonitic and heavily iron stained sand.	MEPUNGA FORMATION
87	90	SAND	Clear, frosted and heavily iron stained unconsolidated sand. Occasional limonitic grains.	
90	93	CLAY	Brown, soft, well bounded clay. Embedded with rounded sand grains some limonitic.	
93	117	CLAY	Dark brown, soft, plastic, strongly bounded clay. Minor fine sand embedded in the clay.	
117	120	CLAY	Lighter brown. Clay not as strongly bounded with some coarse sand grains.	
120	130	CLAY	Brown, well bounded clay. Approx 20 to 30% unconsolidated, medium to coarse sand.	
130	146	CLAY	Dark brown, soft, pliable, strongly bounded clay. Minor embedded very fine sand.	
146	149	CLAY	Dark brown, soft, pliable, strongly bounded clay. Minor fine sand.	
149	152	SAND	The well is transitioning from clay to sand. Gamma begins to open at 149m and is full extension at 152m.	DILWYN FORMATION
152	153	SAND	Coarse sand – 50% average – 1.72mm	
153	154	SAND	Coarse sand – 50% average – 1.9mm	
154	155	SAND	Coarse sand – 50% average – 1.48mm	
155	156	SAND	Coarse sand – 50% average – 1.5mm	
156	157	SAND	Coarse sand – 50% average – 1.2mm	
157	158	SAND	Coarse sand – 50% average – 1.6mm	
158	159	SAND	Coarse sand – 50% average – 1.3mm	
159	160	SAND	Coarse sand – 50% average – 1.2mm	
160	161	SAND	Coarse sand – 50% average – 1.1mm	
161	162	SAND	Coarse sand – 50% average – 1.4mm	
162	163	SAND	Coarse sand – 50% average – 1.3mm	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
163	164	SAND	Coarse sand – 50% average – 1.65mm	
164	165	SAND	Coarse sand – 50% average – 1.3mm	
165	166	SAND	Coarse sand – 50% average – 1.5mm	
166	167	SAND	Coarse sand – 50% average – 2.18mm	
167	168	SAND	Coarse sand – 50% average – 2.0mm	
168	169	SAND	Coarse sand – 50% average – >2.5mm	
169	170	SAND	Coarse sand – 50% average - > 2.5mm	
170	171	SAND	Coarse sand – 50% average - > 2.5mm	
171	172	SAND	Coarse sand – 50% average – >2.5mm	
172	173	SAND	Coarse sand – 50% average – 2.1mm	
173	174	SAND	Coarse sand – 50% average - > 2.5mm	
174	175	SAND	Coarse sand – 50% average - > 2.5mm	
175	176	SAND	Coarse sand – 50% average - > 2.5mm	
176	177	SAND	Coarse sand – 50% average - > 2.5mm	
177	191.2	SANDSTONE	Grey, weakly cemented sand, highly micaceous and reflective. Fine unconsolidated quartz sand. Milky grains. Pyritic. Metallic sheen. High % brown silt.	EUMERALLA FORMATION

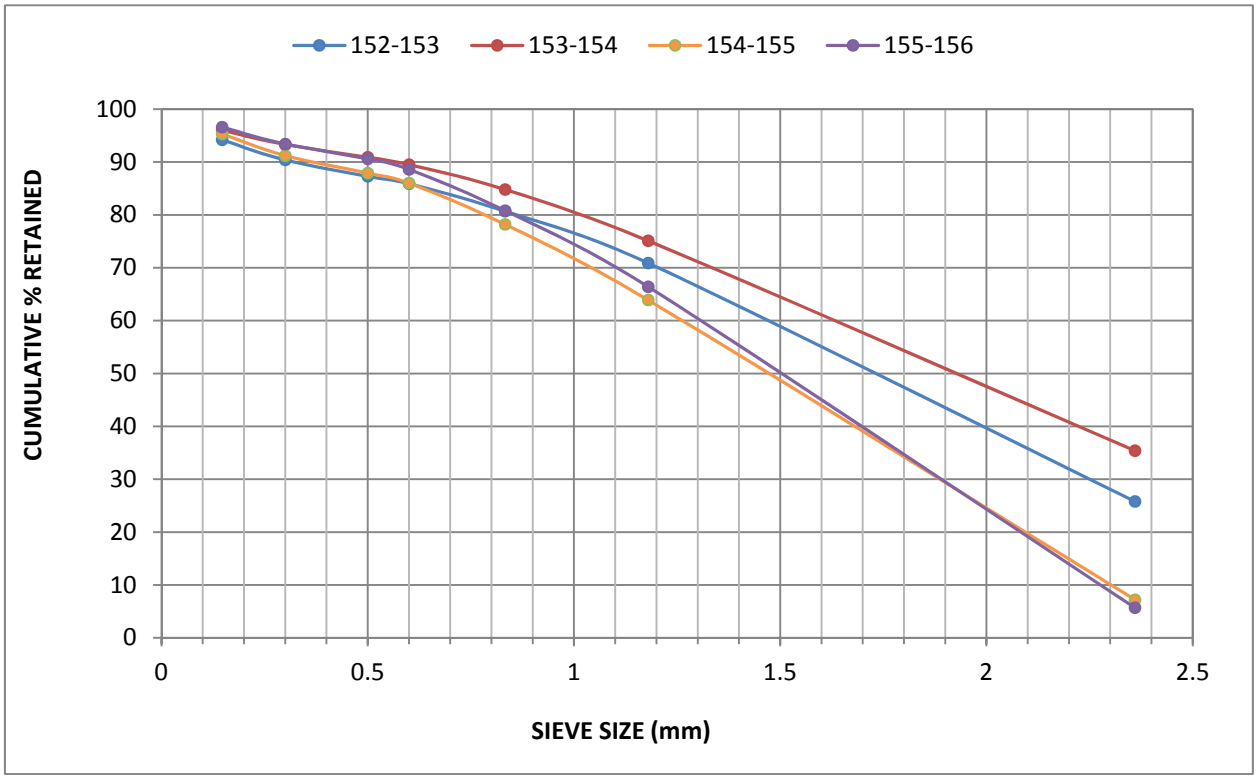
Water Cut Information

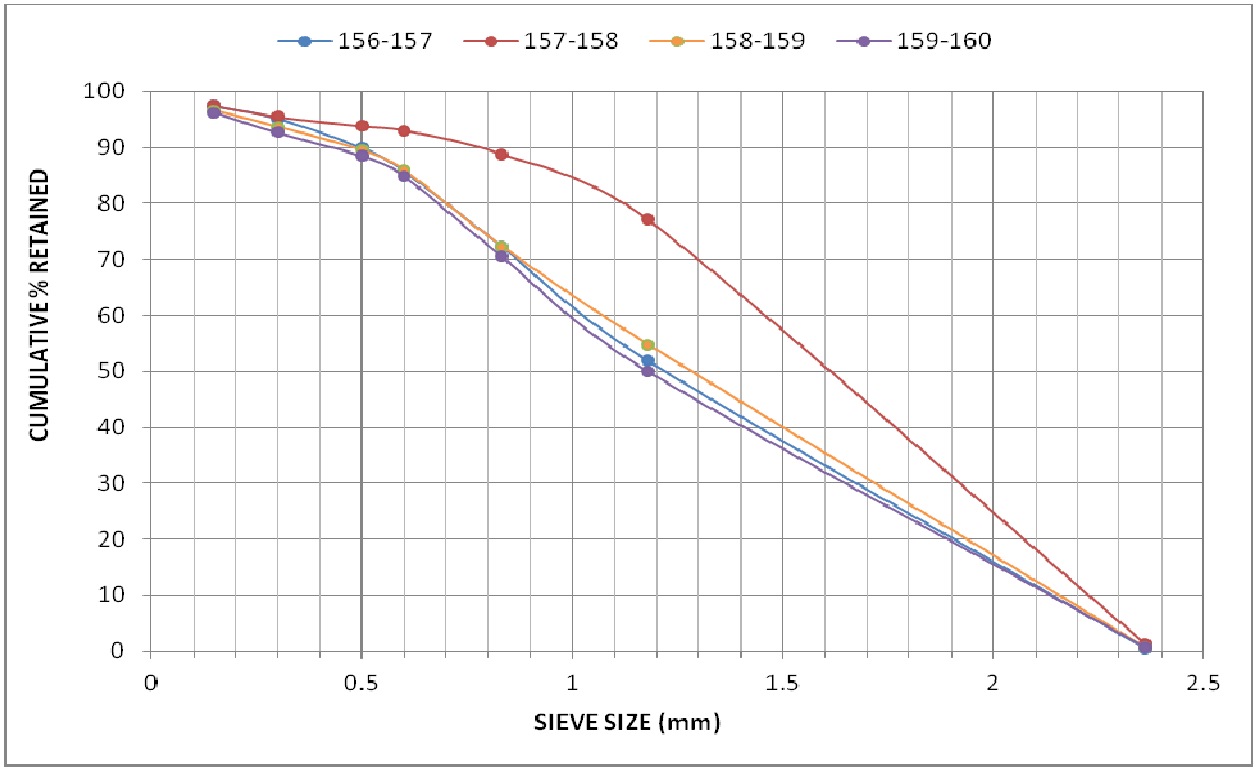
Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		Yield (L/s)	Test Length (min)	Method	Sample No.	Salinity	Salinity Unit (mg/L/EC)
162	174	38.14	40	1440	Pump	N/A	N/A	1200/2250

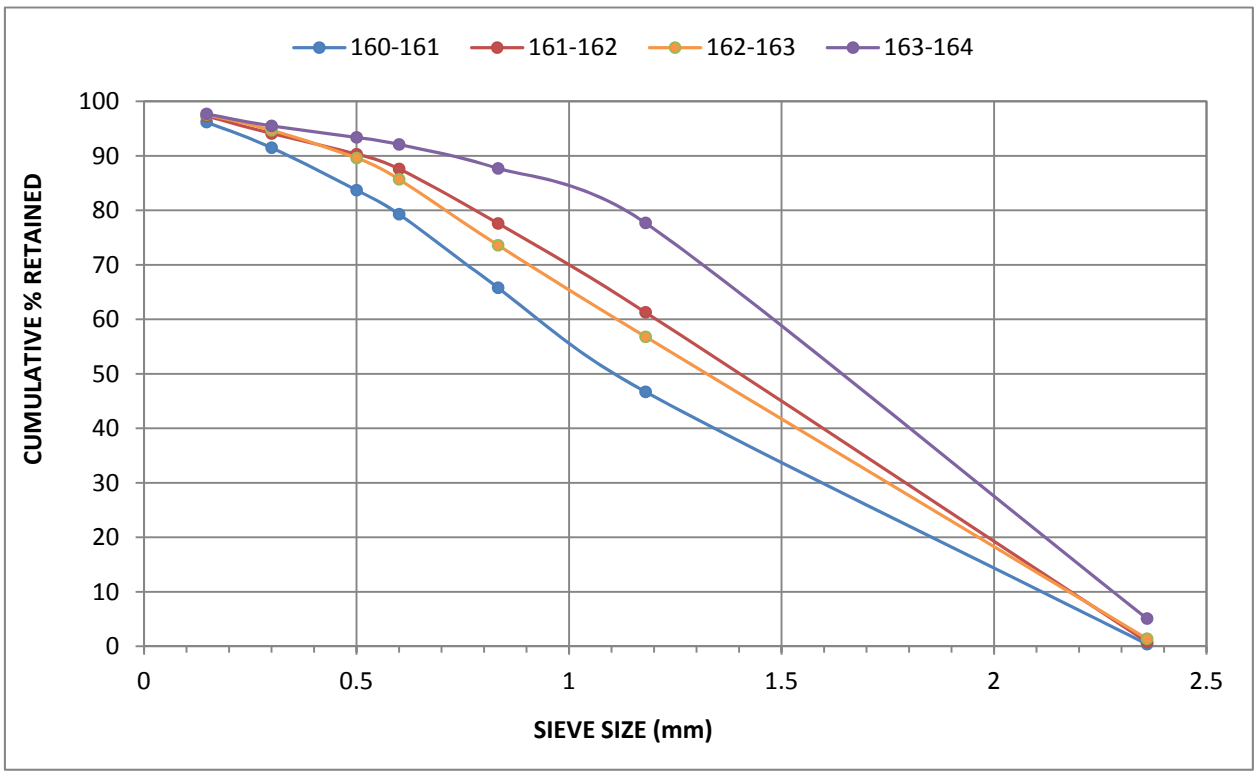
Casing and Production Zone Information

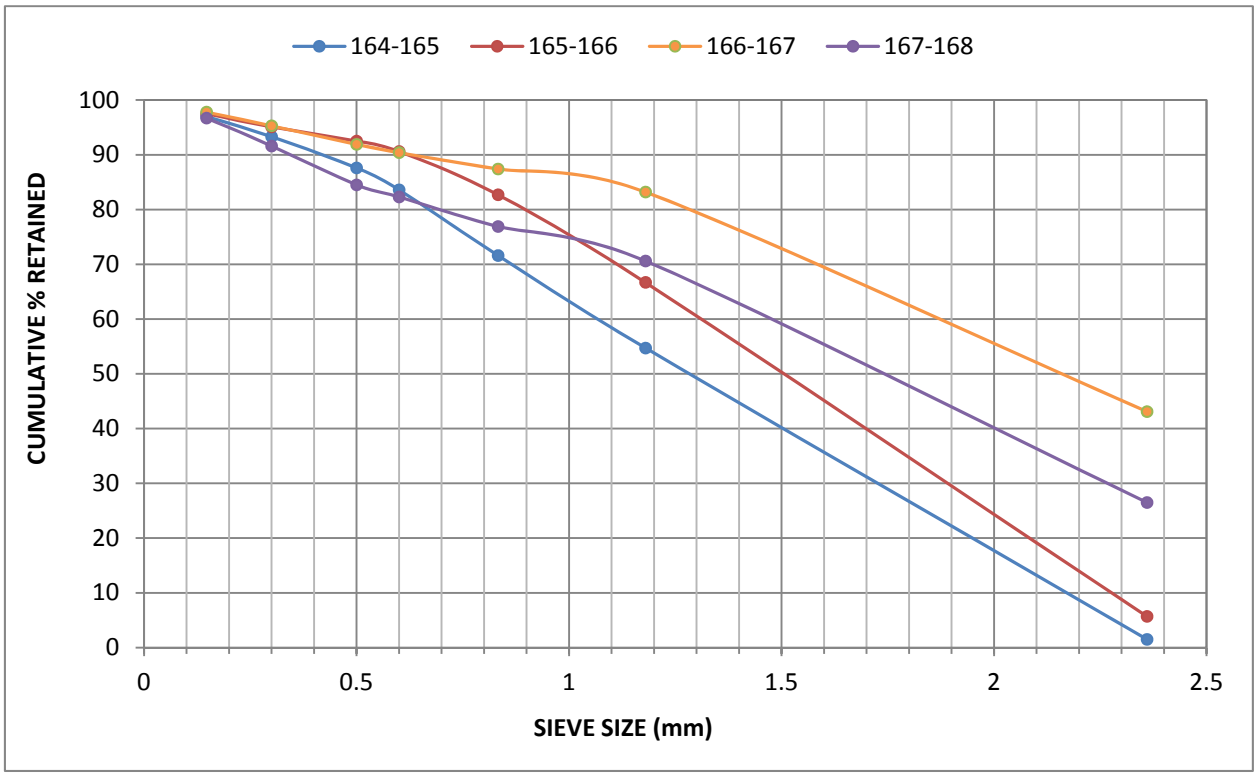
Case or Production Zone	Depth (m)		Inner Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Surface control casing	0	6	450	Schedule 20 steel		y	0	6
Well Casing	0	145	300	Hetron 922 FRP		Y	0	145
Riser Pipe	140	162	200	Zero aperture stainless steel				
Prod zone	162	174	200	316 Stainless wire-wound screen	1.5			
Sump	174	176		Zero aperture stainless steel				

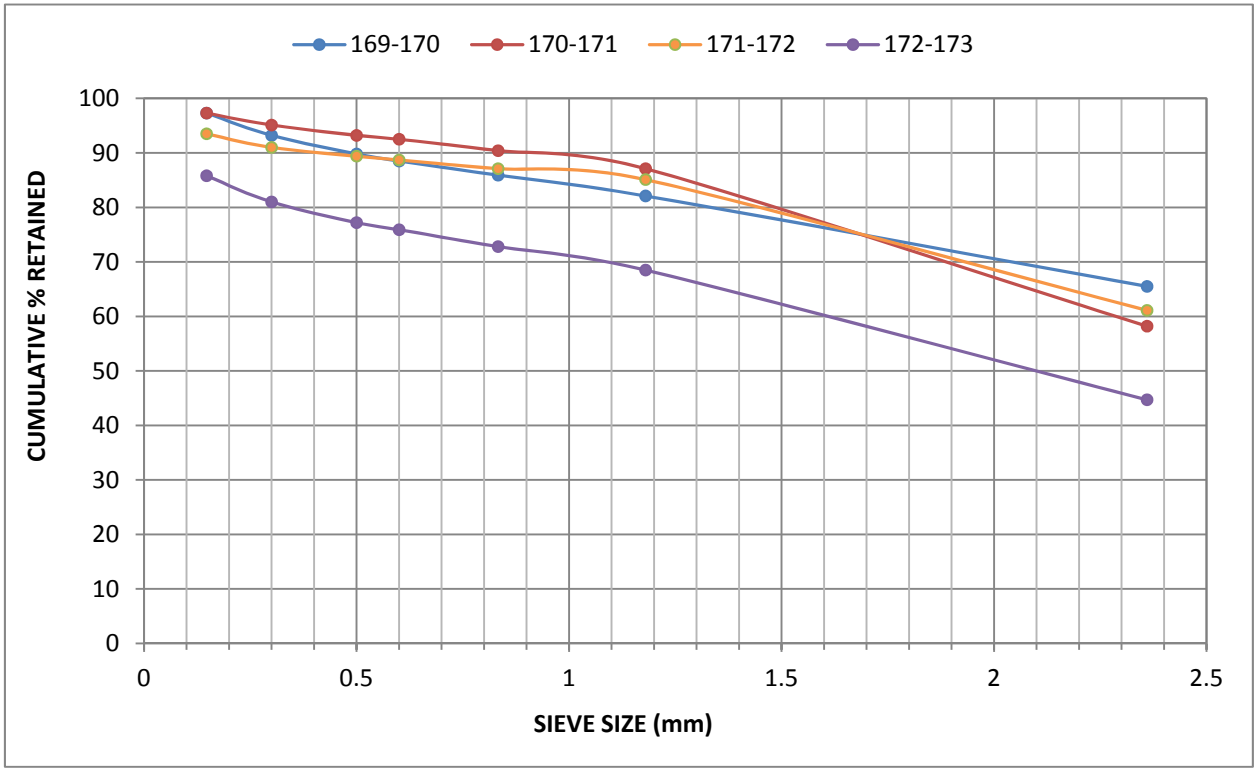
D. DILWYN FORMATION SIEVE ANALYSIS

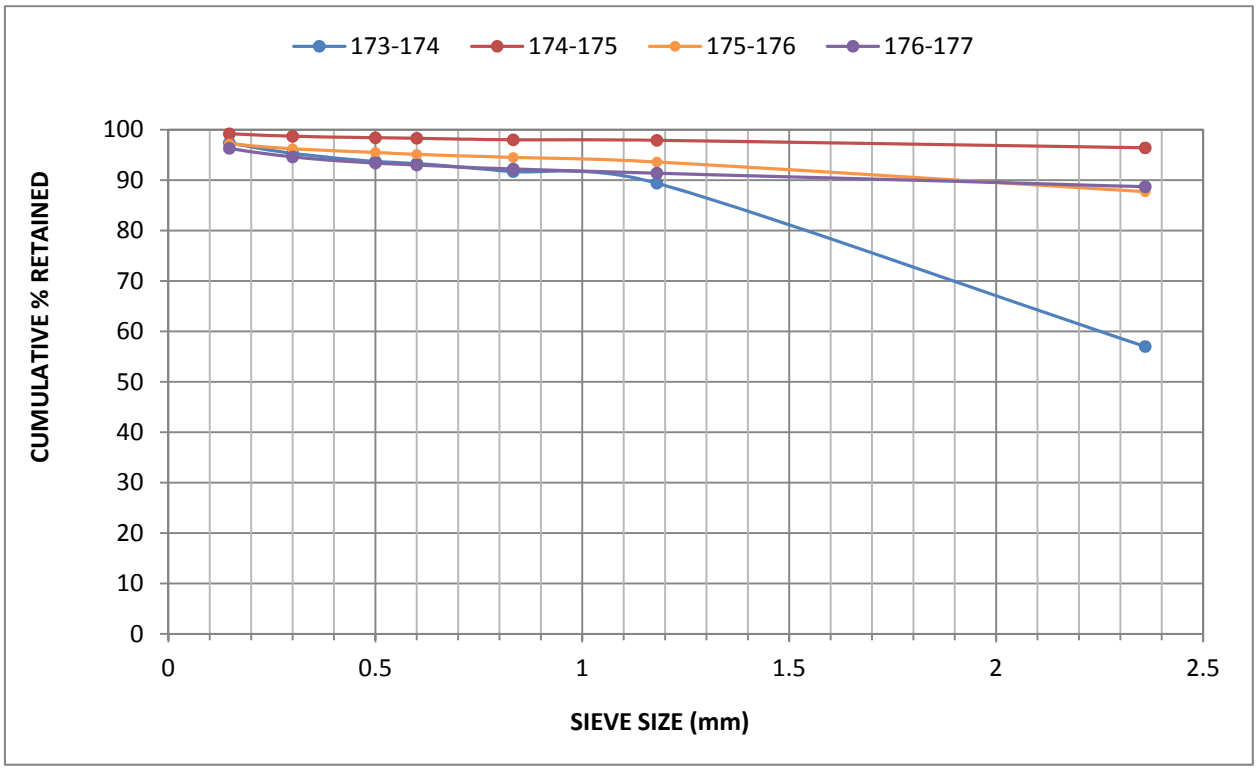





160-161
161-162
162-163
163-164
CUMULATIVE % RETAINED
100
90
80
70
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
SIEVE SIZE (mm)


164-165
165-166
166-167
167-168
CUMULATIVE % RETAINED
100
90
80
70
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
SIEVE SIZE (mm)


169-170
170-171
171-172
172-173
CUMULATIVE % RETAINED
100
90
80
70
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
SIEVE SIZE (mm)


173-174
174-175
175-176
176-177
CUMULATIVE % RETAINED
100
90
80
70
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
SIEVE SIZE (mm)

E. PUMPING TEST DATA

E.1 NARACOORTE TWS 13 STEP DRAWDOWN TEST

NARACOORTE TWS 13

Start date	Start time	Step	Duration (min)	Q (L/s)	Well Name	Well Type	r (m)	Aquifer	Ref Elev. (m AHD)
12/06/2012	14:30	1	60	40	Naracoorte TWS 13 7024-6113	Prod.	0	Dilwyn Formation	80.8 m (DEM)
"		2	60	45	"	"	"	"	"
"		3	60	50	"	"	"	"	"

NARACOORTE TWS13 MANUAL DATA

Step No.	Q (L/s)	Time (min)	DTW (m)	DD (m)
1	40	0	38.14	0.00
1	40	1	41.16	3.02
1	40	2	41.18	3.04
1	40	3	41.19	3.05
1	40	4	41.22	3.08
1	40	5	41.22	3.08
1	40	6	41.23	3.09
1	40	7	41.23	3.09
1	40	8	41.24	3.10
1	40	9	41.25	3.11
1	40	10	41.25	3.11
1	40	12	41.27	3.13
1	40	14	41.28	3.14
1	40	16	41.29	3.15
1	40	18	41.30	3.16
1	40	20	41.31	3.17
1	40	22	41.31	3.17
1	40	24	41.32	3.18
1	40	26	41.33	3.19
1	40	28	41.34	3.20
1	40	30	41.35	3.21
1	40	35	41.38	3.24
1	40	40	41.39	3.25
1	40	45	41.40	3.26
1	40	50	41.42	3.28
1	40	55	41.43	3.29
1	40	60	41.43	3.29
2	45	61	42.00	3.86
2	45	62	42.02	3.88

Step No.	Q (L/s)	Time (min)	DTW (m)	DD (m)
2	45	63	42.03	3.89
2	45	64	42.04	3.90
2	45	65	42.04	3.90
2	45	66	42.05	3.91
2	45	67	42.05	3.91
2	45	68	42.06	3.92
2	45	69	42.06	3.92
2	45	70	42.07	3.93
2	45	72	42.07	3.93
2	45	74	42.08	3.94
2	45	76	42.09	3.95
2	45	78	42.09	3.95
2	45	80	42.10	3.96
2	45	82	42.10	3.96
2	45	84	42.11	3.97
2	45	86	42.11	3.97
2	45	88	42.12	3.98
2	45	90	42.13	3.99
2	45	95	42.14	4.00
2	45	100	42.15	4.01
2	45	105	42.16	4.02
2	45	110	42.18	4.04
2	45	115	42.19	4.05
2	45	120	42.19	4.05
3	50	121	42.71	4.57
3	50	122	42.73	4.59
3	50	123	42.74	4.60
3	50	124	42.74	4.60
3	50	125	42.74	4.60
3	50	126	42.75	4.61
3	50	127	42.76	4.62
3	50	128	42.76	4.62
3	50	129	42.77	4.63
3	50	130	42.77	4.63
3	50	132	42.77	4.63
3	50	134	42.78	4.64
3	50	136	42.78	4.64
3	50	138	42.78	4.64
3	50	140	42.79	4.65
3	50	142	42.79	4.65
3	50	144	42.80	4.66
3	50	146	42.80	4.66

Step No.	Q (L/s)	Time (min)	DTW (m)	DD (m)
3	50	148	42.84	4.67
3	50	150	42.85	4.68
3	50	155	42.88	4.70
3	50	160	42.90	4.72
3	50	165	42.90	4.74
3	50	170	42.90	4.76
3	50	175	42.91	4.77

E2 NARACOORTE TWS 13 CONSTANT RATE DISCHARGE TEST

NARACOORTE TWS 13

Start date	Start time	Step	Duration (min)	Q (L/s)	Well Name	Well Type	r (m)	Aquifer	Ref Elev. (m AHD)
13/06/2012	09:00	1	Pumping 1440 Recovery 90	40	Naracoorte TWS 13 7024-6113	Prod.	0	Dilwyn Formation	80.8 m (DEM)

NARACOORTE TWS13 MANUAL DATA

Q (L/s)	Time (min)	DTW (m)	DD (m)
40	0	38.15	0.00
40	1	41.29	3.14
40	2	41.35	3.20
40	3	41.36	3.21
40	4	41.35	3.20
40	5	41.36	3.21
40	6	41.37	3.22
40	7	41.38	3.23
40	8	41.39	3.24
40	9	41.39	3.24
40	10	41.40	3.25
40	12	41.43	3.28
40	14	41.44	3.29
40	16	41.45	3.30
40	18	41.47	3.32
40	20	41.47	3.32
40	22	41.48	3.33
40	24	41.48	3.33
40	26	41.49	3.34
40	28	41.51	3.36
40	30	41.53	3.38
40	35	41.54	3.39
40	40	41.56	3.41
40	45	41.56	3.41
40	50	41.57	3.42
40	55	41.59	3.44
40	60	41.6	3.45
40	70	41.63	3.48
40	80	41.65	3.50
40	90	41.67	3.52
40	100	41.70	3.55
40	120	41.73	3.58
40	140	41.77	3.62
40	160	41.77	3.62

Q (L/s)	Time (min)	DTW (m)	DD (m)
40	180	41.79	3.64
40	200	41.80	3.65
40	250	41.83	3.68
40	300	41.90	3.75
40	350	41.92	3.77
40	400	41.96	3.81
40	450	42.00	3.85
40	500	42.02	3.87
40	550	42.05	3.90
40	600	42.09	3.94
40	650	42.13	3.98
40	700	42.16	4.01
40	750	42.44	4.29
40	800	42.53	4.38
40	850	42.65	4.50
40	900	42.70	4.55
40	950	42.73	4.58
40	1000	42.72	4.57
40	1050	42.63	4.48
40	1100	42.60	4.45
40	1150	42.60	4.45
40	1200	42.59	4.44
40	1250	42.59	4.44
40	1300	42.60	4.45
40	1350	42.60	4.45
40	1400	42.60	4.45
0	1441	39.41	1.26
0	1442	39.40	1.25
0	1443	39.36	1.21
0	1444	39.33	1.18
0	1445	39.31	1.16
0	1446	39.27	1.12
0	1447	39.27	1.12
0	1448	39.27	1.12
0	1449	39.27	1.12
0	1450	39.25	1.10
0	1452	39.24	1.09
0	1454	39.24	1.09
0	1456	39.23	1.08
0	1458	39.23	1.08
0	1460	39.23	1.08
0	1462	39.22	1.07

Q (L/s)	Time (min)	DTW (m)	DD (m)
0	1464	39.21	1.06
0	1466	39.19	1.04
0	1468	39.19	1.04
0	1470	39.18	1.03
0	1475	39.17	1.02
0	1480	39.16	1.01
0	1485	39.15	1.00
0	1490	39.12	0.97
0	1495	39.12	0.97
0	1500	39.12	0.97
0	1510	39.07	0.92
0	1520	39.05	0.90
0	1530	39.04	0.89

F. WATER CHEMISTRY

PO Box 1751 Adelaide SA 5001 | 250 Victoria Square Adelaide SA 5000 | Tel: 1300 653 366 Fax: 1300 883 171 | Internet: www.awqc.com.au Email: awqc@sawater.com.au

Australian Water Quality Centre

SAW Infrastructure
ATTN: Tim Driver
250 Victoria Square
Adelaide
SA 5100 AUSTRALIA

02/07/2012

Dear Tim

Please find attached the Final Analytical Report for

Customer Service Request: 105296-2012-CSR-14
Account: 105296
Project: AWQC-59881 SAW Infrastructure -Naracoorte Bore 13 Commissioning

This report has also been sent to: Maree Shephard

Please note AWQC Sample Receipt hours are Monday to Friday 8.30am - 4.30pm.

Yours sincerely,

Pat Poldervaart
Account Manager
Pat.Poldervaart@sawater.com.au
+61 8 7424 2095

NATA WORLD RECOGNISED ACCREDITATION

ABN 69336525019 A business unit of the South Australian Water Corporation

PO Box 1751 Adelaide SA 5001 | 250 Victoria Square Adelaide SA 5000 | Tel: 1300 653 366 Fax: 1300 883 171 | Internet: www.awqc.com.au Email: awqc@sawater.com.au

Australian Water Quality Centre

FINAL REPORT: 105219

Report Information

Project Name	AWQC-59881
Customer	SAW Infrastructure
CSR_ID	105296-2012-CSR-14

Analytical Results

Customer Sample Description	Naracoorte Bore 13
Sampling Point	72210-Naracoorte Bore No 13
Sampled Date	12/06/2012 11:40:00AM
Sample Received Date	12/06/2012 8:24:50PM
Sample ID	*2012-002-3472
Status	Endorsed
Collection Type	Customer Collected

Bacteriology	LOR	Result
Coliforms T0080-07 WMZ-500		
Coliforms		1 /100mL
Coliforms - Presumptive		1 /100mL
E.coli T0081-07 WMZ-500		
E.coli		0 /100mL
E.coli - Presumptive		0 /100mL

Customers - eg Regional Samplers	LOR	Result
Temperature EXT		
# Temperature		21.0 °C

Inorganic Chemistry - Metals	LOR	Result
Aluminium - Acid Soluble TIC-003 W09-023		
Aluminium - Acid Soluble	0.001	<0.001 mg/L
Aluminium - Soluble TIC-003 W09-023		
Aluminium - Soluble	0.001	<0.001 mg/L
Aluminium - Total TIC-003 W09-023		
Aluminium - Total	0.001	0.009 mg/L
Antimony - Soluble TIC-003 W09-023		
Antimony - Soluble	0.0005	<0.0005 mg/L
Antimony - Total TIC-003 W09-023		
Antimony - Total	0.0005	<0.0005 mg/L
Arsenic - Soluble TIC-003 W09-023		
Arsenic - Soluble	0.0003	<0.0003 mg/L
Arsenic - Total TIC-003 W09-023		
Arsenic - Total	0.0003	<0.0003 mg/L
Barium - Soluble TIC-003 W09-023		
Barium - Soluble	0.0005	0.0358 mg/L
Barium - Total TIC-003 W09-023		
Barium - Total	0.0005	0.0357 mg/L
Beryllium - Soluble TIC-003 W09-023		

NATA WORLD RECOGNISED ACCREDITATION

Corporate Accreditation No.1115
Chemical and Biological Testing
This document is issued in accordance with NATA's accreditation requirements.

Notes
1. The last figure of the result value is a significant figure.
2. Samples are analysed as received.
3. # determination of the component is not covered by NATA Accreditation.
4. ^ indicates result is out of specification according to the reference Guideline. Refer to Report footer.
5. * indicates incident have been recorded against the sample. Refer to Report footer.
6. & Indicates the results have changed since the last issued report.
7. The Limit of Reporting (LOR) is the lowest concentration of analyte which is reported at the AWQC and is based on the LOQ rounded up to a more readily used value. The Limit of Quantitation (LOQ) is the lowest concentration of analyte for which quantitative results may be obtained within a specified degree of confidence.

ABN 69336525019

PO Box 1751 Adelaide SA 5001 | 250 Victoria Square Adelaide SA 5000 | Tel: 1300 653 366 Fax: 1300 883 171 | Internet: www.awqc.com.au Email: awqc@sawater.com.au

Australian Water Quality Centre

FINAL REPORT: 105219

Analytical Results

Customer Sample Description	Naracoorte Bore 13
Sampling Point	72210-Naracoorte Bore No 13
Sampled Date	12/06/2012 11:40:00AM
Sample Received Date	12/06/2012 8:24:50PM
Sample ID	*2012-002-3472
Status	Endorsed
Collection Type	Customer Collected

Beryllium - Soluble TIC-003 W09-023		
Beryllium - Soluble	0.0003	<0.0003 mg/L
Beryllium - Total TIC-003 W09-023		
Beryllium - Total	0.0003	<0.0003 mg/L
Boron - Soluble TIC-003 W09-023		
Boron - Soluble	0.020	0.560 mg/L
Cadmium - Soluble TIC-003 W09-023		
Cadmium - Soluble	0.0001	<0.0001 mg/L
Cadmium - Total TIC-003 W09-023		
Cadmium - Total	0.0001	<0.0001 mg/L
Calcium Hardness as CaCO3 W09-023		
Calcium Hardness as CaCO3	2.0	155 mg/L
Calcium TIC-003 W09-023		
Calcium	0.04	62.0 mg/L
Carbonate Hardness as CaCO3 T0203-01 W09-023		
Carbonate hardness as CaCO3	2	314 mg/L
Chlorides - Total as NaCl W09-023		
Chlorides - Total as NaCl	7	781 mg/L
Chromium - Soluble TIC-003 W09-023		
Chromium - Soluble	0.0001	0.0002 mg/L
Chromium - Total TIC-003 W09-023		
Chromium - Total	0.0001	0.0002 mg/L
Copper - Soluble TIC-003 W09-023		
Copper - Soluble	0.0001	<0.0001 mg/L
Copper - Total TIC-003 W09-023		
Copper - Total	0.0001	0.0004 mg/L
Dissolved Solids by Calculation W09-023		
Dissolved solids by calculation	0	1240 mg/L
Ion Balance W09-023		
Ion balance		-1.2 %
Iron - Soluble TIC-003 W09-023		
Iron - Soluble	0.0005	0.0076 mg/L
Iron - Total TIC-003 W09-023		
Iron - Total	0.0005	0.1281 mg/L
Langelier Index W09-023		
Langelier Index		0.30
Lead - Soluble TIC-003 W09-023		
Lead - Soluble	0.0001	<0.0001 mg/L

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Australian Water Quality Centre

FINAL REPORT: 105219

Analytical Results

Customer Sample Description	Naracoorte Bore 13
Sampling Point	72210-Naracoorte Bore No 13
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Lead - Total TIC-003 W09-023		
Lead - Total	0.0001	0.0001 mg/L
Magnesium Hardness as CaCO3 W09-023		
Magnesium Hardness as CaCO3	2	212 mg/L
Magnesium TIC-003 W09-023		
Magnesium	0.04	51.6 mg/L
Manganese - Soluble TIC-003 W09-023		
Manganese - Soluble	0.0001	0.0237 mg/L
Manganese - Total TIC-003 W09-023		
Manganese - Total	0.0001	0.0239 mg/L
Mercury - Soluble TIC-003 W09-023		
Mercury - Soluble	0.00003	<0.00003 mg/L
Mercury - Total TIC-003 W09-023		
Mercury - Total	0.00003	<0.00003 mg/L
Molybdenum - Soluble TIC-003 W09-023		
Molybdenum - Soluble	0.0001	0.0004 mg/L
Molybdenum - Total TIC-003 W09-023		
Molybdenum - Total	0.0001	0.0004 mg/L
Nickel - Soluble TIC-003 W09-023		
Nickel - Soluble	0.0001	0.0025 mg/L
Nickel - Total TIC-003 W09-023		
Nickel - Total	0.0001	0.0028 mg/L
Noncarbonate Hardness as CaCO3 T0204-01 W09-023		
Noncarbonate hardness as CaCO3	2	53 mg/L
Potassium TIC-003 W09-023		
Potassium	0.040	18.2 mg/L
Selenium - Soluble TIC-003 W09-023		
Selenium - Soluble	0.0001	<0.0001 mg/L
Selenium - Total TIC-003 W09-023		
Selenium - Total	0.0001	<0.0001 mg/L
Silver - Soluble TIC-003 W09-023		
Silver - Soluble	0.00003	<0.00003 mg/L
Silver - Total TIC-003 W09-023		
Silver - Total	0.00003	<0.00003 mg/L
Sodium Adsorption Ratio W09-023		
Sodium Adsorption Ratio - Calculation		7.29
Sodium TIC-003 W09-023		
Sodium	0.04	321 mg/L

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Sodium/Total Cations Ratio W09-023		
Sodium/Total cations ratio	1	64.2 %
Sulphur TIC-004 W09-023		
Sulphate	1.5	126 mg/L
Tin - Soluble TIC-003 W09-023		
Tin - Soluble	0.0005	<0.0005 mg/L
Tin - Total TIC-003 W09-023		
Tin - Total	0.0005	<0.0005 mg/L
Total Hardness as CaCO3 W09-023		
Total Hardness as CaCO3	2.0	367 mg/L
Uranium - Soluble TIC-003 W09-023		
Uranium - Soluble	0.0001	<0.0001 mg/L
Uranium - Total TIC-003 W09-023		
Uranium - Total	0.0001	<0.0001 mg/L
Zinc - soluble TIC-003 W09-023		
Zinc - Soluble	0.0003	0.0098 mg/L
Zinc - Total TIC-003 W09-023		
Zinc - Total	0.0003	0.0205 mg/L

Inorganic Chemistry - Nutrients	**LOR**	**Result**
Ammonia as N T0100-01 W09-023		
Ammonia as N	0.005	0.399 mg/L
Bromide T0114-01 W09-023		
Bromide	0.025	1.05 mg/L
Chloride T0104-02 W09-023		
Chloride	4.0	474 mg/L
Fluoride W09-023		
Fluoride	0.10	1.2 mg/L
Iodide T0117-01 W09-023		
Iodide	0.01	0.03 mg/L
Nitrate + Nitrite as N T0161-01 W09-023		
Nitrate + Nitrite as N	0.003	0.004 mg/L
Nitrate + Nitrite as NO3 T0161-01 W09-023		
Nitrate + Nitrite as NO3	0.02	<0.02 mg/L
Nitrate as N W09-023		
Nitrate as Nitrogen	0.005	<0.005 mg/L
Nitrite as N T0107-01 W09-023		

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Nitrite as N T0107-01 W09-023		
Nitrite as Nitrogen	0.003	<0.003 mg/L
Phosphorus - Filterable Reactive as P T0108-01 W09-023		
Phosphorus - Filterable Reactive as P	0.003	0.045 mg/L
Phosphorus - Total T0109-01 W09-023		
Phosphorus - Total	0.005	0.051 mg/L
Silica - Reactive T0111-01 W09-023		
Silica - Reactive	1	12 mg/L
TKN as N T0112-01 W09-023		
TKN as Nitrogen	0.05	0.38 mg/L

Organic Chemistry	**LOR**	**Result**
Dissolved Organic Carbon W09-023		
Dissolved Organic Carbon	0.3	1.7 mg/L
GCMS Scan - Dichloromethane T1072-01 W09-023		
# GCMS Scan		No semi-volatile organic compounds were detected. Some compounds may not have even been extracted using dichloromethane and/or detected by GC/MS.
OrganoChlorine Pesticides T0700-01 W09-023		
Aldrin	0.01	<0.01 µg/L
Chlordane-a	0.01	<0.01 µg/L
Chlordane-g	0.01	<0.01 µg/L
Chlorothalonil	0.05	<0.05 µg/L
Chlorpyrifos	0.05	<0.05 µg/L
Chlorthal-Dimethyl	0.05	<0.05 µg/L
DDD	0.05	<0.05 µg/L
DDE	0.05	<0.05 µg/L
DDT	0.05	<0.05 µg/L
Dieldrin	0.01	<0.01 µg/L
Endosulfan 1	0.05	<0.05 µg/L
Endosulfan 2	0.05	<0.05 µg/L
Endosulfan Sulphate	0.05	<0.05 µg/L
Endrin	0.05	<0.05 µg/L
Heptachlor	0.05	<0.05 µg/L
Heptachlor Epoxide	0.05	<0.05 µg/L
Hexachlorobenzene	0.05	<0.05 µg/L
Lindane	0.05	<0.05 µg/L
Methoxychlor	0.05	<0.05 µg/L

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OrganoChlorine Pesticides T0700-01 W09-023

Total Aldrin and Dieldrin	0.02	<0.02 µg/L
Trifluralin	0.05	<0.05 µg/L
Vinclozolin	0.05	<0.05 µg/L

Organophosphorous and Triazine Pesticides T0800-01 W09-023

Atrazine	0.5	<0.5 µg/L
Azinphos-methyl	0.5	<0.5 µg/L
Diazinon	0.5	<0.5 µg/L
Fenitrothion	0.5	<0.5 µg/L
Hexazinone	0.5	<0.5 µg/L
Malathion	0.5	<0.5 µg/L
Parathion	0.5	<0.5 µg/L
Parathion methyl	0.3	<0.3 µg/L
Prometryne	0.5	<0.5 µg/L
Simazine	0.5	<0.5 µg/L

Inorganic Chemistry - Physical	LOR	Result

Alkalinity Carbonate Bicarbonate and Hydroxide T0101-01 W09-023

Alkalinity as Calcium Carbonate		314 mg/L
Bicarbonate		383 mg/L
Carbonate		0 mg/L
Hydroxide		0 mg/L

Carbon Dioxide - Free W09-023

Carbon Dioxide - Free	0	15 mg/L

Conductivity & Total Dissolved Solids T0016-01 W09-023

Conductivity	1	2250 µScm
Total Dissolved Solids (by EC)	1.0	1200 mg/L

pH T0010-01 W09-023

pH		7.6 pH units

Inorganic Chemistry - Waste Water	LOR	Result

Chlorine Demand - 24 hrs T0136-03 W09-023

Chlorine Demand 24hrs		3.065 mg/L

Chlorine Demand - 30 mins T0136-03 W09-023

Chlorine Demand 30 mins		2.53167 mg/L

Chlorine Demand - 8 hrs T0136-03 W09-023

Chlorine Demand 8 hrs		2.9683 mg/L

Cyanide - Total T0167-03 W09-023

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Cyanide - Total T0167-03 W09-023		
Cyanide as CN - Total	0.05	<0.05 mg/L

Western Radiation Services	**LOR**	**Result**
Gross Alpha Activity W09-023		
!External Lab Report No.		WRS 6946
Gross Alpha Activity	0.005	0.053 Bq/L
Gross Beta Activity (K-40 corrected) W09-023		
!External Lab Report No.		WRS 6946
Gross Beta Activity (K-40 corrected)	0.010	0.314 Bq/L

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NATA Signatories


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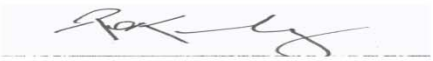
Krys Garstka - Organic Chemistry Technical Officer


Roger Kennedy - Inorganic Chemistry Process Coordinator


Melissa Phillips - Inorganic Chemistry Technical Officer


Kamilla Springer - Organic Chemistry Technical Officer

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Incidents

Sample ID	S.Point	Description	Sampled Date	Analysis (where Applicable)	Incident Description
2012-002-3472	72210	Naracoorte Bore 13	12/06/2012	Barium - Soluble	Dependent results are within acceptable analytical uncertainty
2012-002-3472	72210	Naracoorte Bore 13	12/06/2012	TKN as N	Dependent results are within acceptable analytical uncertainty

Analytical Method

Analytical Method Code	Description	Reference Method
T0010-01	Determination of pH	
T0016-01	Determination of Conductivity	
T0080-07	Coliforms - MPN Defined Substrate Technique	AS 4276.21-2005
T0081-07	E Coli - MPN Define Substrate Technique Refer T0080-07	AS 4276.21-2005
T0100-01	Ammonia/Ammonium - Automated Flow Colorimetry	APHA 4500-NH3 G
T0101-01	Alkalinity - Automated Acidimetric Titration	
T0104-02	Chloride - Automated Flow Colorimetry	APHA 4500-Cl- E
T0107-01	Nitrite - Automated Flow Colorimetry	APHA 4500-NO3-I
T0108-01	Filterable Reactive Phosphorus - Automated Flow Colorimetry	APHA 4500-P G
T0109-01	Total Phosphorus - Automated Flow Colorimetry	APHA 4500-P F
T0111-01	Reactive Silica - Automated Flow Coloimetry	APHA 4500-Si02 F
T0112-01	TKN - Automated Flow Colorimetry	APHA-N org A
T0114-01	Bromide	USEPA Method 300.0 (1993).
T0117-01	Iodide	USEPA Method 300.0 (1993).
T0136-03	Chlorine Demand	APHA 2350 B
T0136-03	Chlorine Demand	Cowell method
T0161-01	Nitrate + Nitrate (NOx) - Automated Flow Colorimetry	APHA 4500-NO3-I
T0167-03	Cyanide - Total	APHA 4500-Cl- E
T0203-01	Carbonate Hardness as CaCo3	
T0204-01	Noncarbonate Hardness as CaCo3	
T0700-01	Chlorinated Pesticides	USEPA Method 508
T0800-01	Nitrogen and Phosphorous Containing Pesticides	USEPA Method 507
T1072-01	Fullscan by GCMS	In House
TIC-003	Elemental Analysis - ICP Mass Spectrometry	
TIC-003	Elemental Analysis - ICP Mass Spectrometry	EPA method 200.8
TIC-004	Determination of Metals - ICP Spectrometry by ICP2	APHA 3120
W-052	Preparation of Samples for Metal Analysis	APHA 3030A to 3030D

Sampling Method

Sampling Method Code	Description
EXT	EXTERNAL
EXT	Sampled externally
W09-023	Sampling Method for Chemical Analyses
WMZ-500	Sampling Method for Microbiological Analyses

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Laboratory Information

Laboratory	NATA accreditation ID
Bacteriology	1115
Customers - eg Regional Samplers	-
Inorganic Chemistry - Metals	1115
Inorganic Chemistry - Nutrients	1115
Organic Chemistry	1115
Inorganic Chemistry - Physical	1115
Inorganic Chemistry - Waste Water	1115
Western Radiation Services	14174

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