NEW HOPE GROUP

G.4 Groundwater

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G.4.1 Stage 3 Aquifer Testing Report

New Acland Coal Mine

Stage 3 Expansion Project

- Groundwater Resources Pump Test Report
- 29 July 2009
- Final

New Acland Coal Mine

Stage 3 Expansion Project

Sinclair Knight Merz

ABN 37 001 024 095

32 Cordelia Street
South Brisbane QLD 4101 Australia
PO Box 3848
South Brisbane QLD 4101 Australia

Tel: +61 7 3026 7100

Fax: +61 7 3026 7306

Web: www.skmconsulting.com

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1. Groundwater Resources Pump Test

The Project site is situated in the western portion of the Clarence-Moreton Basin and is located approximately 15 km north of the township of Oakey in southeast Queensland. The Walloon Coal Measures within the Clarence-Moreton Basin underlie the Project site and regionally contain a coal resource of over 800 million tonnes.

The Project site is located in undulating terrain that spans two catchments. Runoff from the majority of the Project site drains to Lagoon Creek. Both Lagoon and Doctors Creeks flow into Oakey Creek which is part of the larger Condamine River Catchment.

1.1. Hydrogeology

The geology of the Project site comprises the following formations which are described below.

1.1.1. Quaternary Deposits

Quaternary deposits consist of recent alluvium (e.g. clay, silt, sand and gravel) deposited by creeks and rivers. Within the Project area, these deposits are likely to occur in association with the Lagoon Creek catchment. The nearest alluvial deposit with significant groundwater supplies is associated with Oakey Creek approximately 15 km southeast of Acland Township.

1.1.2. Tertiary Basalt

The Tertiary Basalt unconformably overlies the Walloon Coal Measures in several localities in the Acland area. Remnants of Tertiary age basalt flows from the hill tops in the Acland area occur as low lying horizontal continuous flows. The presence of weathered basalt below fresh basalt, in combination with relict soil profiles and sedimentary layers, indicate that there has been a succession of basalt flows in the Acland area.

The Tertiary Basalt aquifer consists of olivine basalts and varies in thickness from 1 m to 90 m. The Tertiary Basalt aquifer is interbedded with clay which has the potential to act as an aquitard. There is a minor outcrop of the Tertiary Basalt aquifer in the northern section of the Project site.

1.1.3. Walloon Coal Measures

The Walloon Coal Measures consists of shale, siltstone, carbonaceous mudstone, minor sandstone and coal layers. This geological unit outcrops over much of the Project site with the coal seams being the principal conduit for groundwater. Even though numerous wells have been drilled into the coal measures at the Project site, few are able to deliver useful quantities of water. Neighbouring farm properties also use groundwater from the Walloon Coal Measures.

1.1.4. Marburg Sandstone

The Marburg Sandstone is up to 500 m thick and regionally dips to the southwest. The Marburg Sandstone is made up of poorly sorted, coarse to medium-grained, feldspathic sandstone and fine-grained, well sorted quartzose sandstone. Minor carbonaceous siltstone, mudstone, coal and rare pebble conglomerate also occur within the Marburg Sandstone.

The Marburg Sandstone aquifer is a confined aquifer which occurs at a depth of approximately 150 m below ground level (bgl) within the Project site. Aquitards within the Walloon Coal Measures act as effective confining layers for the Marburg Sandstone aquifer.

1.2. Recharge

The aquifer is recharged by infiltration of rainfall where the aquifers outcrop. There are two mechanisms of recharge adopted in the model. These represent rainfall on the alluvial overburden and the Tertiary Basalt respectively. The percentage of rainfall recharge to the Tertiary Basalt is much higher than recharge to the alluvial sediments because of the higher permeability of the Tertiary Basalt.

1.3. Discharge

The Project will consist of a series of mine pits and voids which will intersect the Quaternary Alluvial overburden and the Walloon Coal Measures. It is anticipated that these formations will be dewatered during mining through the use of in-pit sumps and pumps.

The Quaternary Alluvial sediments are considered to be a minor aquifer within the Project site and do not represent a significant groundwater resource. It is unlikely to be impacted by the Project due to its limited use and limited interaction with surface water.

The Walloon Coal Measures are also considered to be limited in their capacity to store and transmit water. This observation is consistent with pumping tests carried out in the Walloon Coal Measures which indicated transmissivities of between 7 m^2 per day and 40 m^2 per day. However, it is recognised that most of the dewatering undertaken for coal mining will occur in the coal measures and as such there are potential impacts from the Project associated with the Walloon Coal Measures aquifer. Also of interest is the potential for groundwater impacts to occur in the Marburg Sandstone Aquifer located beneath the coal measures.

2. Aquifer Pump Test

The derivation of the hydraulic properties for the Walloon Coal Measures aquifer were based on pumping test data obtained during the Project baseline investigations. Step tests and constant rate tests at two recently installed groundwater monitoring locations were conducted by SKM during December 2007.

The purpose of the step test is to establish the efficiency of the bore and to provide preliminary information on the yield of the bore from both a quantity and quality standpoint. The purpose of the constant rate test is to determine the hydraulic properties of the aquifer to explore for and identify nearby hydrologic boundaries.

Details of these groundwater monitoring locations are shown in **Table 2-1**.

Table 2-1 Bore Details for Pumping Tests

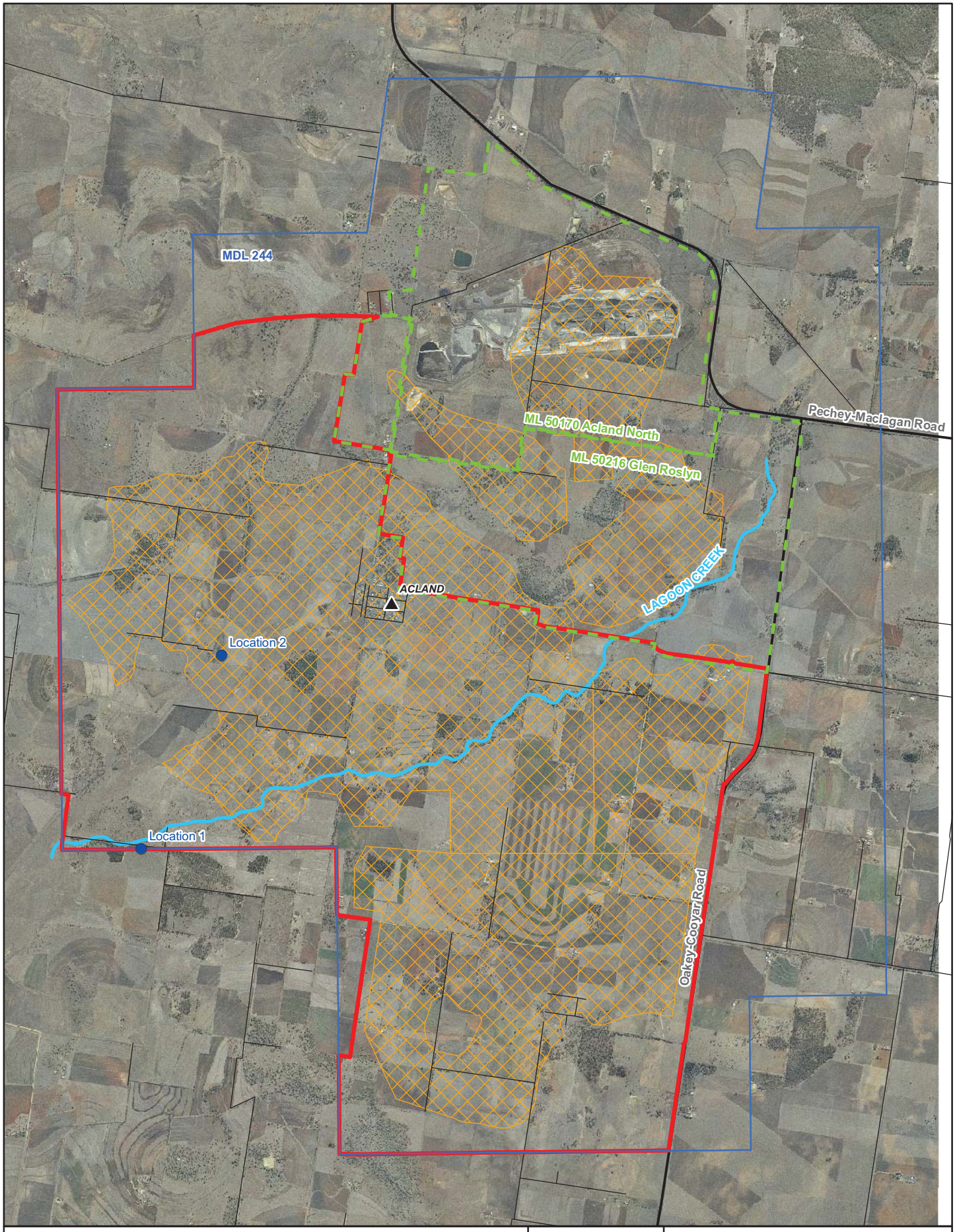
Location	Production Bore	Observation Bore	Distance from Production Bore (m)	Aquifer Material	Total Depth (mBGL)	Screened Interval (mBGL)
Location 1	120WB	N/A	N/A	Coal	90	73.5-83.5
		117PGC	22.05	Coal	90	73.5-83.5
		118P	17.60	Coal	61	49-56
Location 2	121WB	N/A	N/A	Coal	36	27-34
		113PGCA	14.45	Coal	78	27-34
		113PGCB	14.45	Coal	78	43-50

The pumping test locations are located approximately 2.5 km apart and the locations of both sites are shown in **Figure 2-1**.

The two pumping bores, monitor different coal seams within the coal measures. Bore 120WB intersects the deeper coal seam. Bore 121WB intersects the shallow coal seam. Each location consists of a production bore and two observation bores. Location 1 is situated approximately 50 m from a surface water drainage feature which was observed as being dry during December 2007 when these tests were undertaken.

At Location 1, production bore 120WB is situated 17.60 m from observation bore 118P and 22.05 m from observation bore 117PGC. The two observation bores at this location are situated 4.45 m from each other.

At Location 2, production bore 121WB is located at a distance of 14.45 m from both of the observation bores (113PGCA and 113PGCB) which were constructed as a nested peizometer. **Figure 2-2** and **Figure 2-3** display the conceptual layout of Location 1 and Location 2 respectively.



LEGEND

- Locality
- Pumping Test Sites
- Road
- Pit Boundary
- Existing Mining Lease
- Stage 3 Mining Lease Application
- Stage 3 MDL

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FIGURE 2-1

NEW ACLAND STAGE 3 COAL MINE EXPANSION

Pumping Test Locations

0 400 800 1,200 1,600 2,000

Metres

Scale 1:60,000 on A4

Projection: AMG - Zone 56 (AGD84)

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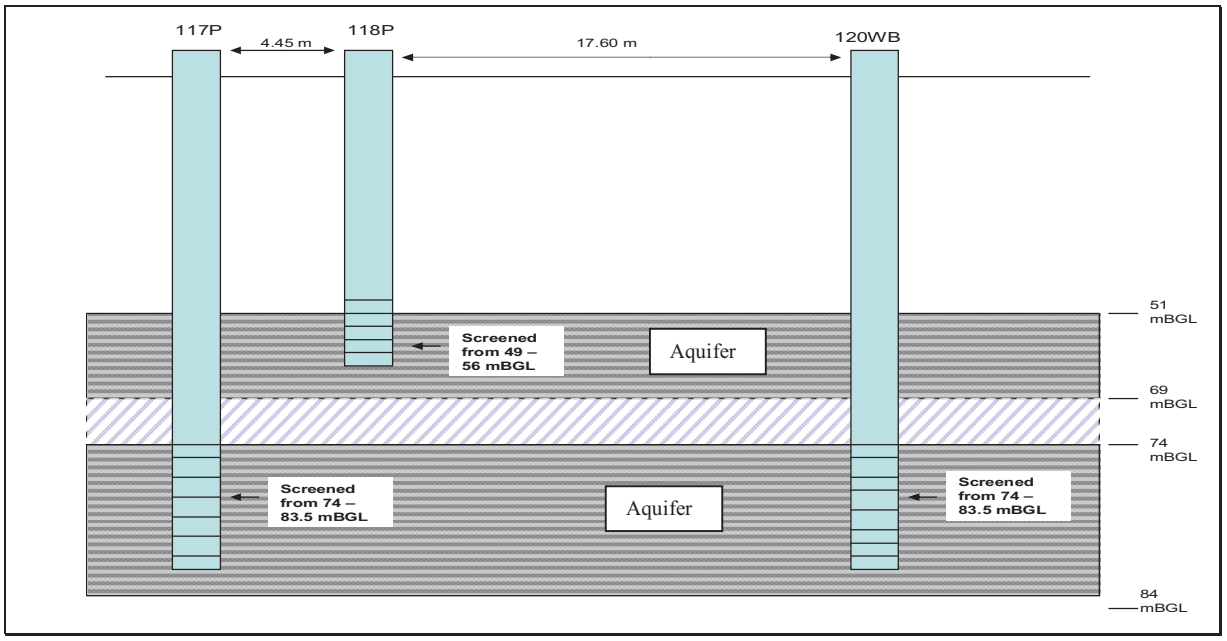

Figure 2-2 Location 1 Layout

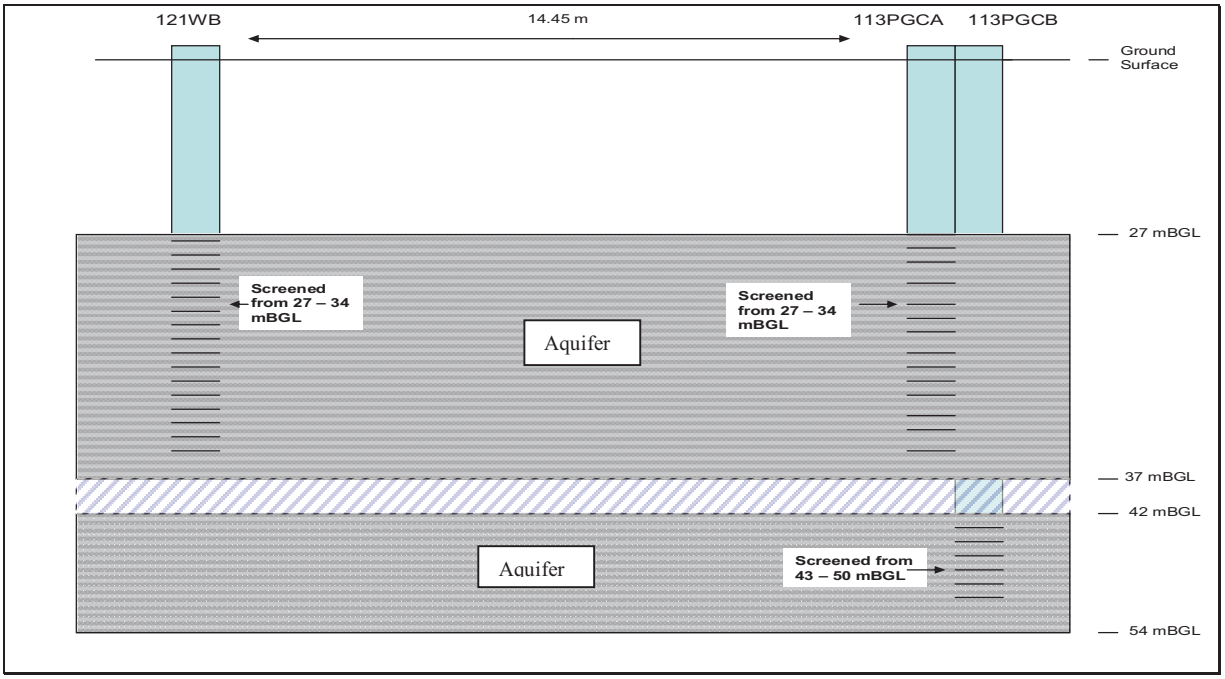

Figure 2-3 Location 2 Layout

2.1. Pump Test for Location 1

Step Test

A step test was undertaken at the production bore 120WB. The step test comprised three 60 minute intervals with yields ranging between 1.3 L/sec and 3.3 L/sec as can be seen in **Figure 2-4**.

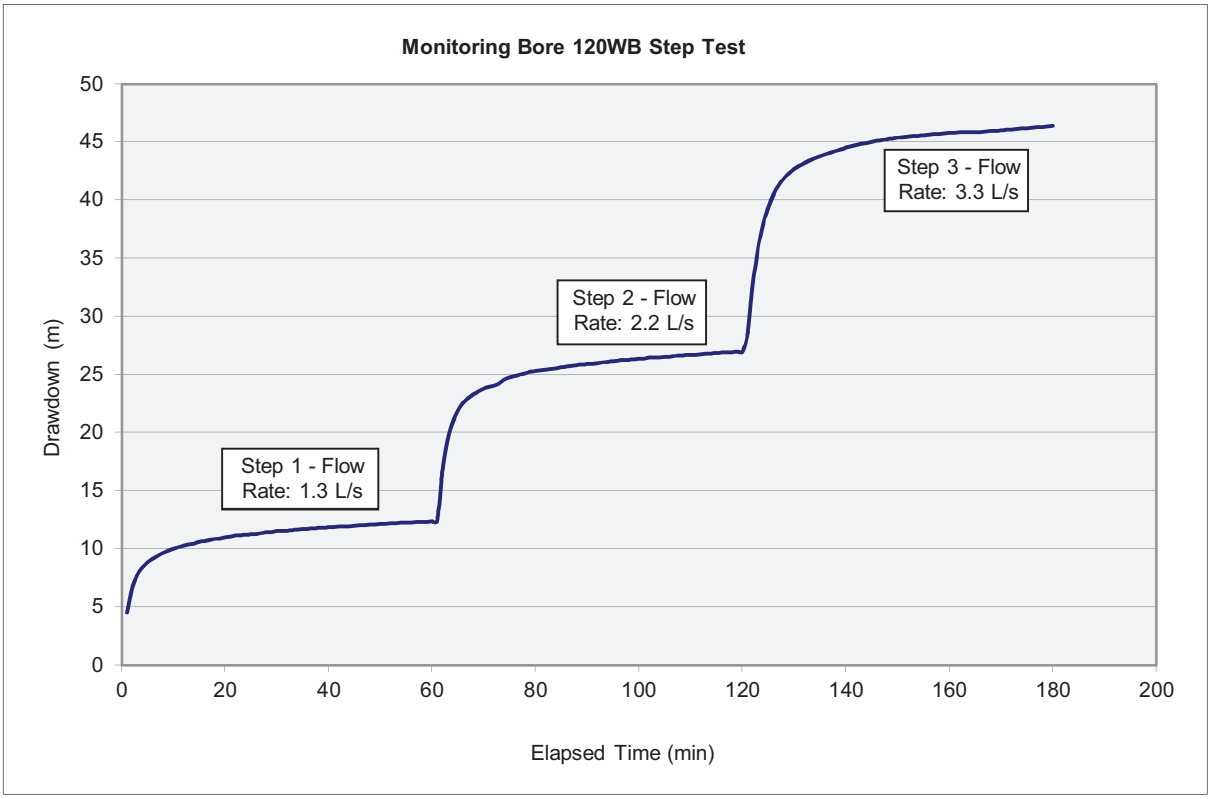

Figure 2-4 Step Test undertaken in production bore 120WB

Constant Rate Test

During the constant rate pumping test, the bore was pumped at an average of 2.32 L/sec for a duration of approximately 7 hours. **Figure 2-5** below shows that the maximum drawdown observed in the production bore 120WB was 26.76 m after 7 hours.

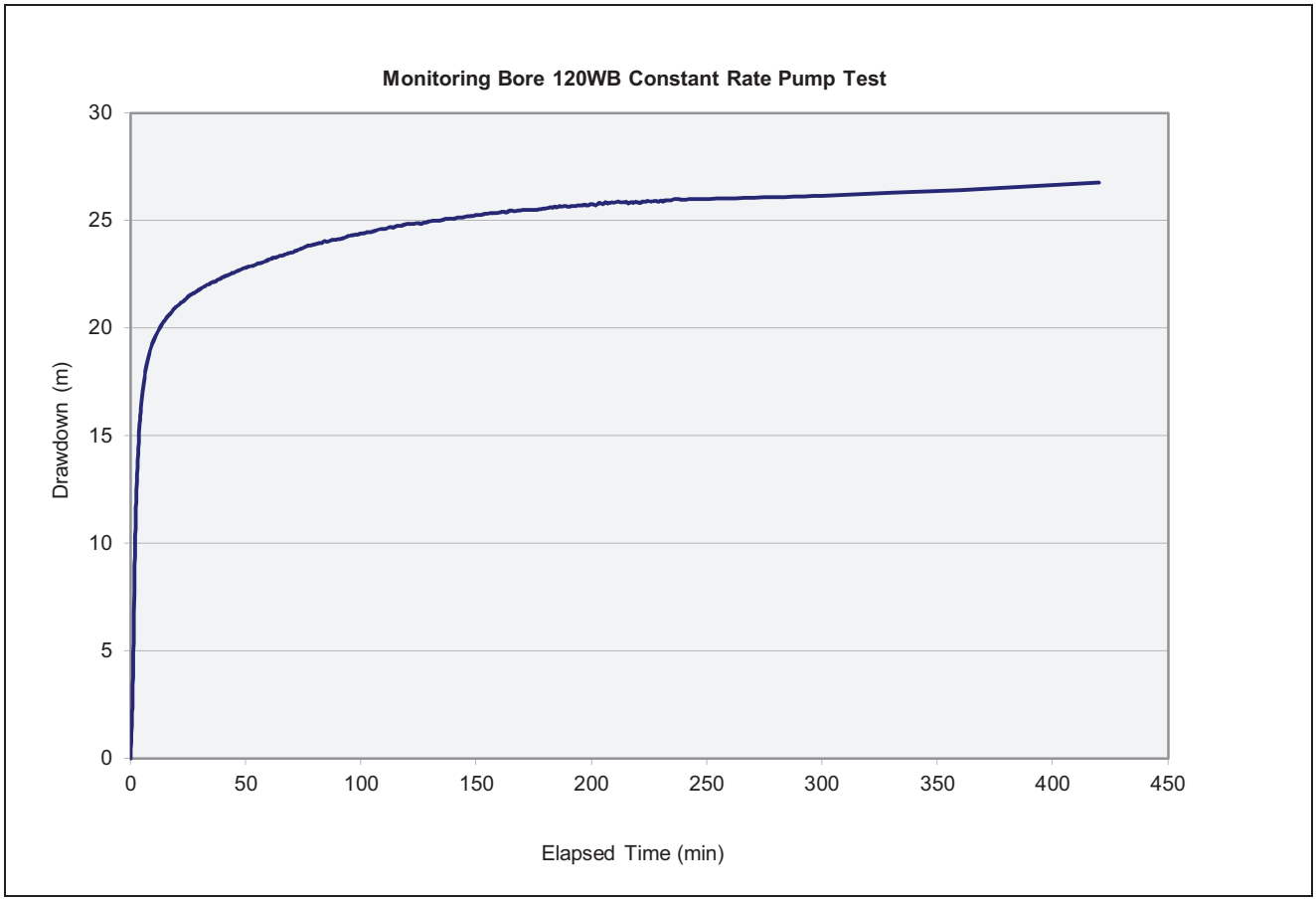

Figure 2-5 Drawdown observed in pumping bore 120WB

Results obtained from observation bores 117PGC and 118P are shown in **Figure 2-6** and **Figure 2-7** below.

The maximum drawdown observed during the constant rate test at observation bore 117PGC was 9.11 m. Results obtained during the constant rate test at observation bore 118P displayed a varied response with very little drawdown observed over the test interval. Observation bore 118P was screened at a shallower depth and in a separate coal seam than observation bore 117PGC and production bore 120WB. Analysis of the borehole data shows that an interbed of carbonaceous mudstone (~4.5 m thickness) separates these two coal seams. The lack of response in observation bore 118P to groundwater extraction from the production bore suggests that the carbonaceous mudstone layer hydraulically separates (to some extent) the two coal seams.

Drawdown observed in the adjacent observation bores (117PGC and 118P) suggest that observation bore 118P displays poor hydraulic connection with sites 120WB and 117PGC. However, it is likely that the relatively short duration of the test resulted in the small amount of drawdown at bore 118P in comparison to the amount of drawdown observed at bore 117PGC.

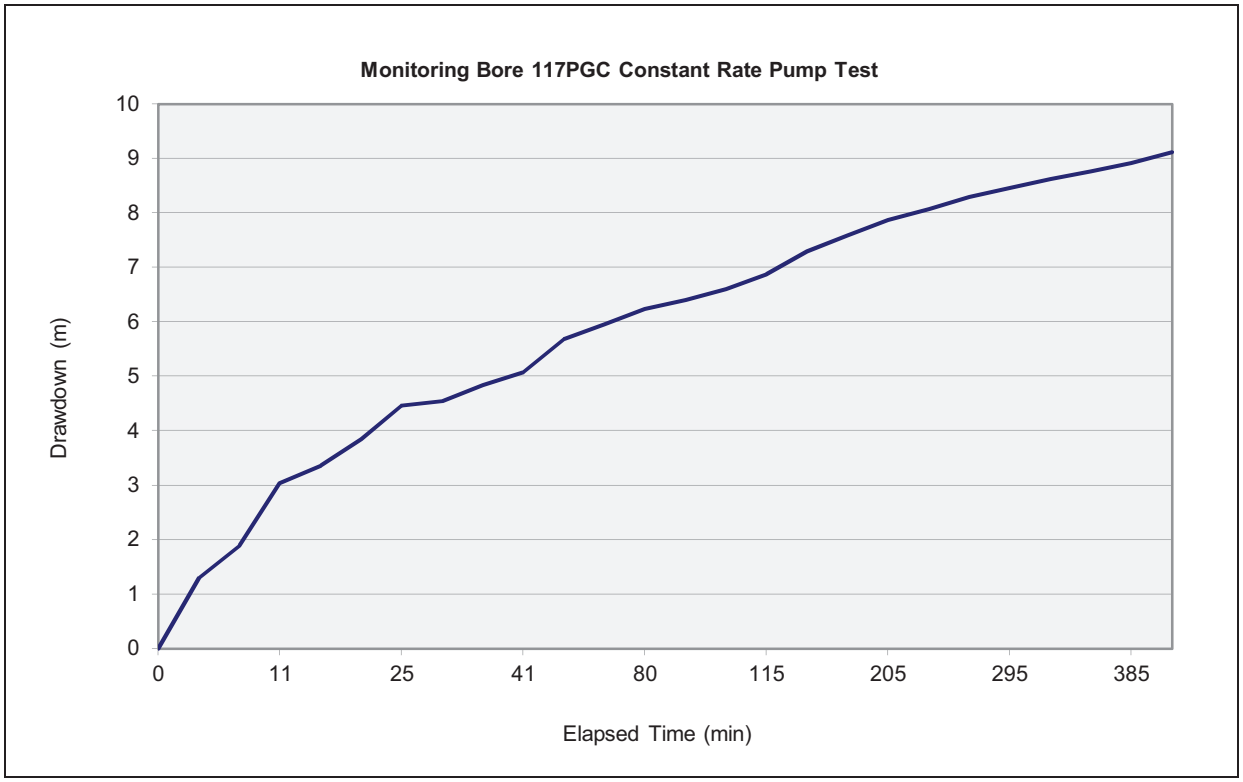

Figure 2-6 Constant Rate test results observation bores 117PGC

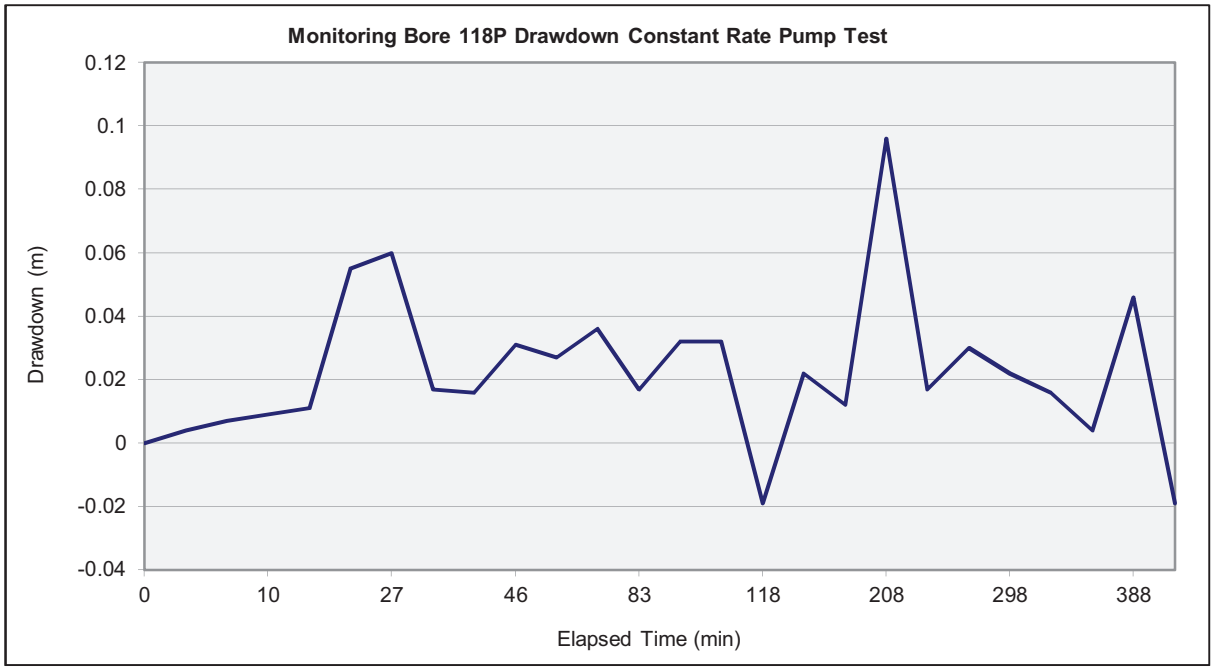

Figure 2-7 Constant Rate test results observation bores 118P

2.2. Pump Test Outputs for Location 1

Pump test outputs for Location 1 are presented below in **Figure 2-8** to **Figure 2-11**.

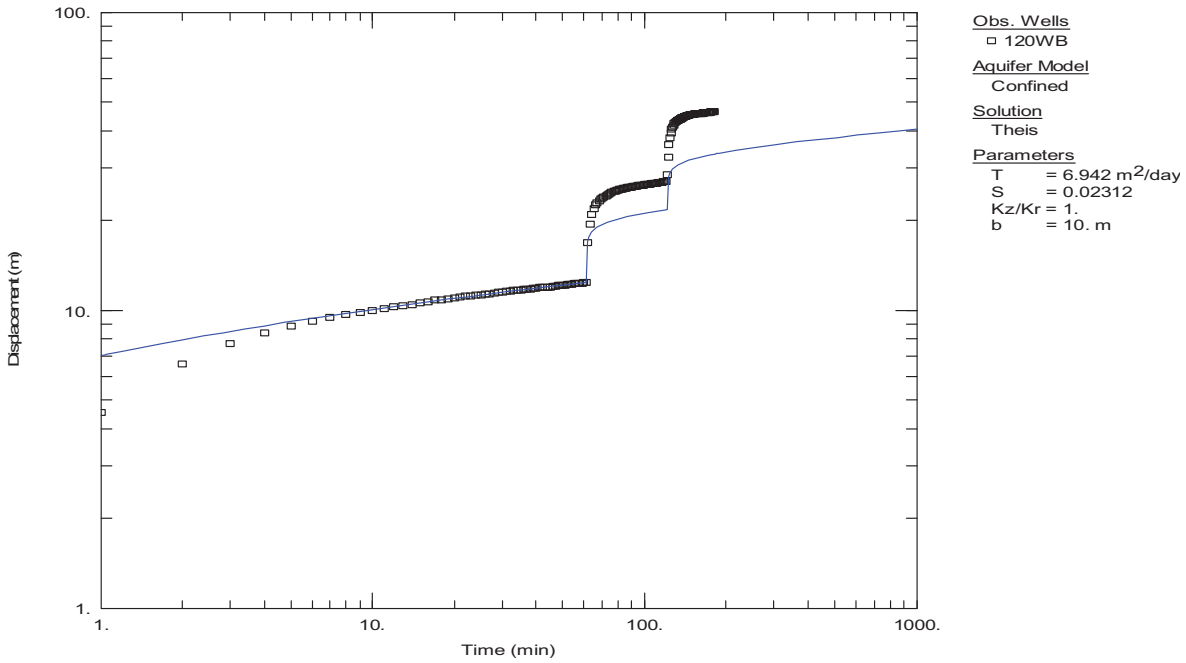

Figure 2-8 Production Bore 120WB – Step Test

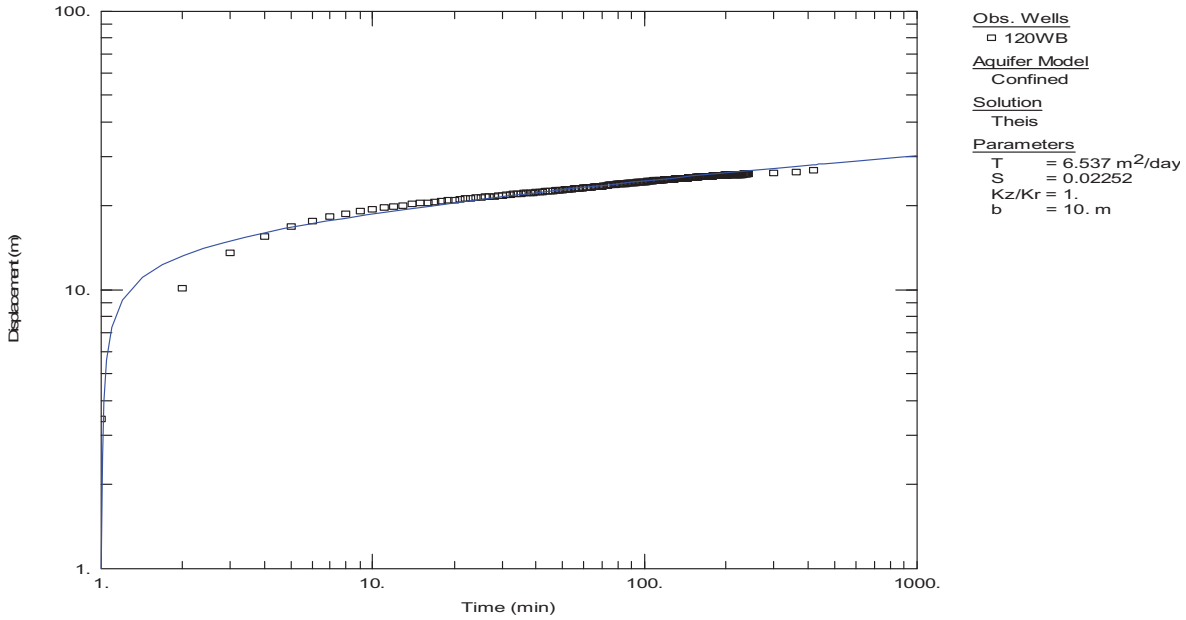

Figure 2-9 Production Bore 120WB – Constant Rate Test

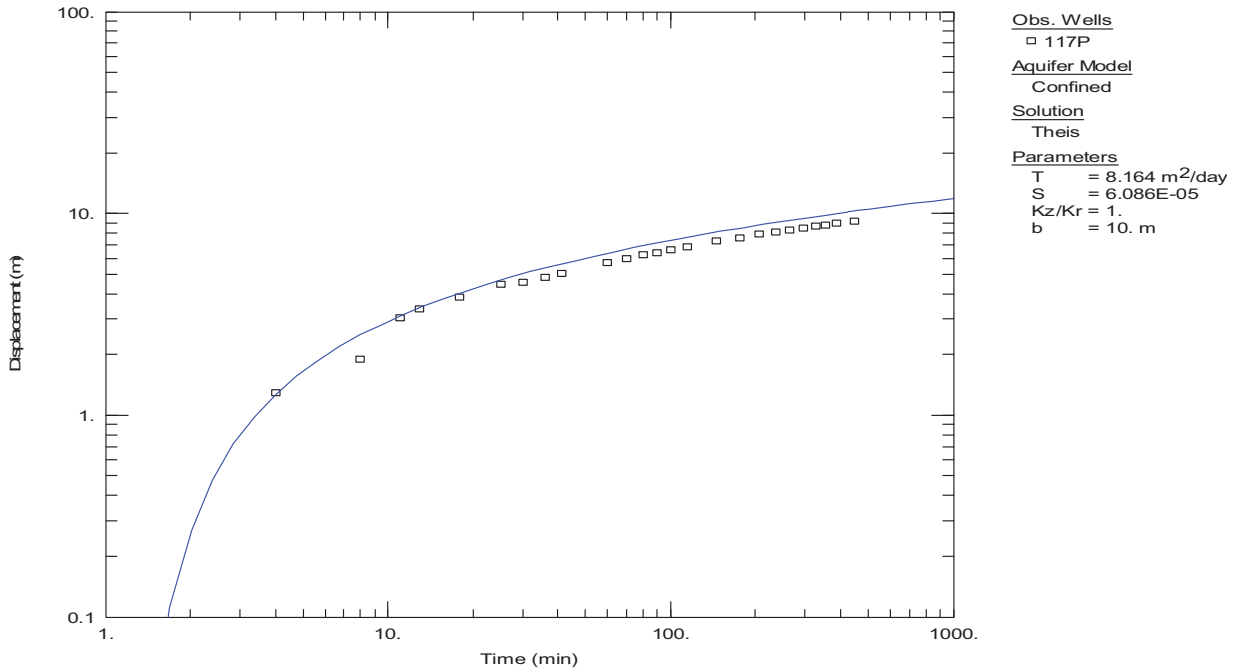

Figure 2-10 Observation bore 117PGC

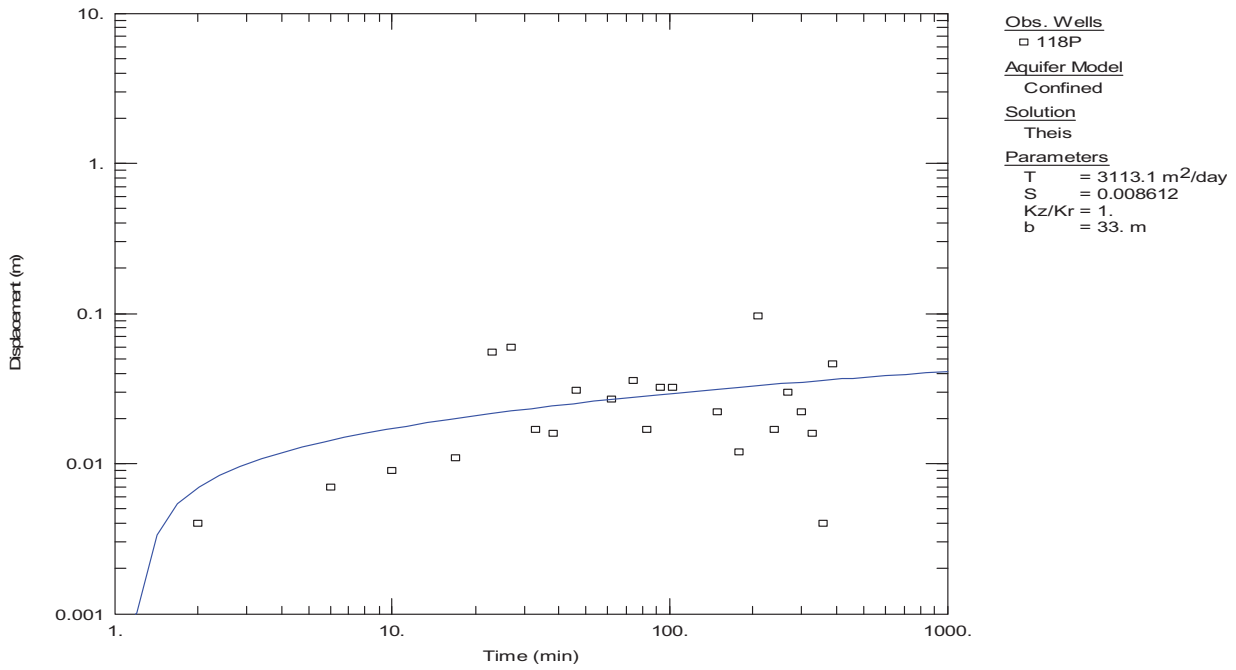

Figure 2-11 Observation Bore 118P

2.3. Pump Test for Location 2

Step Test

A step test was undertaken in the production bore 121WB. The step test comprised three 60 minute intervals with yields ranging between 1.1 L/sec and 3.0 L/sec as can be seen in **Figure 2-12**.

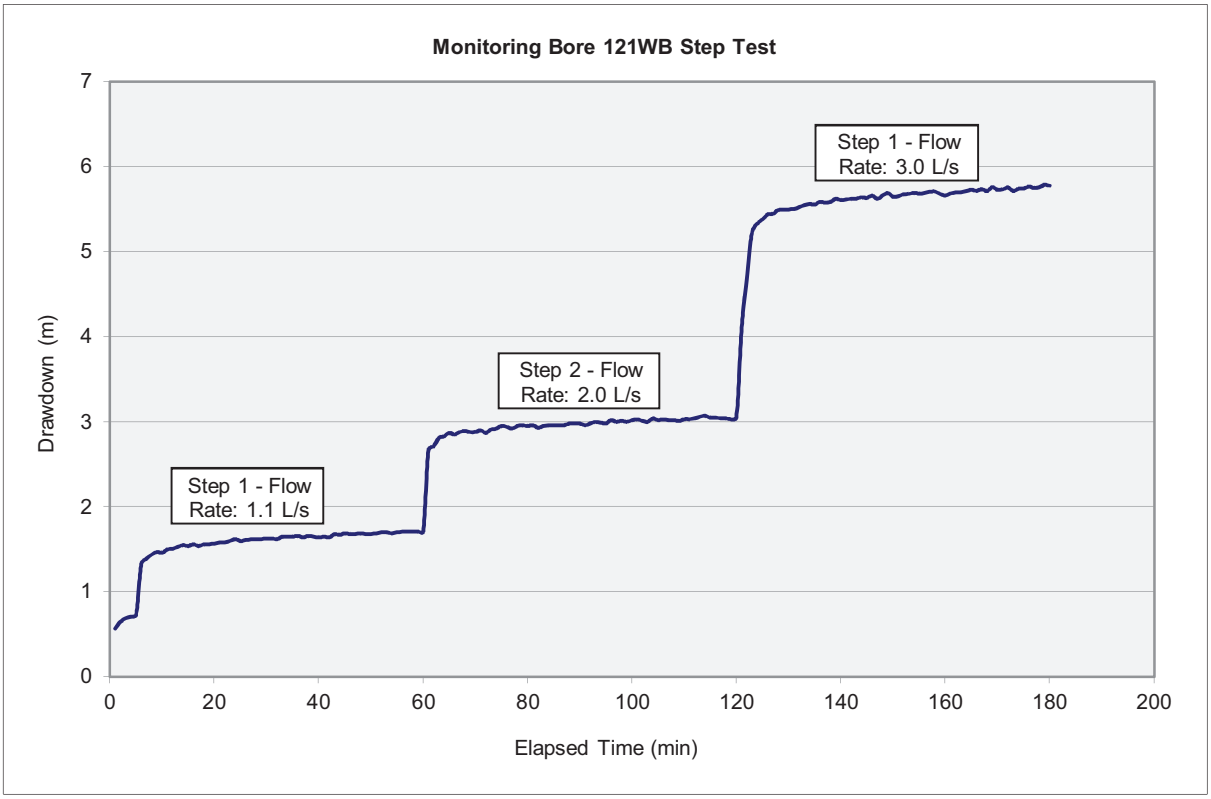

Figure 2-12 Step test conducted in 121WB

Constant Rate Test

During the constant rate test, the bore was pumped at an average of 2.44 L/sec for a duration of approximately 6 hours. Drawdown observed from the constant rate test conducted in the production bore is shown in **Figure 2-13**. Maximum drawdown observed over this time was 5.34 m.

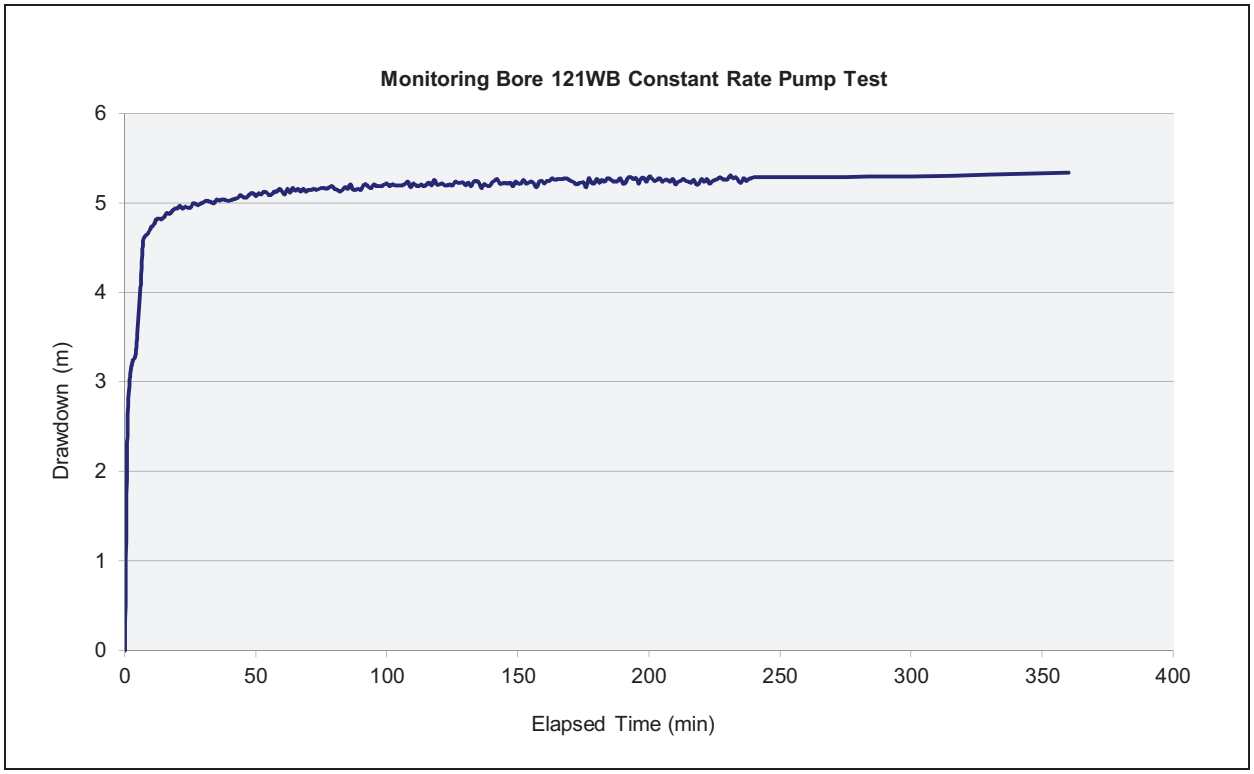

Figure 2-13 Drawdown observed in production bore 121WB during the constant rate test

Results obtained from observation bores 113PGCA and 113PGCB are shown in **Figure 2-14** and **Figure 2-15** below. Maximum drawdown observed during the constant rate test at observation bore 113PGCA was 0.79 m. Drawdown at observation bore 113PGCB was 0.11 m. Observation bore 113PGCB was screened at a greater depth and in a separate coal seam than observation bore 113PGCA and production bore 121WB. Analysis of borelog data showed that an interbed of siltstone (~5 m thick) separates the two coal seams.

Analysis of the drawdown observed in the adjacent observation bores suggests that bore 113PGCB is in poor hydraulic connection with the aquifer observed at bores 121WB and 113PGCA. The slight response to groundwater extraction from the production bore observed at location 113PGCB is indicative of a leaky aquifer system.

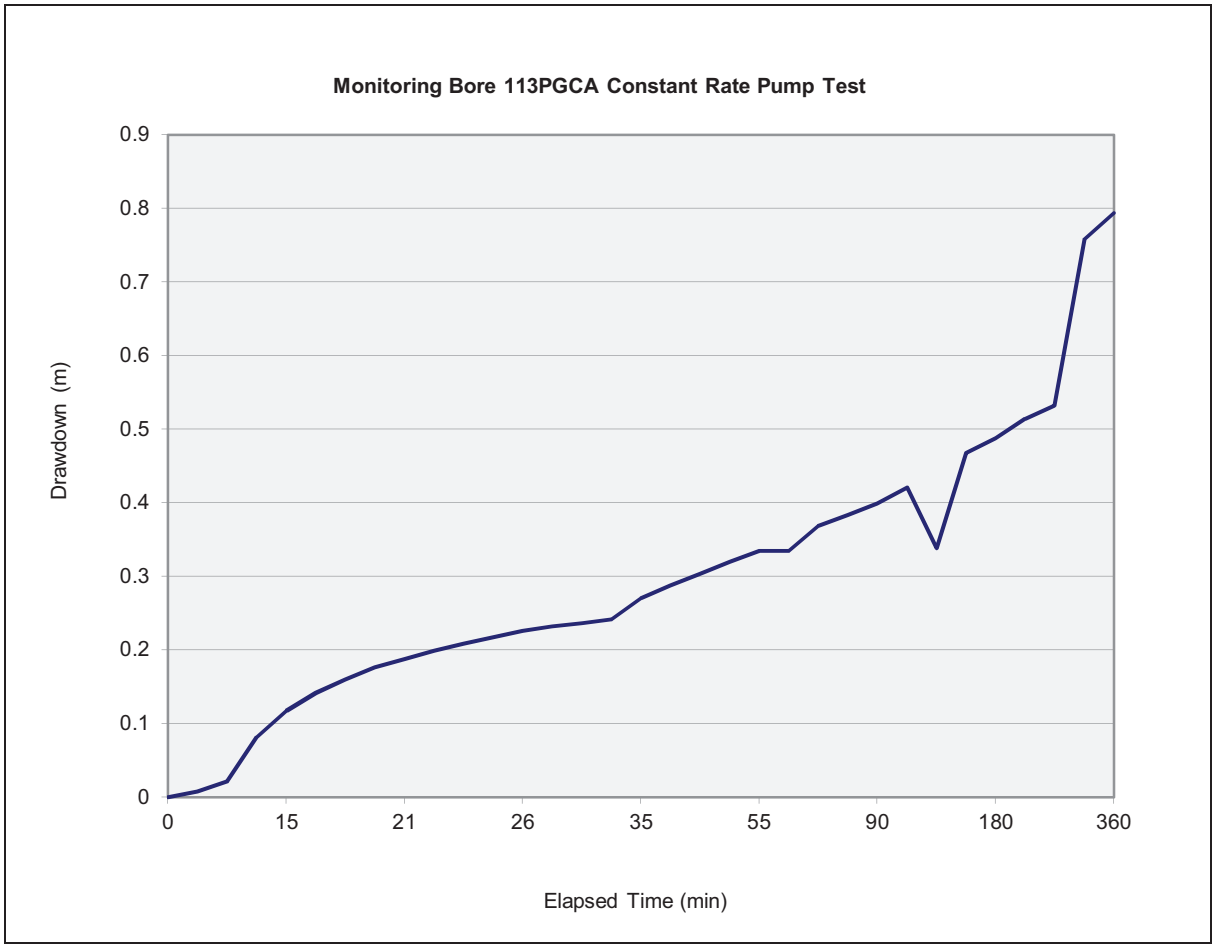

Figure 2-14 Results for Constant Rate test in observation bores 113PGCA

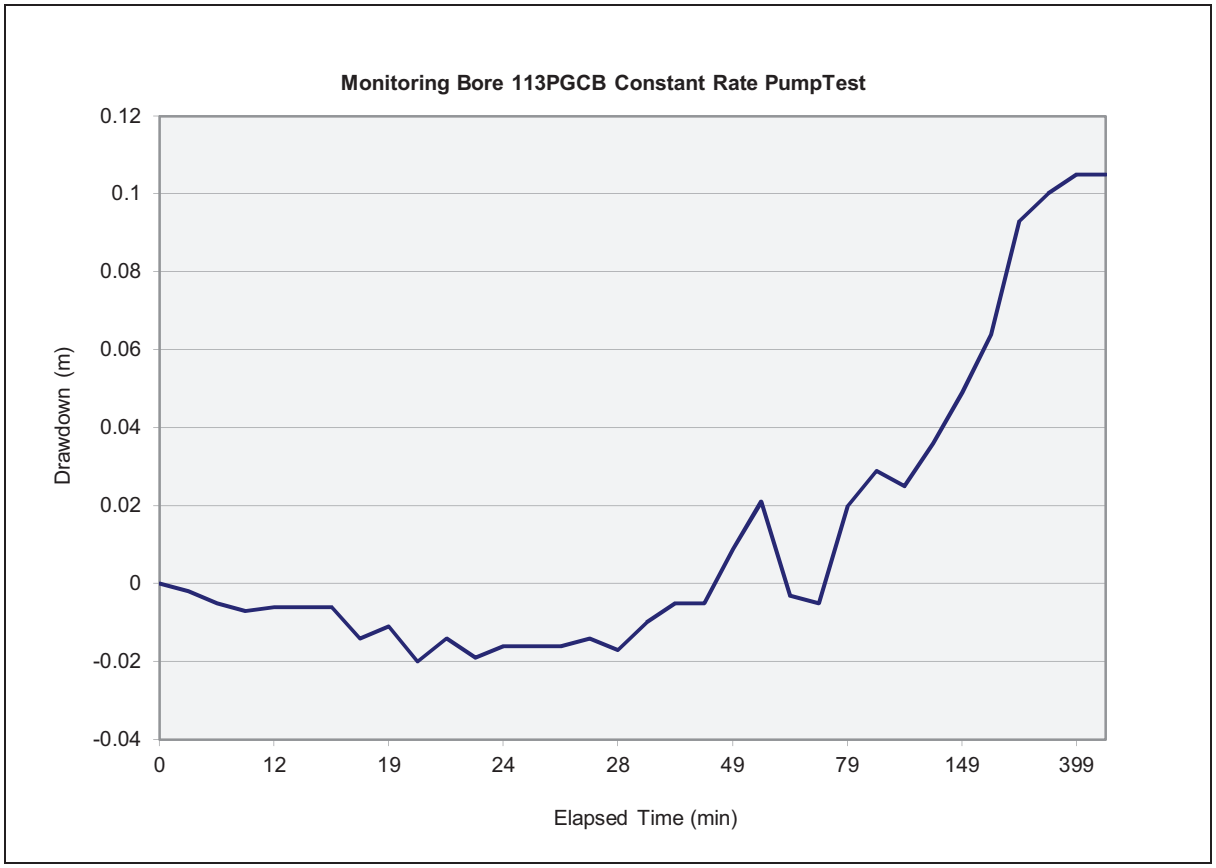

Figure 2-15 Results for Constant Rate test in observation bores 113PGCB

2.4. Pump Test Outputs for Location 2

Pump test outputs for Location 2 are presented below in **Figure 2-17** to **Figure 2-19**.

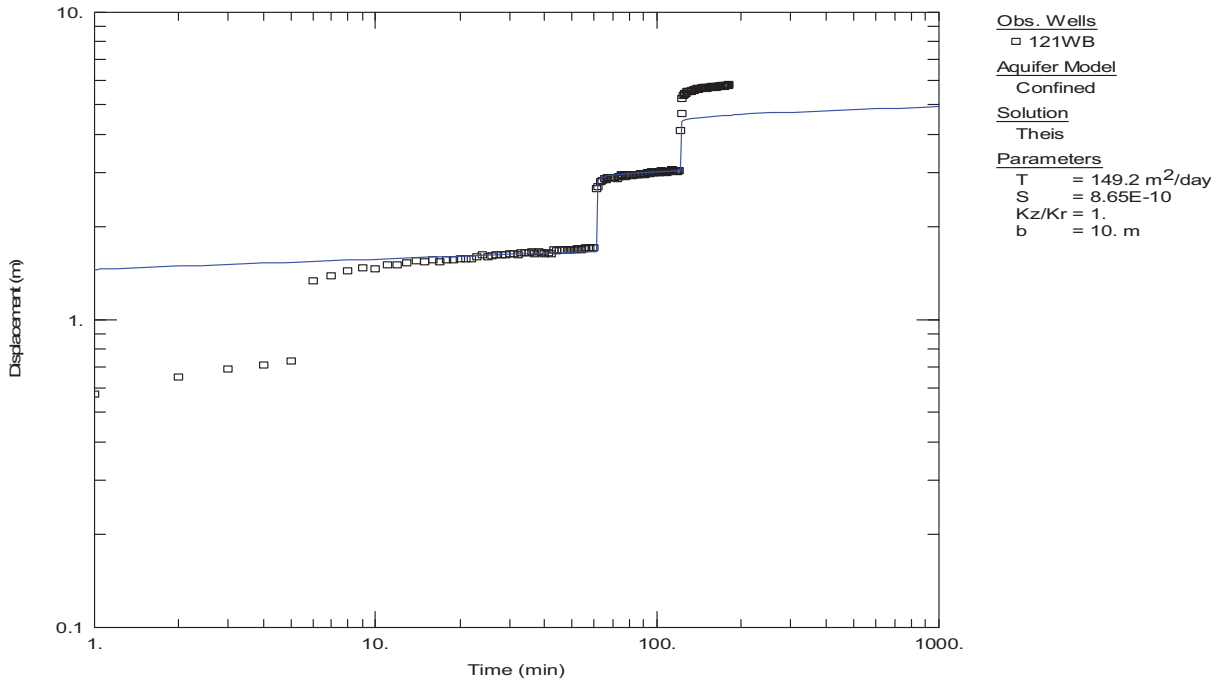

Figure 2-16 Production Bore 121WB – Step test

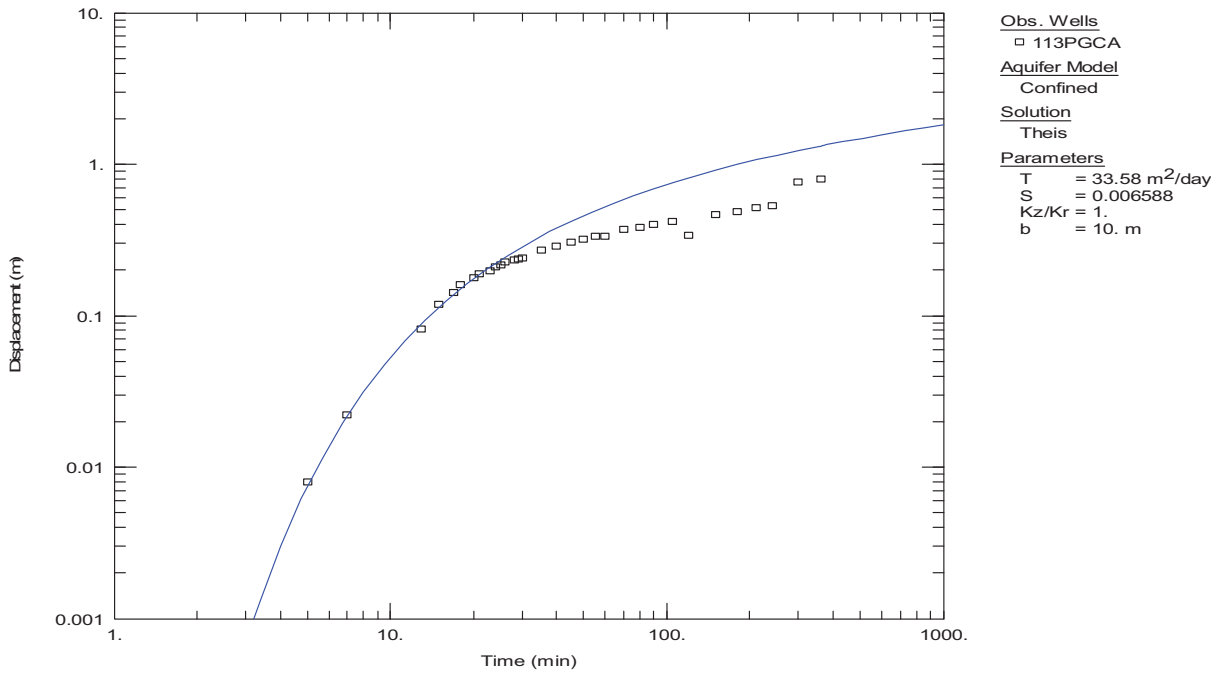

Figure 2-17 Observation Bore 113PGCA – confined model

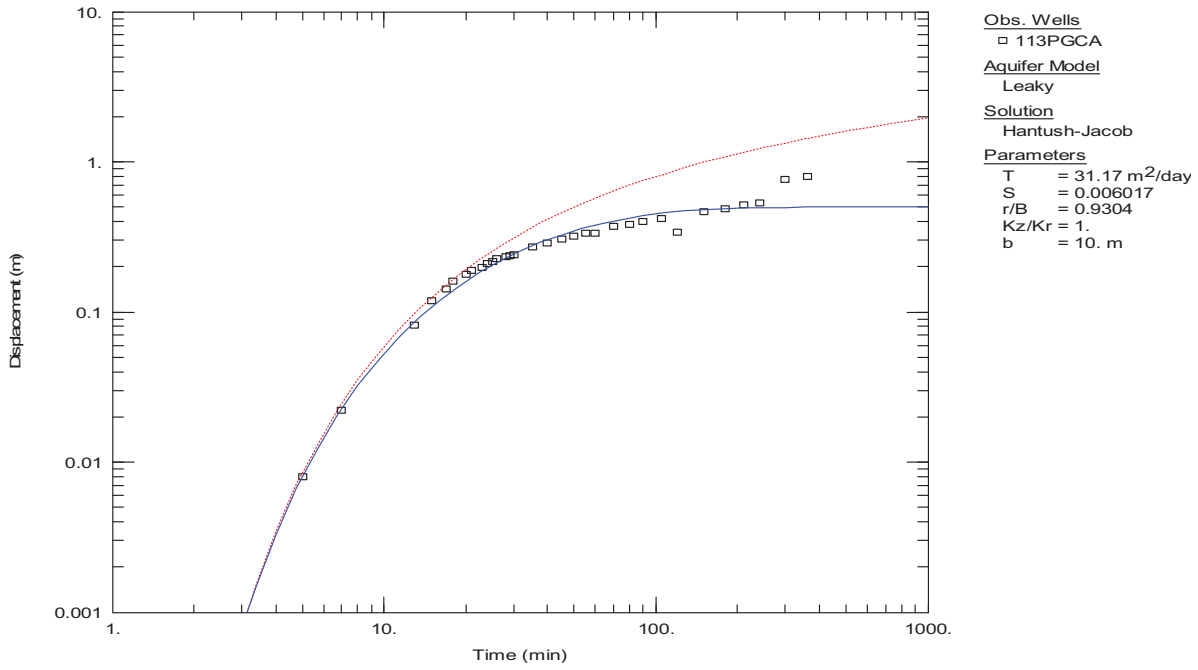

Figure 2-18 Observation Bore 113PGCA – Leaky aquifer model

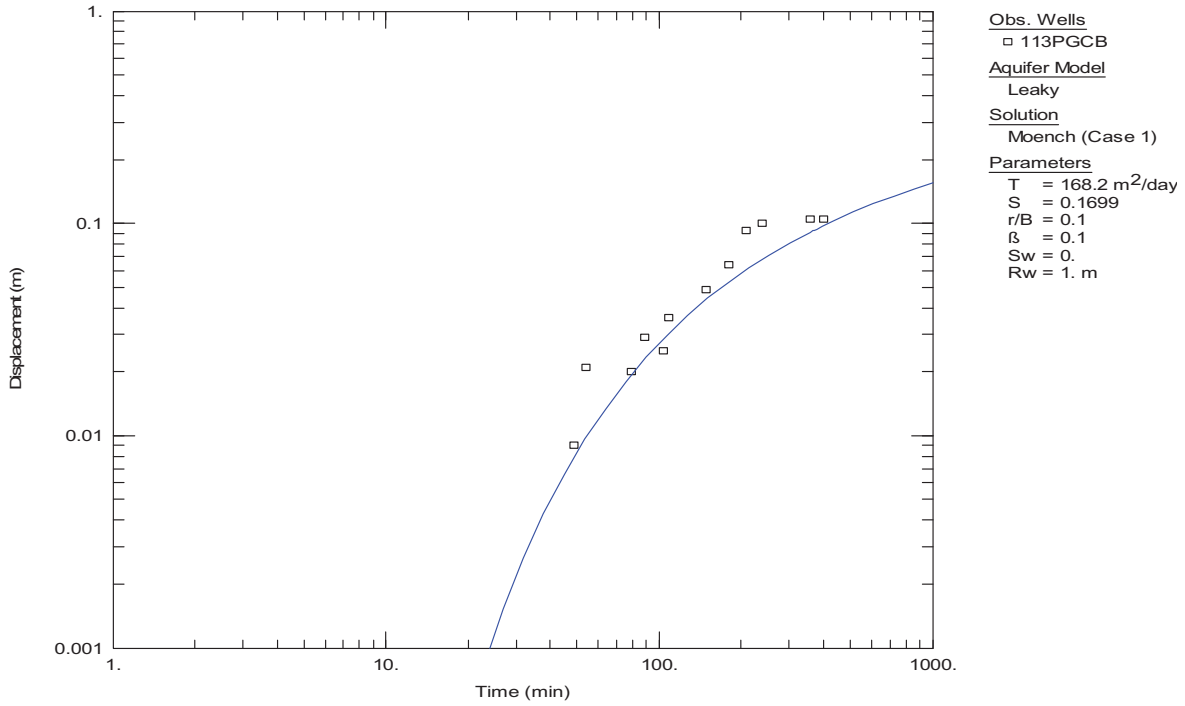

Figure 2-19 Observation Bore 113PGCB

2.5. Transmissivity

Transmissivity characteristics have been assessed based on the pumping test data obtained during December 2007. Transmissivity values were derived using the Theis (1935) confined aquifer solution (apart from bore 113PGCA results which were analysed using the Hantush-Jacob 1955 leaky aquifer solution) as shown in **Table 2-2**. Outputs from these analyses are included below for reference purposes.

Table 2-2 Transmissivity Values

Location	Bore ID	Transmissivity (m^2/day)	Deep/Shallow Bore
Location 1	120WB (production)	6.5	Deep
	117PGC (observation)	8.2	Deep
Location 2	121WB (production)	47	Shallow
	113PGCA (observation)	31*	Shallow

*Note: Value was derived using the Hantush-Jacob (1955) leaky aquifer solution.

Results observed at Location 1 and Location 2 display a large variation in transmissivity values. Transmissivity values observed at Location 1 were low in comparison with the transmissivity values observed at Location 2. No known specific structural features have been identified near these locations to result in the differences in transmissivity values observed at the two locations. It has been assessed that Location 1 is representative of transmissivity values for the deeper coal seams where as Location 2 reflects transmissivity values for the shallow coal seams.

Pumping tests conducted during the Stage 2 EIS indicated that transmissivity values of 30 m²/day were observed within the Walloon Coal Measures aquifer. This is consistent with transmissivity values observed at Location 2 (113PGCA) which was derived using the Hantush-Jacob (1955) leaky aquifer solution.

2.6. Storage

Aquifer storage characteristics were assessed based on the pumping test data obtained during December 2007. Storativity values were derived using the Theis (1935) confined aquifer solution (apart from bore 113PGCA results which were analysed using the Hantush-Jacob 1955 leaky aquifer solution) as shown in **Table 2-3**. Outputs from these analyses are included below for reference purposes.

Table 2-3 Storativity Values

Location	Bore ID	Storage Coefficient	Deep / Shallow Bore
Location 1	120WB (production)	-	Deep
	117PGC (observation)	6 E-05	Deep
Location 2	121WB (production)	-	Shallow
	113PGCA (observation)	6 E-03*	Shallow

*Note: Value was derived using the Hantush-Jacob (1955) leaky aquifer solution.

Results show that there is a notable difference between the storage coefficients observed at the two locations. Location 1 is screened in the deeper aquifer and has a lower storativity compared with Location 2 which is screened in the shallow aquifer. The reliability of storage co-efficient from short duration pumping

tests is low and lower storage co-efficient results are observed due to a lag between the start of pumping and commencement of leakage from the overlying aquitard.

Although the results suggest that the lower aquifer is fully confined at this location compared with the shallow aquifer which is semi-confined, it is likely that the lower aquifer is also semi-confined (leaky aquifer system).

3. Conclusion

Results obtained from the pumping tests undertaken at the two locations suggest that the Walloon Coal Measures are a single system with variable aquifer parameters. It is assessed that a semi-confining layer consisting of carbonaceous mudstone and siltstone exist within the coal measures. Although short term pumping tests indicate that the coal seams behave as discrete aquifers separated by carbonaceous mudstones and siltstones, it is likely that over the long term the seams will behave as one aquifer system when stressed by pumping (dewatering).

Pumping tests conducted as part of the Project baseline assessment suggest that a leaky aquifer system exists with vertical movement of groundwater occurring where the confining layer is thin or absent and via fractures within the coal measures aquifer system.