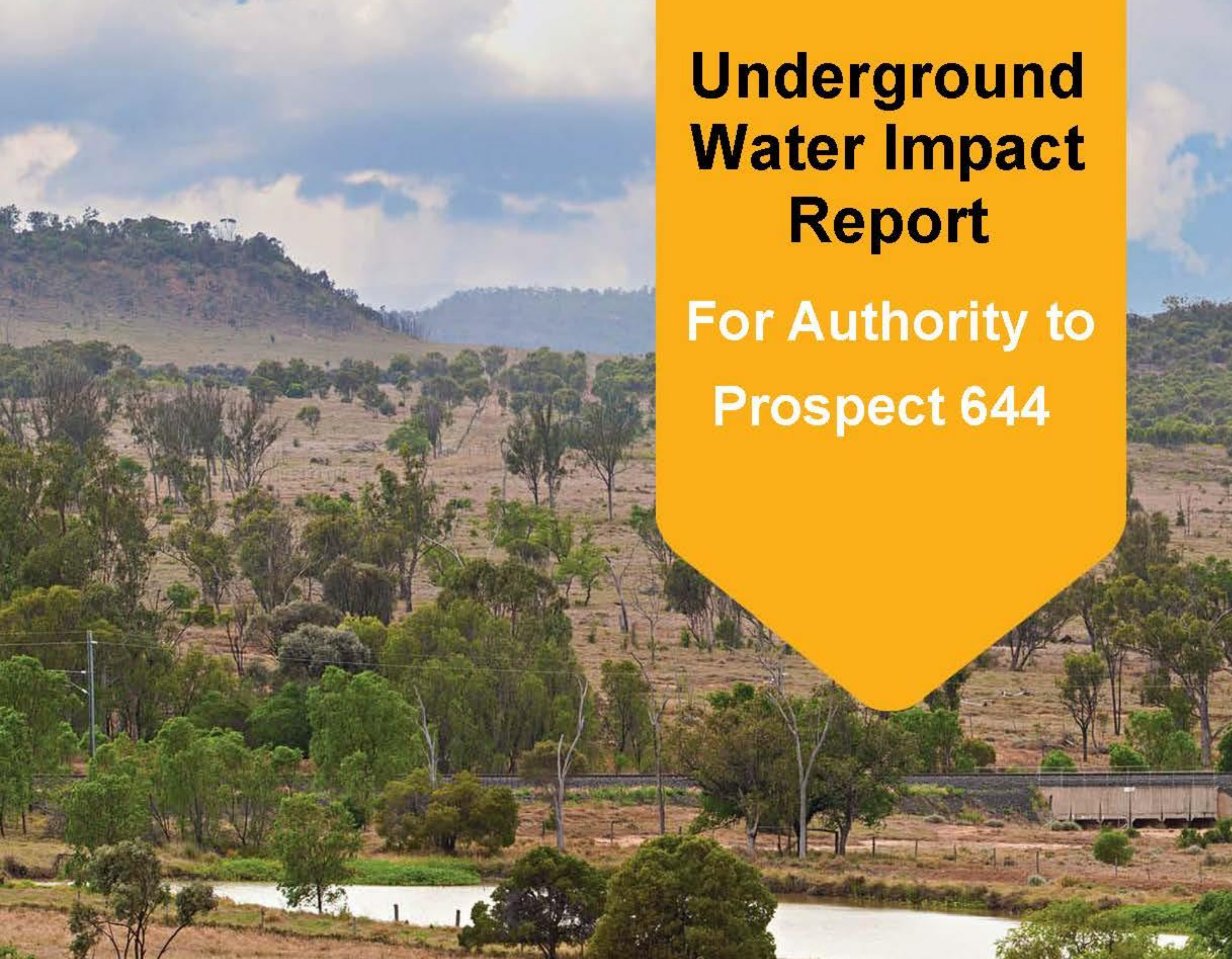
Underground Water Impact Report

For Authority to Prospect 644



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October 2022

REVISION HISTORY

Revision	Revision Date	Revision Summary
0	September 2022	Initial release for consultation
1	October 2022	Released for review

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EXECUTIVE SUMMARY

This document serves as the final report for Authority to Prospect (ATP) 644 after relinquishment in June 2022 and addresses all matters as per s377 of the Water Act 2000.

The registered holders of ATP 644 are B.N.G. Pty Ltd ACN 081 690 691 (70%) and Arrow CSG (Australia) Pty Ltd ACN 054 260 650 (30%).

The Underground Water Impact Report (UWIR) for ATP 644, now referred to as the final report as per s374 of the Water Act 2000, has been complied as completed in support of the relinquishment of the ATP 644 tenure.

The UWIR for ATP 644 has been updated and is a follow on from the UWIR's approved on 6 March 2013 (the 2012 UWIR), 10 June 2016 (the 2016 UWIR) and 8 July 2022 (the 2022 UWIR). Annual Reviews of the UWIR's have been completed, submitted and approved by DES. This report forms the fourth and final UWIR for ATP 644.

There has been no further production testing and monitoring data collection on ATP 644 since the original production testing completed in 2010 as reported in the UWIR's and subsequent Annual Reviews. All production testing wells in ATP 644 were plugged and abandoned in 2015.

As indicated in the 2012 UWIR for ATP 644, it is expected that significant recovery of the water pressures in the area of the production tests would have occurred since the testing occurred. An assessment of the potential recovery indicates pressure recovery to within 91% of initial pressures within the affected aquifers/coal units may have occurred. Based on this, there are likely to be minimal impacts remaining from the production test. Any Immediately Affected Area (IAA) remaining, if present, is unlikely to be significant based on the results of the analytical calculation.

1 INTRODUCTION

The UWIR for ATP 644 has been updated and is a follow on from the UWIR's approved on 6 March 2013 (the 2012 UWIR), 10 June 2016 (the 2016 UWIR) and 8 July 2022 (the 2022 UWIR). On 3 July 2019, DES concluded the 2016 UWIR remained in place unamended due to no activity on the tenure and no UWIR was approved in 2019. Annual Reviews of the UWIR's have been completed, submitted and approved by DES. This report forms the fourth and final UWIR for ATP 644.

The purpose of this report is to address Chapter 3, and in particular, s376 of the Water Act 2000. The contents of the report specific to a final UWIR per s377 of the Water Act 2000 are listed in Table 1, along with the reference in this report.

Table 1: Content of the final report

Item to address	Referenced
1) A final report must include each of the matters mentioned in section 376, other than the following	
(a) an estimate of the quantity of water mentioned in section 376(a)(ii);	Section 2
(b) a map mentioned in section 376(b)(iv);	Figure 10
(c) any of the information mentioned in section 376(d);	Section 7.3 and Figure 11
(d) a program mentioned in section 376(e);	Not applicable
(e) if the responsible entity is the office—the proposed responsible tenure holders mentioned in section 376(h)	Not applicable
(2) Also, a final report must include	
(a) a summary of information about all water bores in the area shown on a map mentioned in section 376(b)(v),including the number of bores, and the location and authorised use or purpose of each bore; and	Section 7.3 and
(b) a summary about how the make good obligations of the responsible tenure holder for each water bore to which the final report relates have been complied with by the holder over the term of the tenure; and	Section 5
(c) a summary of the make good obligations of the responsible tenure holder for each water bore that have not yet been complied with by the holder; and	Not applicable
(d) a plan about how the obligations mentioned in paragraph (c) will be complied with	Not applicable

1.1 Project Area

ATP 644 is located within the Clarence-Moreton Basin as is shown in Figure 1. Production testing historically undertaken on this tenement is located approximately 7km south west of Beaudesert.

1.2 Summary of Methods

An assessment of impacts to groundwater from the production testing activities has been undertaken based on the following tasks:

- Task 1: Review and analysis of site-specific assessment data;
- Task 2: Hydrogeological assessment and conceptualisation;
- Task 3: Analytical groundwater model development to make predictions of groundwater impacts; and
- Task 4: Identification of potential impacts on groundwater.

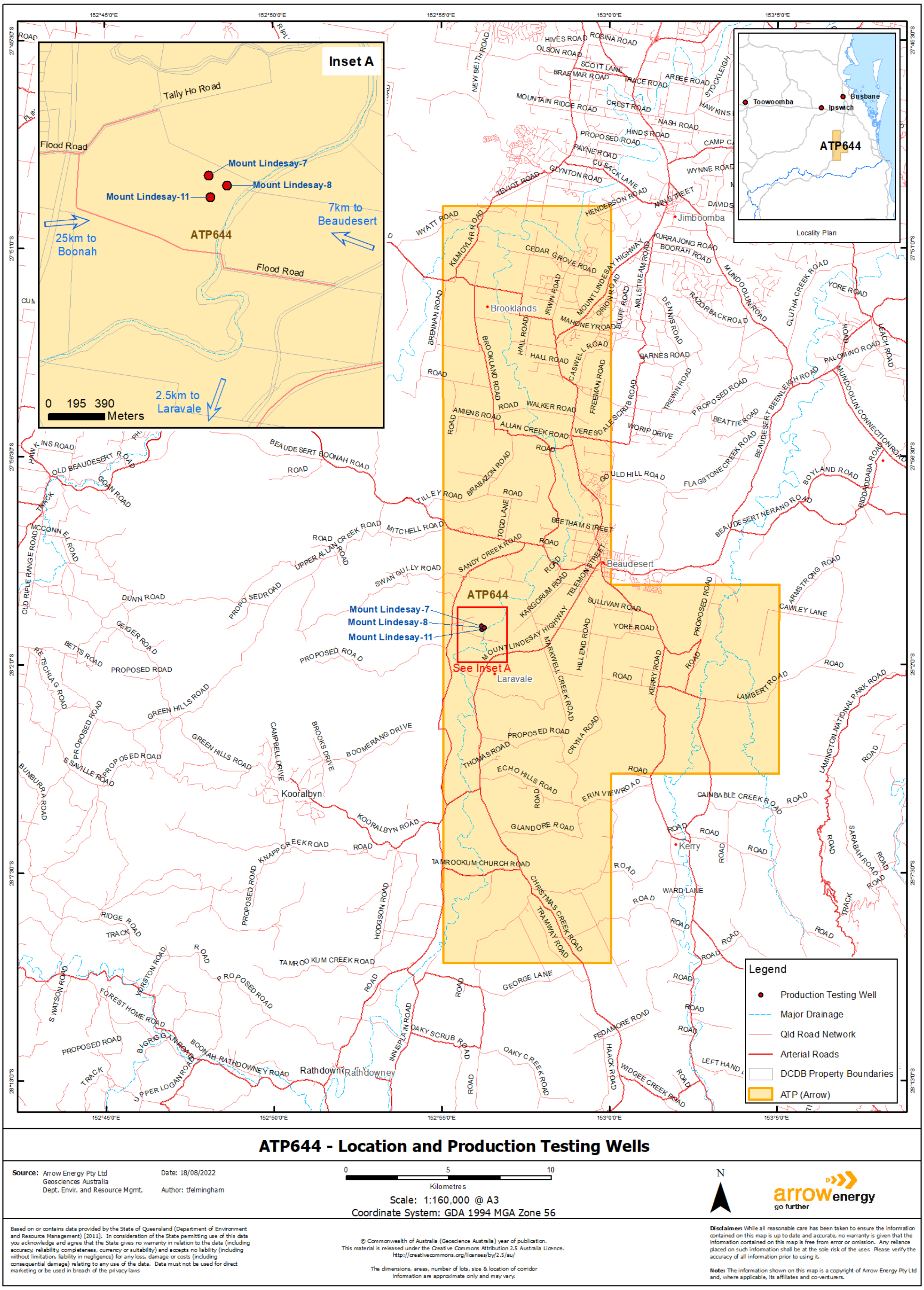

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Figure 1: Location of ATP 644

2 WATER PRODUCTION SCHEDULE

The production wells have been plugged and abandoned and no production testing has been undertaken since October 2010. This is as described in the 2012, 2016 and 2022 UWIR's. As a result, the predictions made including the IAA in the UWIR have not materially changed.

Historical production testing undertaken on ATP 644 comprised:

- Mount Lindesay-7, a total of approximately 0.694 ML of water taken over 7 months;
- Mount Lindesay-8, a total of approximately 0.55 ML of water taken over 7 months; and
- Mount Lindesay-11, a total of approximately 0.54 ML of water taken over 5 months.

3 EXISTING HYDROGEOLOGICAL REGIME

There is no update to the hydrogeological data and conceptual model presented in the previous UWIR. A summary of this is provided for reference below.

3.1 Local Geology

The 2010 Mount Lindesay production tests are located in the Logan sub-basin. A cross section across the Logan sub-basin is shown in Figure 2, showing the stratigraphic and structural relationship between the alluvial Grafton Formation and Kangaroo Creek Sandstone overlying the Walloon Coal Measures (WCM), which in turn overlies the Koukandowie Formation. As can be seen in Figure 2, the Logan Sub-basin is offset by a number of faults which generally strike north-south across the basin.

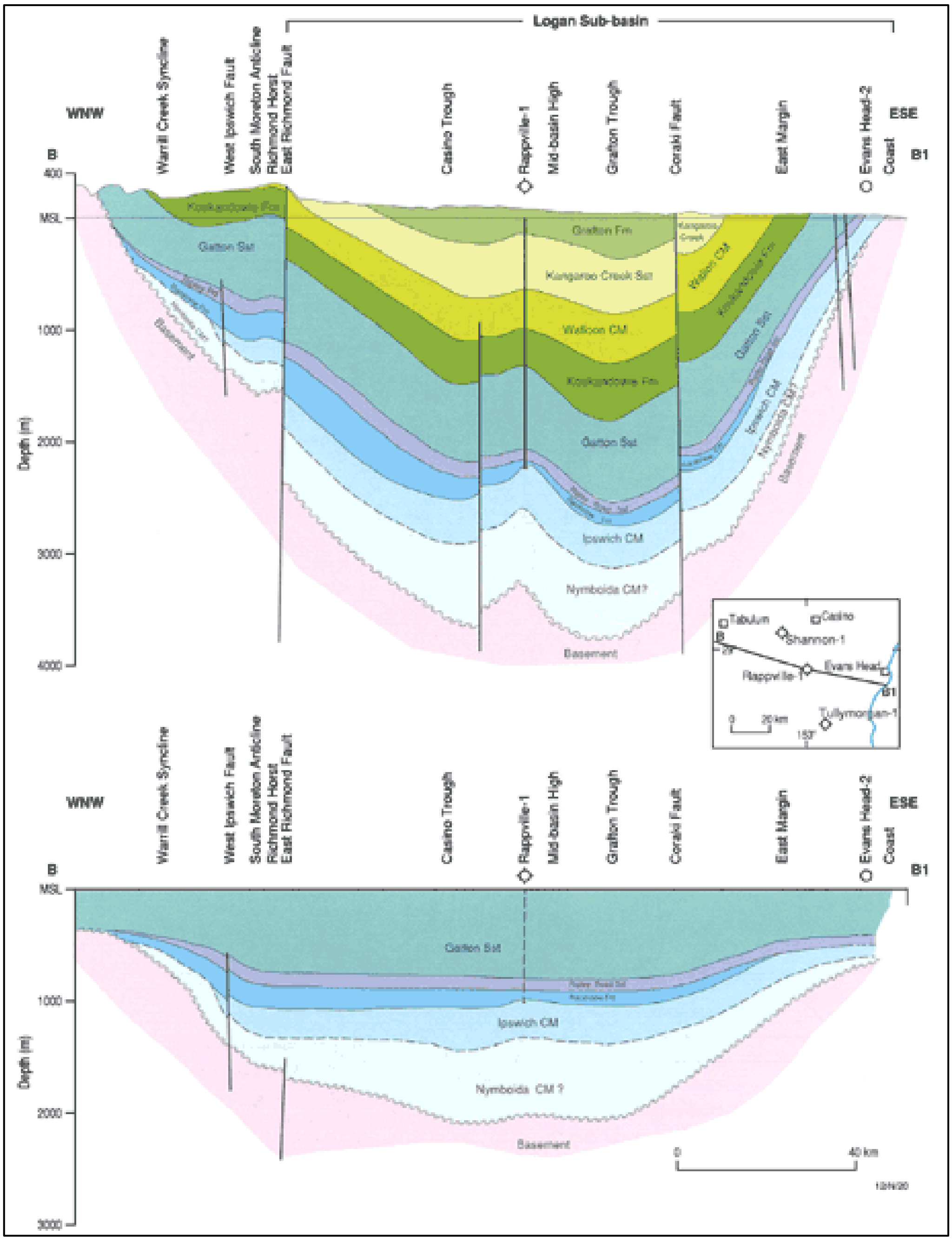

Figure 2: Geological Cross Sections

3.2 Aquifers

3.2.1 *Alluvium*

The Logan Basin Draft Water Resource Plan Environmental Investigations Report: Volume I – Summary Report (DEHP, 2010) describes the groundwater resources in the Logan Basin as follows:

"Most of the groundwater resources in the study area are found in the alluvial aquifers of the Logan and Albert Rivers. The groundwater baseflow component is likely to be chemically variable, depending on local aquifer material. Long and Lloyd (1996) established that the Logan/Albert system follows a relatively simple model of recharge in the southern sector, with regional groundwater flowing northward with an associated increase in total dissolved salts, which is partly the result of evaporative concentration. As reported by Please et al. (1996), to the north the water gets 'older', suggesting that direct recharge to the aquifer in this region is either a very slow process through the unsaturated zone or it is negligible. Horn and Wong (1998) reported almost all groundwater in the catchment is abstracted from depths of between 5 m and 25 m. The primary use for this groundwater is for irrigation and private supplies on farms (Please et al., 1996)."

Data from the Queensland Department of Regional Development Manufacturing and Water (DRDMW) Groundwater Database indicates that a number of bores within 20 km of the historical production tests are screened in the alluvial strata. The alluvial aquifers are comprised of alluvium including clay, silt, sand and gravel and exist predominantly around creeks, rivers and associated flood plains. The alluvial aquifers are classed as porous media aquifers where groundwater occurs within the voids between individual grain particles. The unconsolidated alluvial aquifers in the Logan sub-basin are expected be unconfined or semi-confined.

A summary of registered bores within 2 km of the historical production testing wells and a description of the deepest strata they intersect is provided in Table 1.

Figure 3 shows the locations of these bores. A formal description of the aquifer/formations intersected by most of these bores was not available from the DRDMW database. Where attribution was provided, it is included in the lithological description. However, most bores are shallow (less than 30m deep) suggesting most were targeted at alluvial aquifers.

Table 2: Summary of bore data from the DRDMW Groundwater Database

Bore ID	Deepest Lithological Description	Depth Lithological Description was Encountered (m below natural surface)	Bore Casing Depth (m below natural surface)
120450	Brown clay	42.7	NR[1]
120449	Brown and grey sandy gravel and clay	15.5	21.6
120448	Brown sandy gravel and clay	21.9	NR
120447	Brown sandy gravel and clay	21.3	NR
120446	Brown sandy gravel and clay	21.0	NR
120445	Brown sandy gravel and clay, soft sandstone	20.7	NR
124604	Clay	27.5	29.5
138595	Gravel and silty clay	24	27
138596	Sand and gravel	19.5	28.5
138594	Sand and Clay	13	23.5
145571	Gravel	23.5	28
145572	Gravel	22.5	55
145573	NR	NR	27
145574	Gravel	19.5	22
142767	NR	NR	NR
145575	Brown/grey sandy clay and mudstone	28.5	30
145576	Brown sandy gravel and clay	25	26
14500260A	Logan River Alluvium	20.70	20.6
14500261	Logan River Alluvium	23.50	22.40
14500262	Tan sandstone	17.8	20

3.2.2 *Walloon Coal Measures*

Data from the DRDMW Groundwater Database indicates that a limited number of bores within 20 km are screened in the WCM aquifer. Strata descriptions from the database shows that these bores intersect strata comprised of interbedded coal, shale, clay, mudstone and sandstone of varying grain size and induration. For reference, in the Surat Basin, the percentage of coal within the WCM is approximately 10 %, the remainder being low permeability interburden. It is expected that the WCM in the Clarence Moreton Basin display a similar coal to interburden percentage as that in the Surat Basin.

There are no bores intersecting the WCM within 2 km of the historical production test wells and Figure 3 provides an overview of bores within the vicinity. The nearest WCM bore is located 9.7 km from the production testing wells.

[1] NR – no reliable data

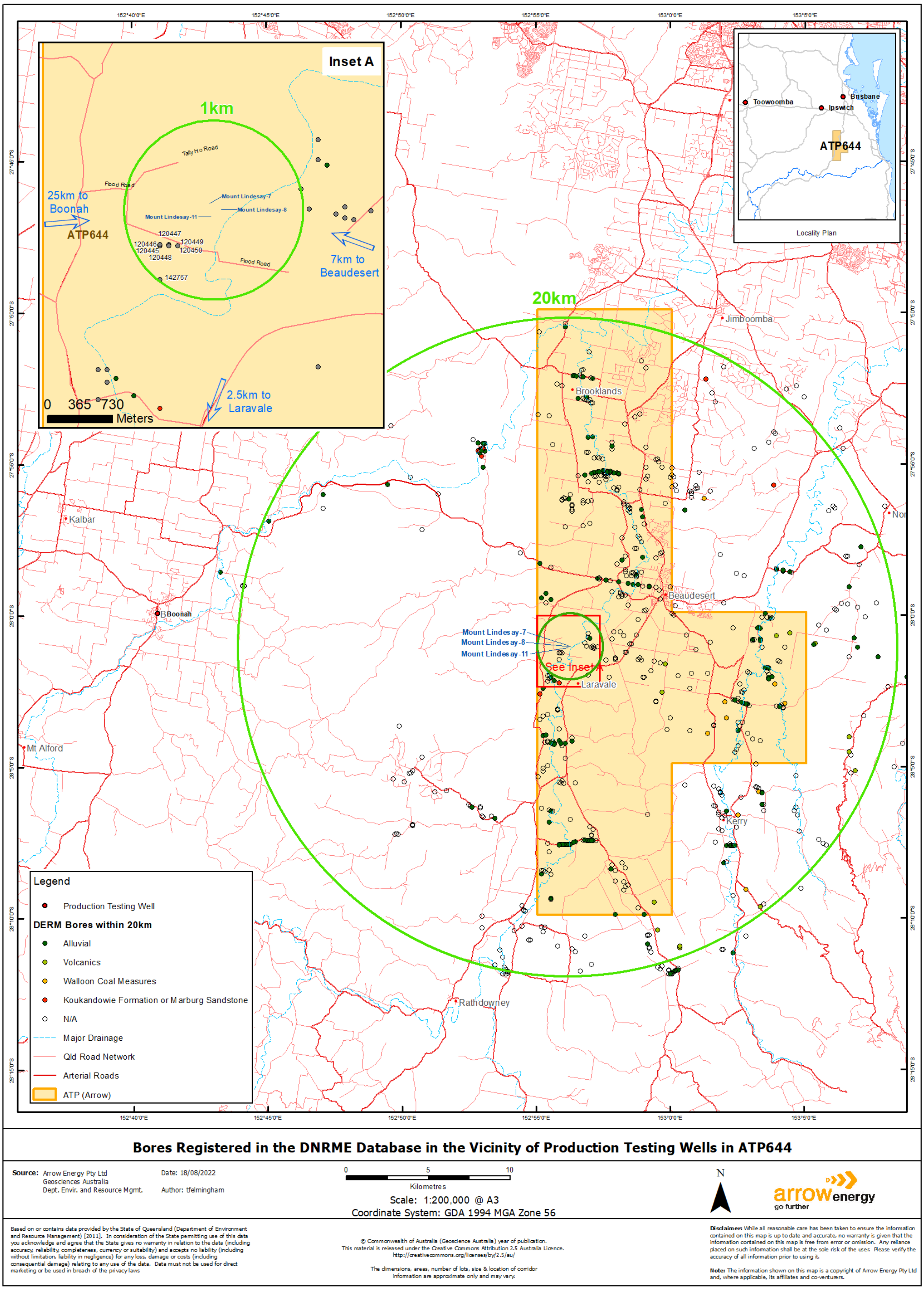

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Figure 3: Bores registered in the DRDMW Groundwater Database

Further information relating to the WCM was available from production test well drilling. The production test well Mount Lindesay-7 was drilled as part of an appraisal program by the registered holders in August 2009. A total of 43.9 m of coal was intersected. A thickness of 16.4 m was intersected in the Upper Coal Zone and 20.1 m was intersected in the Lower Coal Zone. The bore log for Mount Lindesay-7 indicated an alluvium that persists to approximately 140 m, while in Mount Lindesay-8 alluvium extends to about 118 m depth. In Mount Lindesay-11, the alluvium extends to 149 m. The alluvium overlies the WCM which persist to about 520 m below which lies the Koukandowie Formation. Individual zones of coal were identified throughout the extent of the WCM as can be seen from the cross section of the production test area shown in Figure 4.

The production testing wells were perforated as follows

- Mount Lindesay-7 (ML-7); in the WCM from 521 m to 527 m;
- Mount Lindesay-8 (ML-8); in the WCM from 339 m to 354 m, 433 m to 445 m and 510 m to 514 m; and
- Mount Lindesay-11 (ML-11); in the WCM from 344 m to 357 m, 434 m to 446 m and 511 m to 515.3 m.

These wells were cased and cemented so that water is only accessed at these perforated intervals, indicating a vertical separation distance between the perforated interval of these wells and the overlying alluvium of approximately 195 m to 380 m.

Drill Stem Test (DST's) of the units failed due to very low water yields which indicated low permeability coals.

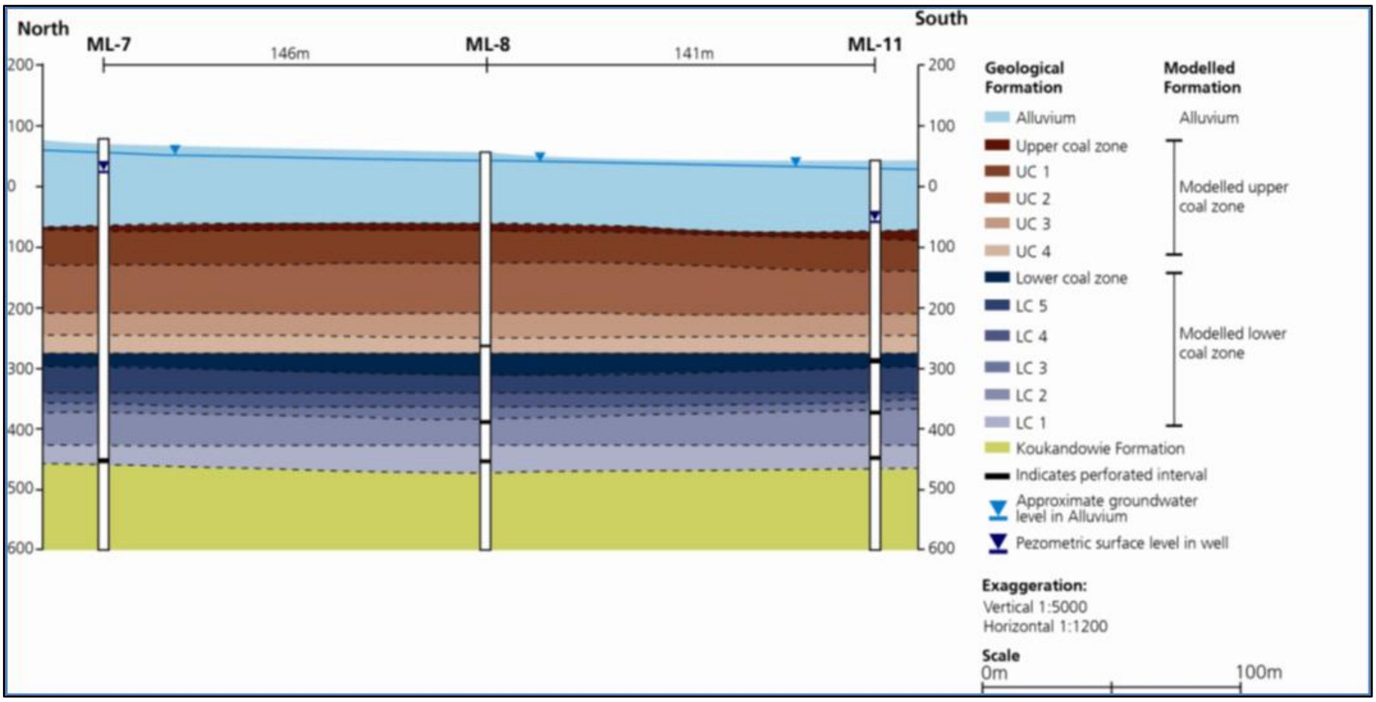

Figure 4: Cross-Section of Well Locations

3.2.3 *Koukandowie Formation*

The Koukandowie Formation is described as being a fine to coarse grained, quartz to quartz-lithic sandstone with interbedded conglomerates, sands, and shales. As discussed above, the main resource aquifers used in the area are the alluvial aquifers. While the Koukandowie Formation unit underlying the WCM has the potential for groundwater use, the likelihood of current and future use in the area is considered low due to the depth of the formation in this area and presence of shallower and more readily accessible water resources.

3.3 Groundwater Levels

3.3.1 *Alluvium*

Groundwater levels in the alluvial aquifer in the vicinity of the production test wells have been in the order of 10 m to 15 m below ground surface (based on available information from the DRDMW Groundwater Database data). Historical groundwater level data was available from Bore RN 142767, obtained from the database, within 2km from the production testing wells. The bore is located approximately 880m from the production test wells and groundwater level is plotted in Figure 5. The water level data in this bore has been collected from the year 2000 to 2011 and has not been recorded since 2011.

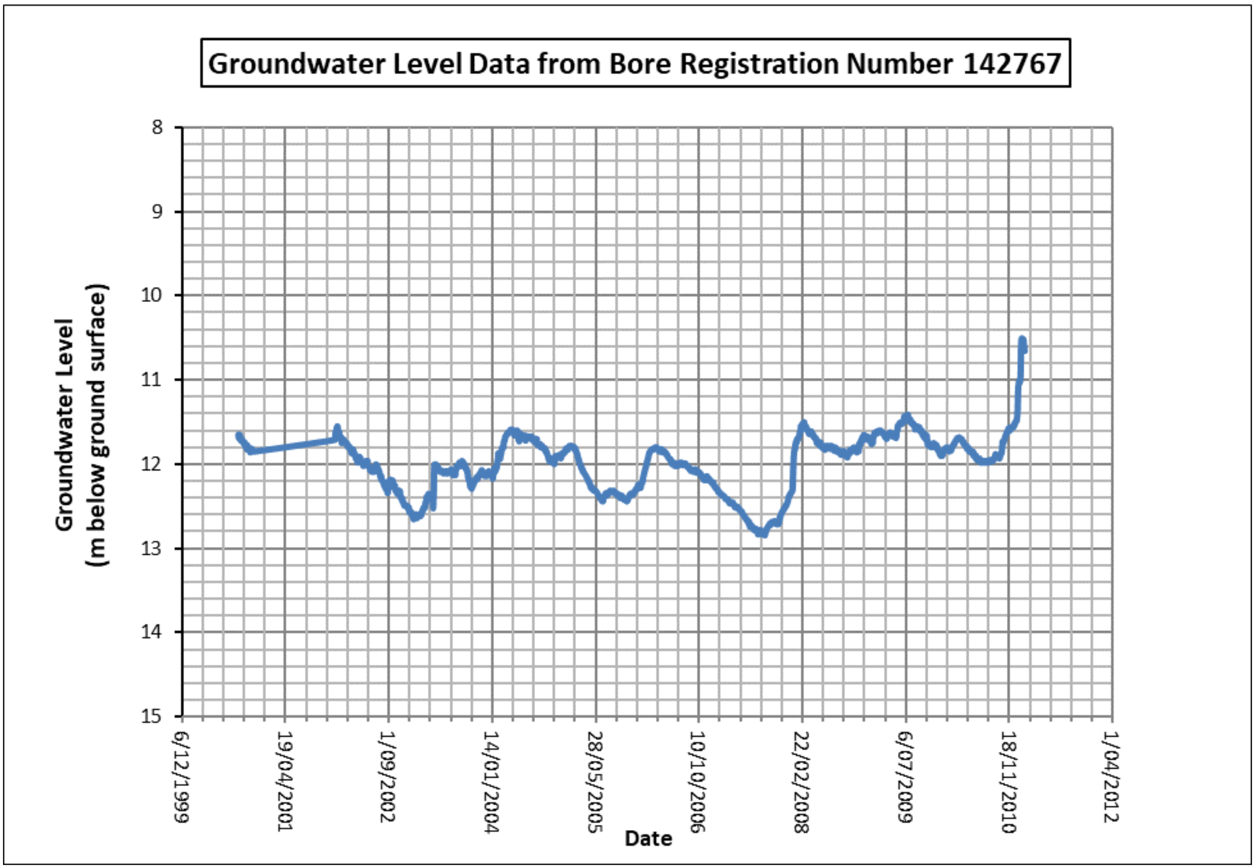

Figure 5: Hydrograph of RN142767

A review of the Queensland Globe online mapping system found two bores in the vicinity of the historic production testing wells with current water level data from the alluvial aquifer shown in Figure 6 and Figure 7. These were bores RN14500260 and RN14500261 located approximately 2,000 metres south of the historic production testing wells.

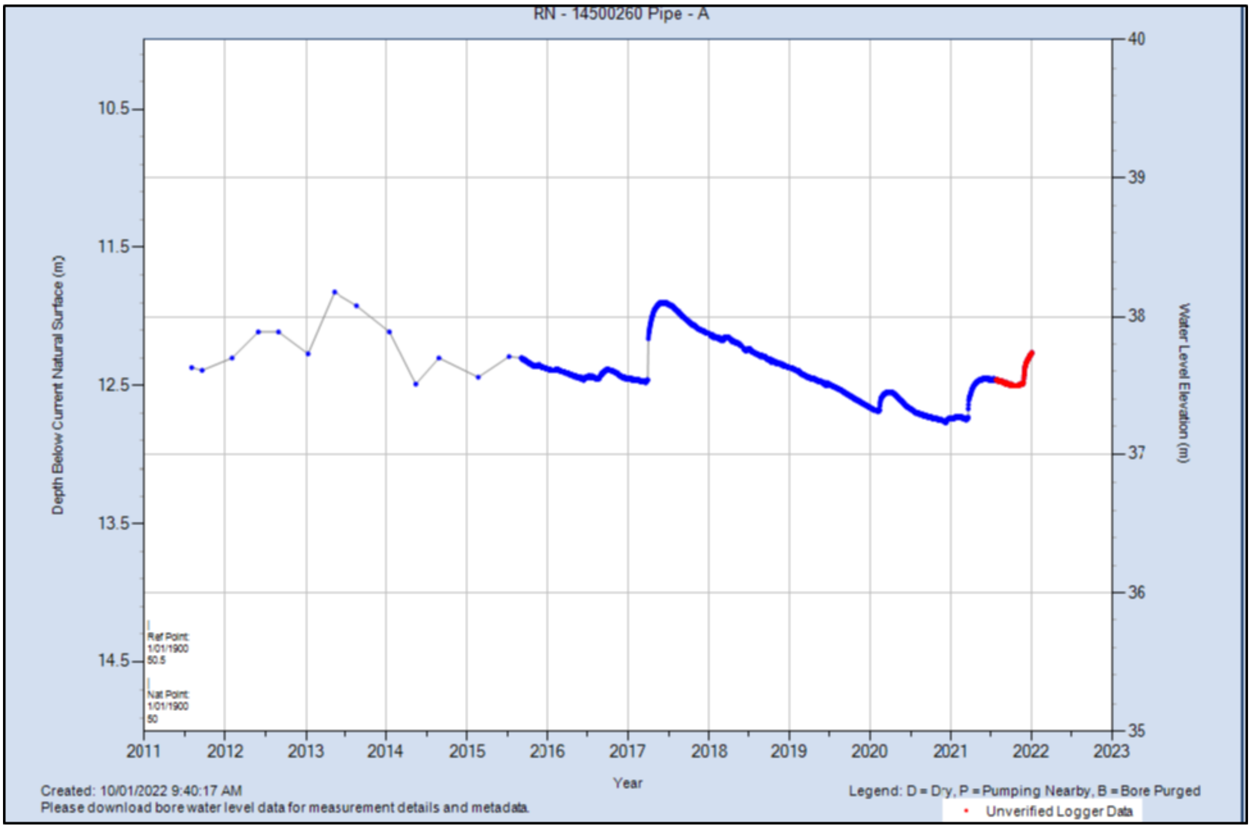

Figure 6: Hydrograph of RN14500260

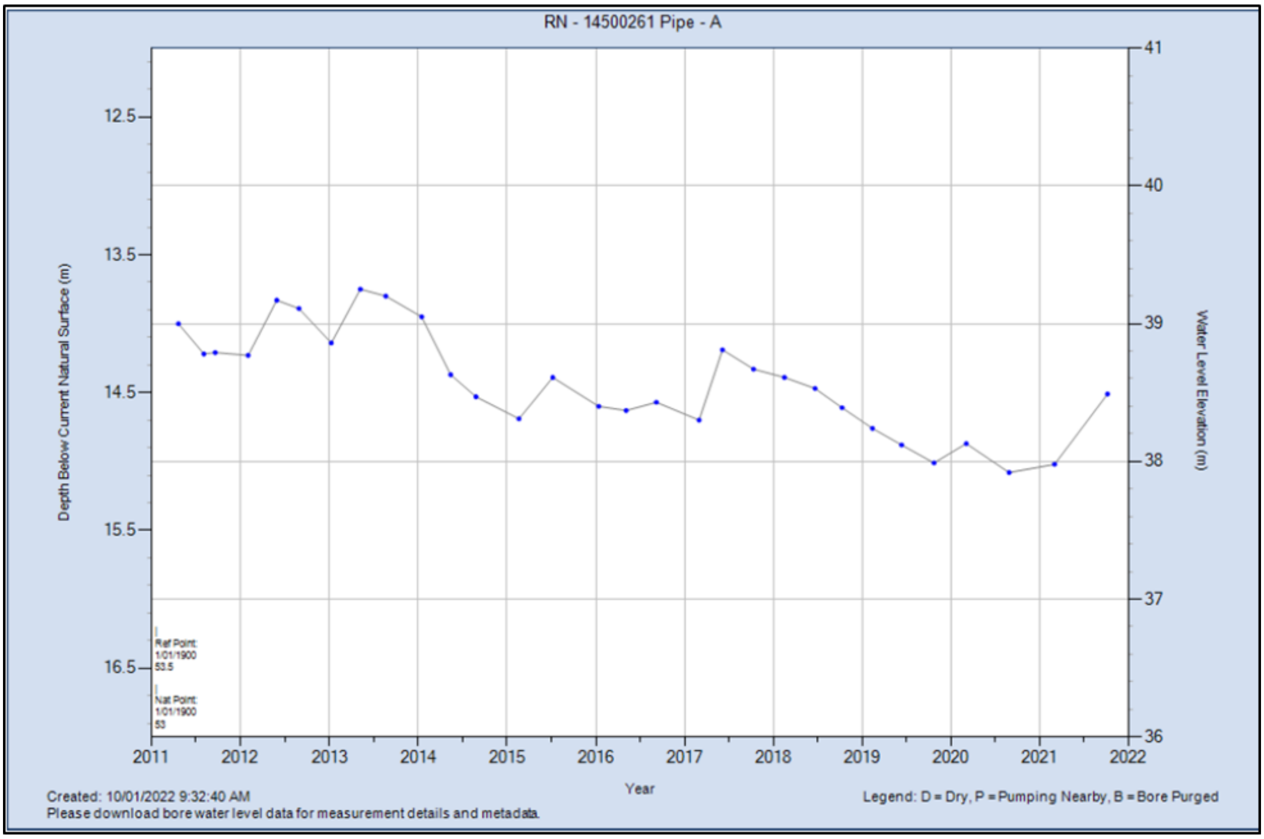

Figure 7: Hydrograph of RN14500261

3.3.2 *Walloon Coal Measures*

There is no groundwater level data available from the DRDMW Database for bores intersecting the WCM within 20 km of the site so local groundwater levels for this formation are taken from information gathered during the production test.

Groundwater levels in the WCM ranged from 45 m below wellhead (ML-7) to a maximum of 108 m below wellhead (ML-11). This suggests that the pressure in the WCM is lower than in the alluvial aquifers and that downward vertical gradients may exist from the alluvial aquifers to the WCM. The variability in groundwater levels within the WCM may indicate very low hydraulic conductivities and/or lack of interconnectedness between layers within this unit.

3.3.3 *Koukandowie Formation*

There are a number of Landholder bores which are described in the DRDMW Database as intersecting the Koukandowie Formation within 20 km of the production test site. These bores are shallow bores (maximum depth is 54 m) so these are unlikely to be representative of the Koukandowie Formation in the vicinity of the production test wells which is present at several hundred metres depth. Groundwater levels for these bores are in the order of 13.8 m to 15.0 m below ground surface. These are similar to the values seen for the alluvial aquifer which may indicate these bores are screened within the alluvial aquifer rather than the Koukandowie Formation.

3.4 Groundwater Flow

3.4.1 *Alluvium*

As indicated in Section 3.2.1, the general flow direction in the alluvial aquifers is anticipated to be northwards in the direction of the Logan River.

3.4.2 *Walloon Coal Measures*

Due to the lack of available data, the flow direction in the WCM is not apparent from the available water level data. It is anticipated that these units have low permeability and a lack of horizontal and vertical connection.

3.5 Groundwater Quality

3.5.1 *Alluvium*

The historically available water quality data from bores in the alluvial aquifers recorded in the DRDMW Database indicates electrical conductivity of 1,430 µS/cm to 3,500 µS/cm, indicating fresh to brackish groundwater. Bore 14500260 reported electrical conductivity of 9,000 µS/cm indicating a more saline water and illustrating that the water quality of the alluvium may be quite variable.

3.5.2 *Walloon Coal Measures*

Total dissolved solids concentrations of groundwater in the coal measures ranged from 2,000 mg/L (Mount Lindesay-8 & Mount Lindesay-11) to 5,870 mg/L (Mount Lindesay-7). For comparison to alluvial aquifer water quality data this is approximately equivalent to 3,130 µS/cm to 9,170 µS/cm. This indicates that the water in the coal measures is generally more saline than the alluvial groundwater although it may have a similar salinity to the more saline alluvial groundwater. Water samples from the WCM collected from flow during the production tests or development of wells are summarised in Figure 8. Data on major cation/anion analysis indicated that the groundwater was generally a sodium-bicarbonate (Na-HCO_3) dominated with lesser amounts of chloride. The data also indicates that the pH of water in the WCM is variable and ranged from near neutral (6.55) to slightly alkaline 8.85.

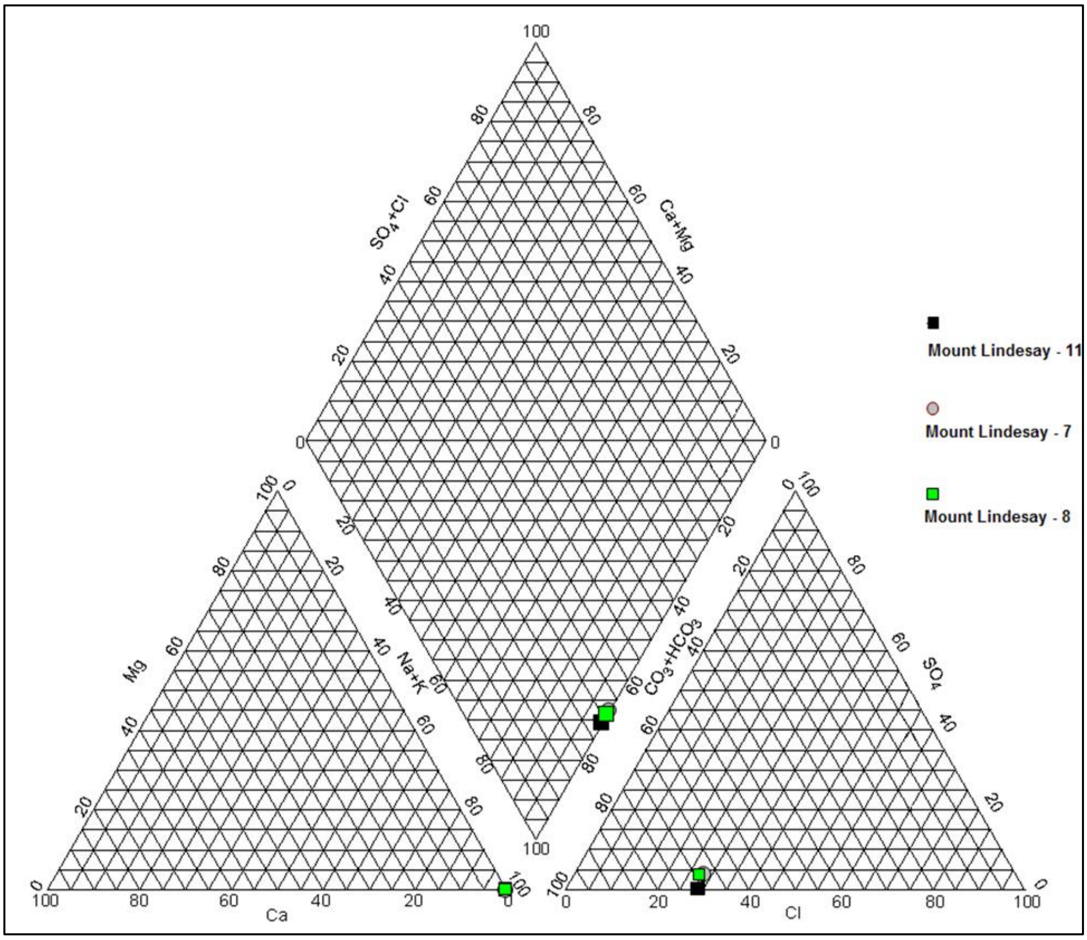

Figure 8: Trilinear Plot of Water Quality in the Walloon Coal Measures

4 CONCEPTUAL HYDROGEOLOGICAL MODEL

The conceptual hydrogeological model comprises an alluvial aquifer of 118 m to 140 m thickness overlying a thick sequence of several hundred metres of low permeability shales, siltstones, claystones, greywackes, sandstones and coals comprising the WCM.

The volume of groundwater stored within the alluvial aquifers and the ability of the aquifers to transmit groundwater is largely a function of the particle size of the material comprising the aquifers and the saturated thickness of the sediments. Aquifer properties are variable depending on the nature of the sediments. The alluvial groundwater is anticipated to be hydraulically connected to the surface water systems. Recharge processes in the alluvial aquifers are likely to be via:

- direct infiltration of rainfall and overland flow where no substantial clay barriers exist in the subsurface; and
- direct infiltration from surface water flow and/or flooding (losing stream).

Primary discharge mechanisms in the alluvial aquifers are likely to be:

- through flow into adjacent or underlying aquifers (in particular the WCM);
- evapotranspiration;
- discharge to surface water systems (gaining stream); and
- groundwater extraction.

The WCM is interpreted to be recharged through vertical leakage from the overlying alluvial aquifer and rainfall runoff on the eastern flank of the Logan Sub-basin with potential for some groundwater exchange between underlying Koukandowie Formation. The WCM are very low permeability units as indicated by the failed DSTs carried out during production test well drilling; where insufficient flow was available for a successful test (i.e. fluid was unable to be recovered from the coals). The perforated intervals of the production test wells are between 195 m and 380 m below the alluvial aquifers and the wells are fully cased and cemented. The 195 m to 380 m thickness of low permeability intervening units are likely to act as an aquitard or series of aquitards between the zones tested by the production tests and the overlying alluvial aquifers.

The stratigraphic sequence in the area of the production testing wells, comprising the permeable alluvium aquifer overlying a thick sequence of Walloons Coal Measures, is considered to be non-complex with little evidence of unconformity or significant structural variation. Groundwater flow is likely to be northward in the alluvium with a component of flow into the WCM (recharge) due to a lower groundwater pressure within these units (indicated in by the higher water level in the alluvial aquifer relative to the WCM shown in Figure 6). The connectivity between the Alluvial aquifer and the WCM is interpreted to be low based on groundwater elevation data and thickness of intervening aquitard.

Groundwater flow within the WCM is likely to be structurally down dip. The non-complex nature and interpreted low connectivity of the formations local to the production test area justifies a simple conceptual model.

5 GROUNDWATER MODELLING AND ASSESSMENT

No new production or production testing has been undertaken on ATP 644 since the last UWIR. Resultantly, there are no changes to the predictions made in the UWIR as approved 6 March 2013.

- There is no IAA (predicted drawdown greater than the 2 m trigger threshold) for the Alluvial aquifer.
- There is a localised IAA (predicted drawdown greater than 5 m trigger threshold) for the WCM aquifer. There are no existing or useable bores in the IAA (WCM).
- No make good obligations are required due to the following:
  - The 5m LAA is no greater than the IAA of the WCM and no existing or useable bores are within the IAA.
  - Groundwater levels are recovering as per Section 5.1.3.

As indicated in the last UWIR it was concluded that the impacts of extraction of underground water during and after production testing within ATP 644 are extremely low given that:

- Groundwater modelling indicates:
  - A limited extent (approximately 550 m) and duration (less than three years) of water level decline in excess of the bore trigger threshold within the WCM;
  - Absence of water level decline in excess of the bore trigger threshold within the alluvial aquifers;
- Limited volumes of water (0.54 ML to 0.69 ML per production test) were abstracted during the production tests;
- A total of 1.8ML was extracted from the 3 wells over the seven-month production testing period;
- The alluvial aquifer (the main resource aquifer used in the area) is separated from the perforated interval of the wells by a 195 m to 380 m thickness of low permeability units for the 3 production test wells;
- The intervening low permeability units have the potential to act as an aquitard or series of aquitards between the zones tested by the production tests and the overlying alluvial aquifer;
- The production test wells are fully cased and cemented between different hydrogeological units. Groundwater behaviour at each unit in the production wells was observed to be significant different; and
- The nearest landholder bore (within the alluvium) is located approximately 500 m away from the production testing wells

Data from monitoring of the production testing indicated drawdown of groundwater levels of approximately 350 m to 400 m within the WCM. An IAA of limited extent (extending approximately 550 m from the production testing wells) was predicted for the WCM. No IAA was predicted in the overlying alluvium. A cross-section of the test production site is shown in Figure 4.

The assessment of the IAA in the 2016 UWIR indicated that the IAA would be transient and likely to reduce as recovery occurred. An analytical calculation of the amount of recovery of groundwater levels in ATP 644 has been carried out as part of this UWIR. This takes into consideration more than 10 years since production testing was completed to evaluate the amount of recovery likely to have occurred to date. The results are presented in more detail in the following sections of the report.

5.1 Analysis of groundwater recovery

5.1.1 *Background*

ATP 644 was subject to production testing which was undertaken using three wells. As indicated above, a total 1.8 ML of groundwater was extracted in 2010 over a period of 7 months as part of this production testing. A UWIR was prepared in 2012 to assess the impacts from the production testing in this tenement and the well locations are shown in Figure 1.

5.1.2 *Method*

An analytical solution was used to assess the potential recovery of water pressures using the Theis (1935) solution that determines transmissivity and storage based on observed drawdown. This also predicted a likely recovery rate based on the parameters that match the observed data. The rate of decline of head in a well penetrating an extensive confined aquifer can be estimated because the rate of decline of head, allowing for storativity and summed over an area is related to the discharge from the well.

This method assumes that drawdown is not negligible and the hydraulic gradient varies with time. In addition, in common with most analytical solutions, it assumes the aquifer:

- is confined,
- is homogeneous,
- has infinite areal extent,
- antecedent conditions are homogenous,
- pumping is at a constant rate, and
- flow to the well is horizontal.

As such this provides an approximate analytical calculation of potential recovery.

The analytical calculation used observed data from well ML-007 which recorded a drawdown of 344.73 m over 224 days of monitoring (Figure 7) and the values for storage (9x10-5 to 9x10-6) and transmissivity (0.001 m2/day) for the WCM determined by the numerical model used in the UWIR. The analytical calculation is therefore based on:

- Observation data over 224 days during production testing (calculated drawdown), extracting 1.8 ML of water over 9 months between 4 March 2010 and 14 October 2010;
- Water levels continued to draw down up to day 304 before recovery commenced up to day 4551, representing the period 2 January 2011 to 18 August 2022.

5.1.3 *Results*

The analytical calculations of recovery at the production test site as shown in Figure 9 indicate:

- Observed drawdown of 274.86 m (day 224) during production testing between 4 March 2010 and 14 October 2010 (day 0 to day 224)
- Water level continued to draw down up to day 304 (January 2011) where after recovery started from 344.73 m and was calculated to have reduced to 31.27 m by 4 February 2022 (day 4551). The calculated recovery is 91% of the 344.73 m drawdown.

The analytical calculation also indicates that recovery is likely to have occurred and it is therefore likely that the current IAA will be smaller than that shown in Figure 10.

Drawdown predictions and analysis of pumping tests in unconfined or confined aquifers using the Theis 1935 solution

Hover mouse over to see more details *Back to Intro sheet*

Hover mouse over to see instructions

Q (m^3/day)	r (m)
8.035	250

Duration of Pumping (days)
224

Automatic (slider bars)	
T (m^2/day)	S
0.001	0.000009

Manually defined (leave blank to use slider bars)	
T (m^2/day)	S
0.001	0.000009

L (m)
1

Measured Drawdown and Recovery

t(days)	s(m)
0.001	0.00
30.000	0.00
60.000	48.00
90.000	140.00
120.000	230.00
150.000	312.00
180.000	323.00
210.000	347.00
240.000	334.00

Calculated Drawdown

t(days)	s(m)
0	0.00
1	0.00
2	0.00
3	0.00
5	0.00
10	0.00
20	0.07
40	4.37
50	10.61
60	19.60
70	30.88
80	43.94
90	58.31
100	73.61
110	89.56
120	105.92
130	122.52
140	139.23
150	155.95
160	172.59
170	189.12
180	205.48
190	221.64
200	237.58
220	268.75
224	274.86
304	388.67

Calculated Recovery

t(days)	s(m)
224	274.86
225	276.38
226	277.90
227	279.42
229	282.45
234	289.97
244	304.75
264	329.40
274	337.25
284	342.10
294	344.42
304	344.73
314	343.49
324	341.08
334	337.81
344	333.91
354	329.55
364	324.88
374	320.00
384	314.99
394	309.92
404	304.83
414	299.75
424	294.72
444	284.86
448	282.93
500	259.31
600	221.82
1000	138.18
2000	70.49
3000	47.26
3955	35.94
4355	32.66
4551	31.27
5000	28.48
6000	23.75
7000	20.38

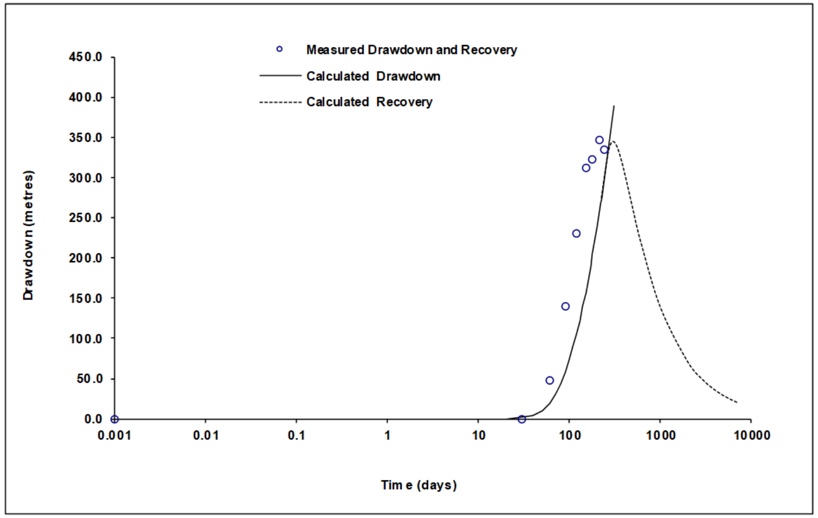

Figure 9: Analytical Calculation of Recovery

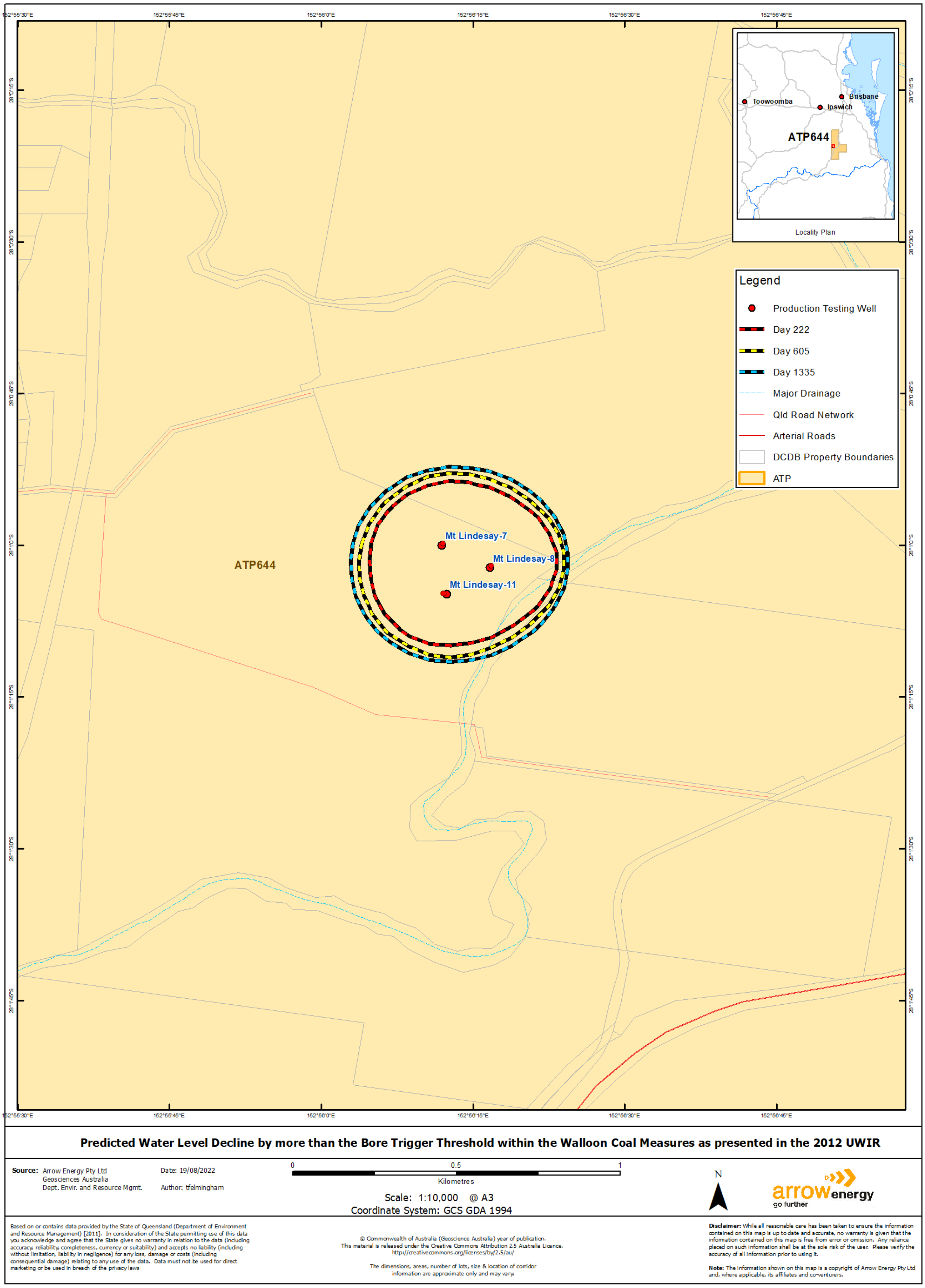

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Figure 10: Predicted Water Level Decline

6 WATER MONITORING STRATEGY

It is concluded that there are limited impacts to groundwater resulting from extraction of underground water during and after production testing within ATP 644. The following supports this conclusion:

- Limited volumes of water (0.54 ML to 0.69 ML per production test) were abstracted during the production tests;
- A total of 1.8ML was extracted from the 3 wells over the seven-month production testing period;
- The alluvial aquifer (the main resource aquifer used in the area) is separated from the perforated interval of the wells by a 195 m to 380 m thickness of low permeability units for the 3 production test wells;
- The intervening low permeability units have the potential to act as an aquitard or series of aquitards between the zones tested by the production tests and the overlying alluvial aquifer; and
- The production test wells are fully cased and cemented between different hydrogeological units. Groundwater behaviour at each unit in the production wells was observed to be significantly different.

Based on this, a Water Monitoring Strategy is not proposed, given that there is no material impact.

7 ENVIRONMENTAL VALUES

This section identifies and describes the groundwater related environmental values in ATP 644 and the potential impacts on those environmental values.

7.1 Requirements

In the Logan sub-basin groundwater is used for a variety of uses, as discussed in Section 3.2, the groundwater resources in the area are primarily in the alluvial aquifers of the Logan and Albert rivers.

Recharge occurs in the southern sector and direct recharge to the aquifer in this region is either a very slow process through the unsaturated zone or it is negligible. Horn and Wong (1998) reported almost all groundwater in the catchment is abstracted from depths of between 5 m and 25 m. The primary use for this groundwater is for irrigation and private supplies on farms (Please et al., 1996).

The enhancement of the values and the protection of groundwater are required in the EPP (water). The EPP (water) provides a framework for identifying the environmental values. For the purposes of this assessment the 'values' as defined in the EPP (water) are those groundwater systems within the potential impact area that are sufficiently important to be protected or enhanced.

This section therefore addresses the following legislative requirements under s376 of the Water Act 2000:

da) a description of the impacts on environmental values that have occurred, or are likely to occur, because of any previous exercise of underground water rights;

db) an assessment of the likely impacts on environmental values that will occur, or are likely to occur, because of the exercise of underground water rights

i. during the period mentioned in paragraph (a)(ii); and
ii. over the projected life of the resource tenure;

7.2 Environmental Values in the area

The groundwater related environmental values with potential to exist in the area include:

- Biological integrity of aquatic ecosystems;
- Suitability for recreational use (primary recreation);
- Suitability for minimal treatment before supply as drinking water;
- Suitability for use in primary industries; and
- Cultural and spiritual values.

7.2.1 *Aquatic Ecosystems*

A review of the Queensland Government Springs database indicated no springs were identified within 20km of the former production wells in the area of ATP 644. The closest springs are understood to be recharge springs on the basalts of the Lamington Volcanics to the east. These springs are understood to be fed by rainfall recharge and not from the underlying units. As such these environmental values are not indicated to have a mechanism by which they would be affected by the production test.

The potential for groundwater to support aquatic ecosystems can also occur where an aquifer interacts with a wetland or stream. GDEs may also be present in these areas. This is represented in ATP 644 by areas of surficial alluvium along the Logan River as shown in Figure 3. This area of potential aquatic ecosystems/GDEs is separated from the zone of production testing by 300-500m of intervening rock units.

7.2.2 *Recreational Use*

The category of suitability for recreational use is not applicable to in-situ groundwater. As noted above there are also no registered groundwater springs in the area. Groundwater seepage from the alluvium into water courses can provide short duration baseflow into rivers and creeks immediately after heavy rains of flooding, however, after large flood events suitability of these water for recreation will be limited by other factors.

7.2.3 *Drinking water*

Water quality data from bores in the alluvial aquifers has an electrical conductivity of 1,430 to 3,500 µS/cm indicating fresh to brackish groundwater that has the potential for potable use with minimal treatment. As previously reported in the UWIR 18 bores are recorded within 2km of the production testing wells. These bores are between 13m and 43m deep. By comparison the production wells accessed zones between 339m and 527m depth.

7.2.4 *Primary Industry*

Water bores may be used for agricultural uses such as stock watering where water quality permits. As indicated above water bores in the Logan river alluvials are present within 2km of the production test wells and are likely to intersect water suitable for agricultural use.

7.2.5 *Cultural and Spiritual Values*

At the time of the installation of the production test wells a cultural heritage assessment was undertaken. The Mullinjalli did not believe that our activities would impact on the cultural significance of the groundwater or Logan River. The results of the assessment are as follows:

- Mt Lindsay 7 – was assessed 20/07/2009 by representatives of the Mullinjalli. The Mullinjalli representatives did not express a belief that any cultural heritage or cultural/spiritual/intangible significance, related to the Logan River or associated groundwater, would be impacted by the construction of the well.
- Mt Lindsay 8 – was assessed 20/07/2009 by representatives of the Mullinjalli. The Mullinjalli representatives did not express a belief that any cultural heritage or cultural/spiritual/intangible significance, related to the Logan River or associated groundwater, would be impacted by the construction of the well. A cultural heritage site of significance was identified (scarred tree), but not associated with groundwater. Mitigations measures were taken to avoid impacts to the scarred tree and surrounds.
- Mt Lindsay 11 – was assessed 20/07/2009 by representatives of the Mullinjalli. The Mullinjalli representatives did not express a belief that any cultural heritage or cultural/spiritual/intangible significance, related to the Logan River or associated groundwater, would be impacted by the construction of the well.

7.2.6 *Potential for subsidence impacts*

Because impacts from production testing are of limited duration and extent and mechanical stresses incurred by the target unit start to recover with recovering pressures once production testing ceases, the potential for subsidence to impact environmental values from production testing are considered to be minimal.

From the above discussion it is concluded the environmental values with potential to exist in ATP 644 include:

- Biological integrity of aquatic ecosystems in or dependent upon alluvial aquifers;
- Drinking water with minimal treatment in alluvial aquifers; and
- Agricultural uses such as stock watering.

7.3 Potential Impacts to Environmental Values

The potential for impacts to environmental values to have occurred or to occur are discussed below.

7.3.1 *Aquatic Ecosystems*

Prior modelling of potential impacts from the production tests indicates that the several hundred metres of intervening rock separating the production test zones to the overlying alluvial aquifer resulted in impacts of less than 1mm at the alluvial aquifer at any time in the future.

As such there is nil to minimal risk for potential impacts to have occurred or to occur to this environmental value.

7.3.2 *Drinking water*

Prior modelling of potential impacts from the production tests indicates that the lateral extent of the 5m trigger threshold in the coals was approximately 550 m at its largest. No recorded groundwater bores are present within this radius as shown in Figure 11.

As such there is nil to minimal risk for potential impacts to have occurred or to occur to this environmental value.

7.3.3 *Primary Industry*

As discussed above and shown in Figure 11 below, there are no landholder bores within area of predicted impact.

As such there is nil to minimal risk for potential impacts to have occurred or to occur to this environmental value.

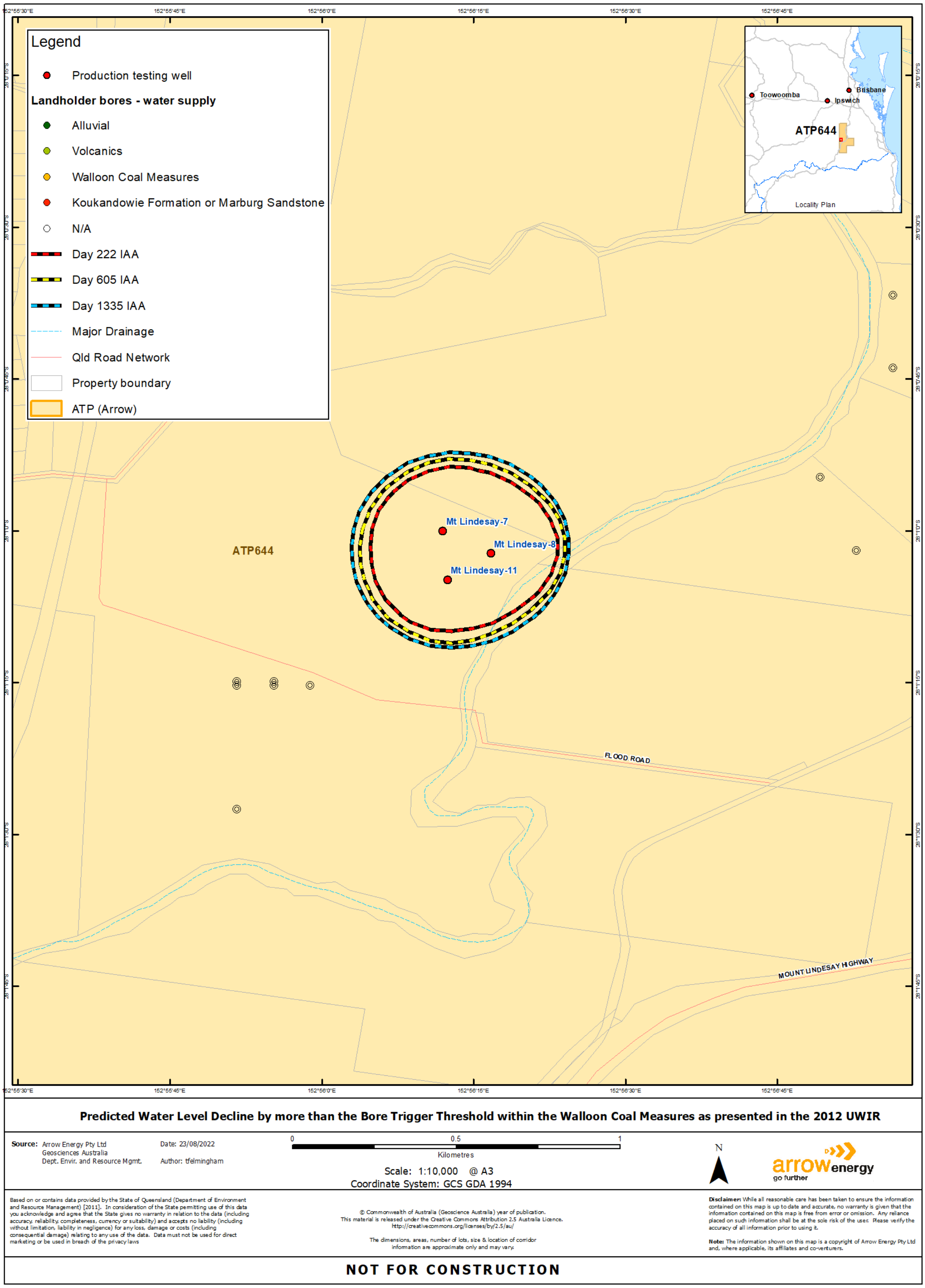

Figure 11: Predicted Water Level Decline – landholder bores