

# TECHNICAL NOTE 2011/03

Department for Water

## **WOOLPUNDA SALT INTERCEPTION SCHEME – OVERLAND CORNER FLOODPLAIN INVESTIGATION DRILLING**

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February 2011

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## **SUMMARY**

Technical investigations were conducted from May-July 2010 to determine the stratigraphy and hydrogeology beneath the Overland Corner floodplain. The investigation program included the drilling of fifteen investigation drillholes and construction of seven observation wells targeting the Monoman Formation. Drilling results show that the Monoman Formation comprises fine to coarse sands with gravel, with groundwater salinity 20,000-29,000 mg/L. Observation well yields were in the range of 5-8 L/s under airlift development.

Interpretation of reduced standing water levels (RSWL) indicates that groundwater flow paths are from the highland to the floodplain. Based on the potentiometric contours, potential exists for the discharge of saline groundwater in the vicinity of river kilometre 425. The interpretation of groundwater flow paths accounts for the elevated (in-river) salinities observed from in-river salinity surveys.

## **BACKGROUND**

During October 2009, in-river salinity surveys identified discharge of saline groundwater between river kilometres 424 and 431 near Overland Corner. SA Water subsequently requested that the DFW undertake an investigation drilling program targeting the floodplain between river kilometres 424 and 426. The aim of the investigation was to determine the potential for the extension of the Woolpunda Salt Interception Scheme to intercept any saline groundwater inflows to the river in this reach. The investigation was funded by the Murray-Darling Basin Authority (MDBA) and administered by the Murray-Darling Basin Operations Unit, Works and Measures Team, DFW. The in-river EC-survey data for river kilometre 424 to 426 are presented in Appendix A.

## **PROJECT OBJECTIVES**

The project (as agreed between MDBA, SA Water and DFW) was to build on existing knowledge of the Woolpunda SIS, by the drilling of investigation holes and the construction of observation wells on the northern side of Overland Corner floodplain between river kilometres 424-426. The key objectives of the drilling program and infrastructure implementation were to:

- 1) Undertake preliminary reverse air circulation drilling (RAC) at up to 15 sites to determine the areal extent, thickness, nature, and lithology of the Monoman Formation.
- 2) Drill and construct observation wells to determine the groundwater flow direction and salinity distribution in the Monoman Formation.

The configuration and number of observation wells was contingent on the results of the investigation drilling and available funds.

## **INVESTIGATION DRILLING**

Provisional locations for investigation drillholes were selected across the western side of the Overland Corner floodplain. It was desirable to drill at sites that would limit disturbance to native vegetation, were accessible, and did not interfere with culturally sensitive areas. All sites were cleared for native vegetation and cultural heritage (Wood 2010).

Drilling was undertaken by Underdale Drillers in May 2010 using reverse air circulation (RAC) drilling methods. Drilling returns were collected at 1 m intervals to a depth of approximately 20 m or until the top

of the Murray Group Limestone (MGL) was intersected. In total, 15 investigation holes were drilled to depths between 12 and 25 m. A summary of the investigation drilling is given in Table 1, with locations of the investigation drillholes shown in Figure 1. Further information on the drillholes can be found in the Drillhole Enquiry System (<https://des.pir.sa.gov.au/deshome.html>).

### *Results*

The results from the investigation drilling indicate:

- Silty clays with minor sand were intersected up to 12 m below ground surface, with an average thickness of approximately 7 m. This unit is classified as the Coonambidgal Formation and was present in all drillholes.
- Sands were intersected between depths of 5-24 m. This unit is classified as the Monoman Formation and varied between 9-16 m thick.
- The Monoman Formation was found to consist of fine to medium sand, tending to very coarse sands with gravel toward the base. The very fine sand layers were generally well sorted. The coarse sands tended to be poorly sorted and were in the size range of 0.8-4.0 mm.
  - The Monoman Formation is saturated over its entire interval and is semi-confined. Groundwater levels rise into the Coonambidgal Formation.
  - Groundwater salinity is in the range of 20,000 to 29,000 mg/L.
  - Occasional fine sands and silty clay bands (with lignite) were noted in some drillholes at depths of 12-14 m.
  - Drillhole RAC 12 intersected silty clays at ~13 m, and had the smallest section of sands on the floodplain (7-13 m). Drilling was terminated at this depth due to a blocked drill bit.
  - Sands at the back of the floodplain (adjacent to cliffs) were limited in thickness. Sand was absent at RAC 4, at RAC 5 it was 1 m thick, and at RAC 6 it was 6 m thick.
- Over the central part of the floodplain, Murray Group Limestone was encountered immediately below the Monoman Formation at depths between 16 and 19 m below ground. The limestone comprised light grey/light brown (sticky) marl with consolidated hard bands. The limestone member was identified as the Glenforslan Formation (AWE 2003). It is possible that the Glenforslan Formation is in direct hydraulic communication with the Monoman Formation at the investigation sites.
- Drillholes RAC 1, RAC 12 and RAC 14 were terminated at 12-14 m due to a blocked drill bit.
- Drillholes RAC 3, RAC 7 and RAC 15 were not drilled due to problems with site access and were replaced by drillholes RAC 16, RAC 17 and RAC 18.

**Table 1. Investigation Drilling Summary**

Name	Drill date	Permit No	Unit number	Easting	Northing	Total Depth (m)	Depth to MF (m)	Depth to MGL (m)	MF Thickness (m)	DTW (m)	Comment
RAC #1	19/05/2010	188793	6929-1031	438535	6220514	12	6	not struck	>6		Bit blocked at 12 m
RAC #2	17/05/2009	188783	6929-1021	438580	6220658	25	11	23	12		
RAC #3											Not drilled. No rig access
RAC #4	20/05/2010	188794	6929-1032	438748	6220789	18	-	12	0		Monoman Sands not present
RAC #5	20/05/2010	188795	6929-1033	438848	6220782	20	11	15	1		Back to clay at 12 m.
RAC #6	20/05/2010	188796	6929-1034	438944	6220780	21	12	18	6		Small section of sands
RAC #7											Not drilled, poor access
RAC #8	18/05/2010	188786	6929-1024	439105	6220656	25	7	23	16		
RAC #9	18/05/2010	188787	6929-1025	439034	6220576	24	10	18	8	2.30	
RAC #10	19/05/2010	188788	6929-1026	438988	6220471	18	5	not struck	13*	1.92	Hole terminated at 18 m
RAC #11	19/05/2010	188789	6929-1027	438934	6220409	20	4	17	13	1.85	
RAC #12	19/05/2010	188790	6929-1028	438856	6220342	14	7	not struck	7^		Bit blocked at 14 m
RAC #13	19/05/2010	188791	6929-1029	438795	6220435	26	4	18	14	2.35	
RAC #14	19/05/2010	188792	6929-1030	438669	6220584	12	5	not struck	>7		Hole terminated at 12 m
RAC #15											Not drilled, poor access
RAC #16	18/05/2010	188784	6929-1022	438726	6220659	19	9	18.5	9.5		
RAC #17	18/05/2010	188785	6929-1023	438825	6220640	17.5	7	17	10		
RAC #18	20/05/2010	188797	6929-1035	439296	6220192	18	3	18*	16		

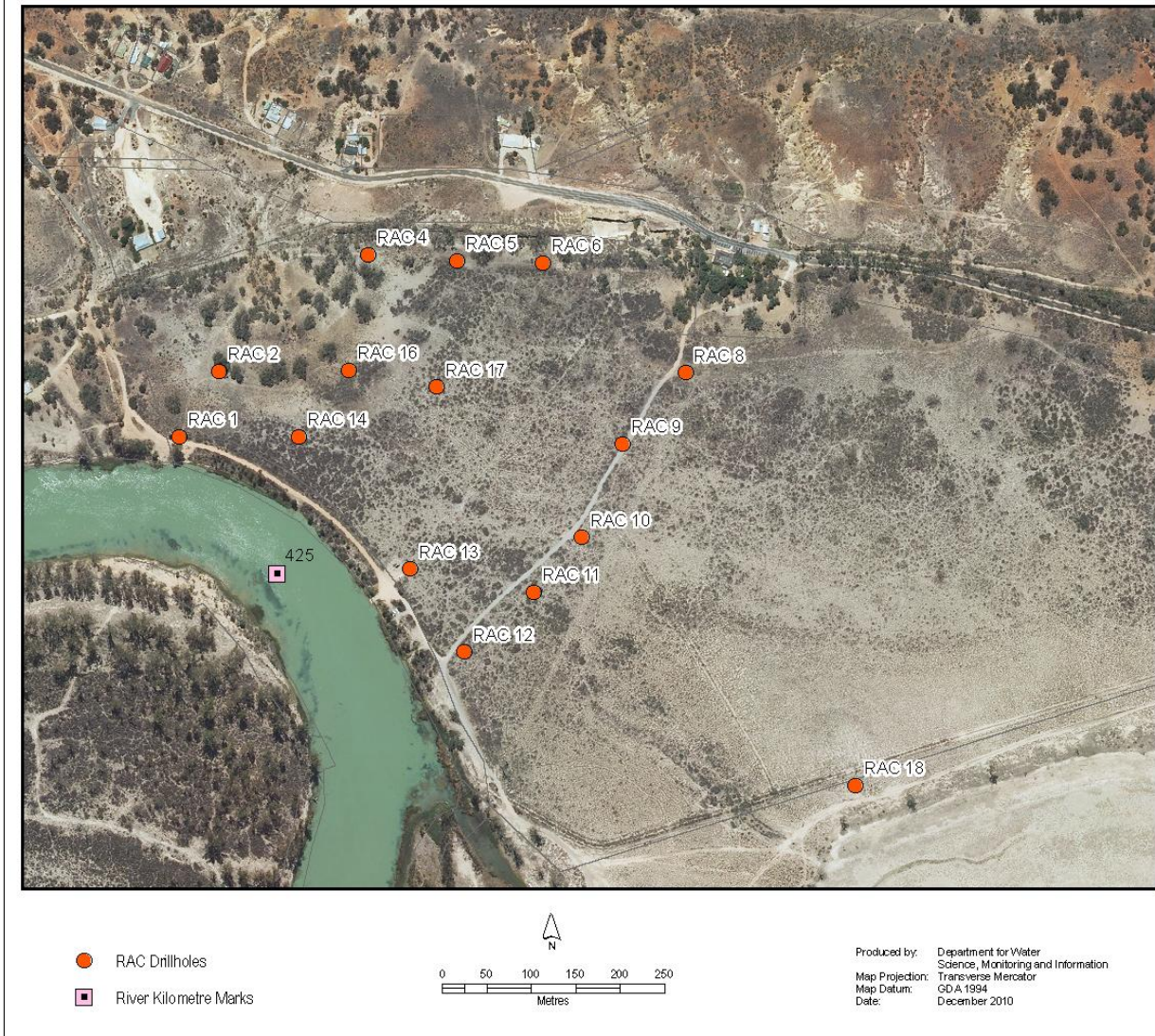
\*estimated

^based on OBSWELL 3

MF Monoman Formation

MGL Murray Group Limestone

OVERLAND CORNER  
**Figure 1: Drilled RAC holes**



**Figure 1. Location of Investigation Drillholes**

## OBSERVATION WELL DRILLING

Results from the investigation drilling were used to select the most suitable locations for the observation wells. Seven observation wells were drilled and constructed in late June–early July 2010 by Underdale Drillers using rotary mud drilling methods. Each well was completed in the Monoman Formation with 150 mm PVC casing (Class 12); and 6 m of 150 mm, 1 mm aperture slotted casing (Class 12) with a 1 m sump. No wells were completed at the back of the floodplain due to the limited thickness of Monoman Formation.

The observation wells were developed by airlifting for 30-60 minutes until drilling fluids were removed and the water became clear. A summary of the observation wells is given in Table 2, with locations shown in Figure 2. The observation wells were surveyed by SA Water using differential GPS (Real Time Kinematic) for reference against Australian Height Datum (AHD). Drilling logs including well-survey data are presented in Appendix B. Up to date information including latest salinity and water levels can be viewed on the Drillhole Enquiry System (<https://des.pir.sa.gov.au/deshome.html>).

### *Results*

- All Monoman Formation observation wells intersected water and yielded between 2.5 and 9 L/s (Table 1). Most wells yielded between 5 and 8 L/s.
- Groundwater salinities during airlifting were recorded between 20,000 and 29,000 mg/L.
- Silty, sandy clay bands (approximately 1 m thick) and occasional lignite zones were seen in sample cuttings between depths of 12-18 m.
- Coarse to very coarse sands and gravels tended to be at the base of the Monoman Formation.
- OBSWELL 7 intersected Murray Group Limestone (Glenforslan Formation) at a depth of 24 m. Very coarse sands and gravels were intersected from 17-23.5 m.
- OBSWELL 3 (adjacent RAC 12) intersected silty clays and clays from 13-16 m. The hole was terminated at 16 m and backfilled to 15 m with gravel prior to insertion of casing.
- OBSWELL 4 was drilled approximately 50 m north-west of drillhole RAC 2. The thickness of the Monoman Formation at this site was only 3 m which resulted in lower yield of ~2.5 L/s.

**Table 2. Monoman Formation Observation Well Drilling Summary**

Name	Drill date	Permit No	Unit No	Easting	Northing	Total depth (m)	Screen Interval (m)	Reference Elevation (m AHD)	Salinity mg/L	DTW (m)	Yield (L/s)
OBSWELL 1	29/06/2010	188798	6929-1014	439105	6220656	17.52	10.52-16.52	9.25	25,413	2.83	7
OBSWELL 2	29/06/2010	188799	6929-1015	438992	6220469	17.63	10.63-16.63	9.16	26,193	2.78	5
OBSWELL 3	30/06/2010	188800	6929-1016	438858	6220344	16	8.0-14.0	9.45	26,859*	3.23	5
OBSWELL 4	30/06/2010	188801	6929-1017	438575	6220698	3.82	14.94-17.94	11.65	22,708	3.82	2.5
OBSWELL 5	1/07/2010	191547	6929-1018	438814	6220645	16.75	9.75-15.75	8.92	24,826	2.78	9
OBSWELL 6	1/07/2010	191548	6929-1019	439299	6220228	17	10.03-16.03	10.32	28,927	3.84	8
OBSWELL 7	2/07/2010	191549	6929-1020	439576	6220309	23.71	16.71-22.71	10.01	26,617	3.60	8

1. Reference elevation is top of flange
2. \*Salinity estimate based on RAC #12



OVERLAND CORNER  
Figure 2: Drilled Observation Wells

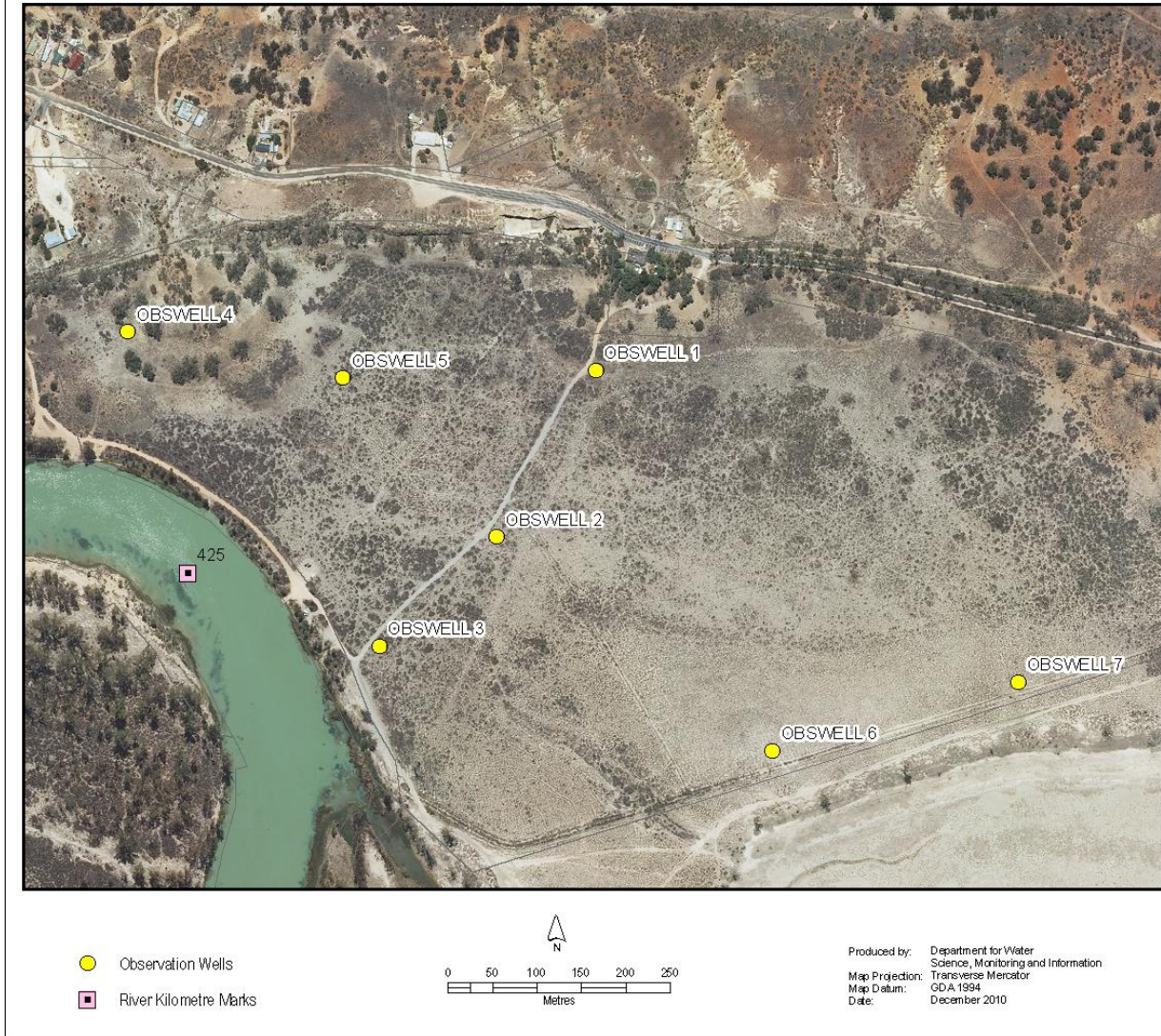


Figure 2. Location of Observation wells

## HYDRAULIC GRADIENT

Depth to water was measured at the time of drilling (July 2010) and during well surveying (September 2010). Groundwater levels for September 2010 were converted to freshwater head (m AHD) using the method developed by Post *et al* 2007 and compared to river pool level at river kilometre 425. Latest groundwater levels for the previously installed highland wells OCO 1 and OCO 2 were also converted to freshwater head. The corrected freshwater heads are given in Table 3 and indicated in Figure 3. Table 4 gives river pool level for various flow rates over Lock 3 (at river kilometre 425). To note is that the highland wells are constructed into the Murray Group Limestone Aquifer which discharges to the floodplain. The aquifer characteristics are likely to differ from the Monoman Formation, however the aquifer is also unconfined and provides useful information about groundwater movement from the highland to the floodplain.

**Table 3. Density Corrected RSWL (freshwater head)**

Well Name	Unit Number	Depth to Water (m)	RSWL (m AHD)	Salinity (mg/L)	Freshwater Head (m AHD)
OBSWELL 1	6929-1014	2.53	6.72	25,413	6.93
OBSWELL 2	6929-1015	2.47	6.69	26,193	6.91
OBSWELL 3	6929-1016	2.75	6.70	26,851	6.88
OBSWELL 4	6929-1017	5.01	6.64	22,708	6.84
OBSWELL 5	6929-1018	2.28	6.64	24,826	6.84
OBSWELL 6	6929-1019	3.63	6.69	28,927	6.90
OBSWELL 7	6929-1020	3.24	6.77	26,617	7.10
OCO 1 <sup>^</sup>	6929-1001	48.72	6.85	6,991	6.87
OCO 2 <sup>^</sup>	6929-1002	38.37	8.86	10,000	8.91

<sup>^</sup>Salinity collected May 2008, SWL collected August 2010

**Table 4. Flow rate at Lock 3 vs River Pool Level**

Flow Rate (Lock 3) ML/day	River Pool Level (m AHD) River KM 425
1,180	6.2
5,000	6.38
10,000	6.6
15,000	6.88
20,000	7.2
30,000	7.82

### Results

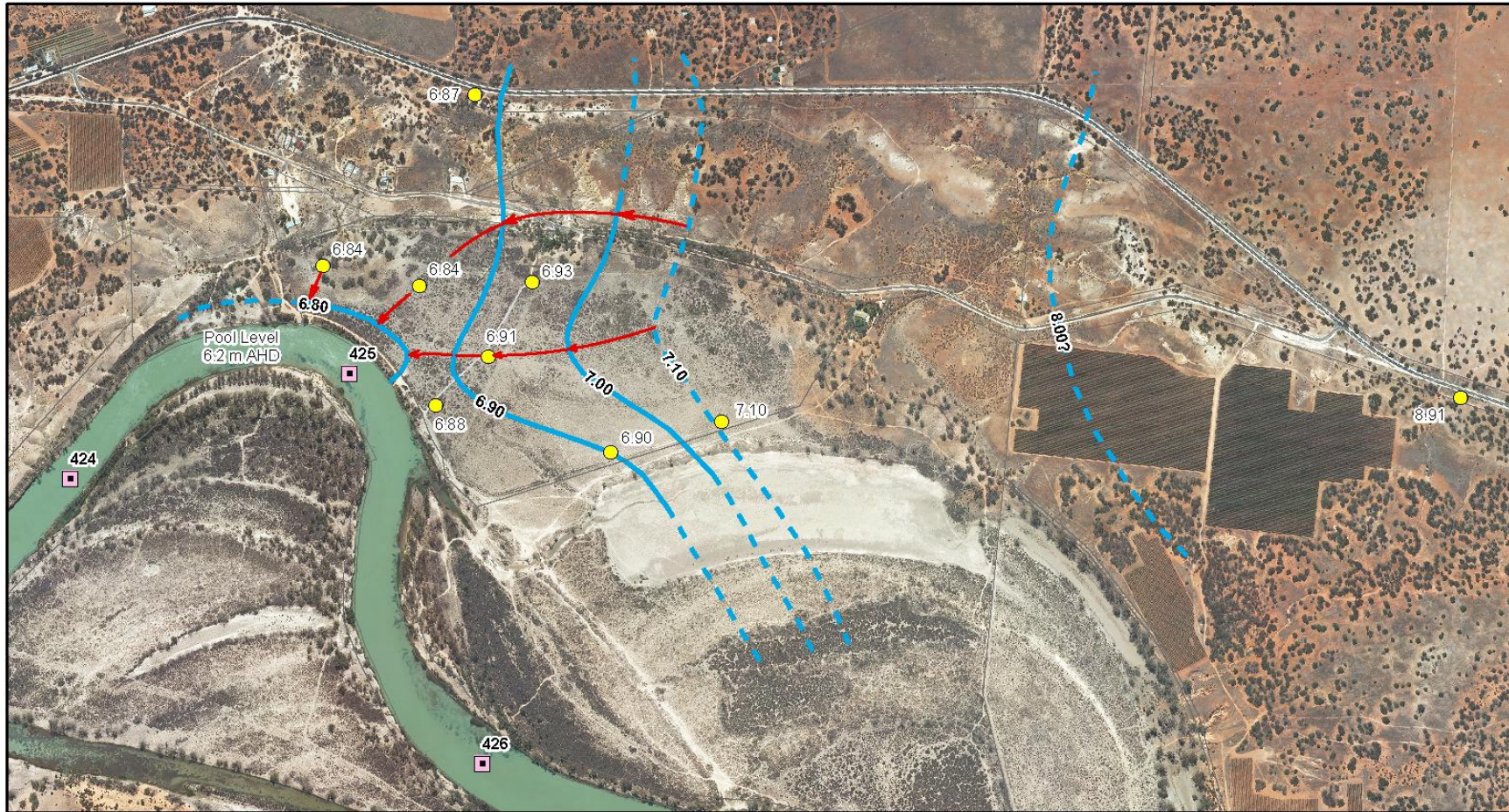
Freshwater heads on the floodplain ranged from 6.84 m AHD at OBSWELL 4 and 5, to 7.10 m AHD at OBSWELL 7. The highland observation wells were 6.87 m AHD at OCO 1 and 8.91 m AHD at OCO 2. The corresponding river pool level at the time of the in-river EC survey (October 2009) was ~6.2 m AHD at a flow of 1,180 ML/day.

Assuming that September 2010 groundwater levels are similar to those occurring at the time of the in-river EC survey (October 2009), the water level elevation contours in Figure 3 indicate groundwater flow paths from the highland to the floodplain, and then from the floodplain to the river, in the vicinity of river

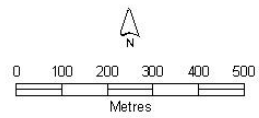
kilometre 425. This is confirmed by the in-river EC data which are presented in Figure 4 (see also Appendix B). As seen from Figure 4, saline groundwater up to 13,000 EC is encountered at the bend of the river, approximately 100 m upstream and 300 m downstream of river kilometre 425. It is clear that groundwater is contributing to in-river EC in this part of the reach.

The data collected are a snap shot in time, and should be considered against other factors such as seasonal variation and changing river pool levels. At the time of reporting (20 September 2010) river flow over Lock 3 was 15,000 ML/day, which corresponds to a river pool level of 6.88 m at river kilometre 425. At this river pool level groundwater discharge is still likely, however discharge from the River to the floodplain may be possible in some sections of the reach. Evapotranspiration and barometric pressure fluctuations are likely to contribute to variations observed between floodplain observation wells. Larger changes in water table elevation are likely to result from recharge to the system through inundation of the floodplain, although this has not occurred for some time.

Figure 3: Freshwater heads (RSWL)



- Observation Well
- River Kilometre Mark
- Potentiometric Contour
- Groundwater Flow Direction

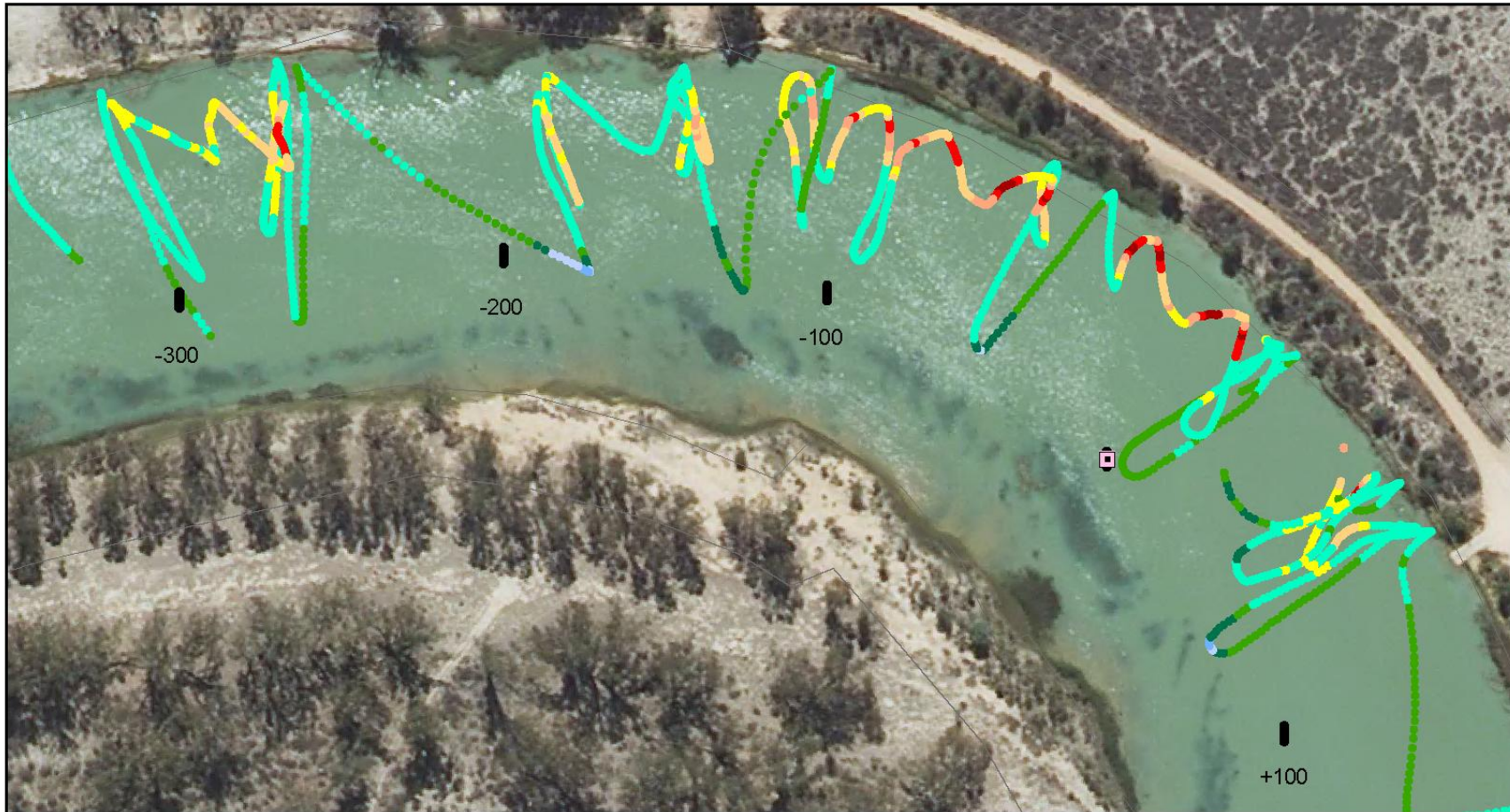


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Science, Monitoring and Information  
Map Projection: Transverse Mercator  
Map Datum: GDA 1994  
Date: January 2011

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Figure 3. Freshwater head (RSWL), potentiometric contours and river pool level at a flow rate of 1,180 ML/day

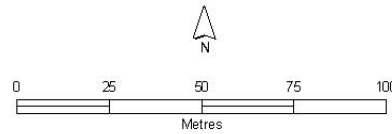
Figure 4: In-river EC - October 2009



Recorded Salinity October 2009 EC

- 534 - 540
- 540 - 542
- 542 - 544
- 544 - 546
- 546 - 548
- 548 - 550
- 550 - 555
- 555 - 560
- 560 - 600
- 600 - 1000
- 1000 - 6000
- 6000 - 13490

- River Kilometre 425
- Downstream Kilometre 425
- Upstream Kilometre 425



Produced by: Department for Water  
Science, Monitoring and Information  
Map Projection: Transverse Mercator  
Map Datum: GDA 1984  
Date: December 2010

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Figure 4. In-river salinity (EC), October 2009

## CONCLUSIONS

Investigation drilling and the completion of observation wells on Overland Corner floodplain indicate the Monoman Formation is a high yielding aquifer. The lithology comprises fine to coarse sands and gravels yielding at rates greater than 5 L/s. The depth to the Glenforslan Formation (MGL) is generally greater than 17 m, except at the back of the floodplain where it was intersected between 12 and 18 m. Groundwater salinities were recorded between 20,000-29,000 mg/L.

Water level elevations corrected to freshwater heads indicate that groundwater flow paths are from the floodplain to the river, close to OBSWELL 4 and OBSWELL 5, before discharging near river kilometre 425. At the time of in-river salinity surveys, groundwater levels were higher than river pool level which accounts for elevated river salinity. Further to this, groundwater discharge is also likely through evaporative processes through the floodplain. Water tables are shallow (less than 3 m) and influence groundwater level, flow direction and salinity.

## RECOMMENDATIONS

- Future drilling investigations targeting the Monoman Formation should focus on the main part of the floodplain to the east of RAC 2, and avoid the back of the floodplain adjacent to the cliffs.
- Further consideration should be given to the hydraulic communication between the Monoman Formation and the Glenforslan Formation. Additional investigation drilling, paired observation wells (Glenforslan Formation wells adjacent existing Monoman Formation wells), and possibly aquifer tests should be considered to determine the hydraulic separation.
- Floodplain observation wells should be monitored quarterly and incorporated into the Woolpunda Salt Interception Scheme Groundwater Monitoring Network. Highland observation wells OCO 1 and OCO 2 should also be included in the network and updated for SWL and salinity.
- Further interpretation of data collected during this investigation should occur as part of a cost-benefit analysis for a Salt Interception Scheme; in particular the estimate of groundwater flux to the River.

## REFERENCES

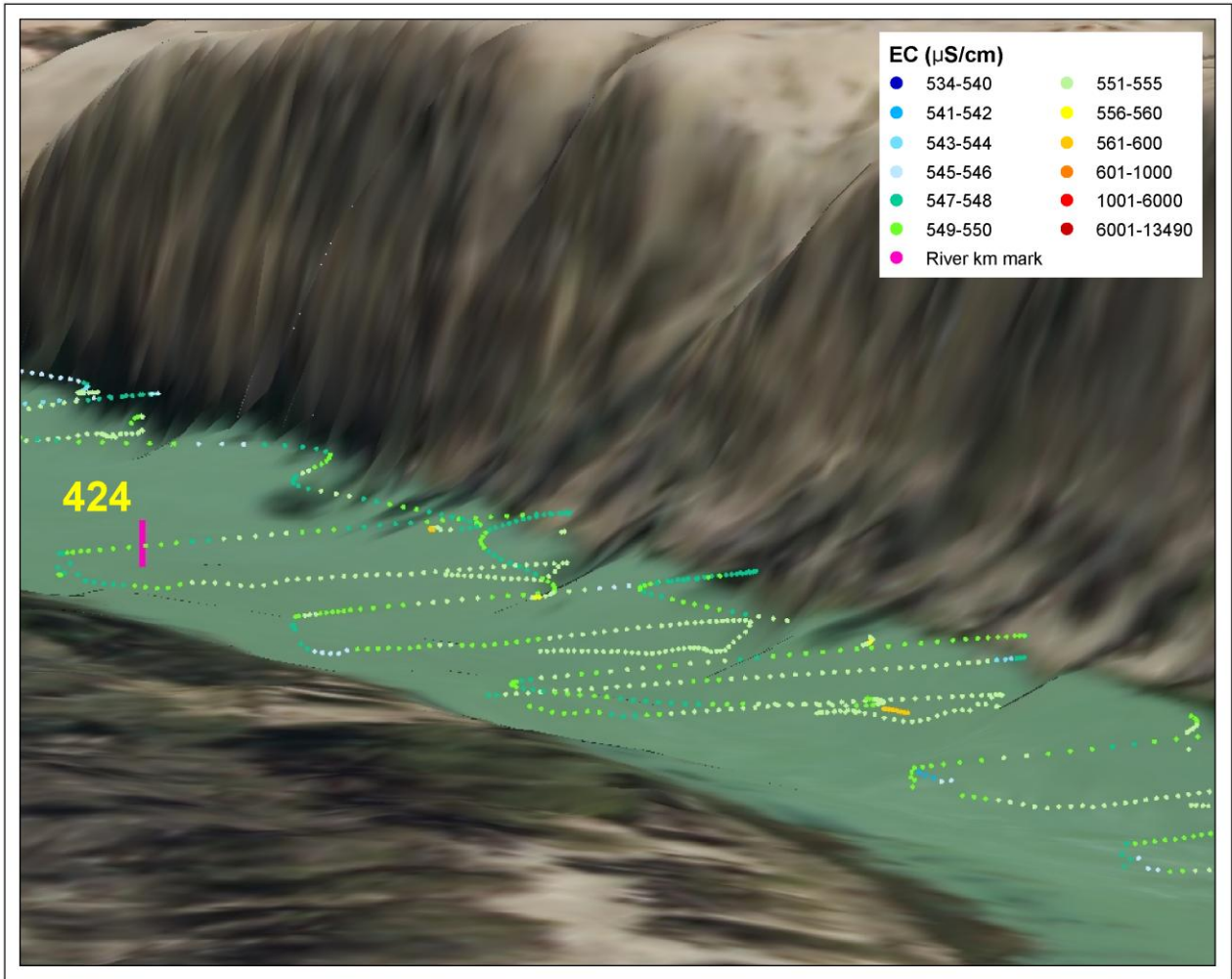
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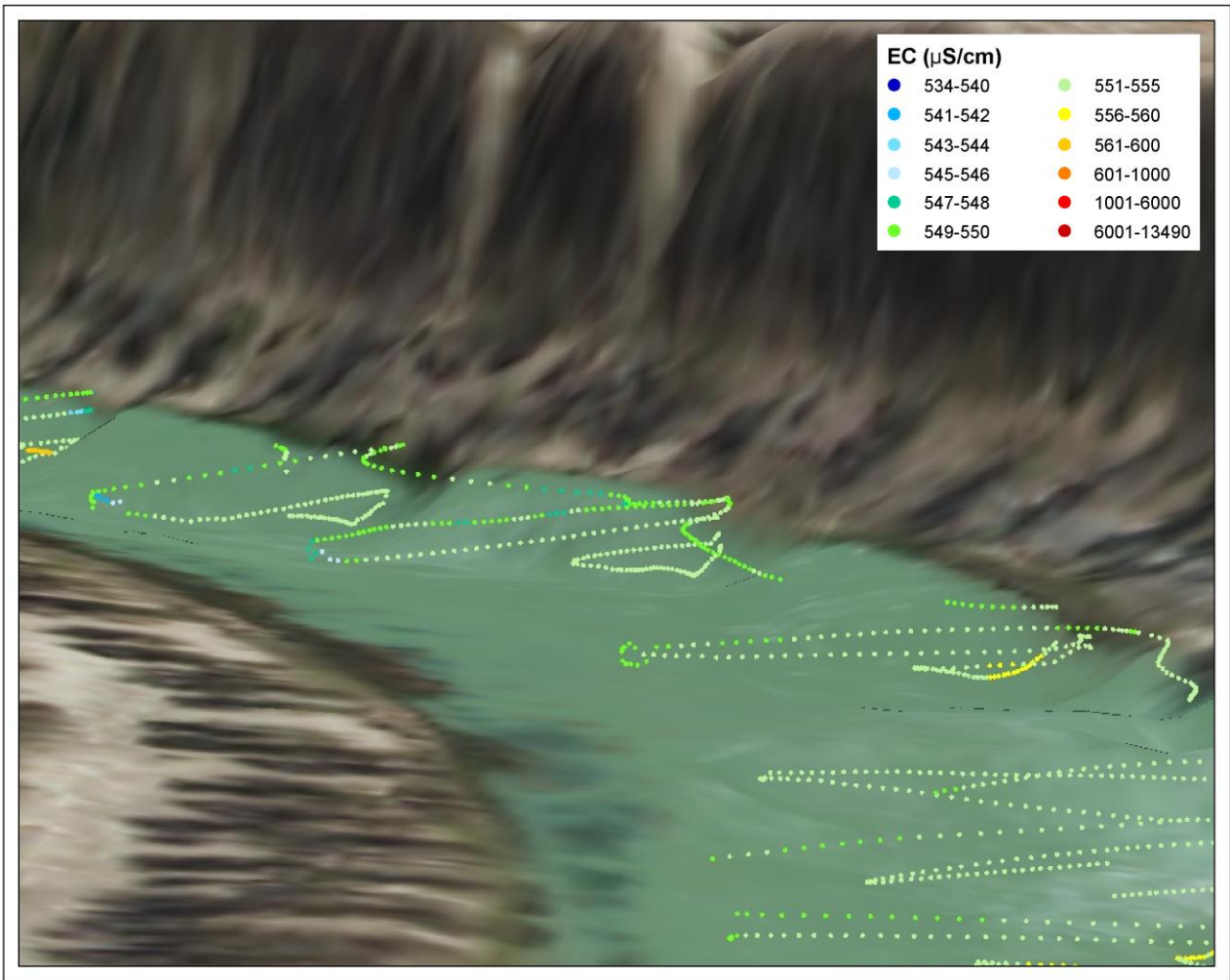
Wood, V (2010). An Indigenous Cultural Heritage Study of Proposed Well Locations on the Overland Corner Floodplain, Upper Murray, South Australia (Woolpunda Salt Interception Scheme Extensions). Vivienne Wood Heritage Consultant Pty Ltd.

**APPENDIX A – IN-RIVER EC DATA, RIVER KILOMETRE 424-426**

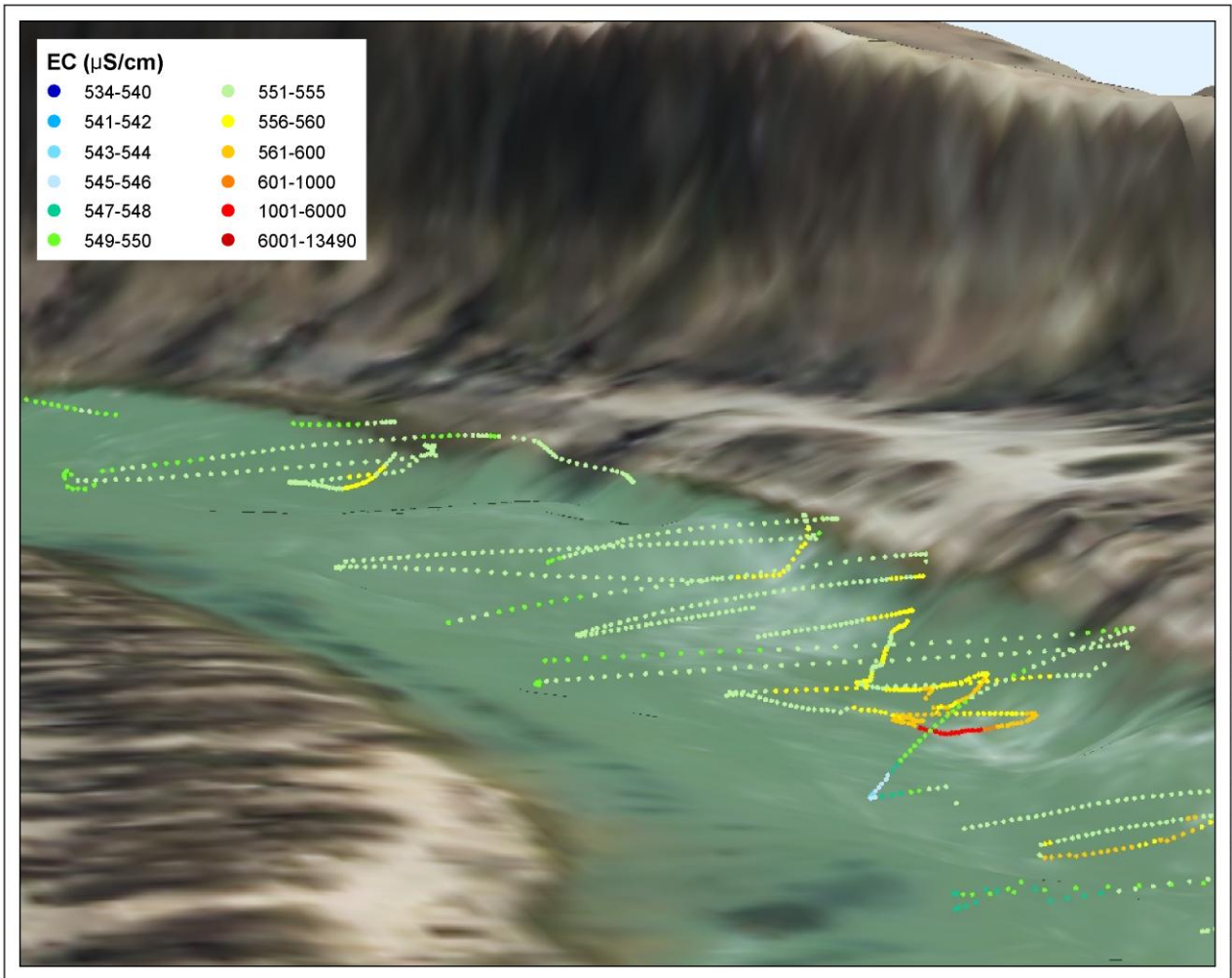




i) In-river EC data upstream of river kilometre 424

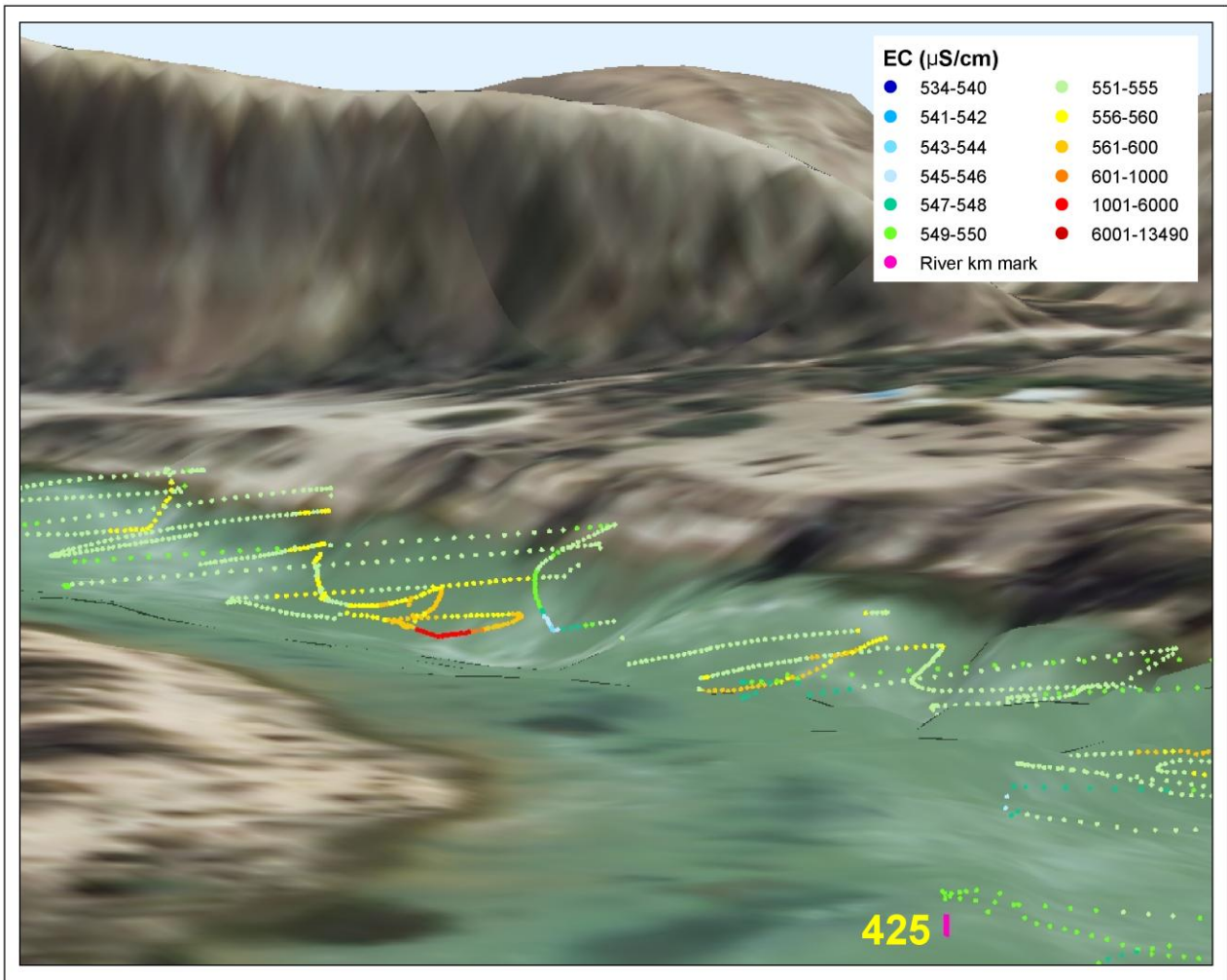


ii) In-river EC data upstream of river kilometre 424, and before river kilometre 425

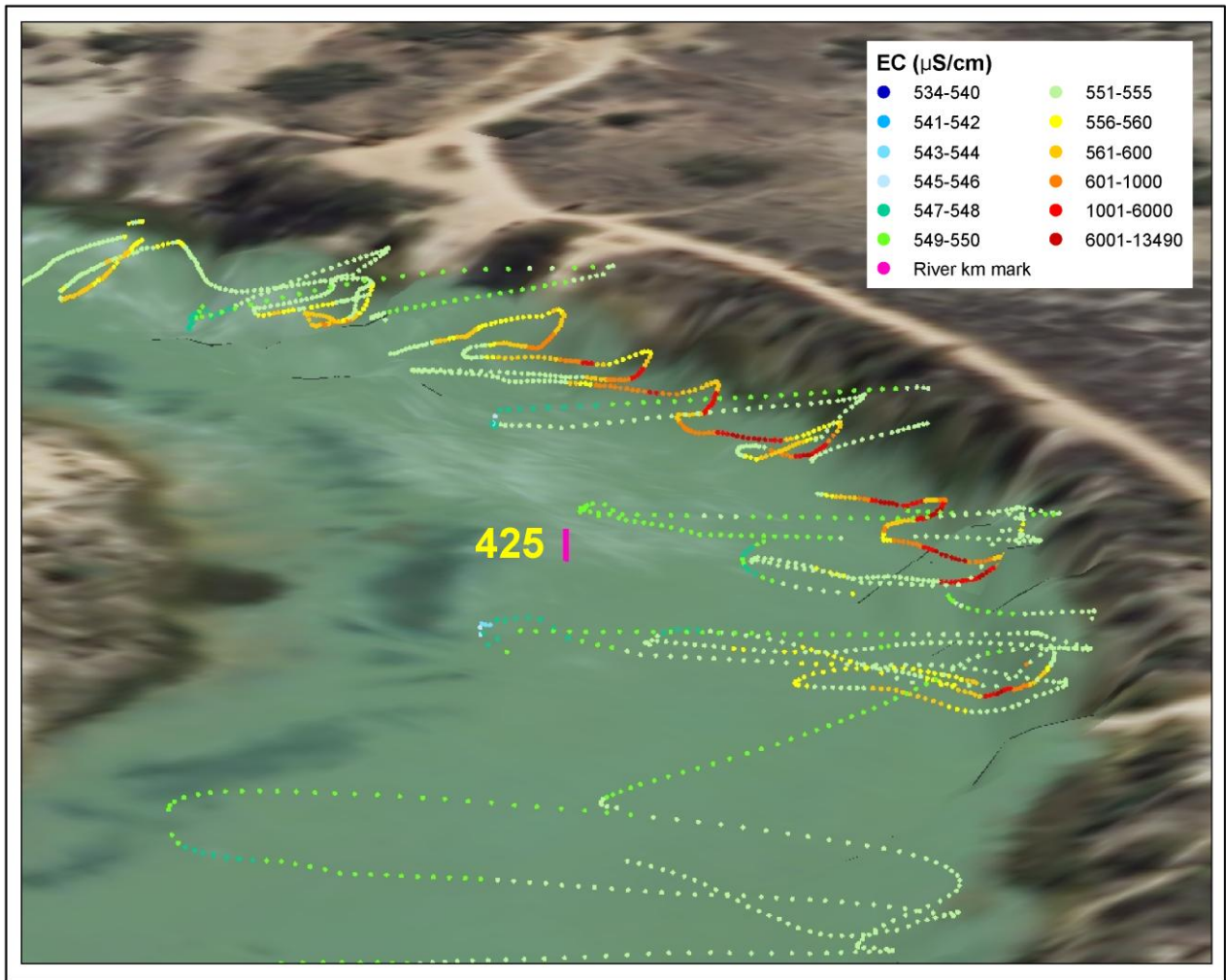


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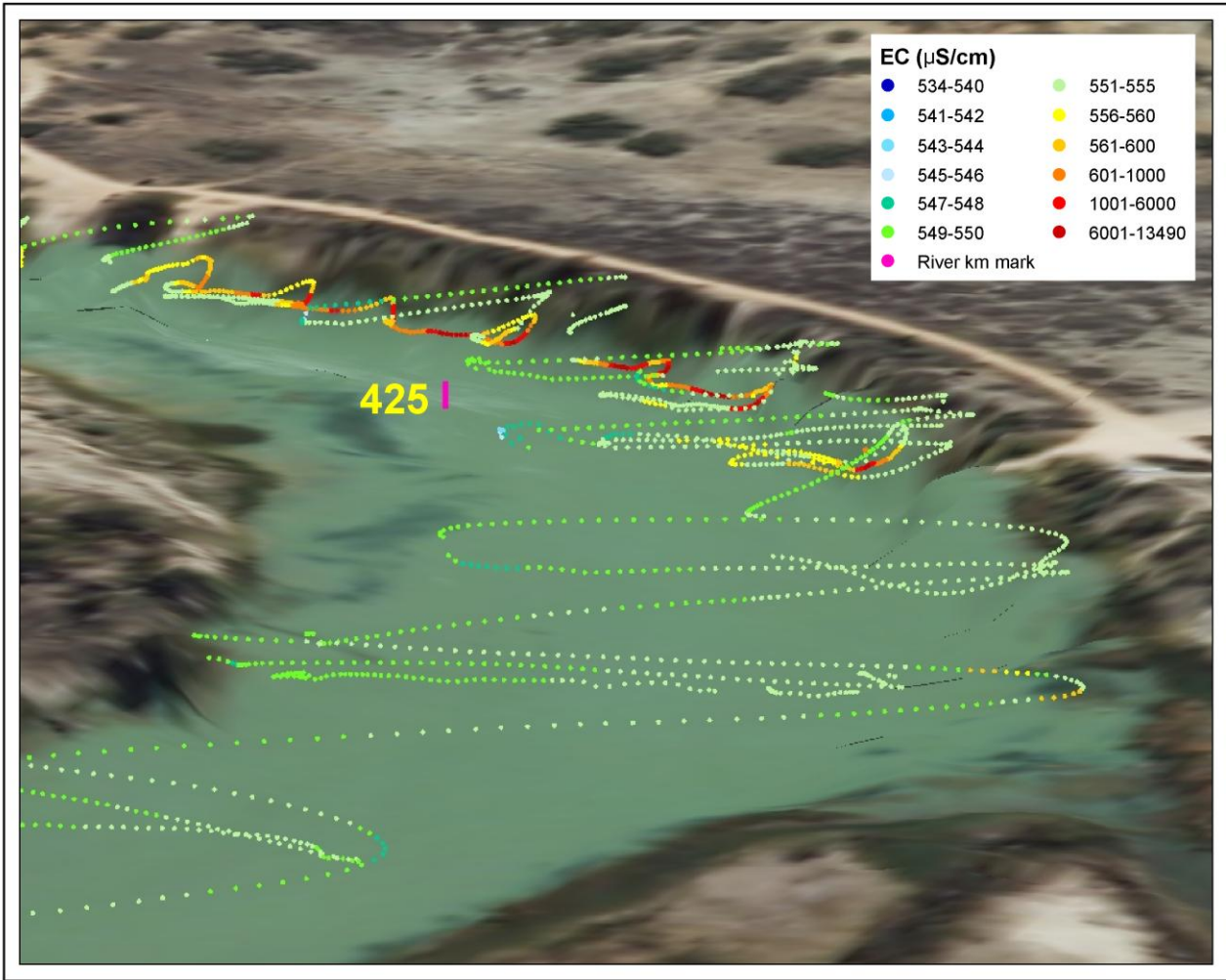
iii) In-river EC data upstream of river kilometre 424, close to river kilometre 425



iv) In-river EC data slightly downstream of river kilometre 425

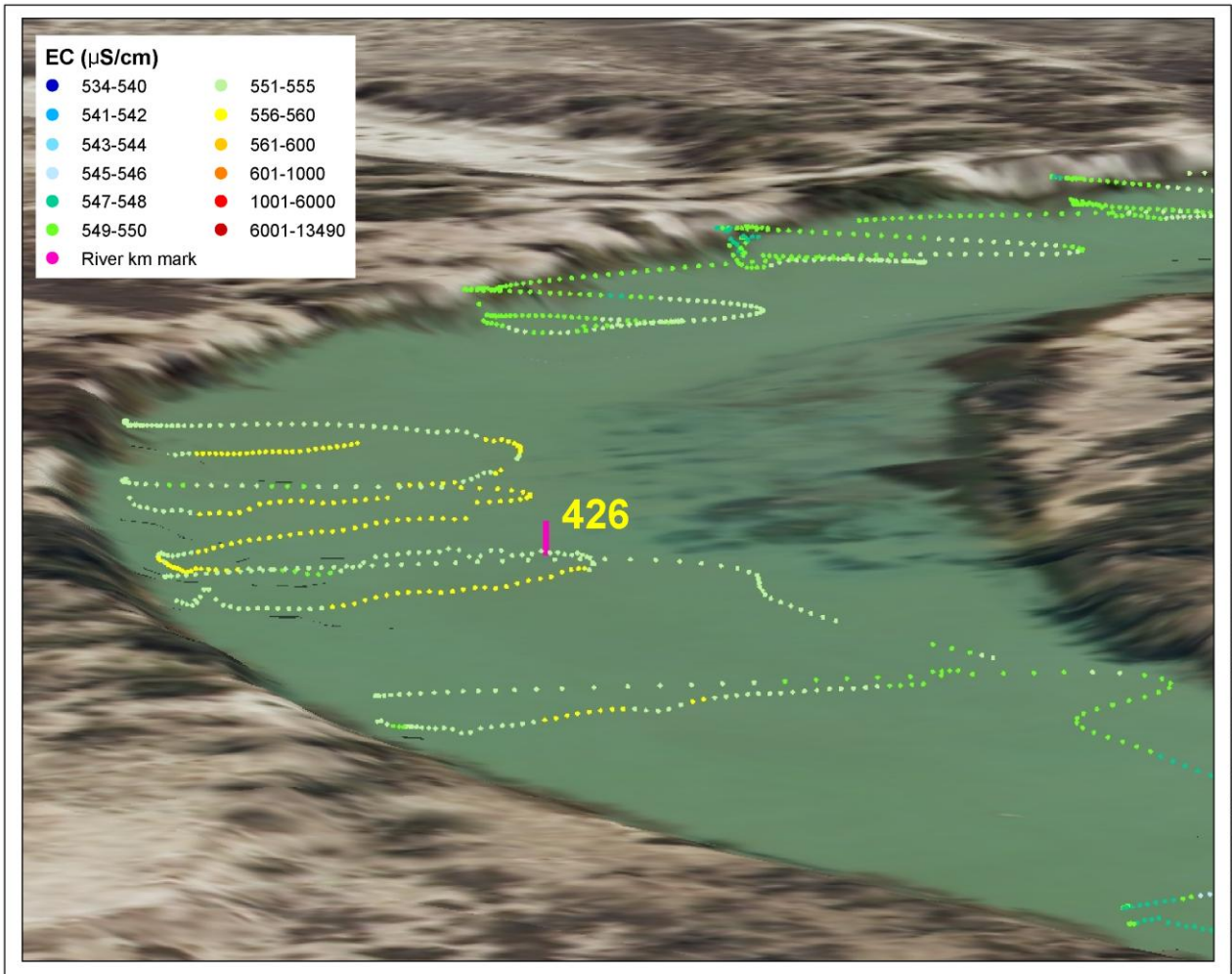


v) In-river EC data at river kilometre 425, at the bed of Overland Corner - saline groundwater discharge clearly evident



vi) **In-river EC data at and slightly upstream of river kilometre 425 - saline groundwater discharge clearly evident**





viii) In-river EC data at river kilometre 426 - saline groundwater discharge not evident



**APPENDIX B – OBSERVATION WELL DRILLING LOGS**



## Groundwater Program Water Well Log

Project: **Woolpunda SIS - Observation Well Installation.  
Overland Corner Floodplain.**

Permit Number: **188798**

Date Completed: **29/6/2010**

Unit No: **6929-1014**

Drillhole Name: **OBSWELL #1**

Logged By: **Paul Magarey**

Total Depth (m): **17.52**

Drill Method: **Mud Rotary**

Drilling Company: **Underdale Drillers**

Driller: **Nathan Bryant**

### Coordinates

Easting: **439102**

Northing: **6220658**

Zone: **54**

Datum: **GDA 94**

Ground Elevation (m AHD): **8.73**

Reference Elevation (m AHD): **9.25**

Reference Point Type: **Top of Flange**

**General Comments:** Drillhole log based on adjacent RAC hole #8.

### Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	1	SAND	Fine to medium sand with organic matter.	COONAMBIDGAL
1	3	SAND/SILT	Fine to medium sand with silt particles stuck to sand grains. Light grey	COONAMBIDGAL
3	4	CLAY/SILT	Silty and sandy clay. Grey to brown	COONAMBIDGAL
4	5	SILT	Well sorted silt with fine sand. Light brown	COONAMBIDGAL
5	6	SILT	Light brown, some fine sand.	COONAMBIDGAL
6	8	SAND	Fine sand, well sorted, 0.08-0.2 mm, light brown tending fawn. Clear and opaque quartz, sub-rounded.	MONOMAN
8	9	SAND	Medium, 0.2-0.4 mm, with minor fine and coarse component. Light brown, fawn. Clear and opaque quartz grains, sub-rounded.	MONOMAN
9	10	SAND	Poorly sorted fine to coarse sand, 0.1- 0.8 mm, minor gravel. Clear and opaque quartz. Sub-rounded	MONOMAN
10	11	SAND	Coarse with gravel, 0.8-1.5 mm. Light brown, clear and opaque quartz, sub-rounded.	MONOMAN
11	12	SAND	Fine sand with silt, and minor coarse component. Light brown.	MONOMAN
12	14	SAND	Coarse with fine component. Light brown	MONOMAN
14	16	SAND	Coarse, well sorted, 0.6-1.0 mm, minor very coarse component. Light brown, clear and opaque quartz, sub-rounded.	MONOMAN
16	17	SAND	Coarse, well sorted, 0.6-1.2 mm. Clear and opaque quartz, sub-rounded. Light brown.	MONOMAN



## Groundwater Program Water Well Log

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
17	18	SAND	Coarse, Clear and opaque quartz, sub-rounded. Light brown. END OF LOG	MONOMAN

### Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length	Method	Sample No	Salinity mg/L	
6	18	2.83	7	45 mins	Airlift	1810078	25,413	

### Casing Information

Depth (m)		Diam (mm)	Material	
From	To			
-0.43	10.52	150	PVC	Stickup and blank casing
10.52	16.52	150	PVC Screen	1.0 mm aperture screen
16.52	17.52	150	PVC	Sump



## Groundwater Program Water Well Log

Project: **Woolpunda SIS - Observation Well Installation.  
Overland Corner Floodplain.**

Permit Number: **188799**

Date Completed: **29/6/2010**

Unit No: **6929-1015**

Drillhole Name: **OBSWELL #2**

Logged By: **Paul Magarey**

Total Depth (m): **17.63**

Drill Method: **Mud Rotary**

Drilling Company: **Underdale Drillers**

Driller: **Nathan Bryant**

### Coordinates

Easting: **438991**

Northing: **6220471**

Zone: **54**

Datum: **GDA 94**

Ground Elevation (m AHD): **8.60**

Reference Elevation (m AHD): **9.16**

Reference Point Type: **Top of Flange**

**General Comments:** Drillhole located adjacent to RAC #10. Lithological log based on RAC #10.

### Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	1	SILT	Silt and fine sand, brown.	COONAMBIDGAL
1	2	SILT	Light brown silt	COONAMBIDGAL
2	3	CLAY	Silty clay, light grey/brown.	COONAMBIDGAL
3	4	SILT	Silt with very fine sand. Yellowish brown	COONAMBIDGAL
4	5	SILT	Silty with very fine sand, brown.	COONAMBIDGAL
5	6	SAND	Medium to coarse sand, 0.2-1.0 mm. Iron stained quartz, clear and opaque. Sub-rounded	MONOMAN
6	7	SILT/SAND	Silt with fine sand (0.08 mm), light brown	MONOMAN
7	8	SAND	Medium to coarse sand (0.4-1.0 mm) with gravel (5%). Clear and opaque quartz. Light brown, sub-rounded	MONOMAN
8	9	SAND	Poorly sorted sand, fine to coarse (0.1-1.0 mm) with gravel (<2%). Clear and opaque quartz. Light brown, sub-rounded	MONOMAN
9	10	SAND	Medium to coarse sand, 0.2-1.5 mm. Clear and opaque quartz, sub-rounded, light brown.	MONOMAN
10	11	SAND/GRAVEL	Poorly sorted sand and gravel, very fine to coarse (0.08-3.0 mm). Predominantly opaque quartz, light brown	MONOMAN
11	12	SAND	Medium to coarse sand 0.2-1.5 mm, poorly sorted, minor gravel. Opaque quartz, sub-rounded, grey.	MONOMAN
12	13	SAND	Poorly sorted fine to coarse sand 0.1-1.0 mm. Opaque quartz, sub-rounded, grey.	MONOMAN
13	14	SAND	Fine to coarse sands, poorly sorted, 0.09-1.2 mm. opaque quartz, sub-rounded, grey	MONOMAN



## Groundwater Program Water Well Log

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
14	15	SAND/SILT	Poorly sorted sand and silt. Sand 0.1-1.2 mm. Grey,	MONOMAN
15	16	SAND	Medium to coarse sands 0.5-1.5 mm, opaque quartz, grey, sub-rounded	MONOMAN
16	17	SAND	Poorly sorted fine to coarse sands, 0.09-1.5 mm. light grey, opaque quartz, sub-rounded.	MONOMAN
17	18	SAND/GRAVEL	Coarse sand and gravel, light grey. Opaque quartz, sub-rounded.	MONOMAN

### Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length	Method	Sample No	Salinity	
5	18	2.78	5	30 mins	Airlift	1810077	26,193	

### Casing Information

Depth (m)		Diam (mm)	Material	
From	To			
-0.41	10.63	150	PVC	Stickup and blank casing
10.63	16.63	150	PVC Screen	1.0 mm aperture screen
16.63	17.63	150	PVC	Sump



## Groundwater Program Water Well Log

Project: **Woolpunda SIS - Observation Well Installation.  
Overland Corner Floodplain.**

Permit Number: <b>188800</b>	Backfilled (Y/N): <b>backfilled with gravel to 15 m</b>
Date Completed: <b>30/6/2010</b>	Total Depth (m): <b>16 m</b>
Unit No: <b>6929-1016</b>	Drill Method: <b>Mud Rotary</b>
Drillhole Name: <b>OBSWELL #3</b>	Drilling Company: <b>Underdale Drillers</b>
Logged By: <b>Paul Magarey</b>	Driller: <b>Nathan Bryant</b>

### Coordinates

Easting: <b>438859</b>	Ground Elevation (m AHD): <b>8.69</b>
Northing: <b>6220348</b>	Reference Elevation (m AHD): <b>9.45</b>
Zone: <b>54</b>	Reference Point Type: <b>Top of flange</b>
Datum: <b>GDA 94</b>	

**General Comments:** Drillhole located adjacent to RAC #12. Water sample collected from RAC #12 during exploration drilling. Monoman Formation not as thick here. Silty clay encountered at 14 m. Backfilled with gravel from 15-16 m.

### Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	3	CLAY	Light to dark grey clay	COONAMBIDGAL
3	4	SILT	Light brown silt, with fine sand.	COONAMBIDGAL
4	5	SAND/SILT	Very fine sand (0.07 mm) with silt, light yellow/brown.	COONAMBIDGAL
5	6	SAND	Well sorted coarse sand, 0.6-1.0 mm. Clear and opaque quartz, sub-rounded, iron stained.	COONAMBIDGAL
6	7	SAND	Medium to coarse sand with gravel (10%). Grain size 0.2-1.5 mm. Clear and opaque quartz, poorly sorted, sub-rounded.	COONAMBIDGAL
7	8	SAND	Poorly sorted medium to coarse sand (0.4-0.8 mm), with minor fine sand. Predominantly opaque quartz, sub-rounded, light brown	MONOMAN
8	9	SAND	Poorly sorted medium to coarse sand (0.2-0.8 mm) with minor fine sand. Light brown, sub-angular to sub-rounded	MONOMAN
9	10	SAND	Poorly sorted medium to coarse sand (0.2-1.0 mm) with minor fine sand. Light brown, sub-angular to sub-rounded	MONOMAN
10	11	SAND	Poorly sorted medium sand (0.2-0.6 mm) with minor fine and coarse component. Light brown, sub-rounded, opaque quartz.	MONOMAN
11	12	SAND	Poorly sorted fine to medium sand (0.08-0.6 mm), with minor coarse sands and gravels. Light brown, sub-rounded, opaque quartz.	MONOMAN



## Groundwater Program Water Well Log

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
12	13	SAND	Fine sand, well sorted, with minor coarse component. Grey.	MONOMAN
13	14	SILT / SAND	Silt with coarse sand (0.6-0.8 mm). Grey	MONOMAN
14	15	SILT	Silty, grey	MONOMAN
15	16	SILT	Silt, grey. Backfilled with gravel to 15 m. END OF LOG	

### Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length	Method	Sample No	Salinity (mg/L)	
5	14	3.23	5	1 hr	Airlift	1722548	26,859	Salinity based on RAC#12

### Casing Information

Depth (m)		Diam (mm)	Material	
From	To			
-0.65	8	150	PVC	Stickup and blank casing
8	14	150	PVC Screen	1.0 mm aperture screen
14	15	150	PVC	Sump



## Groundwater Program Water Well Log

Project: **Woolpunda SIS - Observation Well Installation.  
Overland Corner Floodplain.**

Permit Number: **188801**  
Date Completed: **1/7/2010**  
Unit No: **6929-1017**  
Drillhole Name: **OBSWELL #4**  
Logged By: **Paul Magarey**

Total Depth (m): **18.94**  
Drill Method: **Mud Rotary**  
Drilling Company: **Underdale Drillers**  
Driller: **Nathan Bryant**

### Coordinates

Easting: **438577**  
Northing: **6220701**  
Zone: **54**  
Datum: **GDA 94**

Ground Elevation (m AHD): **11.05**  
Reference Elevation (m AHD): **11.65**  
Reference Point Type: **Top of flange**

**General Comments:** Drillhole approximately 40 m northwest of RAC #2.

Relatively low yielding well due to small thickness of Monoman Sand at this location. Bore cleaner added to enhance development.

### Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	1	CLAY	Silty clay, mottled orange/yellow. Minor gravel (5%), rounded.	COONAMBIDGAL
1	2	CLAY	Clay, mottled orange, yellow with organic matter/soil/ limestone rubble and gravel.	COONAMBIDGAL
2	3	SILT	Silt, mottled orange/yellow with limestone rubble, fine sand and clay.	COONAMBIDGAL
3	4	SAND	Fine sand with clay, mottled yellow orange with limestone rubble, minor gravel.	COONAMBIDGAL
4	5	SILT	Clayey silt, mottled, transitioning to light brown clay	COONAMBIDGAL
5	6	CLAY	Light brown clay.	COONAMBIDGAL
6	7	CLAY/SILT	Light brown clay and silt. Minor gravel (<1%).	COONAMBIDGAL
7	8	CLAY/SILT	Clay and silt, micaceous, grey	COONAMBIDGAL
8	9	SILT	Micaceous silt, dark grey with minor orange	COONAMBIDGAL
9	10	SILT	Micaceous silt, dark grey (80%) with minor orange.	COONAMBIDGAL
10	14	SILT	Clayey silt, micaceous and firm. Grey tending to dark grey.	COONAMBIDGAL
14	15	SILT	Dark grey silt, micaceous, tending to sand at 15 m.	COONAMBIDGAL/ MONOMAN
15	18	SAND	Coarse to very coarse sand with gravel (30%). Sub-angular to sub-rounded, poorly sorted. END OF LOG	MONOMAN





## Groundwater Program Water Well Log

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### Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length	Method	Sample No	Salinity	
15	18	3.82	2.5	1.5 hrs	Airlift	1810076	22,708	

### Casing Information

Depth (m)		Diam (mm)	Material	
From	To			
-0.5	14.94	150	PVC	Stickup and blank casing
14.94	17.94	150	PVC Screen	1.0 mm aperture screen, gravel packed
17.94	18.94	150	PVC	Sump



## Groundwater Program Water Well Log

Project: **Woolpunda SIS - Observation Well Installation.  
Overland Corner Floodplain.**

Permit Number: **191547**  
Date Completed: **1/7/2010**  
Unit No: **6929-1018**  
Drillhole Name: **OBSWELL #5**  
Logged By: **Paul Magarey**

Total Depth (m): **16.75**  
Drill Method: **Mud Rotary**  
Drilling Company: **Underdale Drillers**  
Driller: **Nathan Bryant**

### Coordinates

Easting: **438818**  
Northing: **6220649**  
Zone: **54**  
Datum: **GDA 94**

Ground Elevation (m AHD): **8.38**  
Reference Elevation (m AHD): **8.92**  
Reference Point Type: **Top of flange**

**General Comments:** Lithological log based on adjacent drillhole RAC #17. Very high yielding well.

### Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	1	CLAY/SAND	Brown clay with sand (0.06-0.5mm) and silt.	COONAMBIDGAL
1	2	CLAY	Brown clay, minor sand	COONAMBIDGAL
2	3	CLAY	Brown /orange clay, minor sand.	COONAMBIDGAL
3	4	CLAY	Brown clay, minor fine sand	COONAMBIDGAL
4	5	SILT/CLAY	Grey silty clay, minor fine sand	COONAMBIDGAL
5	6	SAND	Well sorted fine sand, 0.07-0.1 mm, grey, with minor clay/silt. Predominantly opaque quartz grains	MONOMAN
6	7	SAND	Well sorted fine sand, 0.09-0.15 mm, with minor silt. Grey, predominantly opaque quartz grains.	MONOMAN
7	8	SAND	Well sorted fine sand (0.1 mm) transitioning to medium to coarse sand (0.3-1.5 mm). Light brown. Opaque quartz, iron stained with minor clear quartz, sub-rounded.	MONOMAN
8	9	SAND	Poorly sorted sand, fine to coarse (0.1-1.5 mm) with gravel (<2%). Clear and opaque quartz. Light brown, sub-rounded	MONOMAN



## Groundwater Program Water Well Log

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
9	10	SAND	Poorly sorted sand, fine to coarse (0.1-1.2 mm). Clear and opaque quartz, sub-rounded, light brown.	MONOMAN
10	11	SAND	Poorly sorted sand, fine to medium (0.08-0.5 mm). Predominantly opaque quartz, light brown, sub-rounded.	MONOMAN
11	12	SAND	Fine sand (0.1 mm) with minor coarse (5%). Grey/ brown, minor clay. Predominantly opaque quartz grains, sub-rounded.	MONOMAN
12	13	SAND	Sand, fine to medium (0.1-0.5 mm) with minor quartz. Light grey, clear and opaque quartz, sub-rounded.	MONOMAN
13	14	SAND/GRAVEL	Poorly sorted very fine to coarse sands with fine gravel (3 mm). Brown to dark brown, with silt. Sub-rounded	MONOMAN
14	15	SAND	Fine to medium sand (0.1-0.4 mm), light brown. Clear and opaque quartz, minor iron staining. Sub-angular to sub-rounded	MONOMAN
15	16	SAND	Medium to coarse sands 0.2-0.8 mm. Opaque quartz, grey, sub-rounded	MONOMAN
16	17	SAND/LIMESTONE	Poorly sorted fine to coarse sands, 0.09-1.5 mm. light grey, opaque quartz, sub-rounded.  Hard grey limestone at 16.75 m  END OF LOG	MONOMAN

### Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length	Method	Sample No	Salinity	
5	16.75	2.78	9	45 mins	Airlift	1810079	24,826	



## Groundwater Program Water Well Log

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### Casing Information

Depth (m)		Diam (mm)	Material	
From	To			
-0.5	9.75	150	PVC	Stickup and blank casing
9.75	15.75	150	PVC Screen	1.0 mm aperture screen
15.75	16.75	150	PVC	Sump



## Groundwater Program Water Well Log

Project: **Woolpunda SIS - Observation Well Installation.  
Overland Corner Floodplain.**

Permit Number: **191548**  
Date Completed: **2/7/2010**  
Unit No: **6929-1019**  
Drillhole Name: **OBSWELL #6**  
Logged By: **Paul Magarey**

Total Depth (m): **17.03**  
Drill Method: **Mud Rotary**  
Drilling Company: **Underdale Drillers**  
Driller: **Nathan Bryant**

### Coordinates

Easting: **439300**  
Northing: **6220231**  
Zone: **54**  
Datum: **GDA 94**

Ground Elevation (m AHD): **9.78**  
Reference Elevation (m AHD): **10.32**  
Reference Point Type: **Top of flange**

**General Comments:** Well is close to RAC #18.

### Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	2	CLAY	light grey/light brown, silty	COONAMBIDGAL
2	3	CLAY	pale grey / brown	COONAMBIDGAL
3	4	CLAY	yellow-brown, silty	COONAMBIDGAL
4	5	SILT	mottled yellow/grey	COONAMBIDGAL
5	7	SILT	Clayey, micaceous, grey orange.	COONAMBIDGAL
7	9	SAND	Fine to medium, well sorted, sub-rounded. Mottled orange	MONOMAN
9	10	SAND	Coarse, 0.8-1.2 mm, minor gravel. Predominantly clear quartz grains, sub-angular, to sub-rounded. Iron stained; mottled yellow/grey.	MONOMAN
10	11	SAND	Coarse, 0.8-1.0 mm. Minor fine to medium component and gravel. Clear quartz, iron stained, minor biotite. Mottled orange.	MONOMAN
11	12	GRAVEL/SAND	Coarse sand and gravels, 1.0-4.0 mm. Clear and iron stained quartz, biotite, sub-rounded. Grey to light grey, minor black silt.	MONOMAN
13	14	SAND	Grey silt with fine quartz sand.	MONOMAN
14	15	SAND	Poorly sorted coarse sand, 0.6-2 mm. Sub-rounded, grey	MONOMAN
15	16	SAND	SAND/GRAVEL. Poorly sorted coarse sand and gravel, 1.0-4.0 mm. Clear quartz, minor iron stained. Grey	MONOMAN



## Groundwater Program Water Well Log

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
16	17	LIMESTONE	Light grey, crushed. Minor consolidated pieces. Fizzes HCL.  END OF LOG	MURRAY GROUP LIMESTONE

### Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length	Method	Sample No	Salinity mg/L	
7	17	3.84	8	45 mins	Airlift	1810080	28,927	

### Casing Information

Depth (m)		Diam (mm)	Material	
From	To			
-0.48	10.03	150	PVC	Stickup and blank casing
10.03	16.03	150	PVC Screen	1.0 mm aperture screen
16.03	17.03	150	PVC	Sump



## Groundwater Program Water Well Log

Project: **Woolpunda SIS - Observation Well Installation.  
Overland Corner Floodplain.**

Permit Number: **191549**

Date Completed: **2/7/2010**

Unit No: **6929-1020**

Drillhole Name: **OBSWELL #7**

Logged By: **Paul Magarey**

Total Depth (m): **23.71**

Drill Method: **Mud Rotary**

Drilling Company: **Underdale Drillers**

Driller: **Nathan Bryant**

### Coordinates

Easting: **439576**

Northing: **6220308**

Zone: **54**

Datum: **GDA 94**

Ground Elevation (m AHD): **9.41**

Reference Elevation (m AHD): **10.01**

Reference Point Type: **Top of flange**

**General Comments:** Thickest sequence of Monoman Formation observed yet. Murray Group Limestone intersected at ~23.5 m.

### Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	6	CLAY	Sticky, fawn to light grey.	COONAMBIDGAL
6	9	CLAY	silty clay, grey to dark grey	COONAMBIDGAL
9	10	SAND	Fine to medium, 0.1-0.4 mm, well sorted. Sub-rounded, clear and opaque quartz. Light brown, mottled.	MONOMAN
10	11	SAND	Medium, 0.2-0.5 mm, light brown / mottled. Clear and opaque quartz, sub-rounded.	MONOMAN
11	12	SAND/ GRAVEL	Very coarse sand with gravel (10%), 0.8-3.0 mm. Clear and opaque quartz, light grey and iron stained, sub-angular to sub-rounded. Minor biotite.	MONOMAN
12	13	SAND / GRAVEL	Very coarse sand with fine gravel 1.0-4.0 mm and lignite. Clear and opaque quartz, light grey and iron stained.	MONOMAN
13	14	SAND	Medium to coarse with fine gravel (<5%), light grey, yellow, 0.3-3.0 mm. Clear and opaque quartz, iron stained.	MONOMAN
14	15	SAND / GRAVEL	Very coarse sand and fine gravel (~40%), poorly sorted, 1.5-4.0 mm. Clear and opaque quartz, sub-	MONOMAN



## Groundwater Program Water Well Log

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
			rounded. Predominantly grey with some iron staining.	
15	16	SILT	Grey silt with minor coarse sand (<5%)	MONOMAN
16	17	SILT	Grey silt with quartz sand, gravel and lignite.	MONOMAN
17	18	SAND	Coarse, 1.0-2.0 mm, minor gravel, <2%. Iron stained clear and opaque quartz, sub-rounded.	MONOMAN
18	19	SAND	Medium, 0.2-0.5 mm, well sorted. Clear and opaque quartz, minor iron staining. Light grey.	MONOMAN
19	20	SAND	Coarse, 1.0-2.0 mm, with fine component and minor gravel. Clear and opaque quartz, iron stained approx 20%. Light grey.	MONOMAN
20	21	SAND	Coarse, 1.0-2.0 mm, light grey. Clear and opaque quartz, sub-rounded, iron stained ~20%.	MONOMAN
21	22	SAND	Coarse, 1.0-2.0 mm, light grey. Clear and opaque quartz, sub-rounded. Iron stained ~30%.	MONOMAN
22	23	GRAVEL	Gravel (60%) and fine to medium sand, poorly sorted. Grain size vary from 0.1-4.0 mm. Clear and opaque quartz, sub-rounded, minor iron staining. Grey to dark grey.	MONOMAN
23	24	SAND / LIMESTONE	Medium to coarse, 0.5-2.0 mm, tending to limestone at 24 m.  END OF LOG	MONOMAN / MURRAY GROUP LIMESTONE

### Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		L/sec	Test Length	Method	Sample No	Salinity	
9	24	3.60	8	45 mins	Airlift	1810279	26,617	





## Groundwater Program Water Well Log

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### Casing Information

Depth (m)		Diam (mm)	Material	
From	To			
-0.5	16.71	150	PVC	Stickup and blank casing
16.71	22.71	150	PVC Screen	1.0 mm aperture screen
22.71	23.71	150	PVC	Sump