8.0 Review / tabulation of groundwater data across the Galilee Basin study area tenements

The surface and subsurface geology varies considerably from the steeply dipping rocks near the faulted basin margin in the north and east, to the relatively flat lying sediments in the west, to the complex stratigraphic relationships at the edge of the Maneroo Platform. The analysis of the subsurface geology, groundwater stratigraphy, groundwater levels and groundwater quality was further complicated by the pattern of tenure ownership. Specifically, the GBOF member tenements are rarely contiguous. Additionally, there was a need to process and present the data in a manner that adequately protects the GBOF members' confidentiality. Furthermore, the tenements are in different stages of development.

The subsurface geology, groundwater stratigraphy, groundwater levels and groundwater quality data are presented and discussed for each of the active tenements in the following sections.

8.8 Summary of available data for ATP 799

ATP 799 is located in the central Galilee Basin study area north of Muttaburra (Figure 1.2). Drainage in the 3,103 km^2 tenement is to the south via Towerhill Creek. A small segment of ATP 799 is located east of the main tenement area. This segment is located in the Cornish Creek drainage north of the Reedy Creek confluence.

8.8.1 Surface geology for ATP 799

ATP 799 is located in the central Galilee Basin study area away from folded and faulted basin margins. The surface geology consists of Tertiary age fluvial sediments of the Glendower Formation and Wondoola beds (Figure 3.1). The Allaru Mudstone outcrops in north central portion of the tenement. Mackunda Formation outcrops occur along the entire western side of the tenement.

The eastern segment of ATP 799 is covered by Quaternary alluvium, which given the location of the tenement, likely overlies Allaru Mudstone sediments.

8.8.2 Exploration well drilling history for ATP 799

Two exploration wells have been drilled within ATP 799 (Table 8.38). The exploration wells were drilled to define the CSG potential on the tenement in 2009. Data was not publicly available for the CSG wells drilled in 2009 at the time data was downloaded for this report.

Table 8.38 Drilling summary for ATP 799

Attribute		Count
Total number of wells		2
Type of well	Petroleum	0
	Stratigraphic	0
	Coal Seam Gas	2
Earliest spud date	6-Nov-2009	
Latest spud date	09-Dec-2009	
Depth shallowest well (m bKB)	1,305	
Depth deepest well (m bKB)	1,330	
Average well depth (m bKB)	1,318	

8.8.3 Water bore drilling history for ATP 799

DERM records show 35 registered water bores within ATP 799 (Table 8.39). The first bore was drilled in 1888 (RN 2940, 2941) and the most recent bore was drilled on 11 January 2008 (RN 146098). The shallowest bore was drilled to 623 m bGL (RN 69476) in likely Hooray Sandstone and the deepest bore was drilled to 850 m bGL (RN 51353). The deepest well penetrated to the Hutton Sandstone. The average water bore depth is 696 m bGL. However, this number is skewed by the very deep exploration wells that have been converted to water bores. The average depth is further skewed by the general lack of data on drilling depth and completion formations for ATP 799.

The bores drilled within ATP 799 generally tap unconfined aquifers in the shallow Quaternary alluvial and Tertiary sediment aquifers. Fourteen water bores are currently recorded to have controlled or uncontrolled artesian flow.

Table 8.39 Summary of DERM registered water bores within ATP 799

Attribute		Count
Total number of bores		35
Type of bore	Artesian Bore--ceased to flow	6
	Artesian Bore--condition unknown	
	Artesian Bore--controlled flow	11
	Artesian Bore--uncontrolled flow	3
	Subartesian facility	15
Bore Status	Abandoned and destroyed	9
	Abandoned but usable	
	Existing	26
Earliest drill date	RN: 2940, 2941	1888
Latest drill date	RN: 146098	11-Jan-2008
Number of water bores in QPED		0
Depth of the shallowest bore (m bGL)	RN 69476	623
Depth of the deepest bore (m bGL)	RN 51353	850
Average bore depth (m bGL)		737

8.8.4 Subsurface geology for ATP 799

There are no complete stratigraphic logs available for the exploration wells or water bores drilled within ATP 799. The available data suggest that shallow Tertiary sediments are not frequently targeted for groundwater. The available data also suggest that the Rolling Downs Group sediments and the Cadna-owie Formation are not accessed for groundwater supplies within ATP 799.

The DERM GWDB (2010) reports water bores screened in the Hooray, Adori and Hutton Sandstone aquifers. DERM GWDB (2010) does not report the formation top or formation bottom depths for Hooray, Adori and Hutton Sandstones at these water bores.

8.8.5 Aquifers within ATP 799

Bores within the noted aquifers and water bearing sediments are taken from water quality, pump test and water level tables found in the DERM GWDB (2010). These data are not tabulated in this report, thus, bore quantities presented in this report will not necessarily be reflected in the summary text. The following Eromanga Basin aquifers and water-bearing sediments were identified to underlie both sections of ATP 799 (Appendix Table D-1 and Table E-1):

- Allaru Mudstone (no bores identified);
- Hooray Sandstone (2 bores); and
- Hutton Sandstone (5 bores).

No bores were identified to be screened in the Quaternary alluvium or Tertiary sediments overlying the Eromanga Basin sediments. No bores were identified to be screened in the Galilee Basin sediments within ATP 799.

8.8.6 Groundwater level summary for ATP 799

A depth to groundwater of 20.4 m bGL was recorded at water bore RN 51353 on 9 August 1980. The available data suggests that water bore RN 51353 is tapping the Hutton Sandstone (DERM GWDB, 2010).

Although there is only a single water level measurement available, data from the DERM GWDB (2010) indicate that over half the water bores within ATP 799 are currently or formerly artesian.

The groundwater flow direction assessment for the aquifers present within ATP 799 is based on groundwater contours presented on Figure 6.19, Figure 6.20 and Figure 6.21. The groundwater flow direction in the Rolling Downs Group aquifers, Cadna-owie / Hooray Sandstone aquifer and Hutton Sandstone aquifer is to the south-west towards the Maneroo Platform.

8.8.7 Summary of DERM GWDB flow and pumping test data for ATP 799

Pumping test data was received for 23 water bores in DERM GWDB (2010) for ATP 799 (Figure 6.23). The aquifer has been identified for eight water bores in this tenement. The first flow test was conducted on a bore in 5 January 1900 and the most recent was conducted on 18 June 2008.

These bores have been identified as tapping the following aquifers or water-bearing sediments:

- Allaru Mudstone (no bores identified);
- Hooray Sandstone (2 bores); and
- Hutton Sandstone (5 bores).

The changes in aquifer pressure and depth to groundwater over time were assessed by plotting the discharge upon arrival at the bore (Figure 8.22), changes in the static groundwater level (Figure 8.23) and changes in calculated static groundwater level observations (Figure 8.24).

Bore discharge observations were recorded between 1910 and 1970. Two discharge-observations were recorded after 1970. The peak groundwater discharge for bores drilled in the Hooray Sandstone decline non-linearly from 10 L/s per bore in 1925 to 3 L/s per bore in 1989. The peak groundwater

discharge for bores drilled in the Hutton Sandstone decline non-linearly from 14 L/s per bore in 1920 to 6 L/s per bore in 1972. Groundwater discharge also declines non-linearly for bores where the aquifer has not been identified.

Static groundwater level observations prior to 1985 are few and occur at infrequent intervals. There are no clear trends evident in the data prior to 1985. Following 1985, static groundwater level observations are relatively stable for the bores drilled in the Hutton Sandstone but may be declining for bores drilled in the Hooray Sandstone.

The majority of the calculated static groundwater levels are above 20 m aGL for the Hutton Sandstone. There are too few data available to assess calculated static groundwater levels trends for bores drilled in the Hooray Sandstone or bores where the aquifer has not been identified.

Figure 8.22 Bore discharge (L/s) at arrival for ATP 799 water bores with data, 1900 to 2010

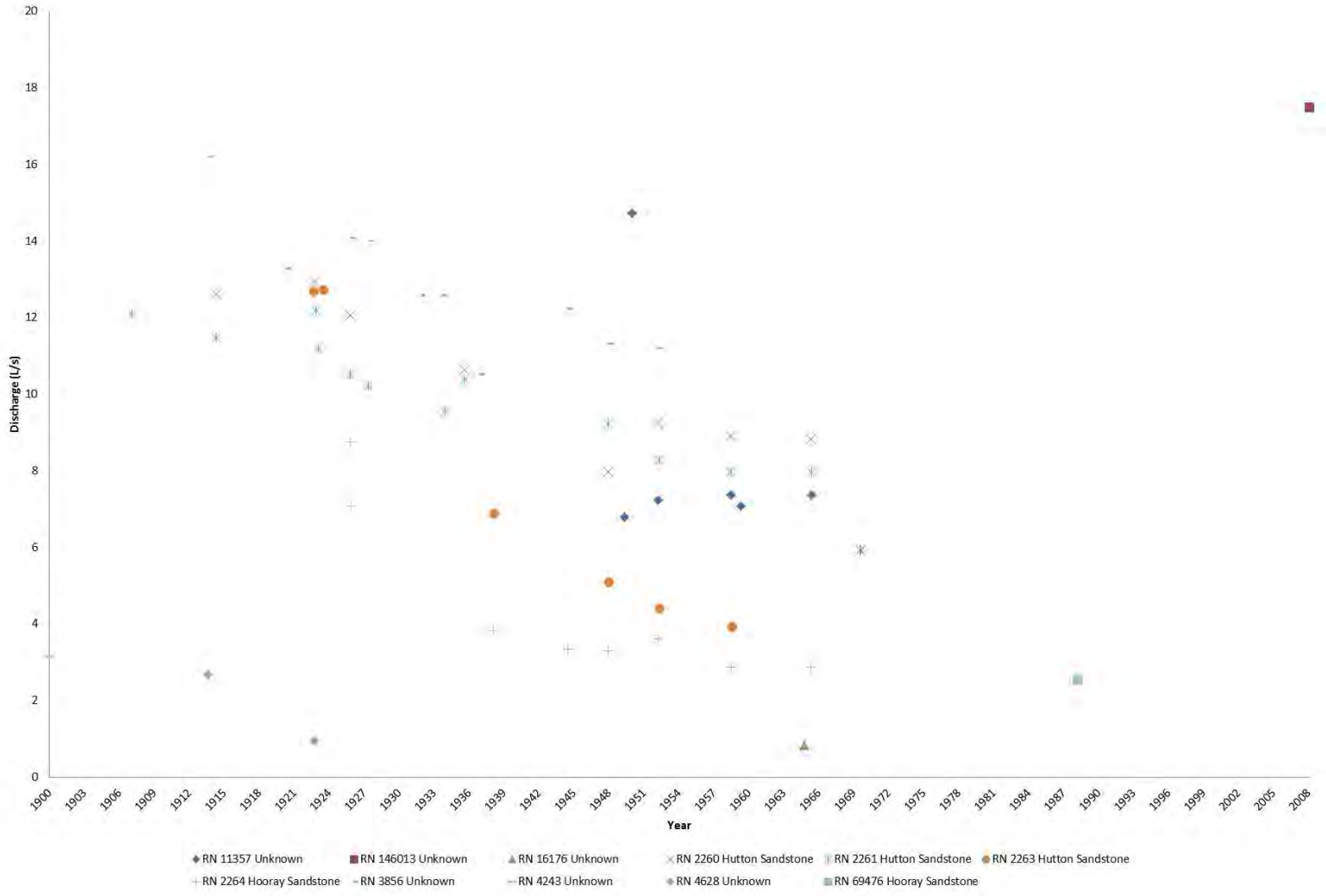


Figure 8.23 Static groundwater levels for ATP 799 water bores with data, 1900 to 2010

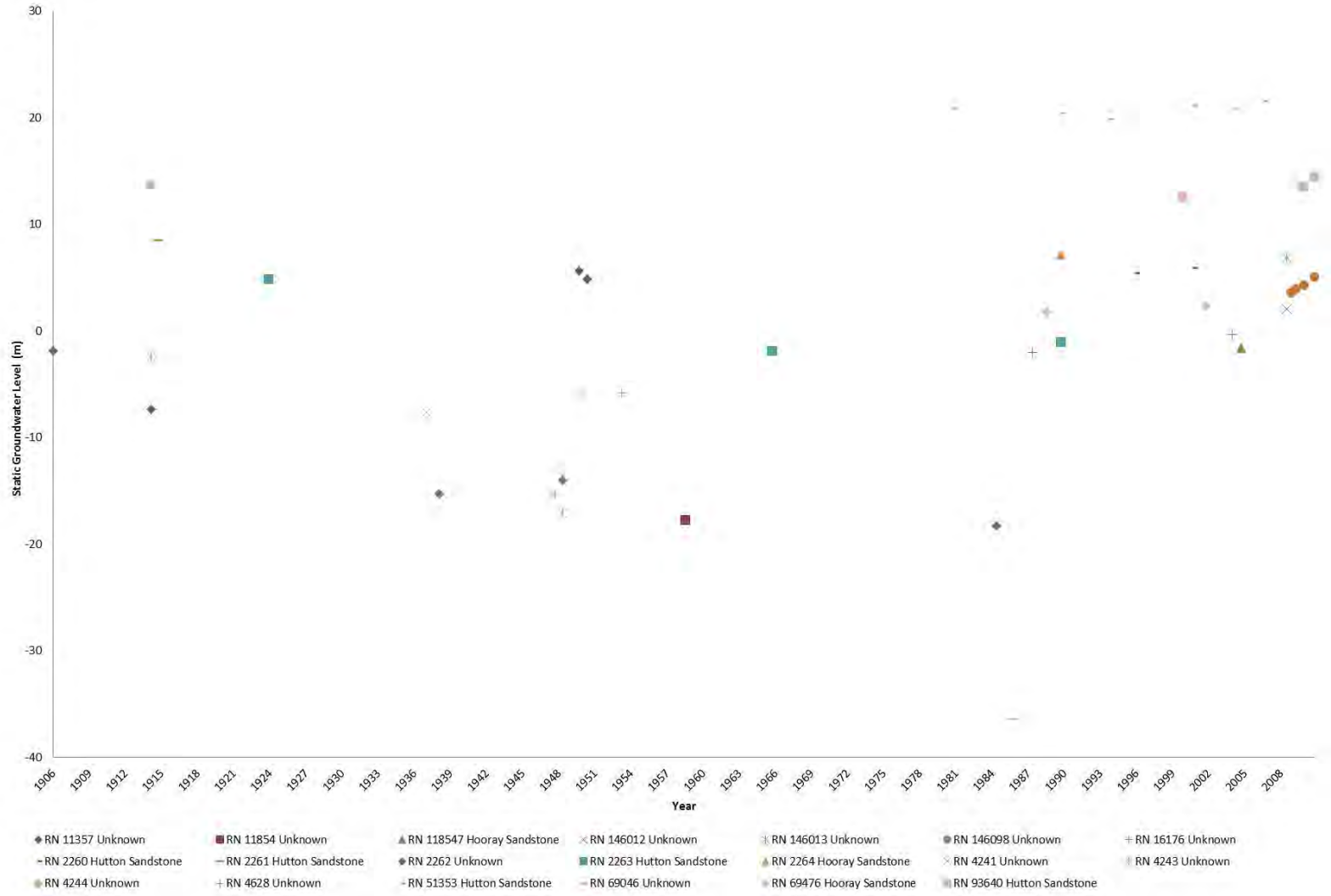
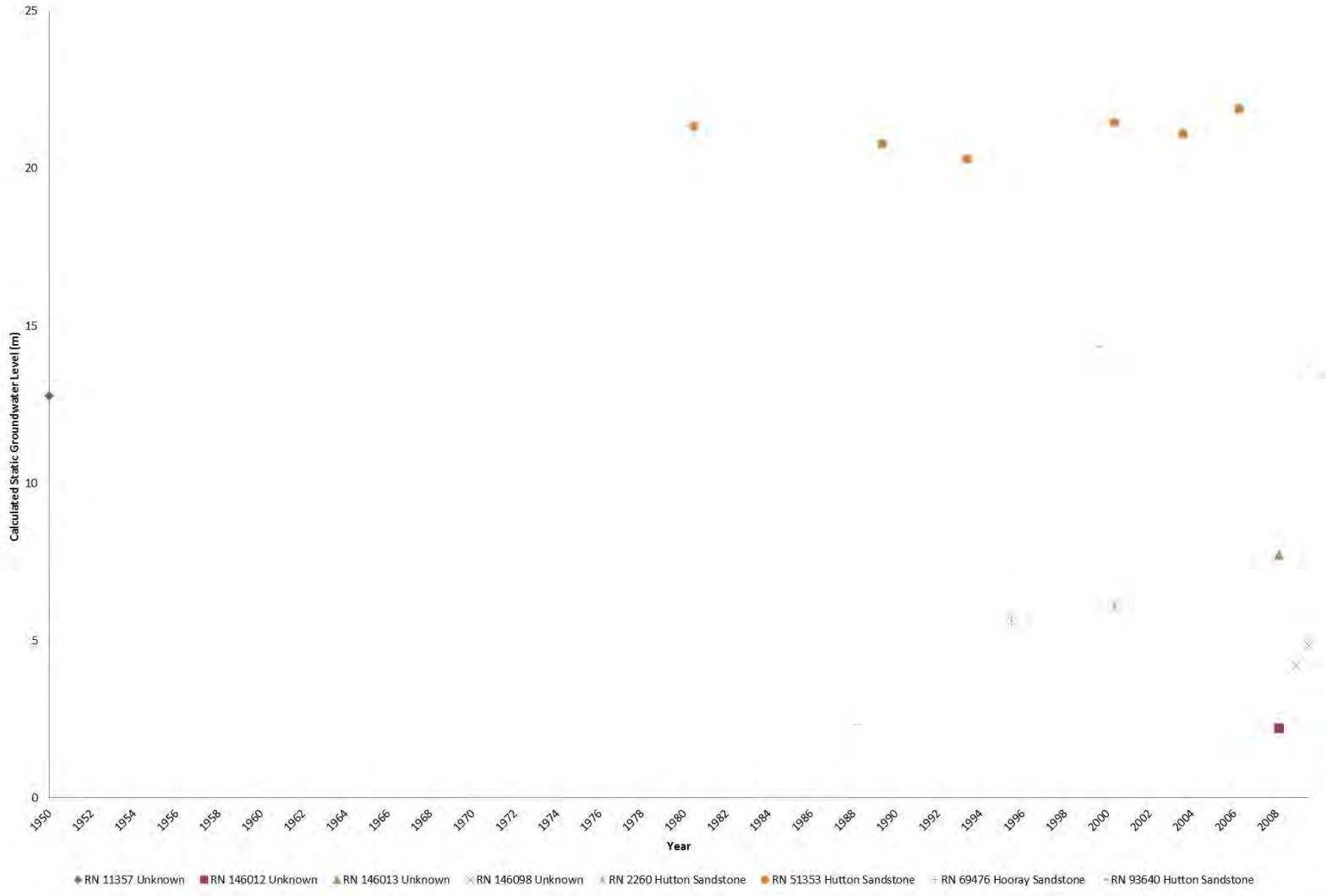


Figure 8.24 Calculated static groundwater levels for ATP 799 water bores with data, 1900 to 2010



8.8.8 Groundwater quality within ATP 799

Laboratory chemical analyses are available for groundwater samples drawn from seven bores recorded as tapping the Hooray and Hutton Sandstone aquifers (Table 8.40 and Appendix Table E-1). To the east of ATP 799 the near surface Rolling Downs Group sediments are tapped extensively for groundwater (Plate 1). The water bore density is significantly less within ATP 799 than it is on the tenements to the west. The bores that are present within ATP 799 frequently target the shallow aquifers, however, deeper water bores dominate the groundwater quality sampling results. No groundwater quality samples are available for the shallow Eromanga Basin aquifers present within ATP 799.

Groundwater quality samples were obtained from between 525 and 983 m bGL:

- Groundwater pH varied between 8 and 9;
- Total dissolved solids ranged from 236 to 607 mg/L, indicating dominantly fresh groundwater system;
- Electrical conductivity ranged from 380 to 1,000 µS/cm;
- Sodium ranged from 61 to 285 mg/L;
- Calcium ranged from 2 to 16 mg/L;
- Chloride ranged from 23 to 110 mg/L;
- Fluoride ranged from 0.1 to 1.6 mg/L;
- Bicarbonate ranged from the 175 to 574 mg/L.

All of the samples plot as sodium / bicarbonate type water on the Piper diagram presented on Figure 8.25. There is slightly less bicarbonate in the groundwater samples obtained from the Hutton Sandstone aquifer than there is from the samples obtained from the Hooray Sandstone aquifer. There is significantly less sodium in the groundwater samples collected from the Hutton Sandstone aquifer than there is from the samples obtained from the Hooray Sandstone aquifer.

Figure 8.25 Piper diagram of the summary groundwater quality results from aquifers present within ATP 799

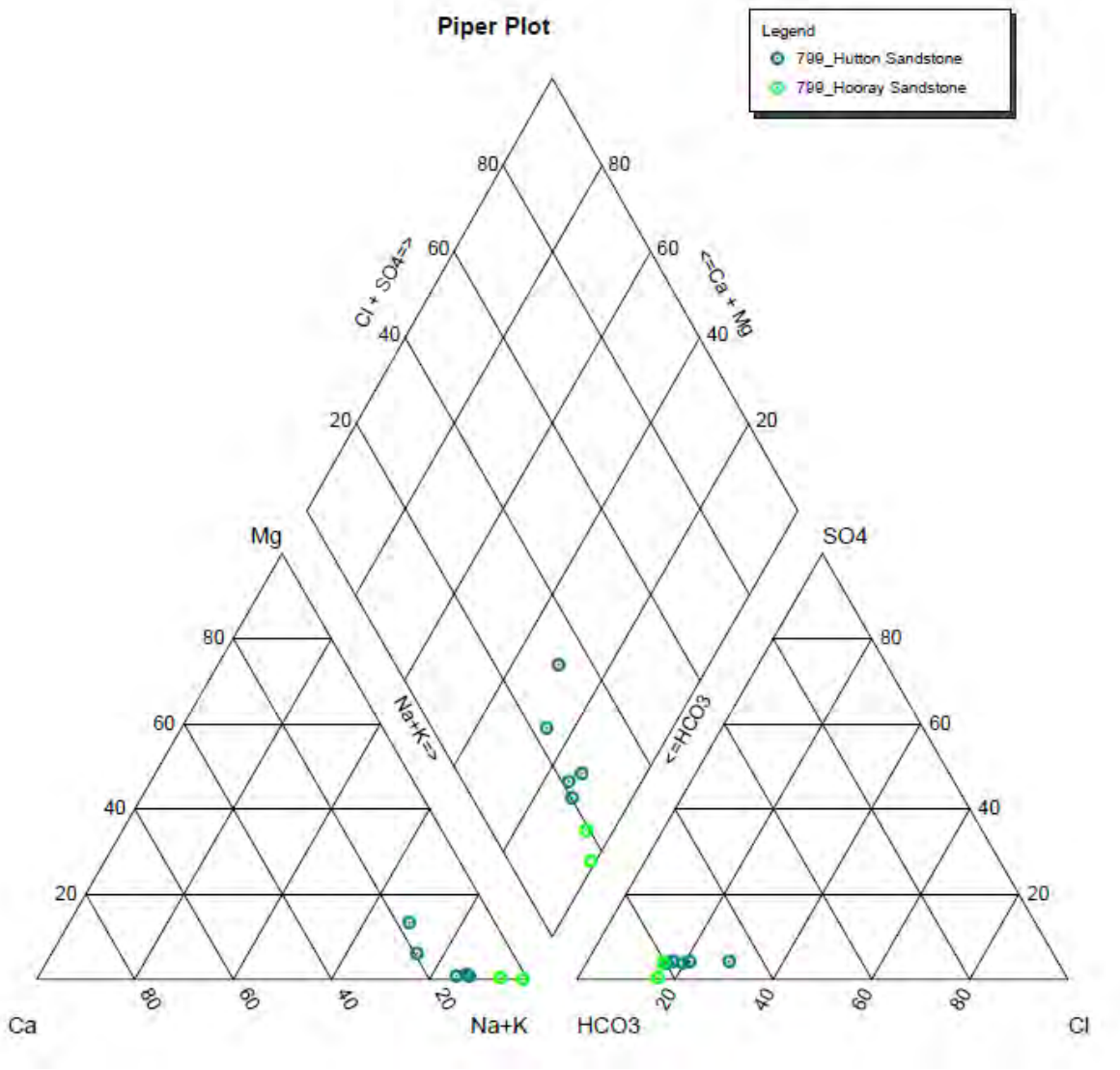


Table 8.40 Groundwater quality data summary for ATP 799

Basin	Identified aquifer or water bearing sediment	Statistic	Depth of Sample m bGL)	Conductivity (uS/cm)	pH	Hardness (mg/L Ca)	Alkalinity (mg/L)	Total Dissolved Solids (MG/l)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Iron (mg/L)	Manganese (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Nitrate (mg/L)	Sulphate (mg/L)	Zinc (mg/L)
Eromanga Basin sequence	Hooray Sandstone	Total number	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		Number of tests	4	4	4	2	4	3	4	3	4	3	3	3	4	3	4	4	0	4	0
		Average	555	825	8.25	12.5	392	487	212	2	3	0.77	0.08	0.01	455	15	63	1.15	--	5	--
		Maximum	643	1,000	9	13	471	607	285	3	4	2	0.15	0.01	574	29	110	1.6	--	10	--
		Minimum	525	410	8	12	174	254	86	1	2	0.1	0.01	0.01	205	4	23	0.2	--	2	--
	Hutton Sandstone	Total number	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
		Number of tests	8	13	13	13	13	12	13	11	13	12	7	6	12	11	13	13	1	11	2
		Average	788	413	8.15	41	170	260	78	10	12	3	0.11	0.09	200	5	32	0.2	2	8	0.015
		Maximum	983	456	9	68	202	290	98	16	16	7.1	0.34	0.19	232	19	44	0.3	2	20	0.02
		Minimum	607	380	8	26	144	236	61	0	8	0.3	0.01	0.01	175	1	24.4	0.1	2	4	0.01

8.8.9 Summary for ATP 799

There are comparatively few exploration wells or registered water bores within ATP 799. The lack of data limits the ability to assess the stratigraphy and hydrogeology of the tenement.

Although there are limited data, the available data suggest that the water bores in the tenement target the deeper Eromanga basin aquifers such as the Adori and Hutton Sandstones. This conclusion is consistent with the finding that more than half of the bores are currently or have been artesian.

The lack of data precludes determining the location or depth of the basal Jurassic or Permian unconformities present within ATP 799.