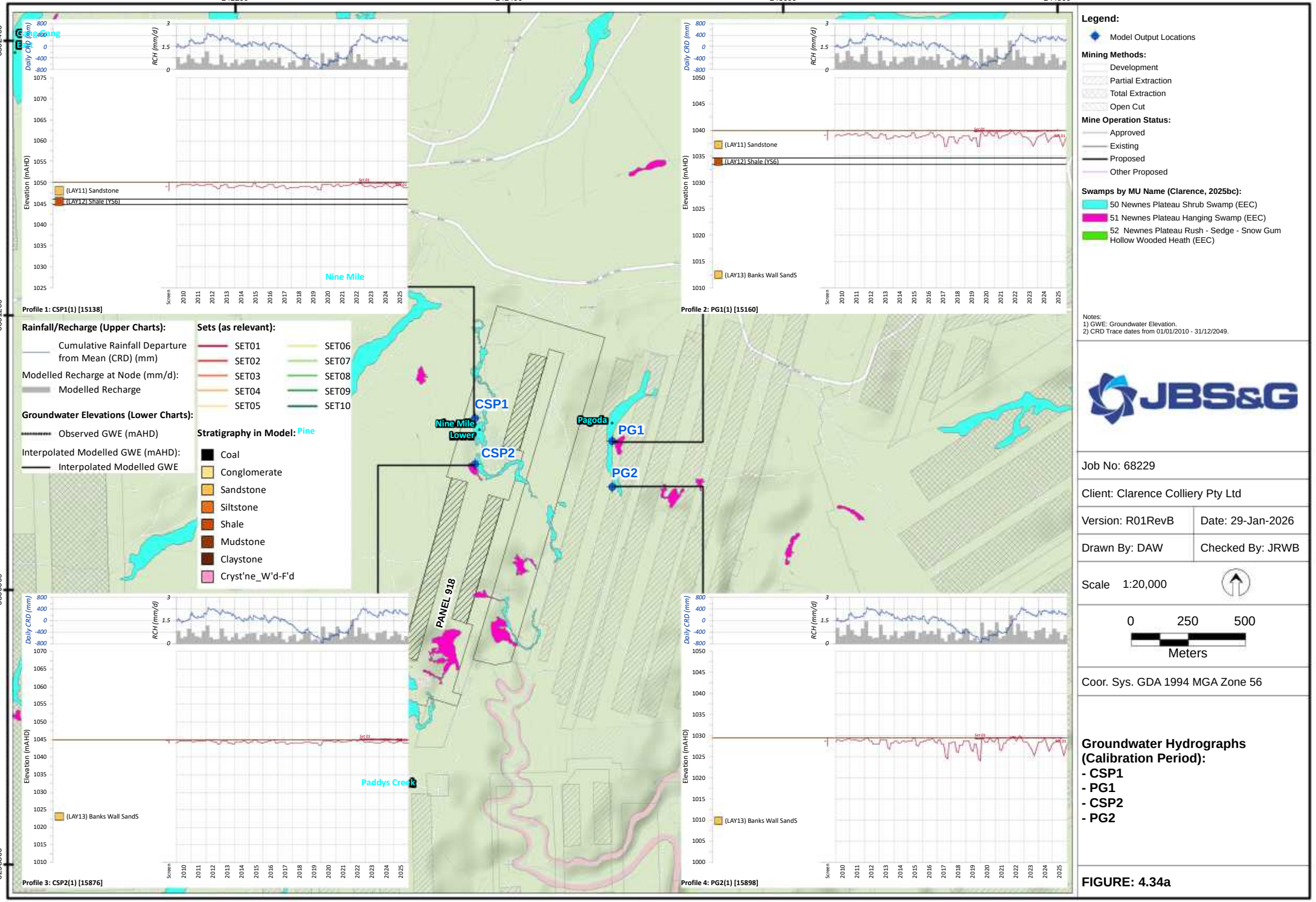


Legend:

- Model Output Locations

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):

- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Notes:
1) GWE: Groundwater Elevation.
2) CRD Trace dates from 01/01/2010 - 31/12/2049.

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevB	Date: 29-Jan-2026
Drawn By: DAW	Checked By: JRWB

Scale 1:20,000

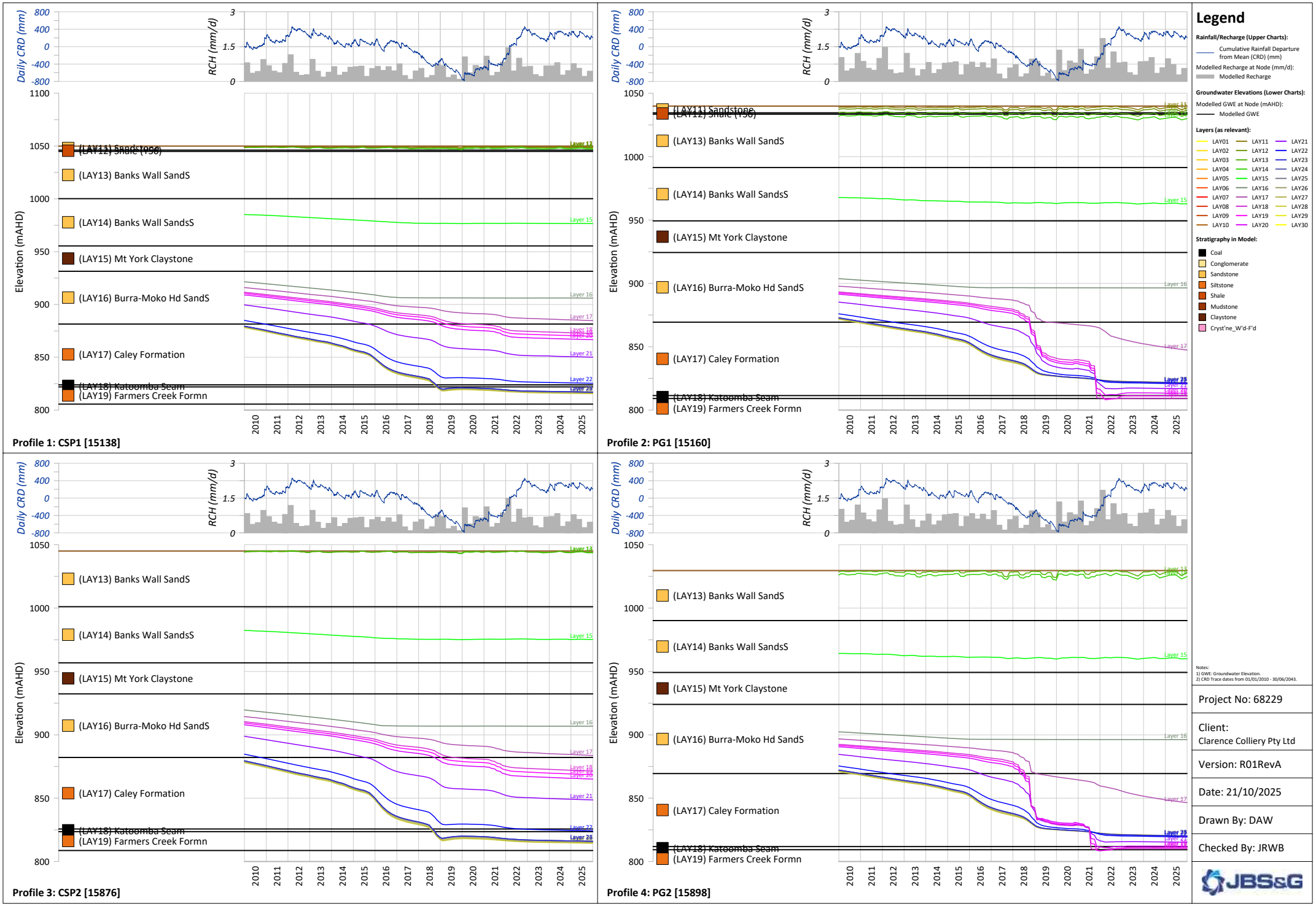
0 250 500
Meters

Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Calibration Period):
- CSP1
- PG1
- CSP2
- PG2

FIGURE: 4.34a

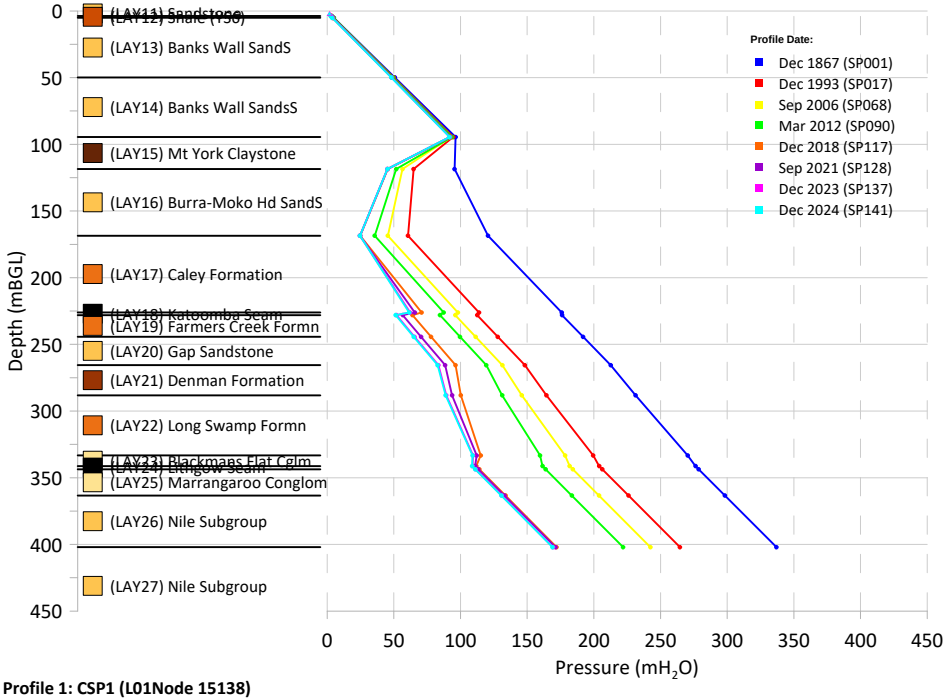
File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevB_D002g_CAL_Hydrographs_CSP1_PG1_CSP2_PG2.mxd



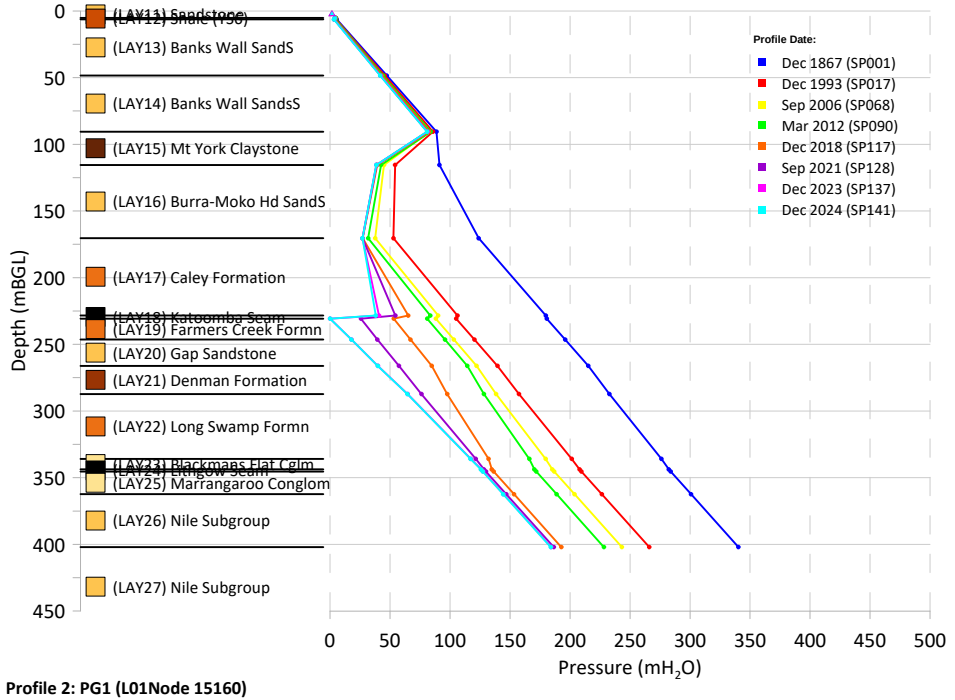
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D003_BinaryHDSMultiLevelHydrographGenerator\68229_R01RevA_D003g\68229_R01RevA_BinaryHDSMultiLevelHydrographGenerator_07_CSP1_PG1_CSP2_PG2.grf

Reference: 68229_R01RevA_APR_03c

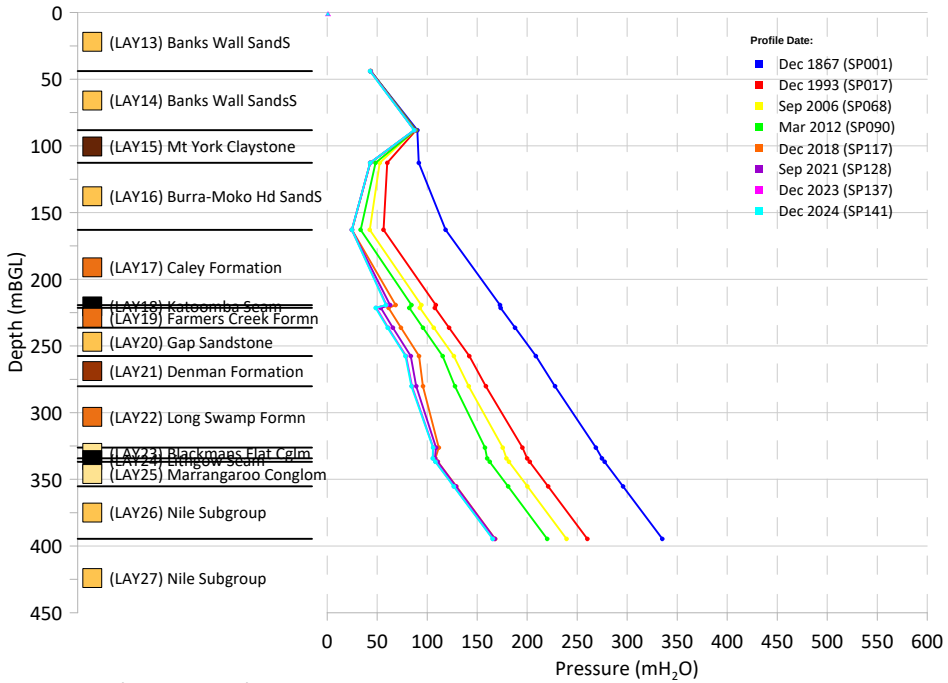
Figure 4.34b: Multilevel Groundwater Hydrographs (Calibration Period) - CSP1, PG1, CSP2, PG2



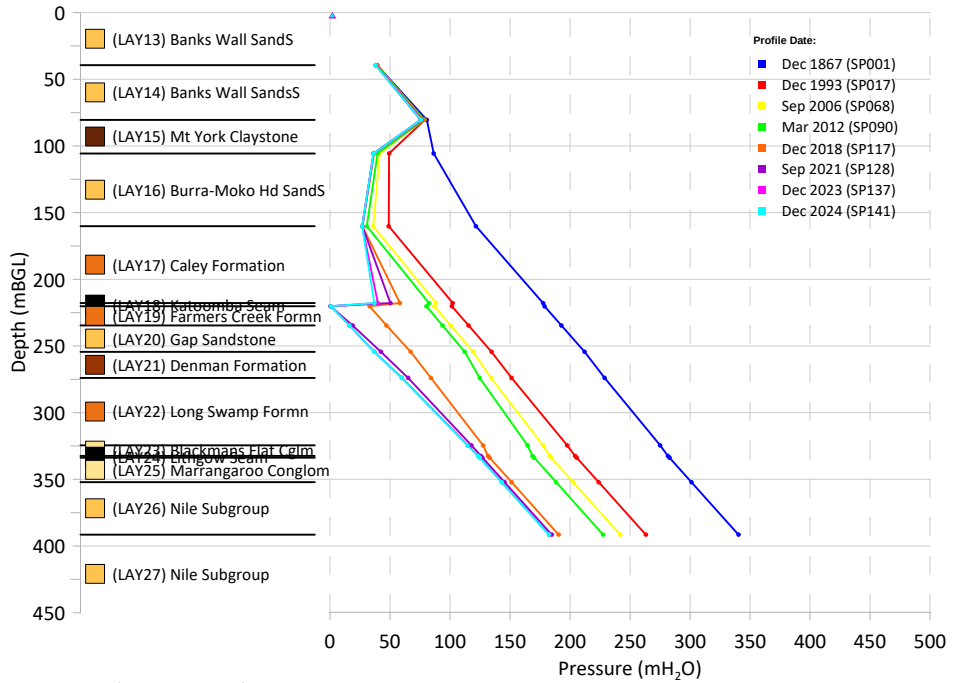
Profile 1: CSP1 (L01Node 15138)



Profile 2: PG1 (L01Node 15160)



Profile 3: CSP2 (L01Node 15876)



Profile 4: PG2 (L01Node 15898)

Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:

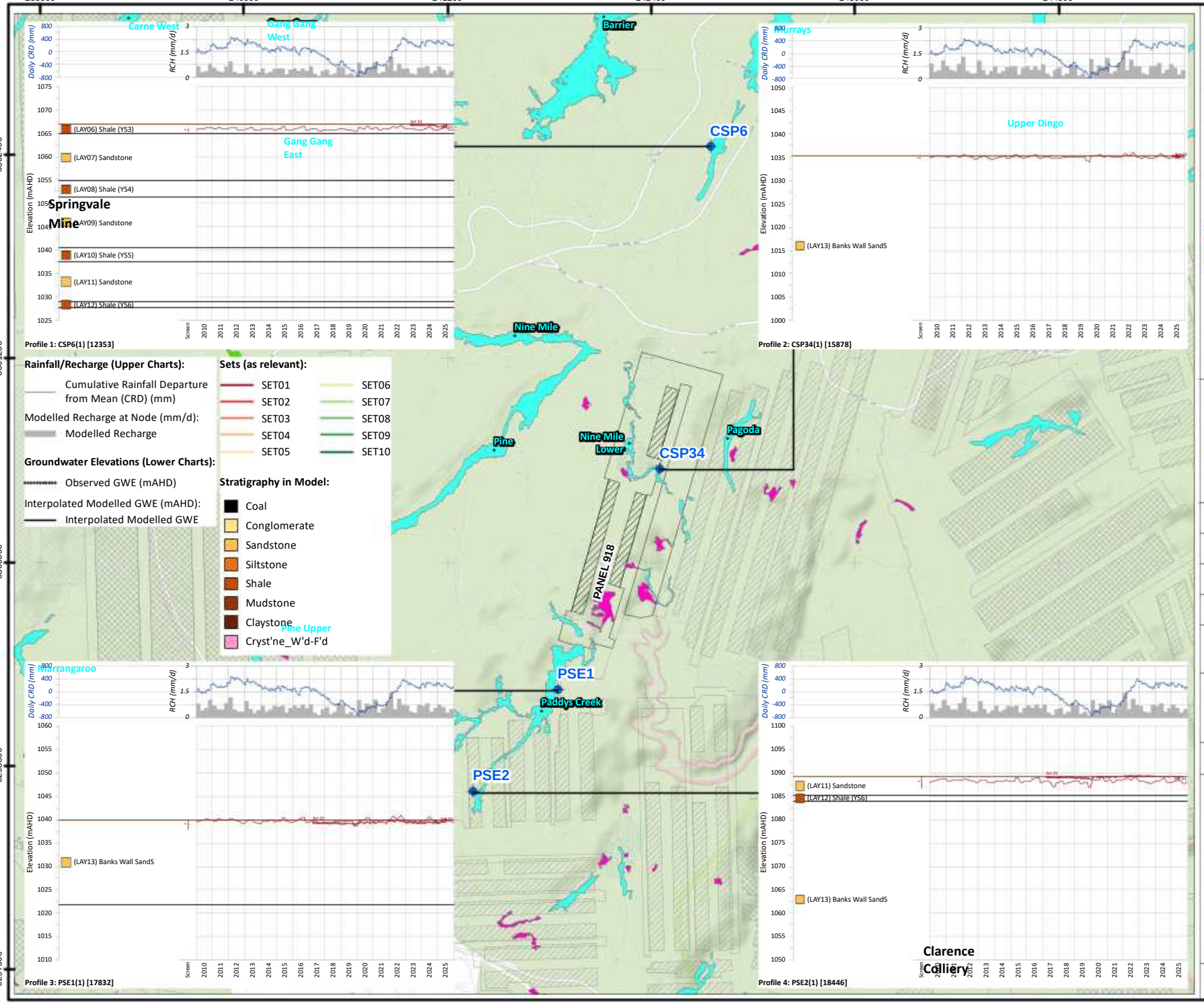
Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 23/10/2025	
Drawn By: DAW	
Checked By: JRWB	

JBS&G

Figure 4.34c: Depth versus Groundwater Pressure Diagrams (Calibration Period) - CSP1, PG1, CSP2, PG2

Reference: 68229_R01RevA_APR_03c.

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D004_BinaryHDSVerticalProfileExtraction_Pressure\68229_R01RevA_D004gl68229_R01RevA_D004g_VerticalProfileExtraction_Pressure_07_CSP1_PG1_CSP2_PG2.grf



Legend:

- Model Output Locations

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):

- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Notes:
1) GWE: Groundwater Elevation.
2) CRD Trace dates from 01/01/2010 - 31/12/2049.

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA | Date: 22-Oct-2025

Drawn By: DAW | Checked By: JRWB

Scale 1:30,000

0 500 1,000
Meters

Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Calibration Period):
- CSP6
- CSP34
- PSE1
- PSE2

FIGURE: 4.35a

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D002h_CAL_Hydrographs_CSP6_CSP34_PSE1_PSE2.mxd

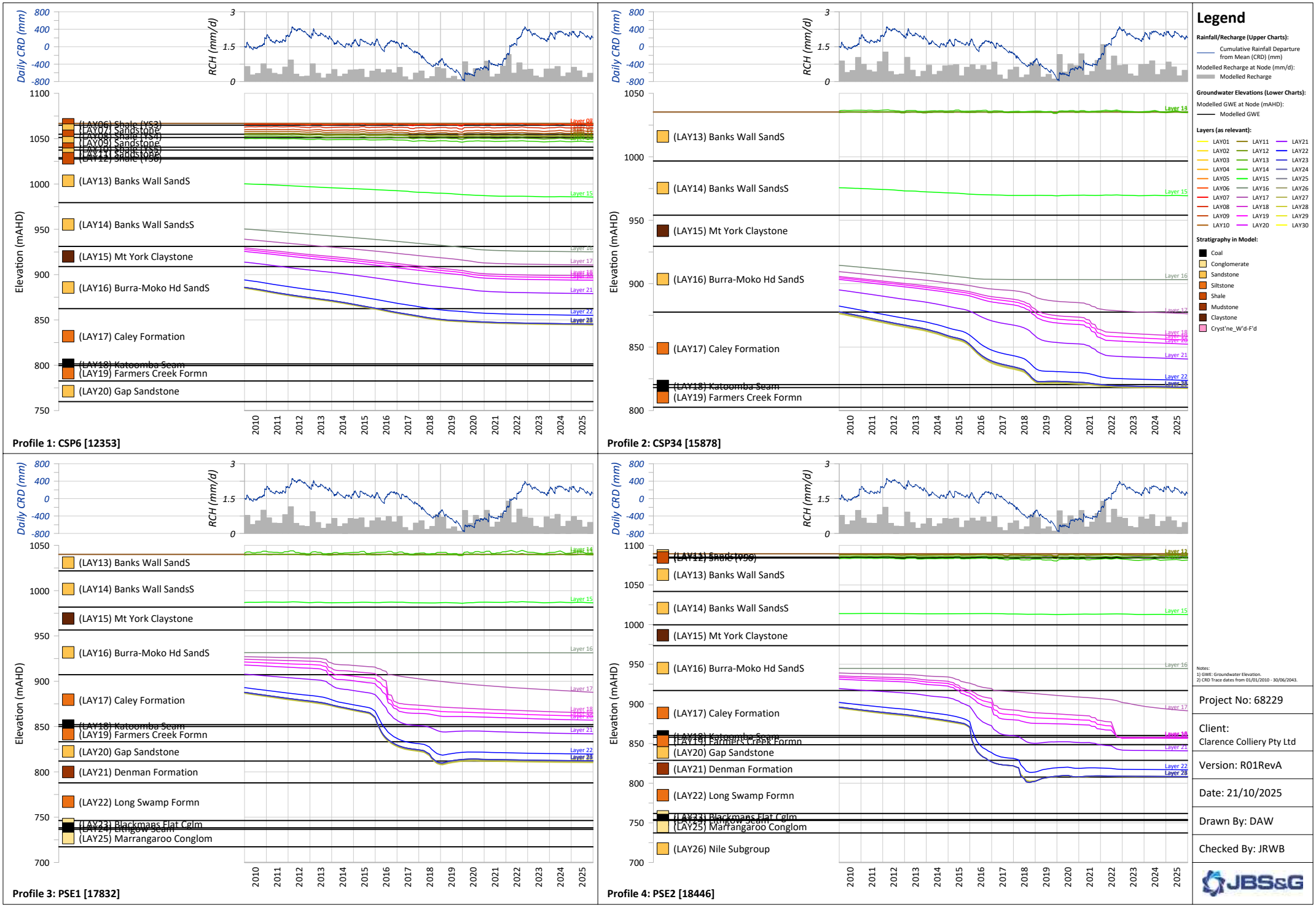
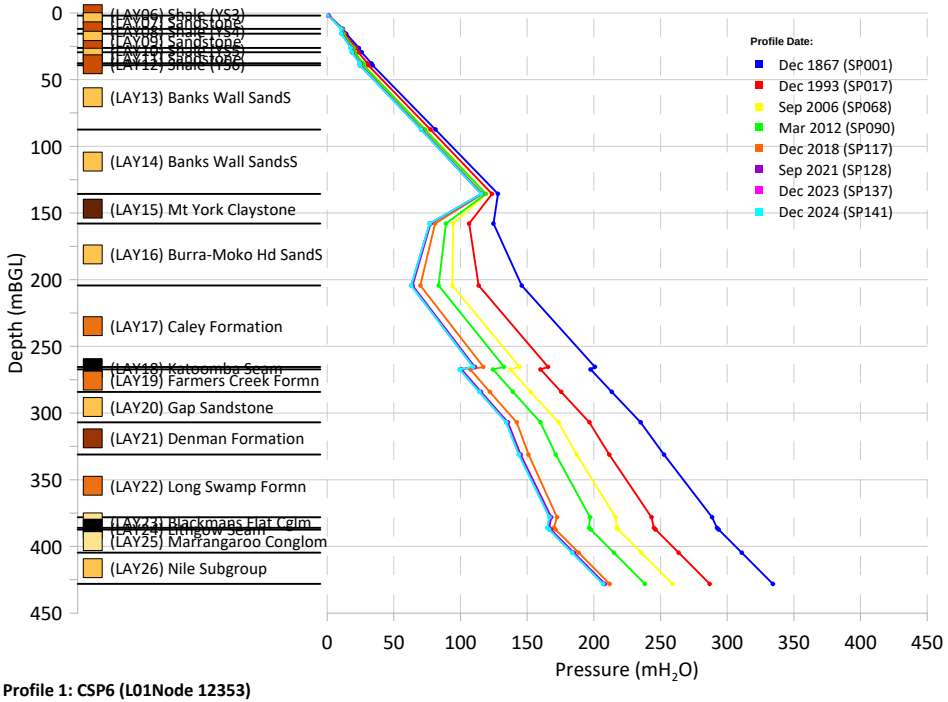


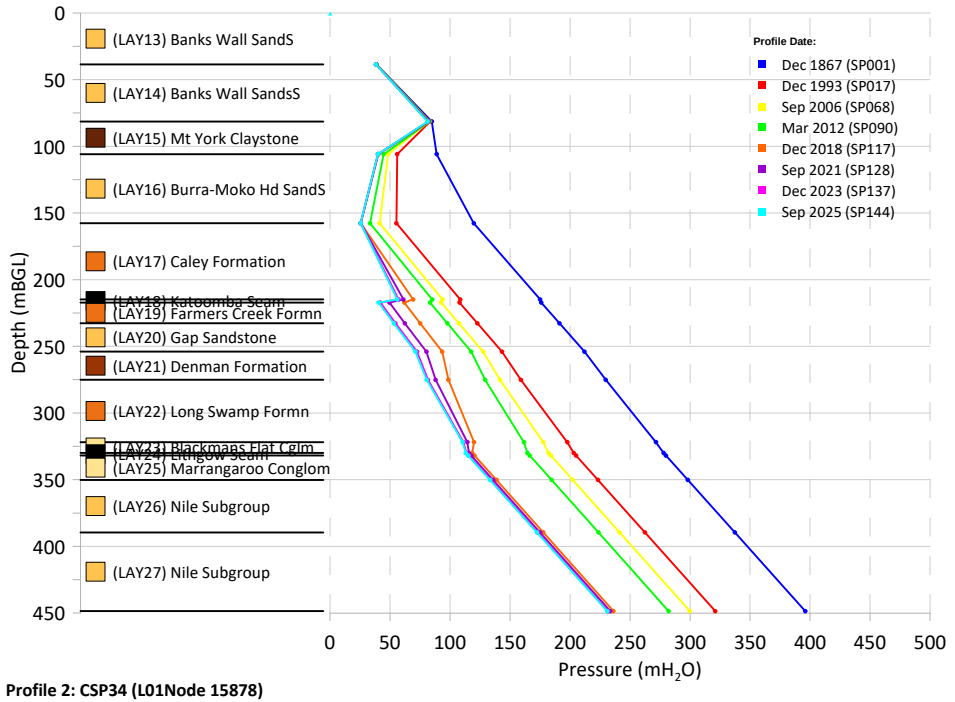
Figure 4.35b: Multilevel Groundwater Hydrographs (Calibration Period) - CSP6, CSP34, PSE1, PSE2

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D003_BinaryHDSMultiLevelHydrographGenerator\68229_R01RevA_D003h\68229_R01RevA_BinaryHDSMultiLevelHydrographGenerator_08_CSP6_CSP34_PSE1_PSE2.grf

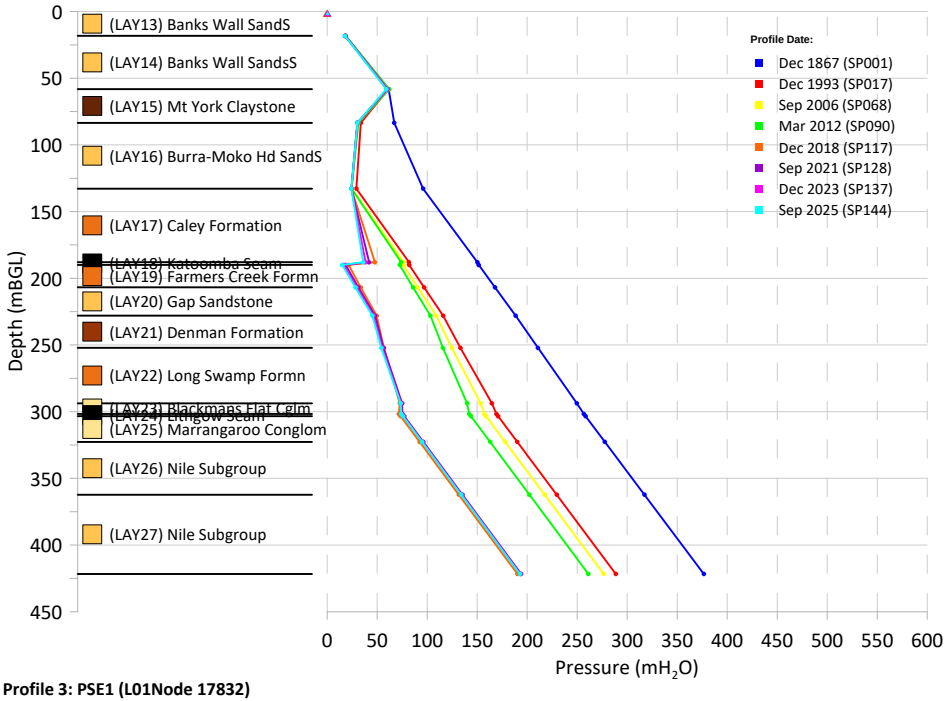
Reference: 68229_R01RevA_APR_03c



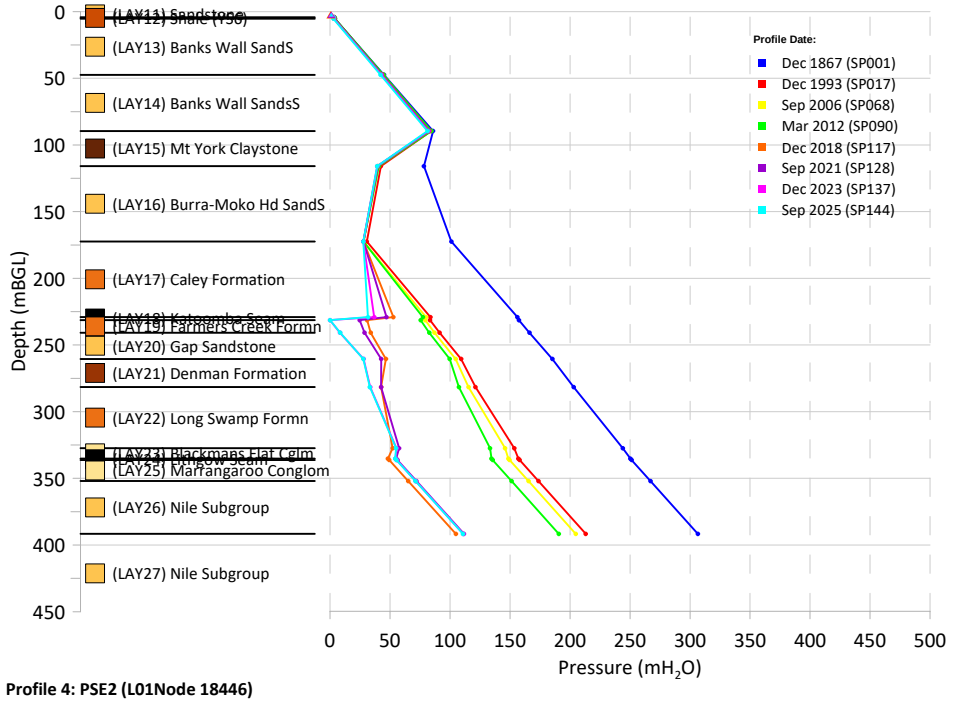
Profile 1: CSP6 (L01Node 12353)



Profile 2: CSP34 (L01Node 15878)



Profile 3: PSE1 (L01Node 17832)



Profile 4: PSE2 (L01Node 18446)

Legend

Profile Type: Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

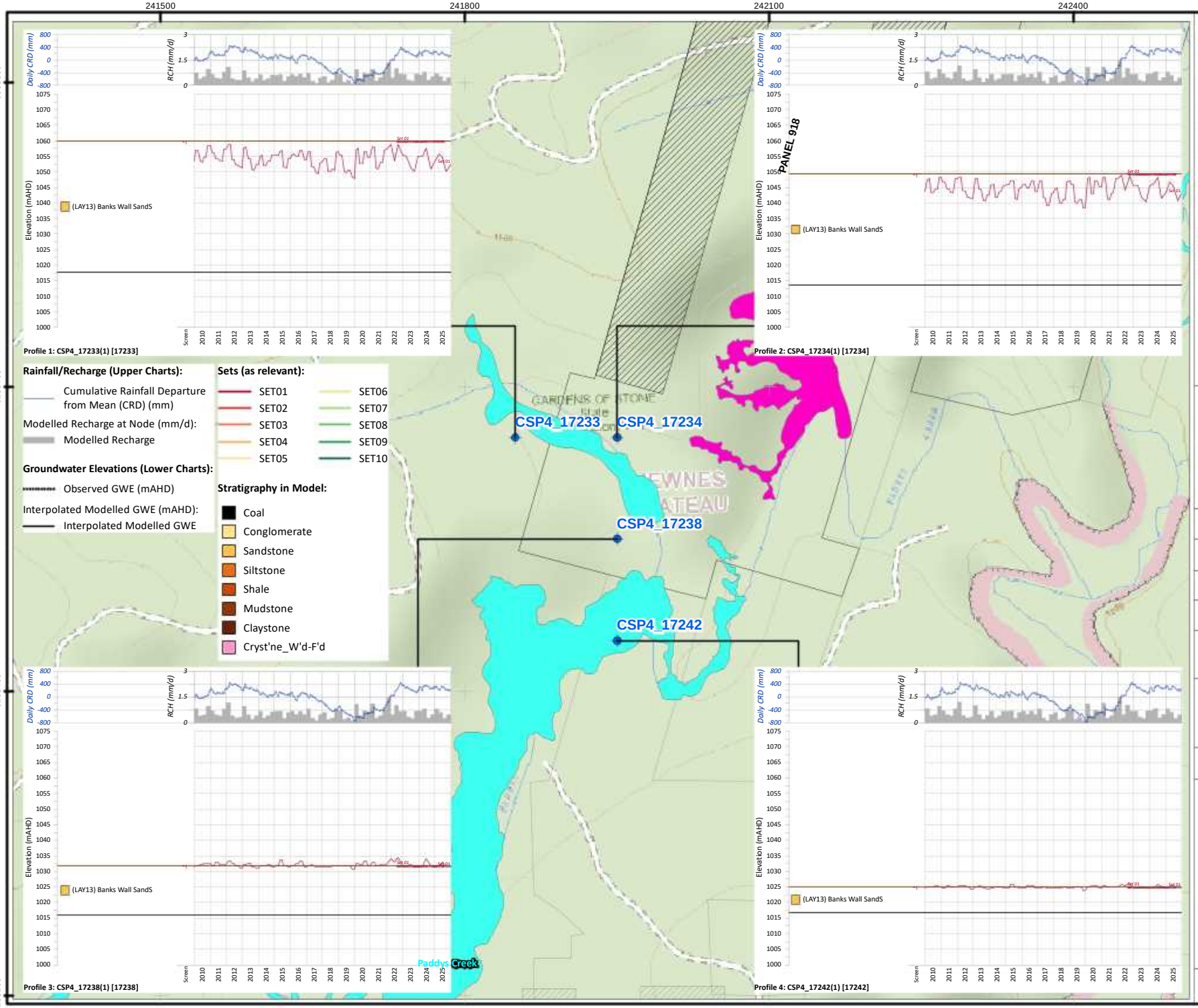
Notes:

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 23/10/2025	
Drawn By: DAW	
Checked By: JRWB	

Figure 4.35c: Depth versus Groundwater Pressure Diagrams (Calibration Period) - CSP6, CSP34, PSE1, PSE2

Reference: 68229_R01RevA_APR_03c.

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EPI\Figures\Grapher\68229_R01RevA_D004_BinaryHDSVerticalProfileExtraction_Pressure\68229_R01RevA_D004h\68229_R01RevA_D004h_VerticalProfileExtraction_Pressure_08_CSP6_CSP34_PSE1_PSE2.grf



Legend:

- Model Output Locations

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):

- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Notes:
1) GWE: Groundwater Elevation.
2) CRD Trace dates from 01/01/2010 - 31/12/2049
3) Observations are translated, to be representative, of the centre of each cell for purpose of comparison.

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 22-Oct-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:5,000

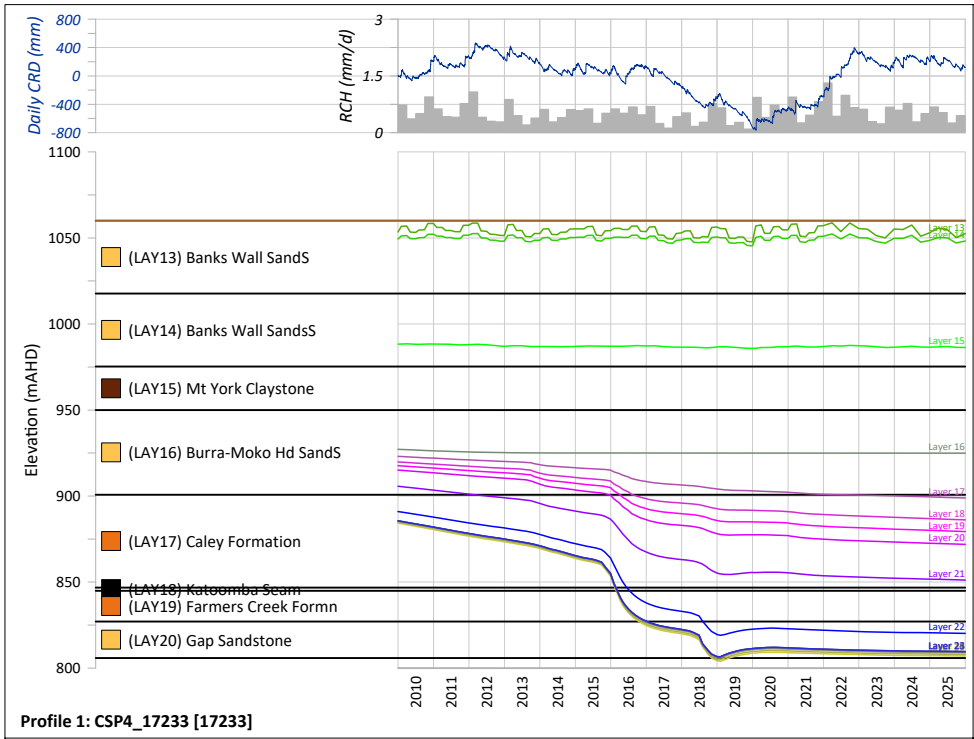
0 100 200
Meters

Coor. Sys. GDA 1994 MGA Zone 56

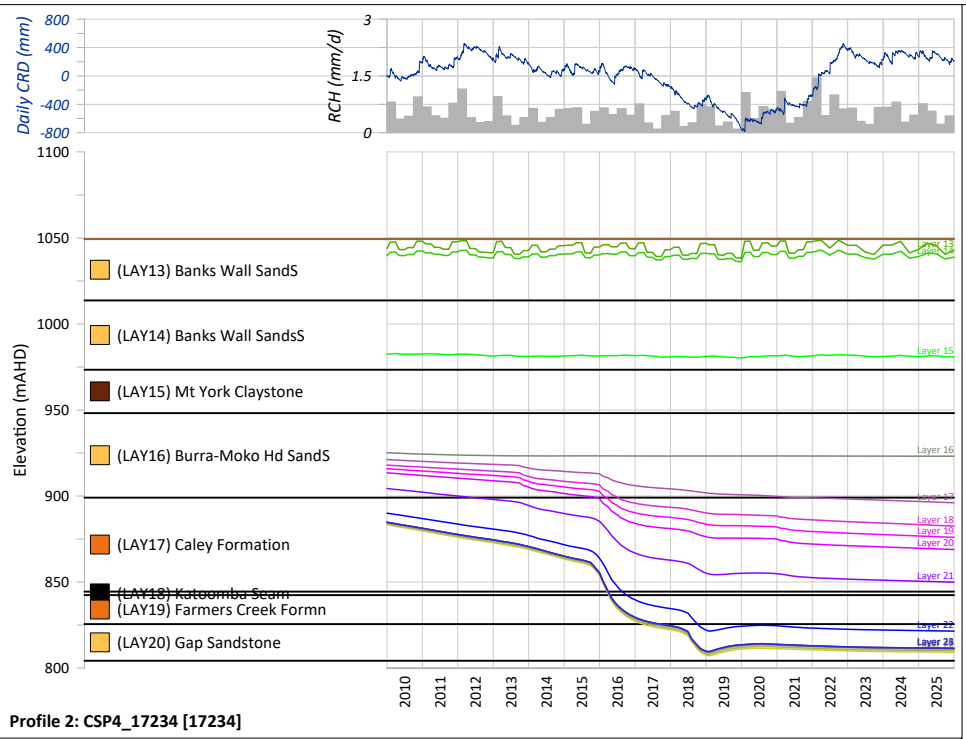
Groundwater Hydrographs (Calibration Period):
- Paddys Creek Shrub Swamp

FIGURE: 4.36a

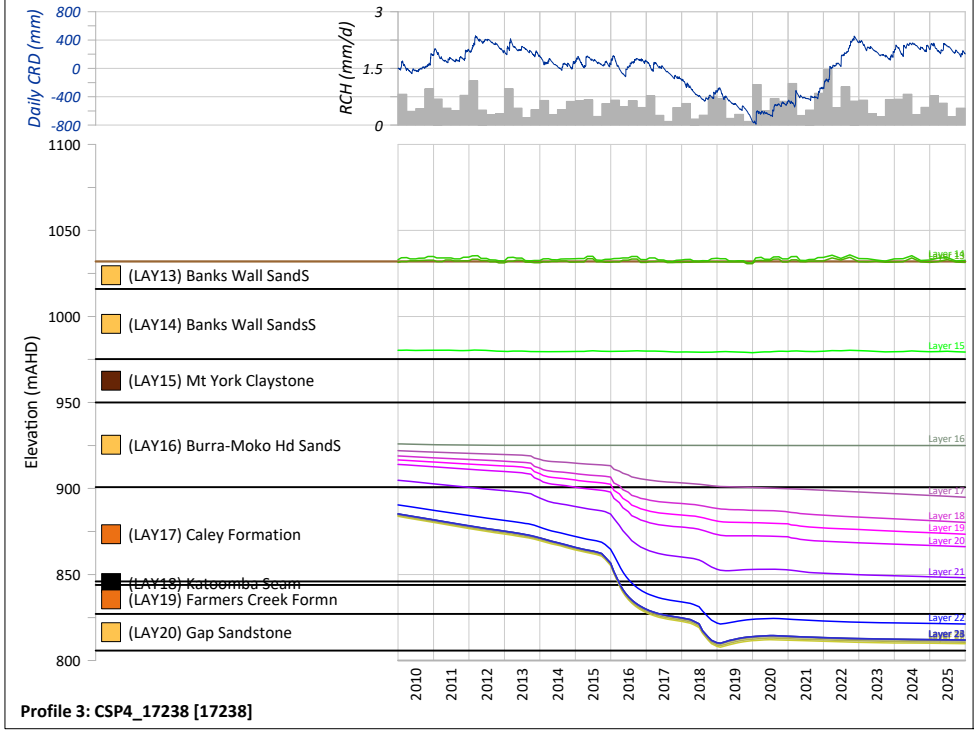
File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D002i_CAL_Hydrographs_PaddysCreekShrub.mxd



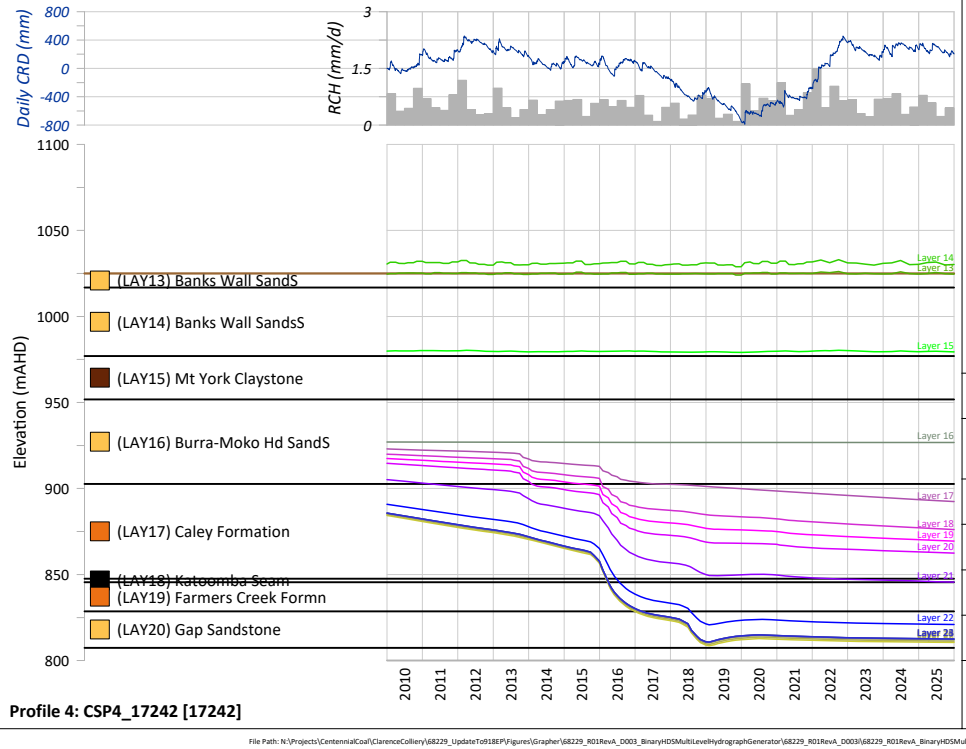
Profile 1: CSP4_17233 [17233]



Profile 2: CSP4_17234 [17234]



Profile 3: CSP4_17238 [17238]



Profile 4: CSP4_17242 [17242]

Legend

Rainfall/Recharge (Upper Charts):

- Cumulative Rainfall Departure from Mean (CRD) (mm)

Modelled Recharge at Node (mm/d):

- Modelled Recharge

Groundwater Elevations (Lower Charts):

Modelled GWE at Node (mAHD):

- Modelled GWE

Layers (as relevant):

LAY01, LAY02, LAY03, LAY04, LAY05, LAY06, LAY07, LAY08, LAY09, LAY10, LAY11, LAY12, LAY13, LAY14, LAY15, LAY16, LAY17, LAY18, LAY19, LAY20, LAY21, LAY22, LAY23, LAY24, LAY25, LAY26, LAY27, LAY28, LAY29, LAY30

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) GWE: Groundwater Elevation.
2) CRD Trace dates from 01/01/2010 - 30/06/2043.

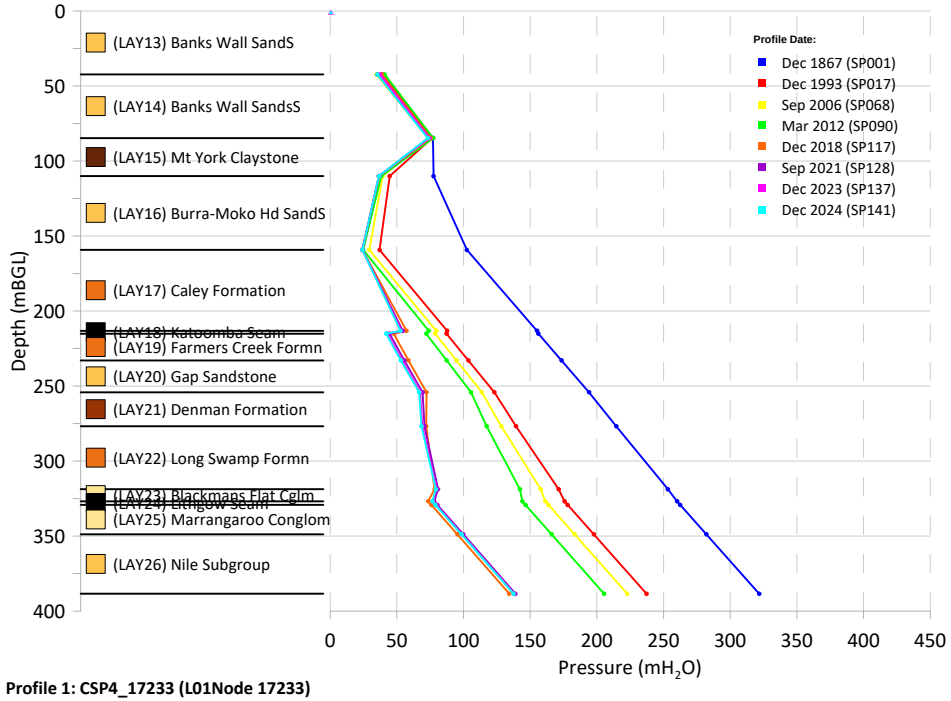
Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 21/10/2025	
Drawn By: DAW	
Checked By: JRWB	

JBS&G

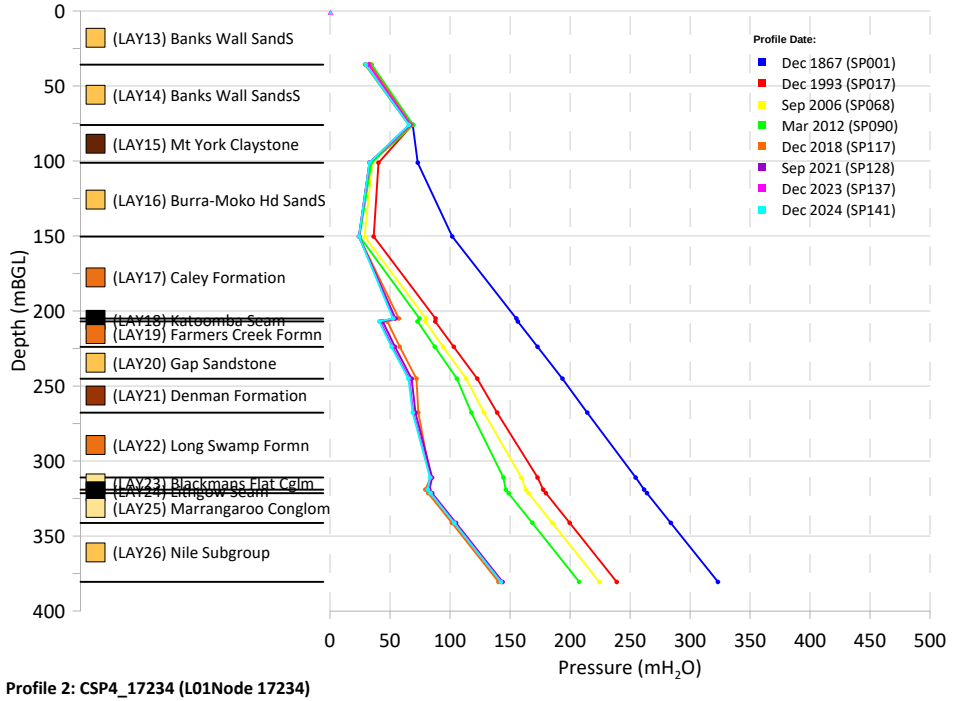
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EPL\Figures\Grapher\68229_R01RevA_D003_BinaryHDSMultiLevelHydrographGenerator\68229_R01RevA_D003\68229_R01RevA_BinaryHDSMultiLevelHydrographGenerator_101_PaddysCreekShrub.grf

Reference: 68229_R01RevA_APR_03c

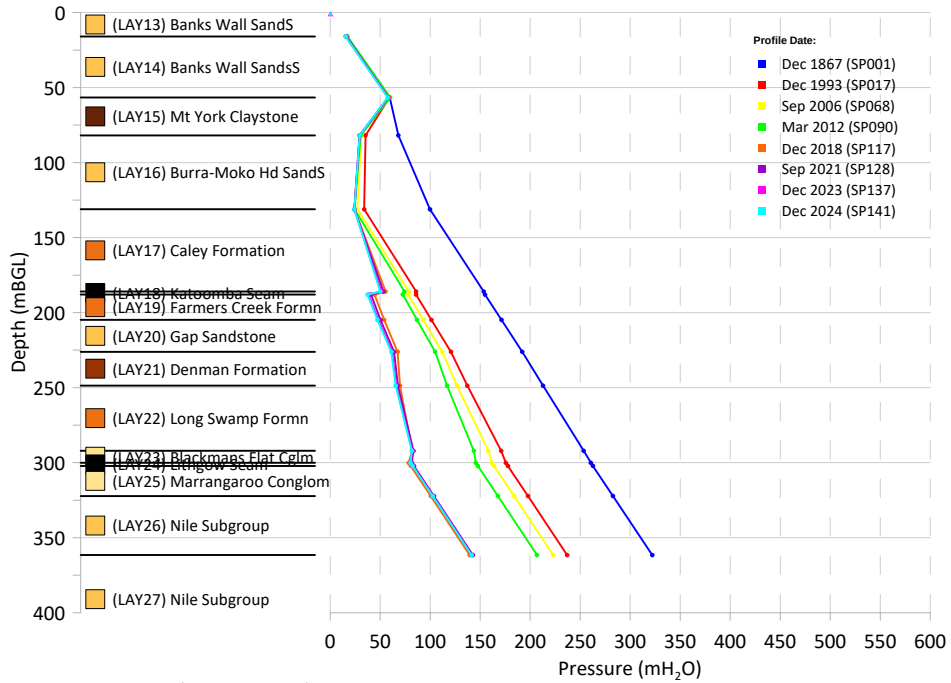
Figure 4.36b: Multilevel Groundwater Hydrographs (Calibration Period) - Paddys Creek Shrub Swamp



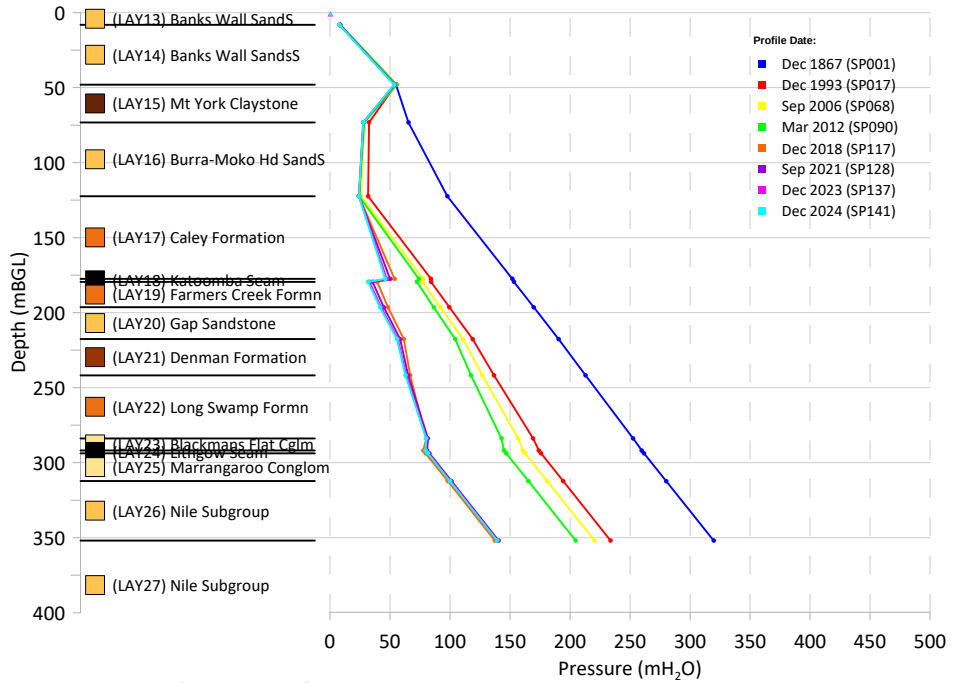
Profile 1: CSP4_17233 (L01Node 17233)



Profile 2: CSP4_17234 (L01Node 17234)



Profile 3: CSP4_17238 (L01Node 17238)



Profile 4: CSP4_17242 (L01Node 17242)

Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:

Project No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA

Date: 23/10/2025

Drawn By: DAW

Checked By: JRWB

Figure 4.36c: Depth versus Groundwater Pressure Diagrams (Calibration Period) - Paddys Creek Shrub Swamp

Reference: 68229_R01RevA_APR_03c.

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EPP\Figures\Grapher\68229_R01RevA_D004_BinaryHDSVerticalProfileExtraction_Pressure\68229_R01RevA_D004\68229_R01RevA_D004i_VerticalProfileExtraction_Pressure_101_PaddysCreekShrub.grf

Paddys Creek Hanging Swamp

Figure 4-37 presents model output at model nodes in the vicinity of Paddys Creek Hanging Swamp.

From **Figure 4-37a**, node [16606] and [17231] have modelled groundwater elevation below ground surface, which is, again due to the steep change in topography at that location. From **Figure 4-37a**, node [17232] and [17236] both have modelled groundwater elevation at ground surface, and as [17232] is closest to development at 918 Panel, it was selected to be used for detailed reporting.

From **Figure 4-37b** and **Figure 4-37c**, model behaviour beneath the listed nodes is, essentially, the same, therefore was not an influence on the selection of the node to use for detailed reporting.

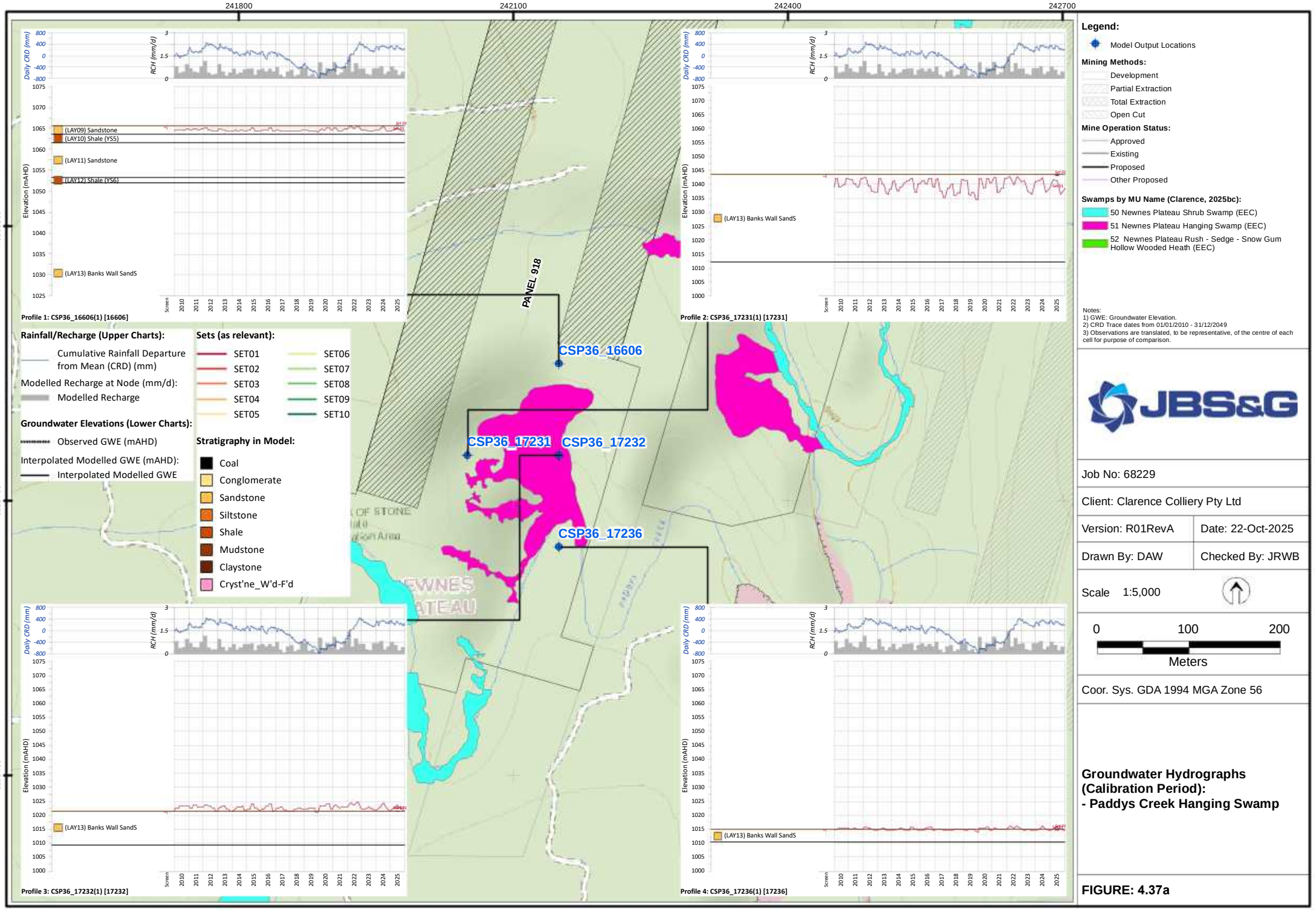
Lower Nine Mile Hanging Swamp

Figure 4-38 presents model output at nodes in the vicinity of Lower Nine Mile Hanging Swamp.

From **Figure 4-38a**, both [16615] and [16616] have modelled groundwater elevation that is not intersecting ground surface. From **Figure 4-38a**, both [16620] and [17247] both have modelled groundwater elevation that intersects ground surface. Of the four nodes presented, [16620] is closest to 918 Panel that intersects ground surface in the Approved Case (Calibration Period) and hence was selected to use for detailed reporting.

From **Figure 4-38b**, depressurisation in the deep groundwater system beneath each of the four model nodes is similar. Depressurisation reflects dewatering of 906 Panel and 908-910 Panel Area ahead of extraction.

From **Figure 4-38c**, depth-versus-pressure profiles beneath each of the four model nodes exhibit a similar behaviour, hence can be considered equivalent, in terms of choice of model node from detailed reporting.



File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D002j_CAL_Hydrographs_PaddysCreekHanging.mxd

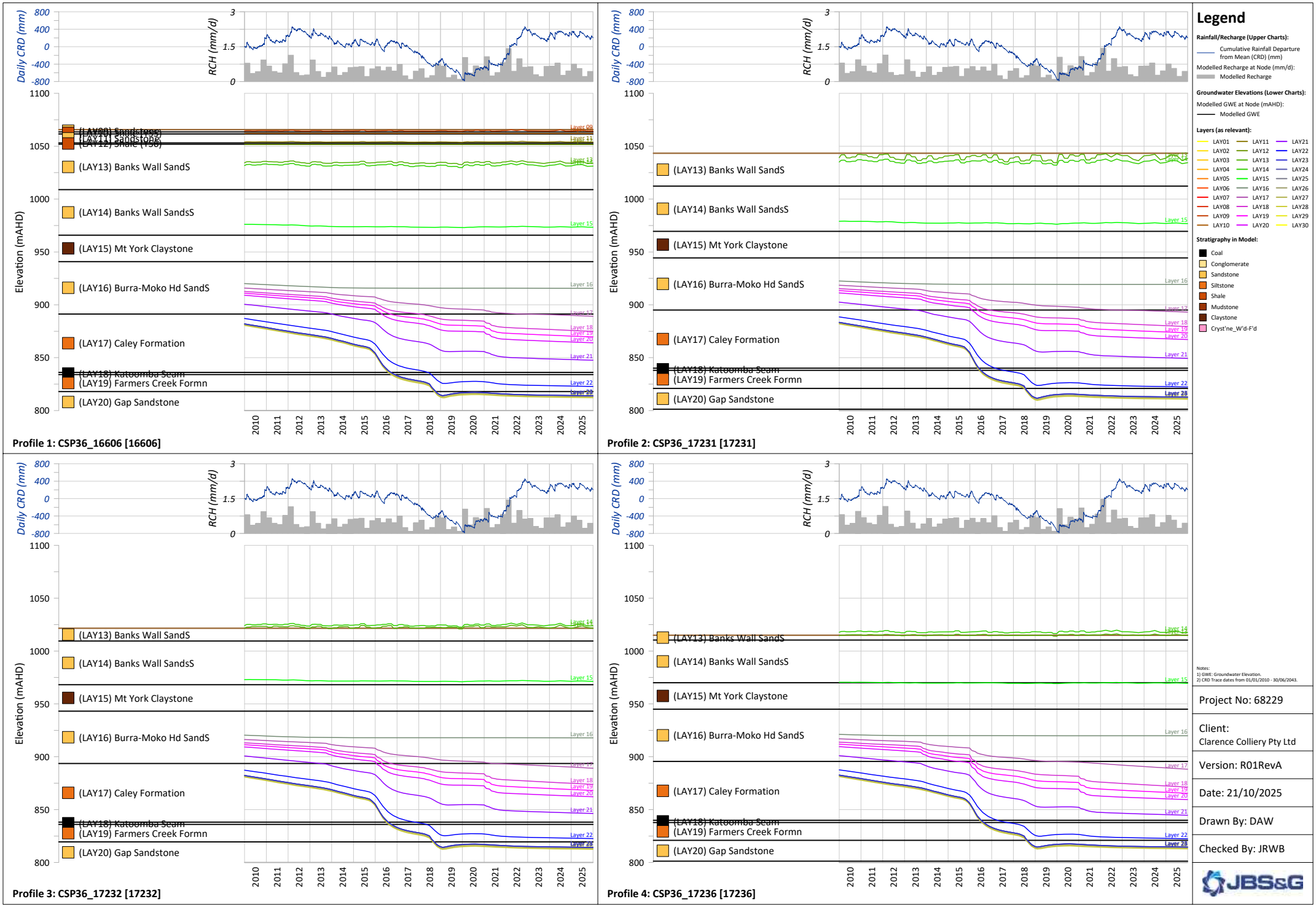
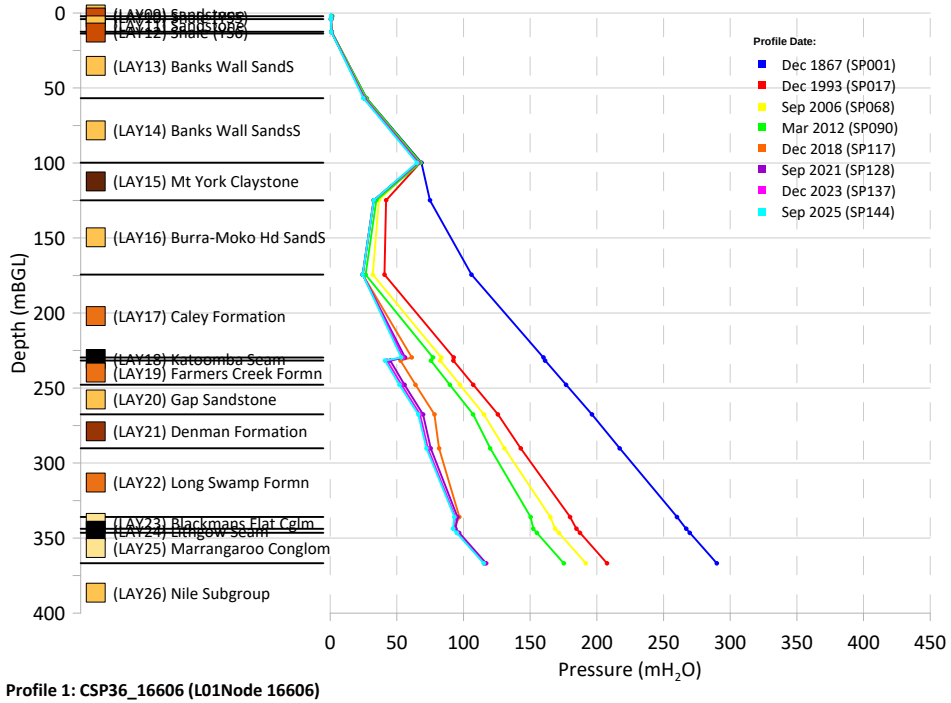


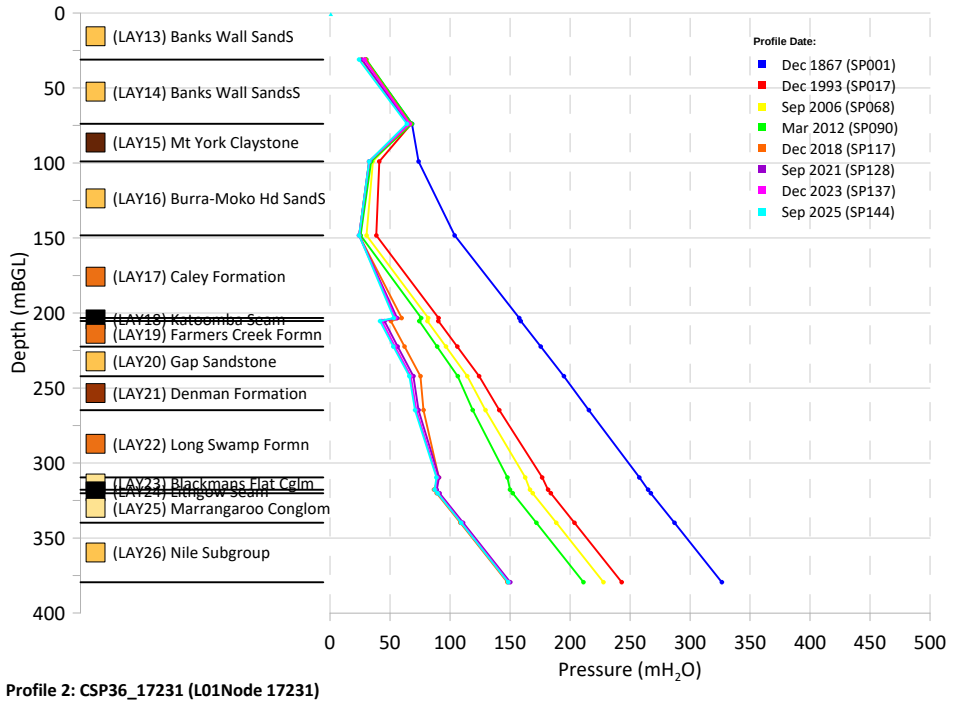
Figure 4.37b: Multilevel Groundwater Hydrographs (Calibration Period) - Paddys Creek Hanging Swamp

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D003_BinaryHDSMultiLevelHydrographGenerator\68229_R01RevA_D003\68229_R01RevA_BinaryHDSMultiLevelHydrographGenerator_102_PaddysCreekHanging.grf

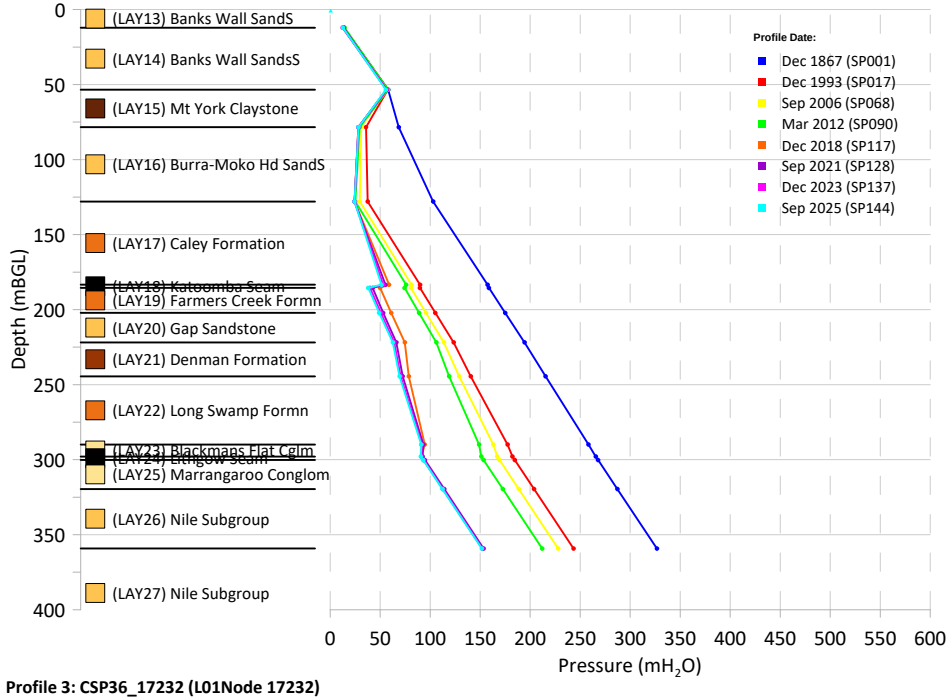
Reference: 68229_R01RevA_APR_03c



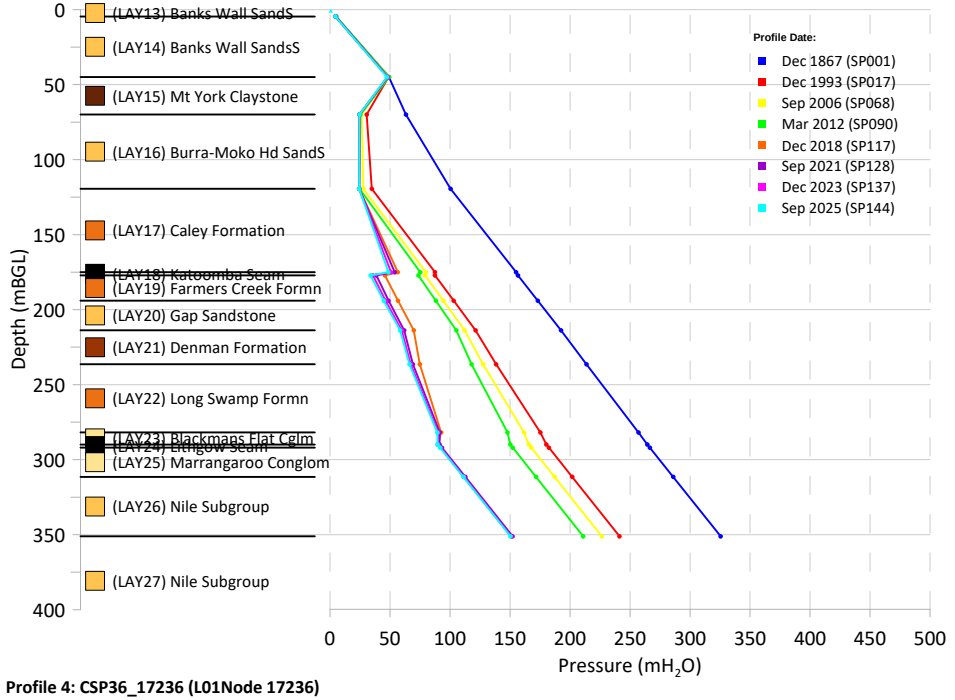
Profile 1: CSP36_16606 (L01Node 16606)



Profile 2: CSP36_17231 (L01Node 17231)



Profile 3: CSP36_17232 (L01Node 17232)



Profile 4: CSP36_17236 (L01Node 17236)

Legend

Profile Type: Modelled – Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:

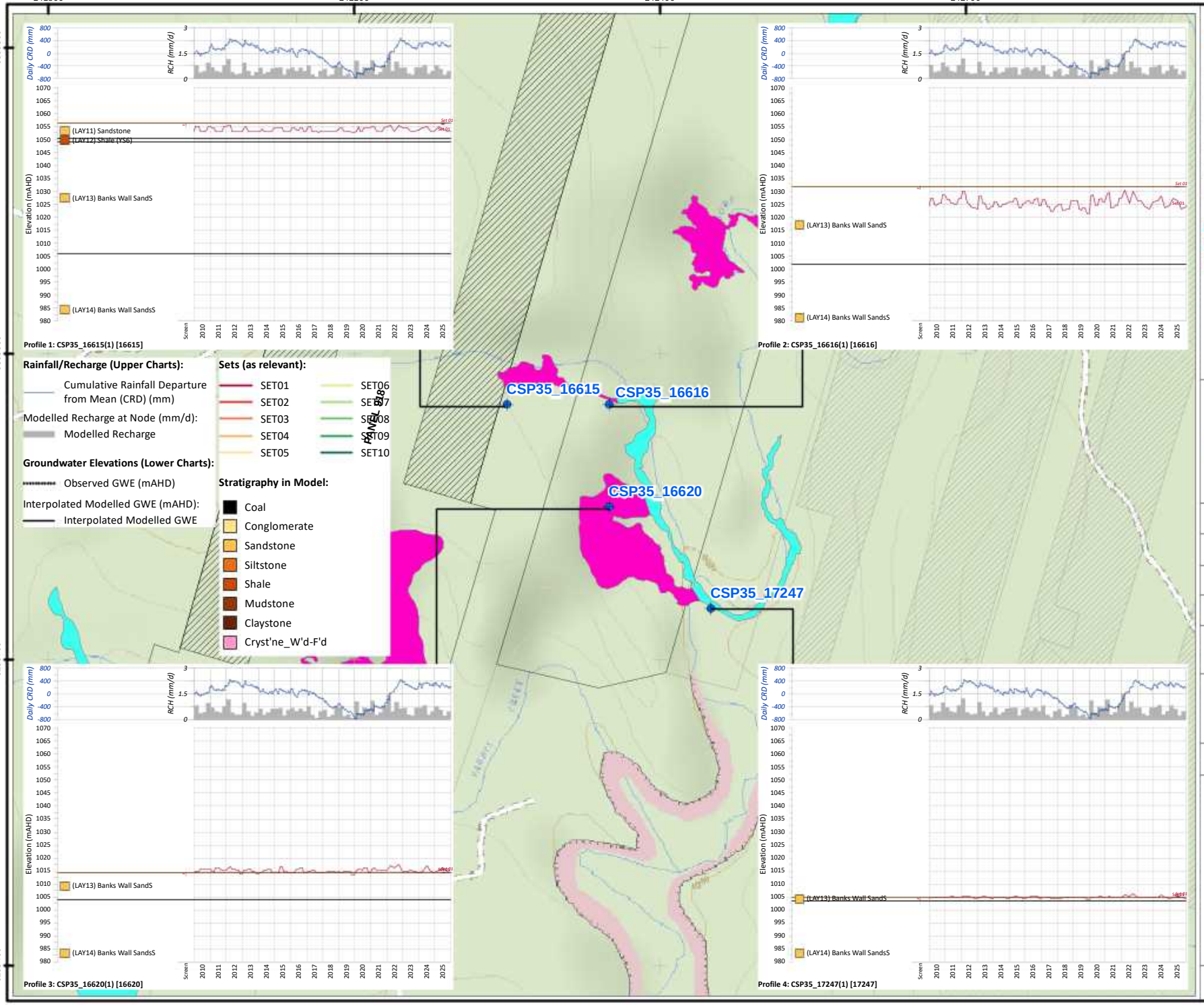
Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 23/10/2025	
Drawn By: DAW	
Checked By: JRWB	

JBS&G

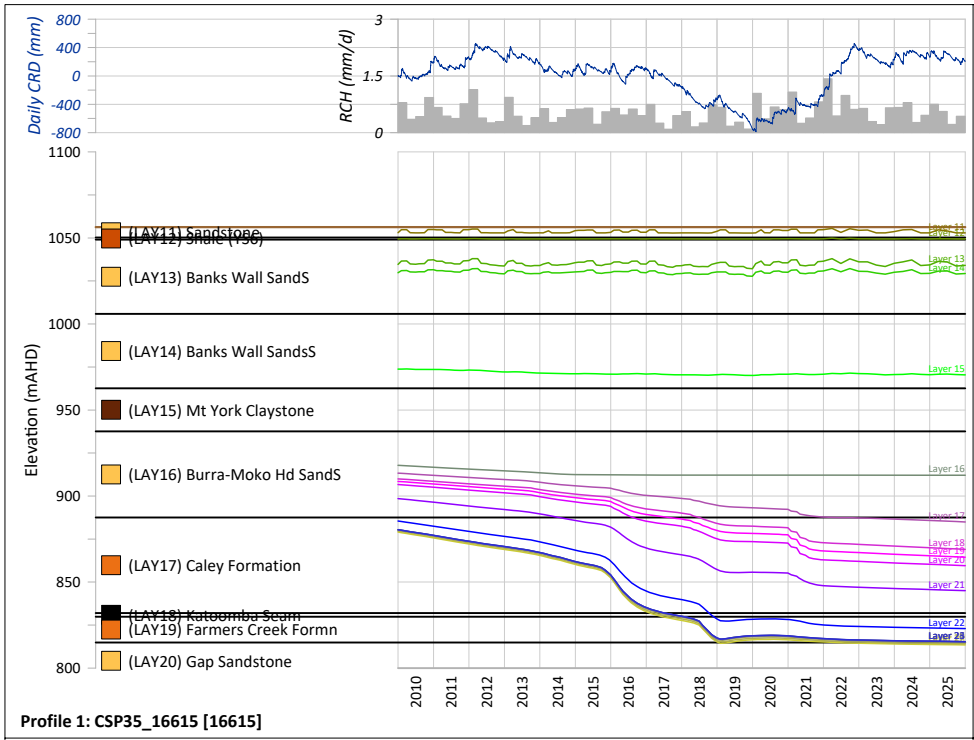
Figure 4.37c: Depth versus Groundwater Pressure Diagrams (Calibration Period) - Paddys Creek Hanging Swamp

Reference: 68229_R01RevA_APR_03c.

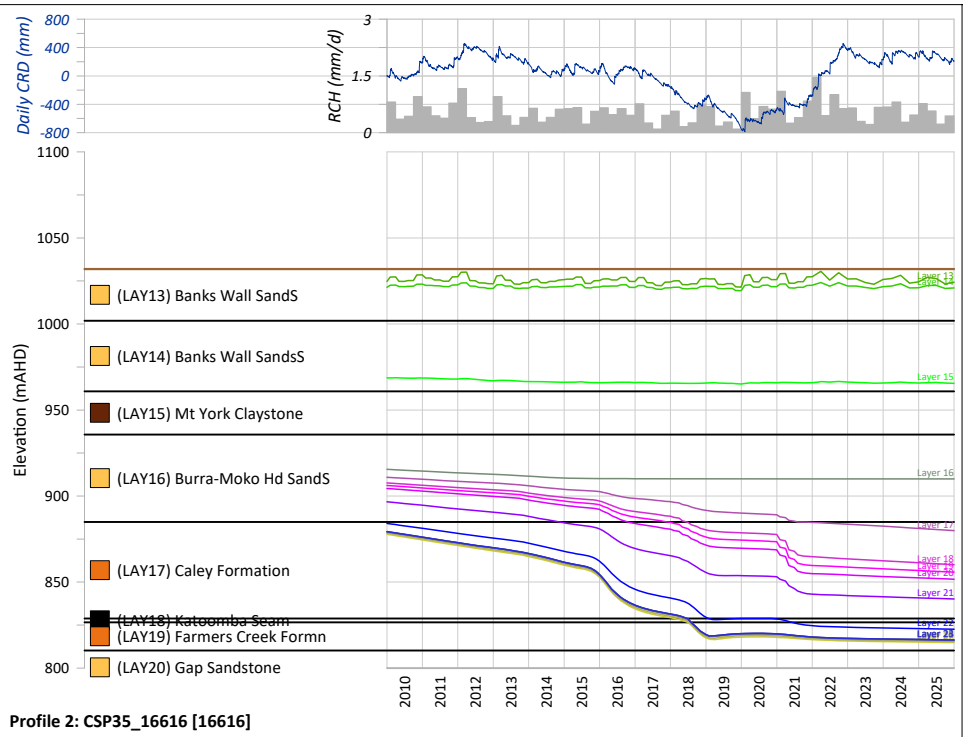
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EPI\Figures\Grapher\68229_R01RevA_D004_BinaryHDSVerticalProfileExtraction_Pressure\68229_R01RevA_D004\68229_R01RevA_D004_VerticalProfileExtraction_Pressure_102_PaddysCreekHanging.grf



File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D002k_CAL_Hydrographs_LowerNineMileHanging.mxd



Profile 1: CSP35_16615 [16615]



Profile 2: CSP35_16616 [16616]

Legend

Rainfall/Recharge (Upper Charts):

Cumulative Rainfall Departure from Mean (CRD) (mm)

Modelled Recharge at Node (mm/d):

Modelled Recharge

Groundwater Elevations (Lower Charts):

Modelled GWE at Node (mAHD):

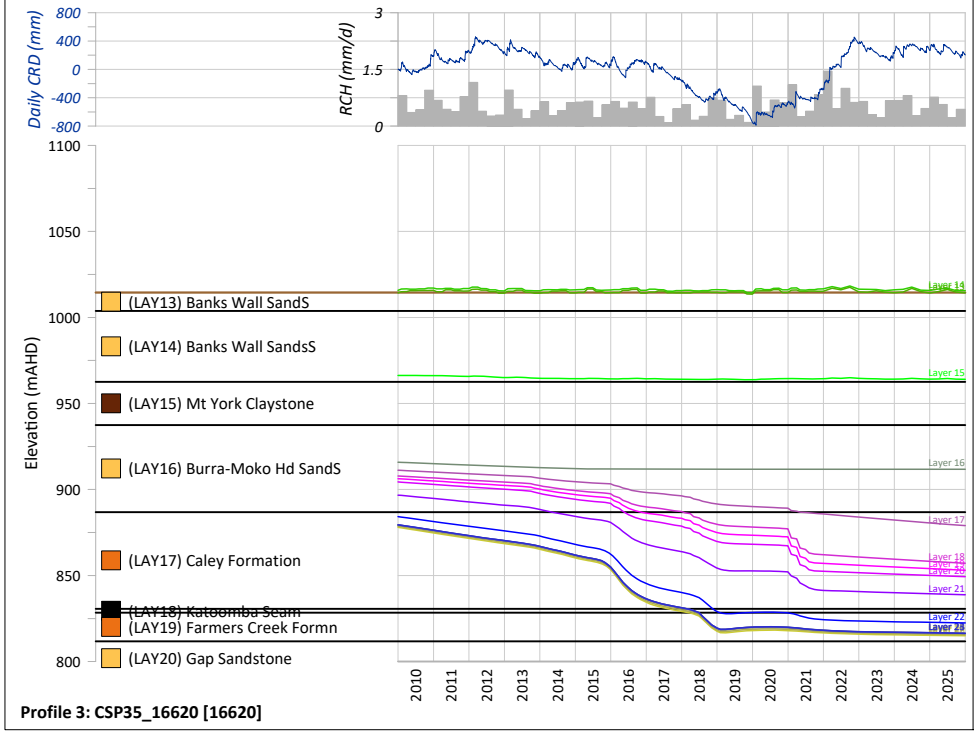
Modelled GWE

Layers (as relevant):

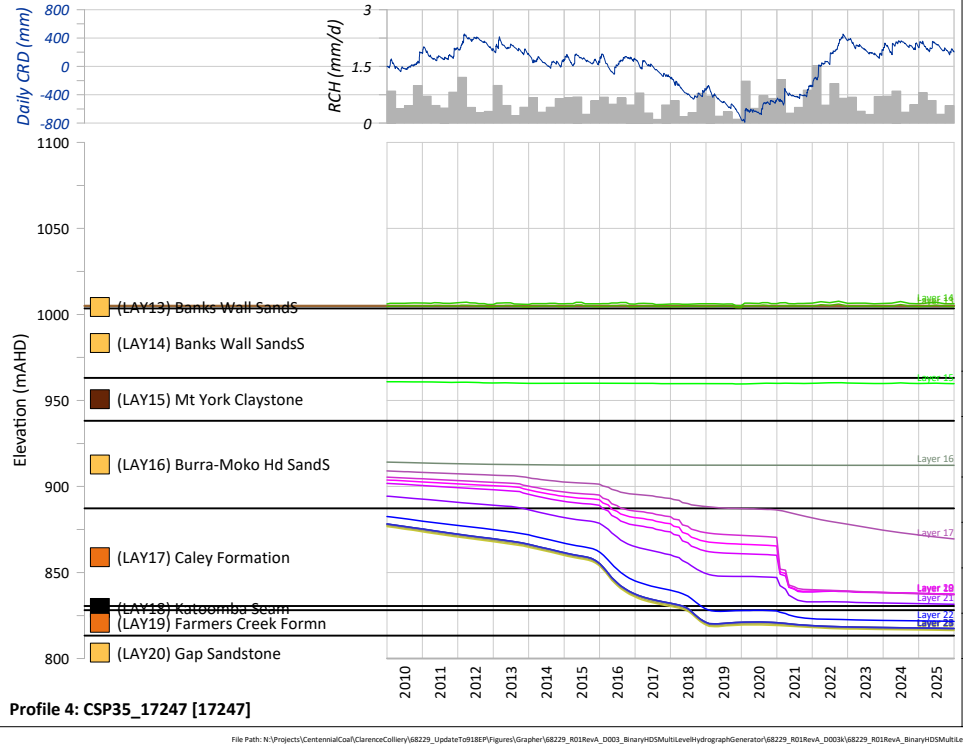
LAY01 LAY02 LAY03 LAY04 LAY05 LAY06 LAY07 LAY08 LAY09 LAY10
LAY11 LAY12 LAY13 LAY14 LAY15 LAY16 LAY17 LAY18 LAY19 LAY20
LAY21 LAY22 LAY23 LAY24 LAY25 LAY26 LAY27 LAY28 LAY29 LAY30

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd



Profile 3: CSP35_16620 [16620]



Profile 4: CSP35_17247 [17247]

Notes:
1) GWE: Groundwater Elevation.
2) CRD Trace dates from 01/01/2010 - 30/06/2043.

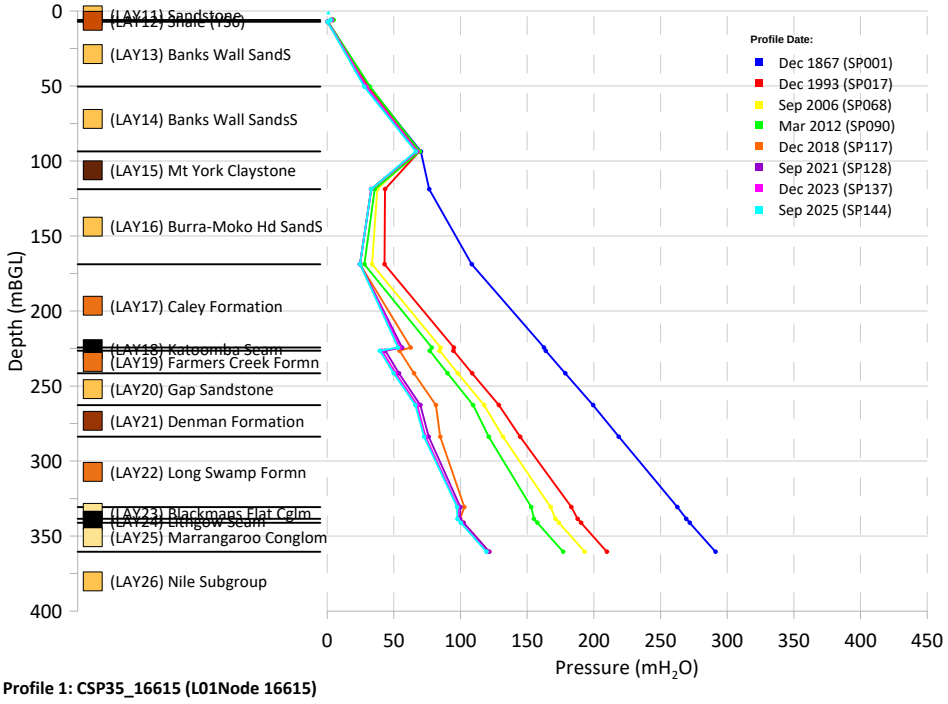
Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 21/10/2025	
Drawn By: DAW	
Checked By: JRWB	

JBS&G

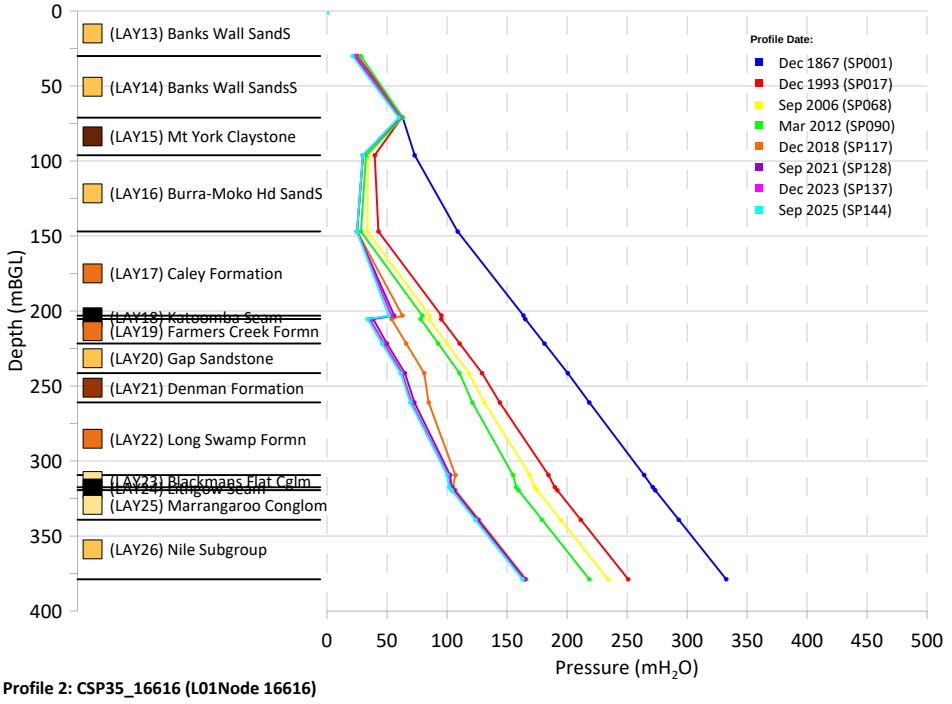
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D003_BinaryHDSMultiLevelHydrographGenerator\68229_R01RevA_D003k\68229_R01RevA_BinaryHDSMultiLevelHydrographGenerator_103_LowerNineMileHanging.grf

Reference: 68229_R01RevA_APR_03c

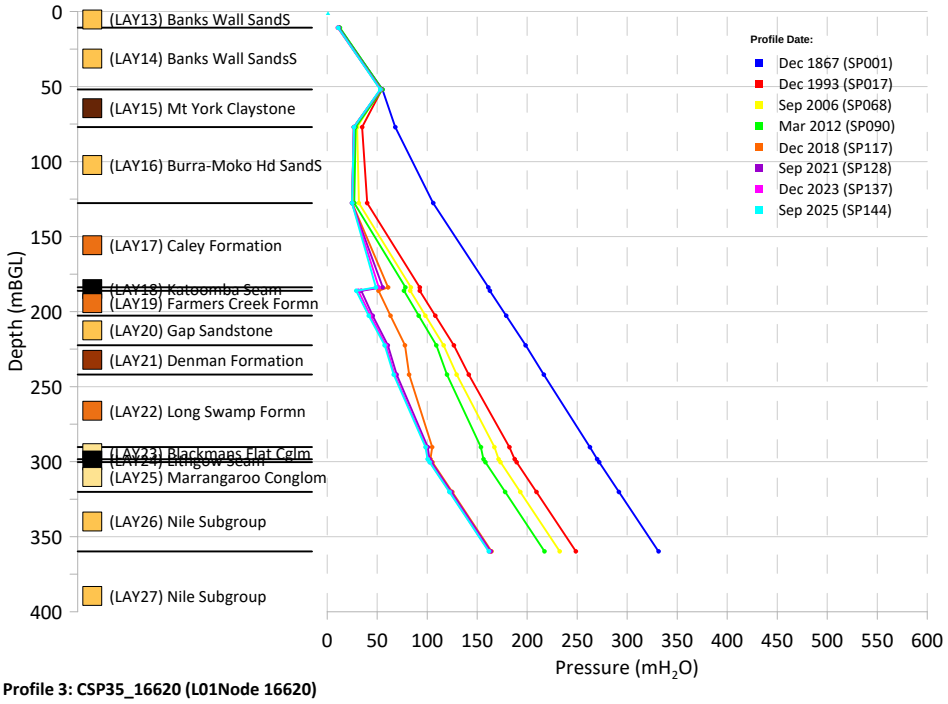
Figure 4.38b: Multilevel Groundwater Hydrographs (Calibration Period) - Lower Nine Mile Hanging Swamp



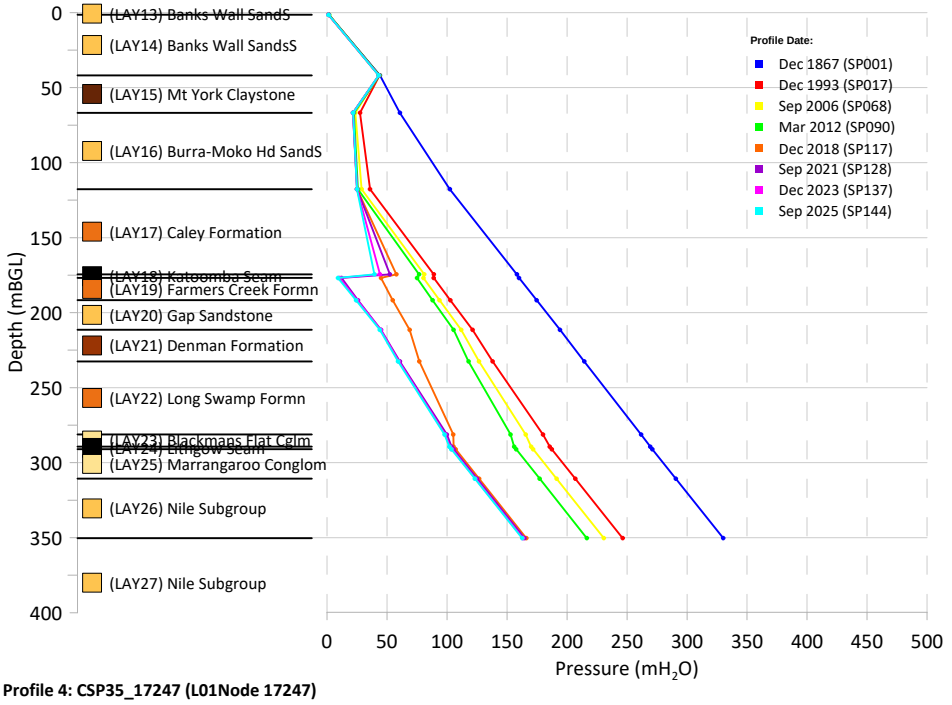
Profile 1: CSP35_16615 (L01Node 16615)



Profile 2: CSP35_16616 (L01Node 16616)



Profile 3: CSP35_16620 (L01Node 16620)



Profile 4: CSP35_17247 (L01Node 17247)

Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 23/10/2025	
Drawn By: DAW	
Checked By: JRWB	

Figure 4.38c: Depth versus Groundwater Pressure Diagrams (Calibration Period) - Lower Nine Mile Hanging Swamp

Reference: 68229_R01RevA_APR_03c.

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EPP\Figures\Graphen\68229_R01RevA_D004_BinaryHDSVerticalProfileExtraction_Pressure\68229_R01RevA_D004k\68229_R01RevA_D004k_VerticalProfileExtraction_Pressure_103_LowerNineMileHanging.grf

4.12.4.5 Groundwater Elevation

Figure 4-39a to **Figure 4-39c** presents groundwater elevation contours in the highest active node, the Mount York Claystone (Layer 15) and the Katoomba Seam Layer 18) during the Calibration Period.

Model output is presented in **Figure 4-39** at the following times:

- Steady-state (SP001)
- 31 December 1957 (SP012)
- 31 December 1993 (SP017)
- 31 December 2013 (SP097)
- 31 December 2018 (SP117)
- 30 September 2025 (SP144).

From **Figure 4-39a**, groundwater flow direction is a subdued reflection of surface topography, as is expected. Groundwater flow is generally from west to east, along the direction of flow of Bungleboori Creek.

From **Figure 4-39b**, groundwater elevation in the Mount York Claystone (Layer 15), pre-mining, is from west to east, with discharge into Bungleboori Creek. Mining has some influence on groundwater elevation by December 1993 (SP017), to the east of 908-910 Panel Area with a minor decline. That decline increases over time through to present (September 2025 (SP144)), however, is not significant. In December 2018 (SP117), extraction at Springvale Mine, to the west of 918 Panel, has a localised influence on groundwater elevation, but that influence has dissipated by present time (September 2025 (SP144)).

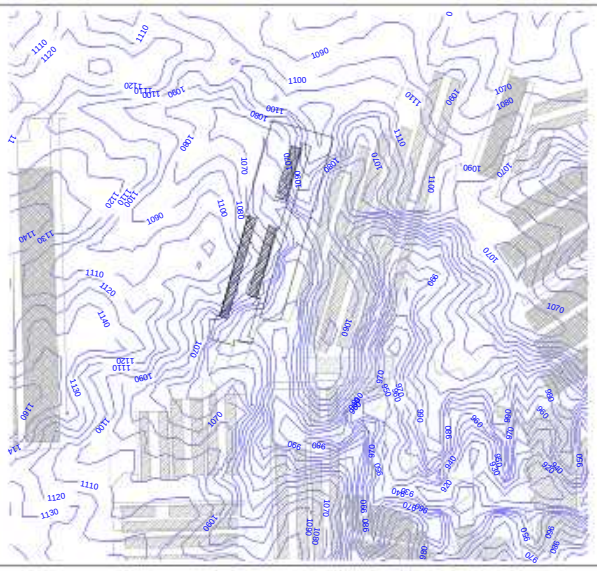
From **Figure 4-39c**, groundwater flow direction in the Katoomba Seam (Layer 18) is eastward, prior to the commencement of mining. Groundwater flow direction is influence by Bungleboori Creek. With mining, groundwater elevation is lowered to coincide with the floor of the Katoomba Seam. By December 2013 (SP097), a groundwater divide has formed between Springvale Mine and Clarence Colliery. The groundwater divide is maintained through to present (30 September 2025, SP144).

Figure 4-39d and **Figure 4-39e** presents two cross-sections through the groundwater model. These sections present groundwater elevation, with the colour of the cell pertaining to the elevation.

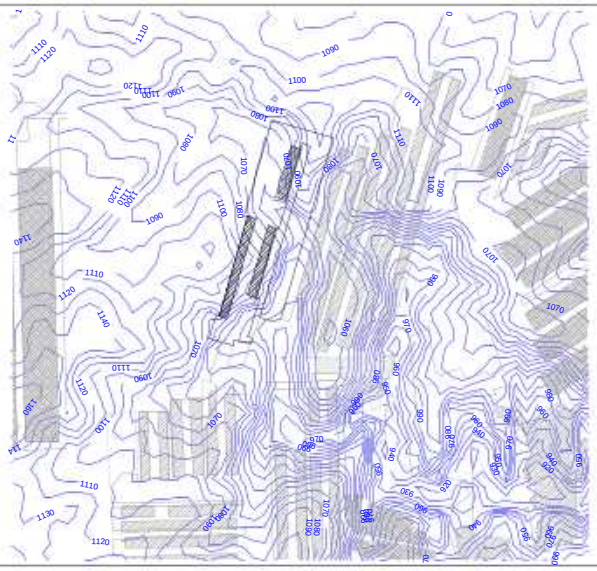
From **Figure 4-39d**, groundwater flow direction through section A-A' is topographically higher portions into lower topographic portions, as is expected. Groundwater/surface water interaction is indicated along Nine Mile Lower Swamp and the next watercourse in the cross-section. At depth, in pre-mining, groundwater flow direction along the cross-section is from west to east, which is consistent with **Figure 4-39c**, as is expected.

From **Figure 4-39d**, by December 1993 (SP017), there is an upward vertical hydraulic gradient from lower model layers into the Katoomba Seam. This is a reversal in direction compared to the pre-mining state. By that time, the downward vertical hydraulic gradient in model layers above the Katoomba Seam has increased. From **Figure 4-39d**, as mining progresses, the groundwater elevation in layers above the Mount York Claystone are maintained, but, within the deep groundwater system, there is a general decline (the colour of most cells in the deep groundwater system are more red).

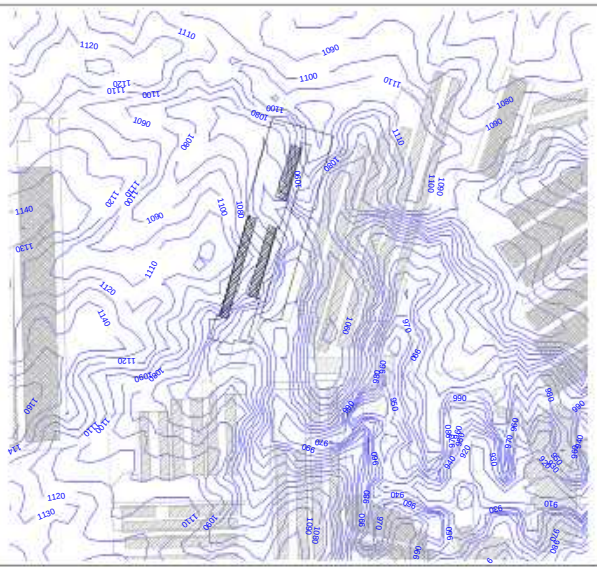
From **Figure 4-39e**, which is section B-B', and is oriented in a south to north direction, is again, from higher topographic portions to lower topographic portions. Groundwater flow direction in the deep groundwater system is from south to north, slightly, in the pre-mining period. As mining commences in the region (State Mine Complex and then at Clarence), a minor groundwater divide forms in the deep groundwater system. Changes in the Lithgow Seam in **Figure 4-39e**, is due to the influence of the adjacent operation at Springvale Mine as well as mining of the 900 District at Clarence.



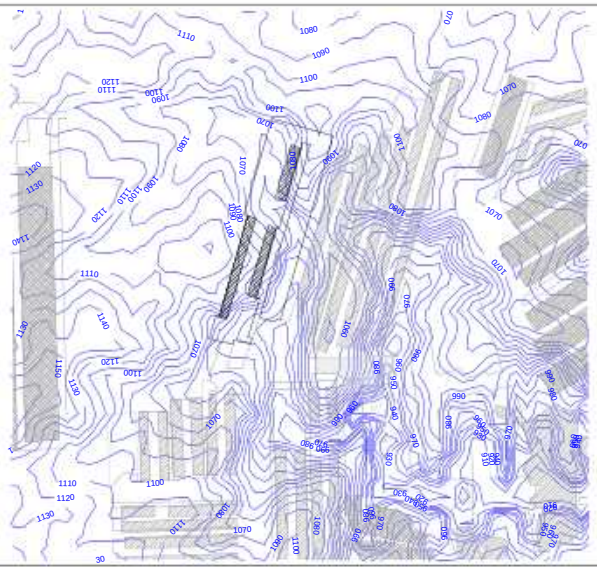
Steady-State (SP001) - Approved Case



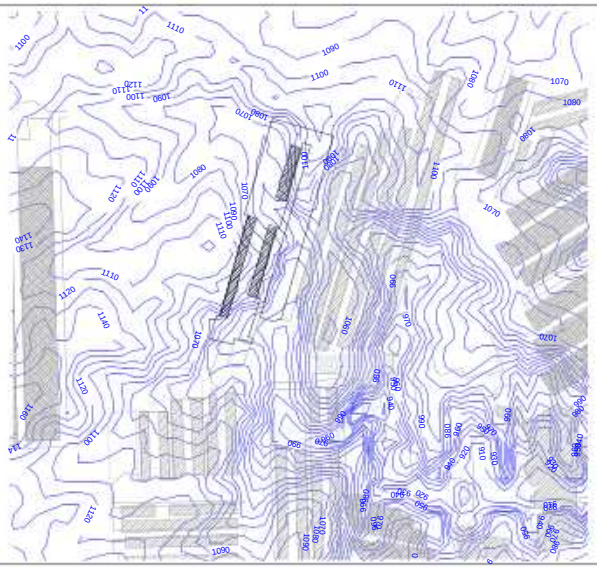
December 1957 (SP012) - Approved Case



December 1993 (SP017) - Approved Case

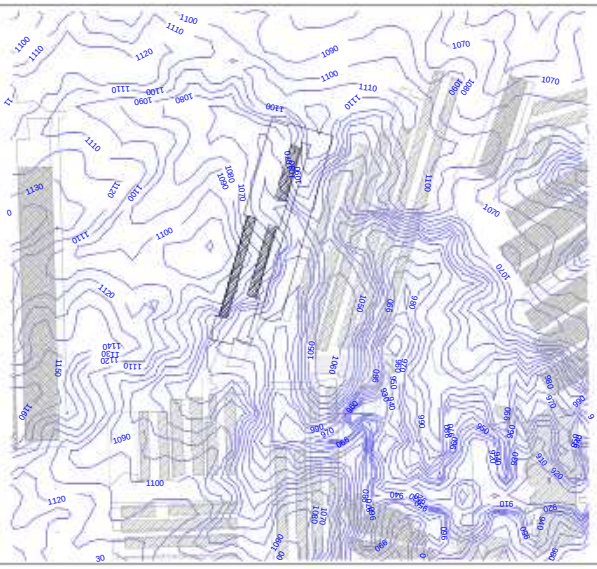


December 2013 (SP097) - Approved Case



December 2018 (SP117) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



September 2025 (SP144) - Approved Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mAHD

Model Results:

- Modelled Groundwater Elevation (mAHD)

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA | Date: 29/10/2025

Drawn By: DAW | Checked By: JRWB

Groundwater Elevation (mAHD) - Calibration Period

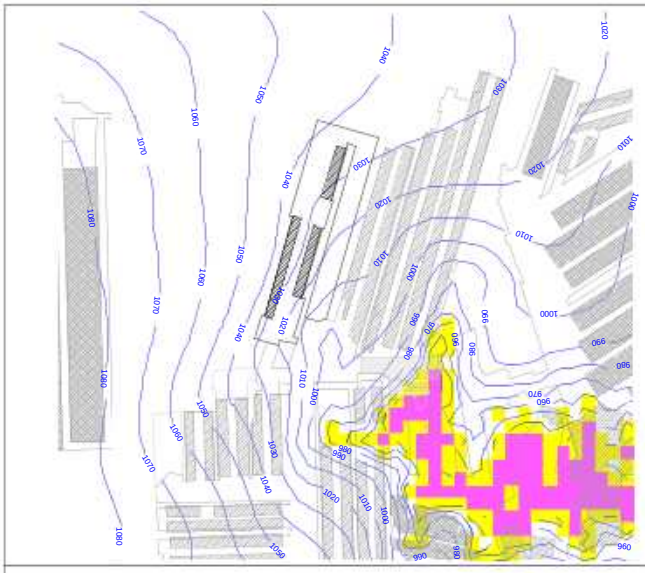
Highest Active Node (SIM0)

Figure 4.39a

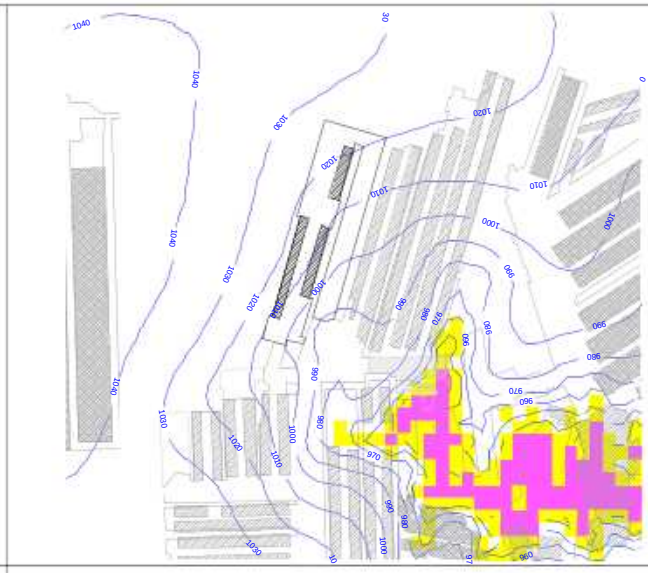
JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D012_APR_03c_GWE\68229_R01RevA_D012a_APR_03c_GWE_UWT\68229_R01RevA_D012a_APR_03c_GWE_UWT.grf

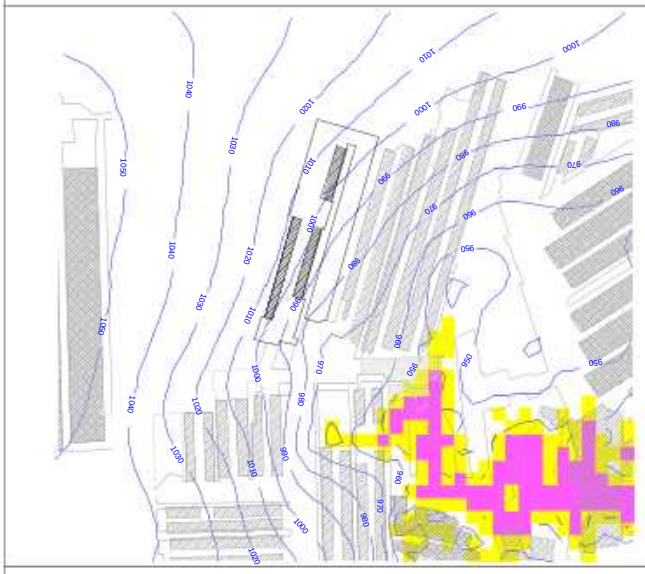
Reference: 68229_R01RevA_APR_03c_21_SIM0



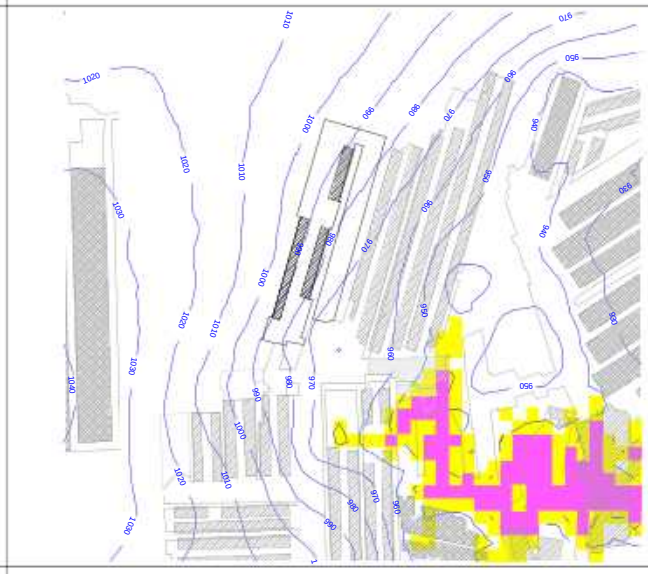
Steady-State (SP001) - Approved Case



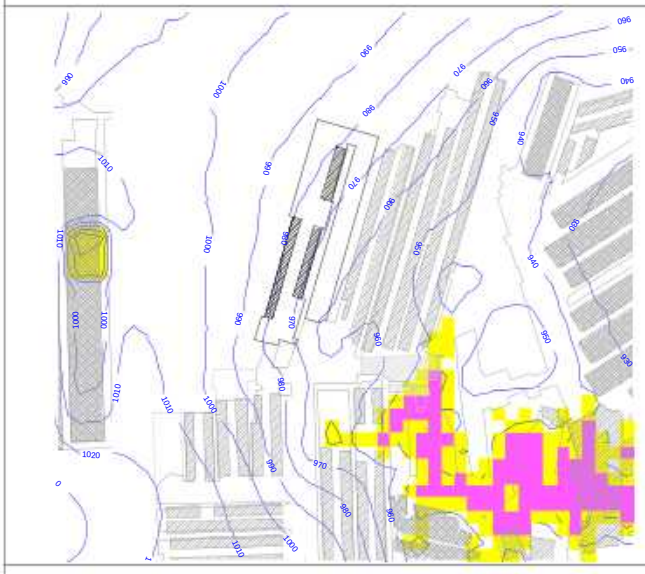
December 1957 (SP012) - Approved Case



December 1993 (SP017) - Approved Case

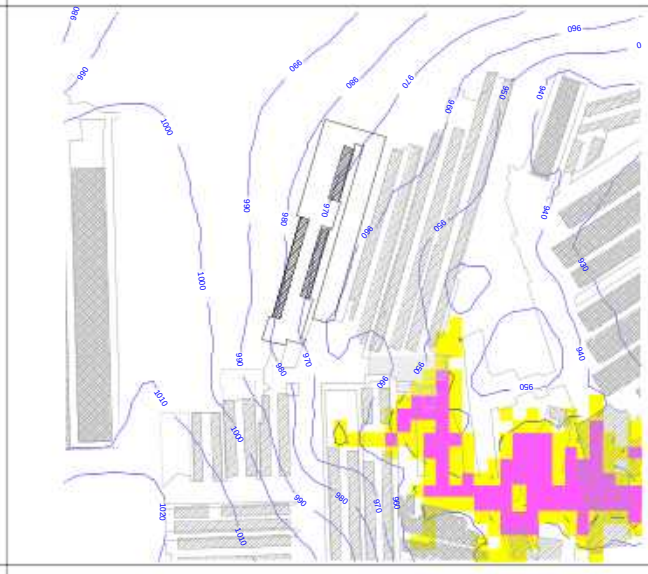


December 2013 (SP097) - Approved Case



December 2018 (SP117) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



September 2025 (SP144) - Approved Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mAHD

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Groundwater Elevation (mAHD)

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA | Date: 31/10/2025

Drawn By: DAW | Checked By: JRWB

Groundwater Elevation (mAHD) - Calibration Period

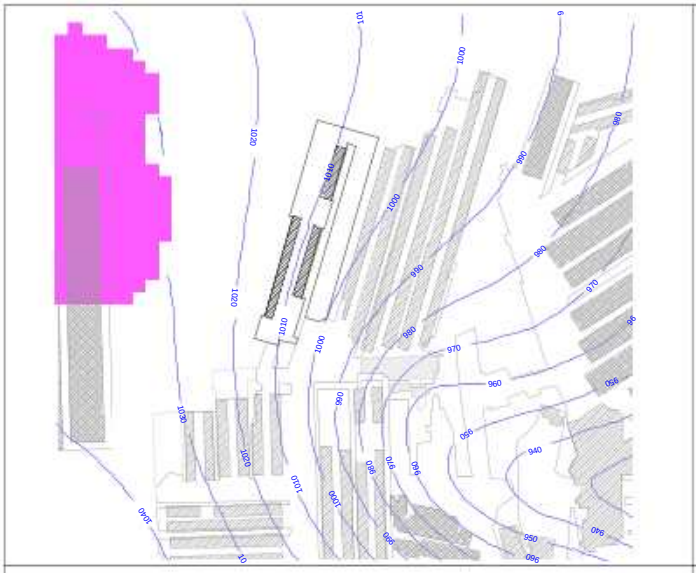
Mount York Claystone (Layer 15) (SIM0)

Figure 4.39b

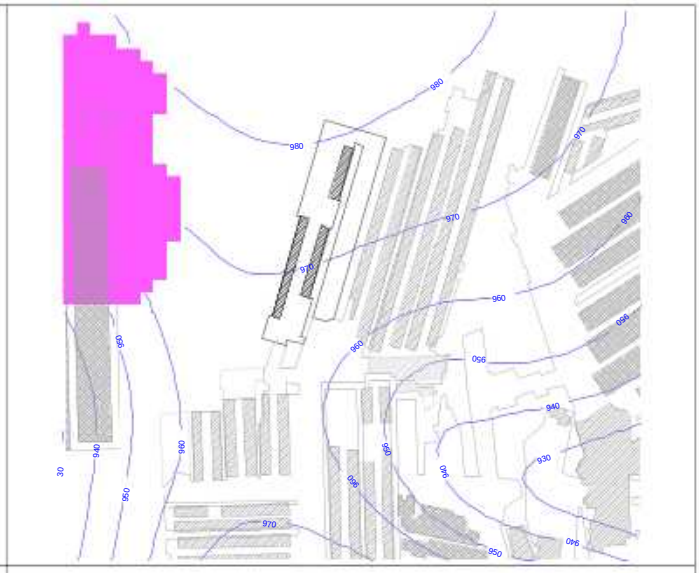
JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D012_APR_03c_GWE\68229_R01RevA_D012b_APR_03c_GWE_L15\68229_R01RevA_D012b_APR_03c_GWE_L15.grf

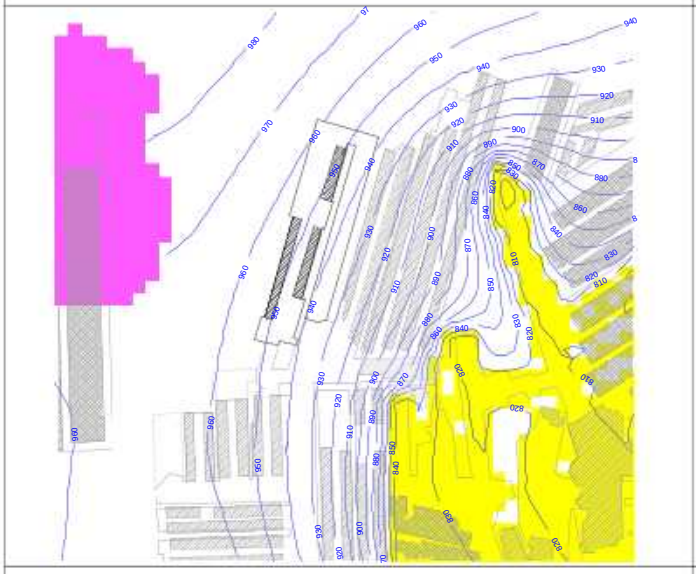
Reference: 68229_R01RevA_APR_03c_21_SIM0



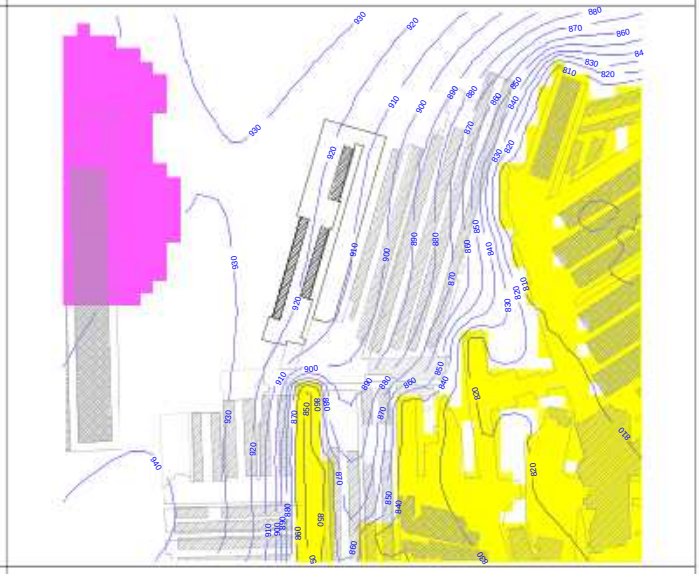
Steady-State (SP001) - Approved Case



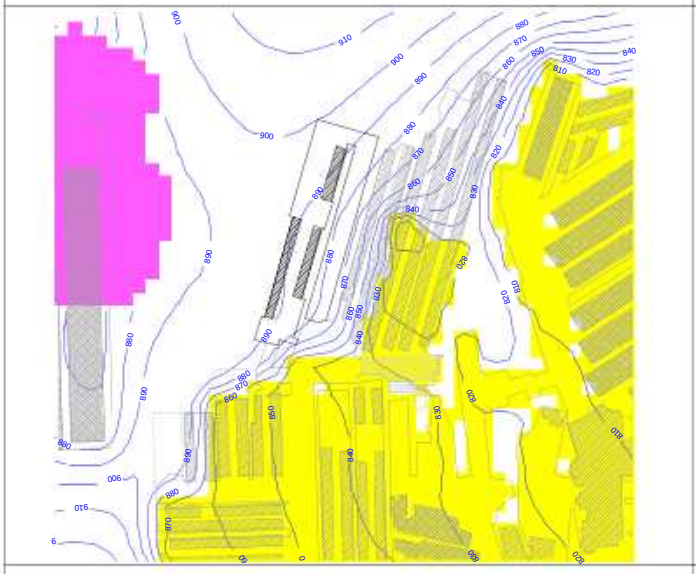
December 1957 (SP012) - Approved Case



December 1993 (SP017) - Approved Case

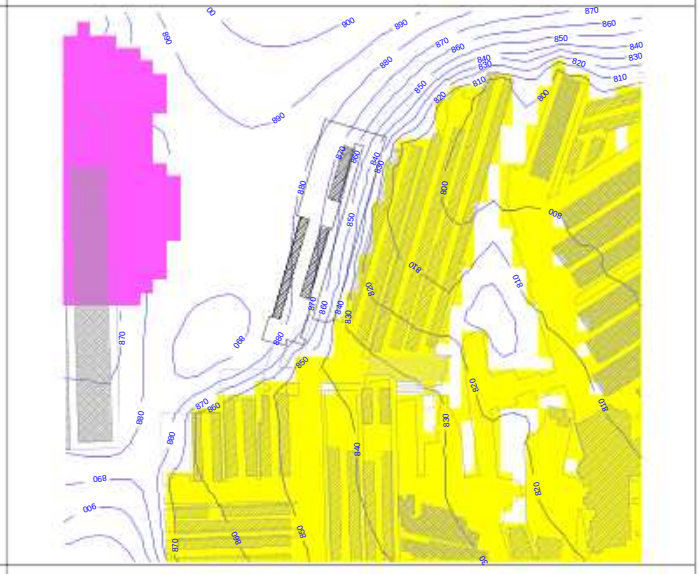


December 2013 (SP097) - Approved Case



December 2018 (SP117) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



September 2025 (SP144) - Approved Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mAHD

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Groundwater Elevation (mAHD)

Job No.: 68229		**Groundwater Elevation (mAHD) - Calibration Period**
Client: Clarence Colliery Pty Ltd		Katoomba Seam (Layer 18) (SIM0)
Version: R01RevA	Date: 31/10/2025	
Drawn By: DAW	Checked By: JRWB	**Figure 4.39c**

JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D012_APR_03c_GWE\68229_R01RevA_D012c_APR_03c_GWE_L18\68229_R01RevA_D012c_APR_03c_GWE_L18.grf

Reference: 68229_R01RevA_APR_03c_21_SIM0

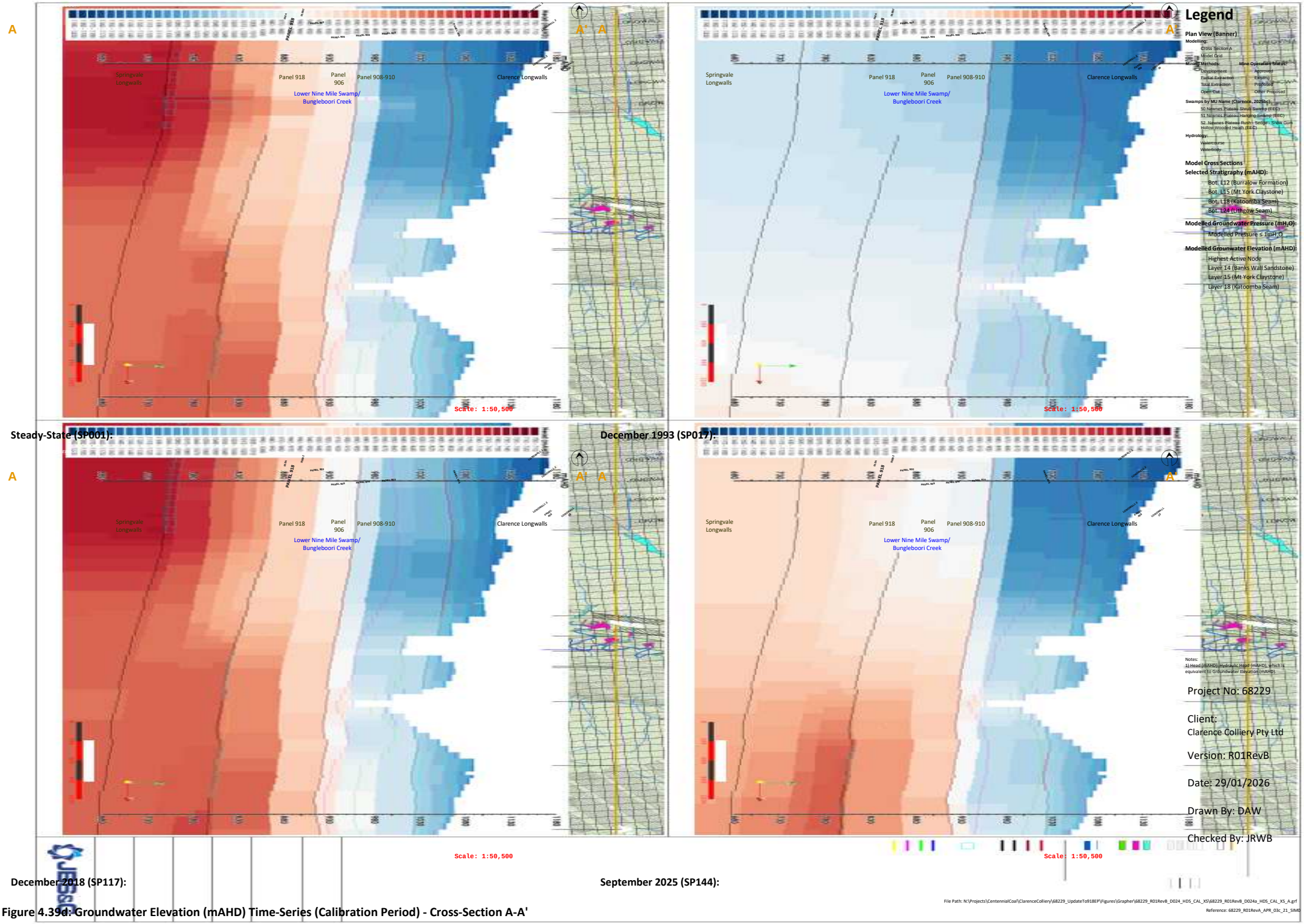


Figure 4.39d: Groundwater Elevation (mAHD) Time-Series (Calibration Period) - Cross-Section A-A'

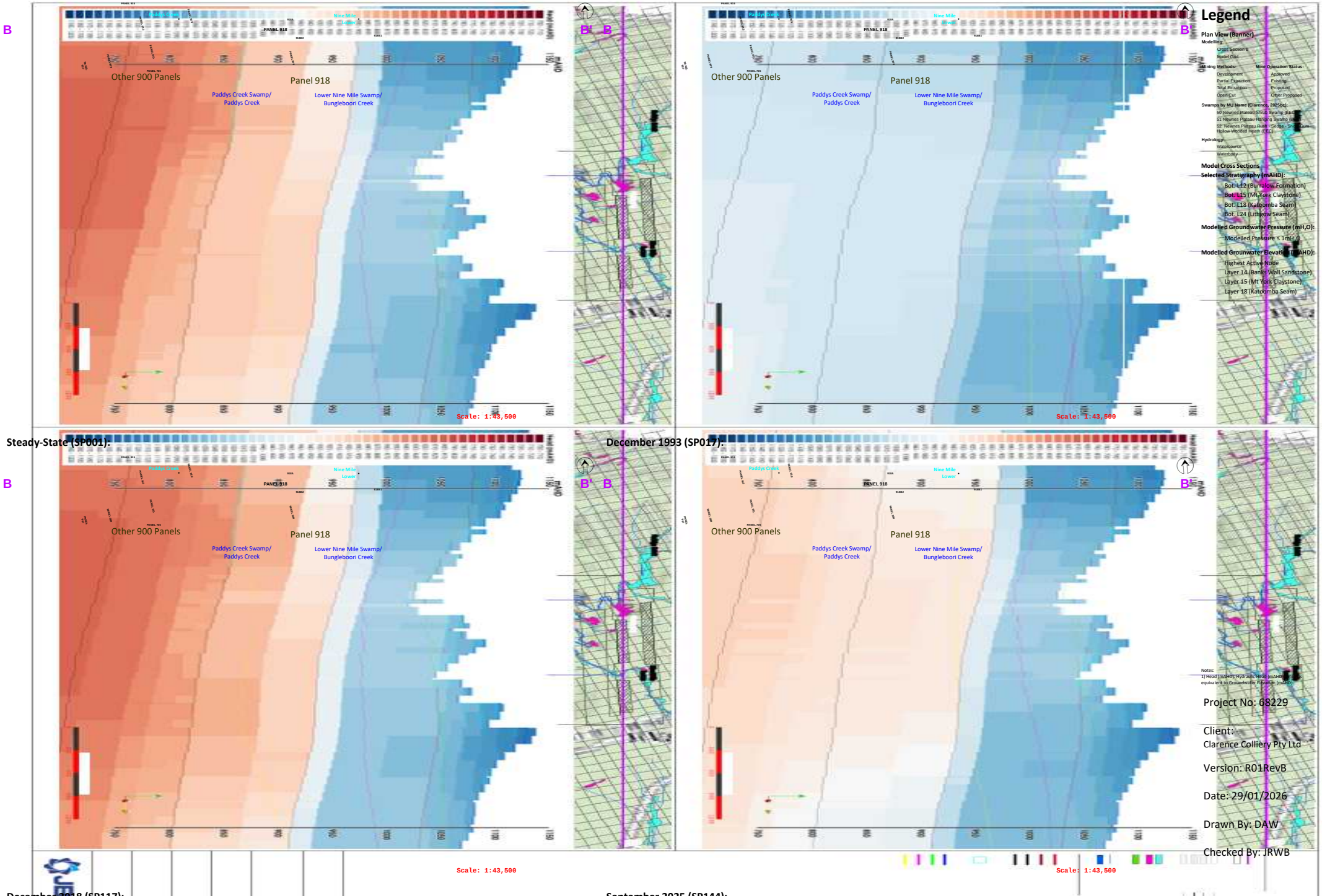


Figure 4.39e: Groundwater Elevation (mAHD) Time-Series (Calibration Period) - Cross-Section B-B'

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevB_D024_HDS_CAL_XS\68229_R01RevB_D024b_HDS_CAL_XS_B.grf
Reference: 68229_R01RevA_APR_03c_21_SIM0

4.12.4.6 Groundwater Pressure

Figure 4-40a and **Figure 4-40b** presents groundwater pressure contours in the Mount York Claystone (Layer 15) and the Katoomba Seam (Layer 18).

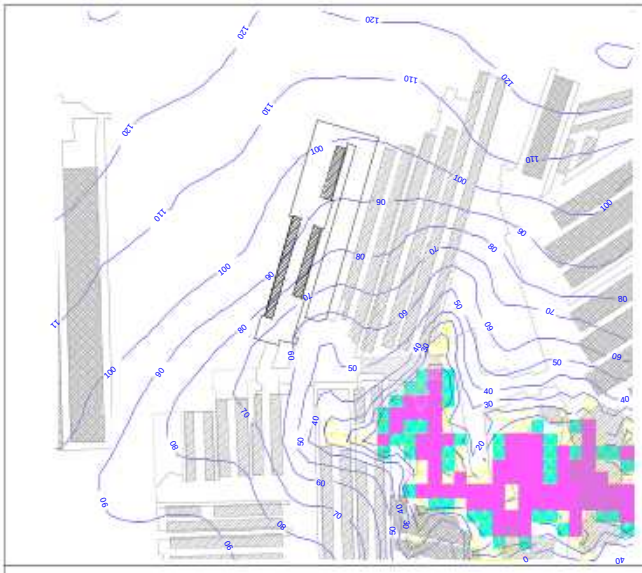
From **Figure 4-40a**, groundwater pressure in the vicinity of 918 Panel at Clarence Colliery is ranges between 60 and 100mH_2O in the pre-mining conditions (SP001). That reduces to between 35 and 50mH_2O at present (30 September 2025 (SP144)). From **Figure 4-40a**, groundwater pressure is dissipated by outcropping of the Mount York Claystone along Bungleboori Creek.

From **Figure 4-40b**, groundwater pressure in the vicinity of 918 Panel at Clarence Colliery is ranges between 150 and 180mH_2O in the pre-mining conditions (SP001). The influence of Bungleboori Creek on pressure head in the Katoomba Seam is evident in **Figure 4-40b**. Groundwater pressure in the vicinity of 918 Panel has reduced since pre-mining period to be between 30 and 60mH_2O at present (30 September 2025 (SP144)).

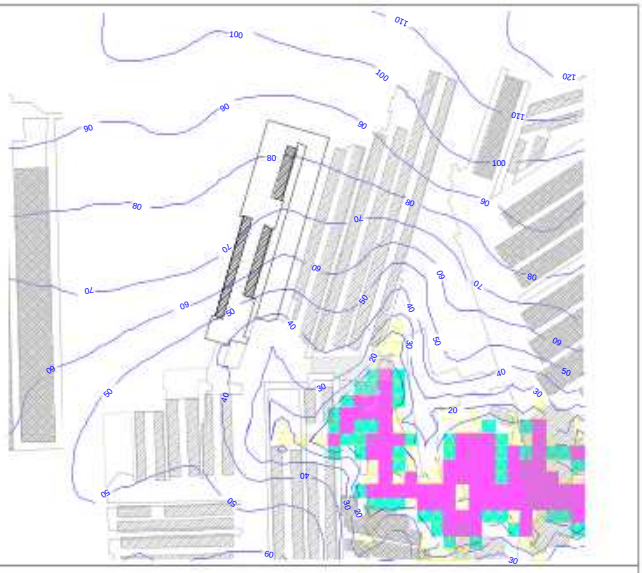
Figure 4-40c and **Figure 4-40d** presents the groundwater pressure in cross-section for each model cell. The location of model output cross-sections is presented in **Figure 4-1**. Pressure was calculated from modelled groundwater elevation, using the base of the respective cell.

From **Figure 4-40c**, depressurisation of the Lithgow Seam (Layer 24) at Springvale Mine and Katoomba Seam (Layer 18) at Clarence Colliery, leads to a general decrease in pressure within the section. The reduction in pressure over time is less pronounced above the Mount York Claystone (Layer 15), as is expected.

From **Figure 4-40d**, mining of the 900 Panel Area at Clarence also leads to a general decline in pressure in the section. There is also a small reduction in pressure above the Mount York Claystone beneath topographic ridgelines over time, but this is not significant with respect to THPSS shrub swamps along watercourses. It is highlighted that the scale used in **Figure 4-40d** is non-linear.

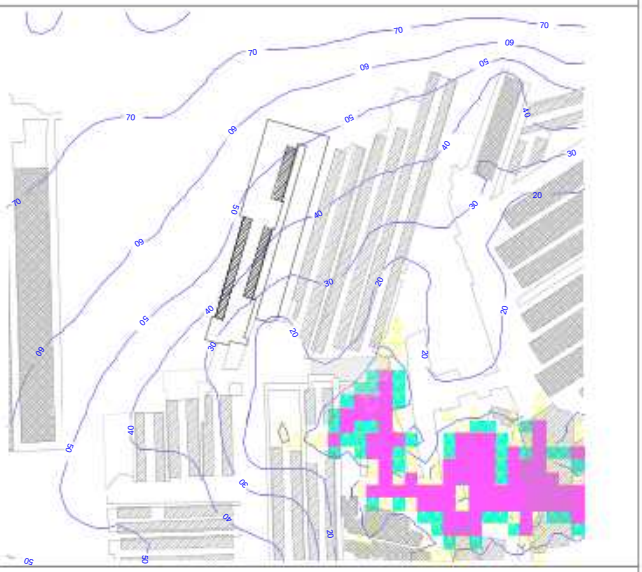


Steady-State (SP001) - Approved Case

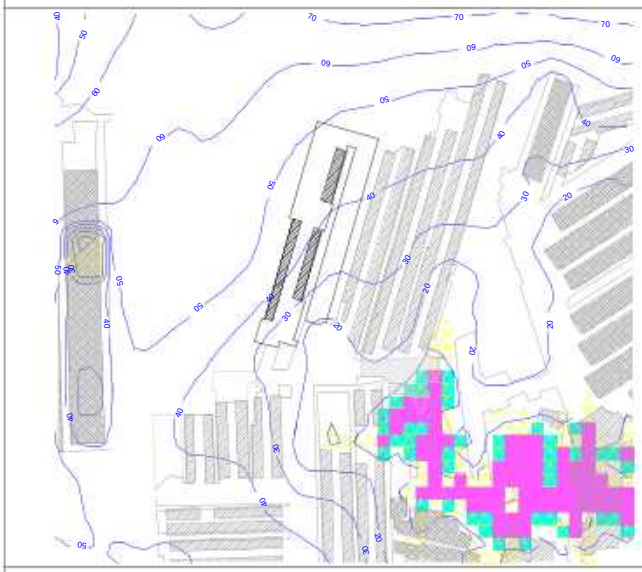


December 1957 (SP012) - Approved Case

December 1993 (SP017) - Approved Case

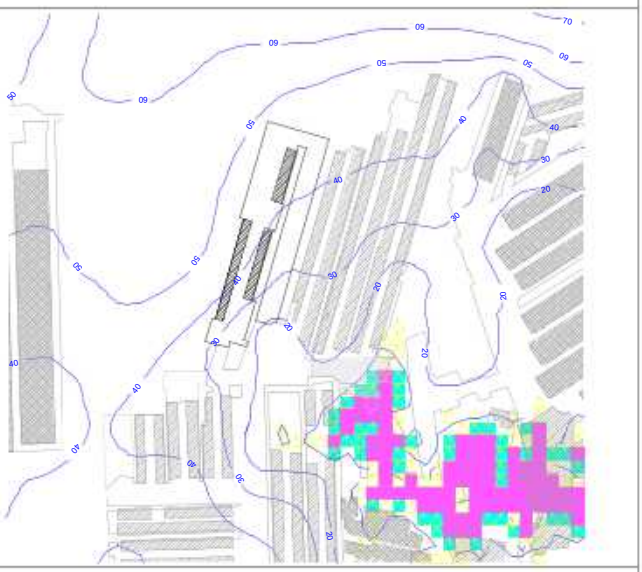


December 2013 (SP097) - Approved Case



December 2018 (SP117) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



September 2025 (SP144) - Approved Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mH$_2$O

Model Cell Type:
- Pinched-Out Cells

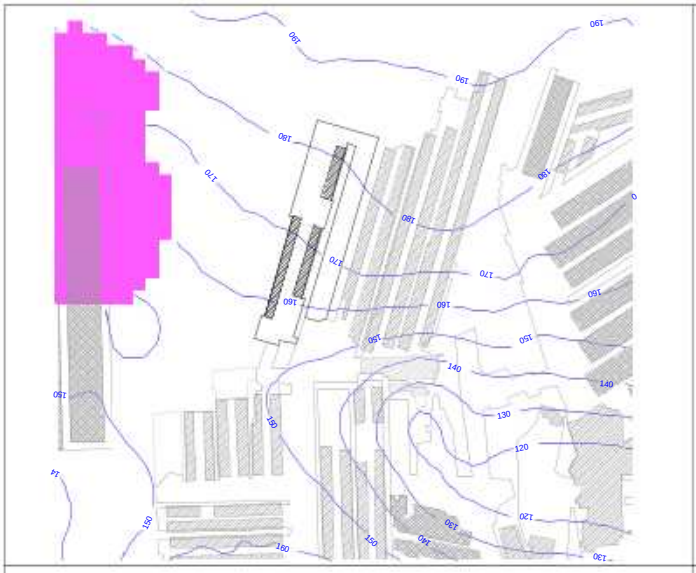
Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Pressure (mH$_2$O)
- Modelled Pressure ≤ 1mH$_2$O

Job No.: 68229		**Pressure Head (mH$_2$O) - Calibration Period**
Client: Clarence Colliery Pty Ltd		Mount York Claystone (Layer 15) (SIM0)
Version: R01RevA	Date: 31/10/2025	
Drawn By: DAW	Checked By: JRWB	**Figure 4.40a**

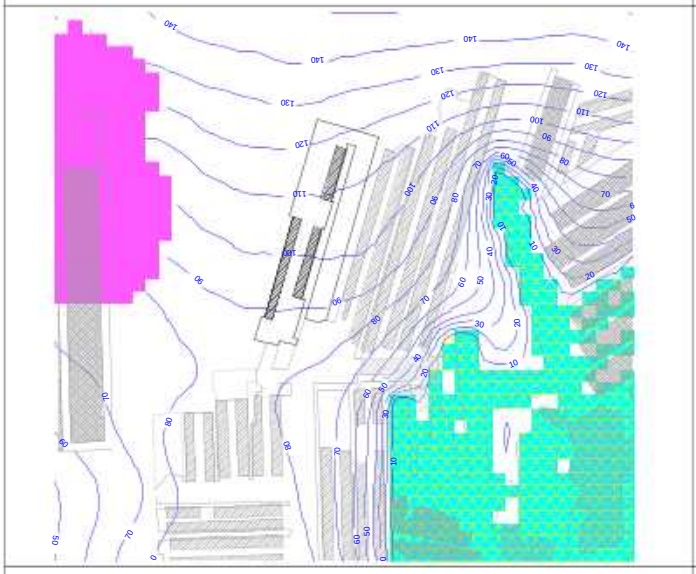
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D017_APR_03c_PH\68229_R01RevA_D017a_APR_03c_PH_L15\68229_R01RevA_D017a_APR_03c_PH_L15.grf

Reference: 68229_R01RevA_APR_03c_21_SIM0

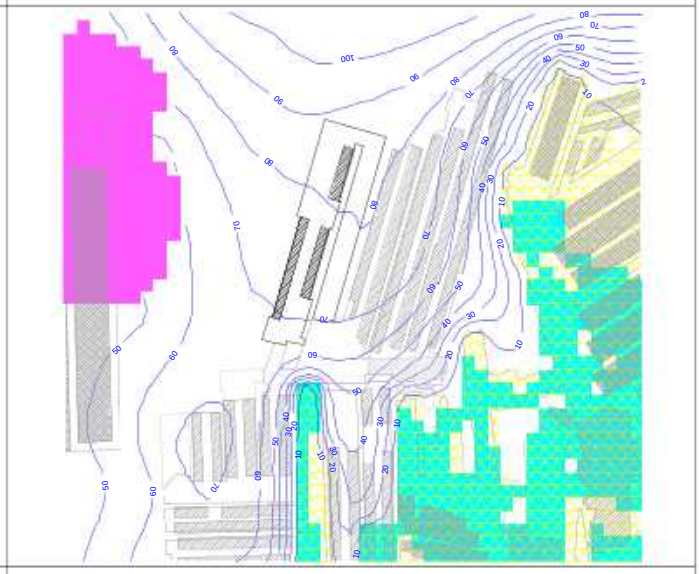


Steady-State (SP001) - Approved Case

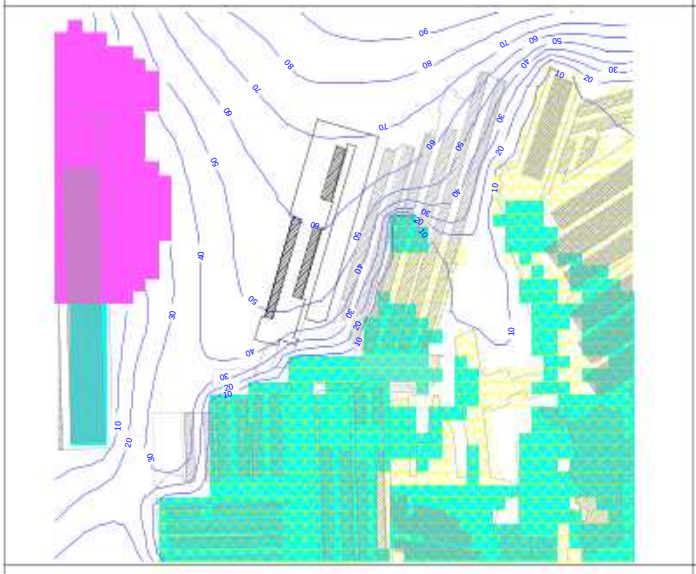
December 1957 (SP012) - Approved Case



December 1993 (SP017) - Approved Case

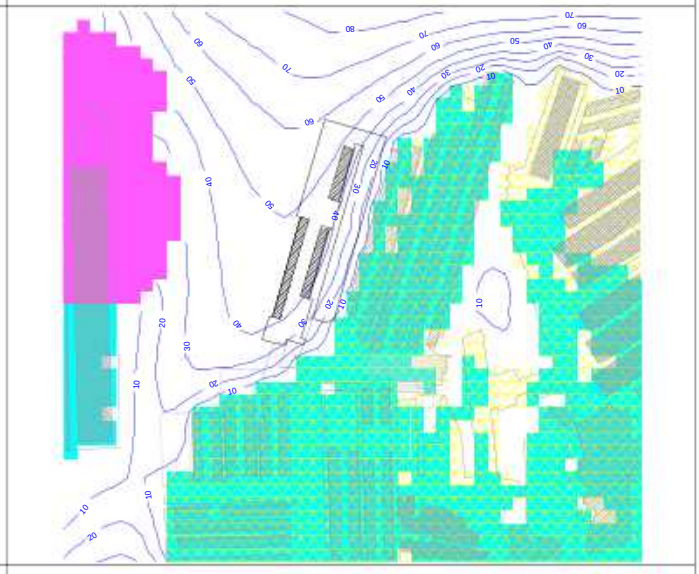


December 2013 (SP097) - Approved Case



December 2018 (SP117) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



September 2025 (SP144) - Approved Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mH$_2$O

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Pressure (mH$_2$O)
- Modelled Pressure ≤ 1mH$_2$O

Job No.: 68229		**Pressure Head (mH$_2$O) - Calibration Period**
Client: Clarence Colliery Pty Ltd		Katoomba Seam (Layer 18) (SIM0)
Version: R01RevA	Date: 31/10/2025	
Drawn By: DAW	Checked By: JRWB	**Figure 4.40b**

JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D017_APR_03c_PH\68229_R01RevA_D017b_APR_03c_PH_L18\68229_R01RevA_D017b_APR_03c_PH_L18.grf

Reference: 68229_R01RevA_APR_03c_21_SIM0

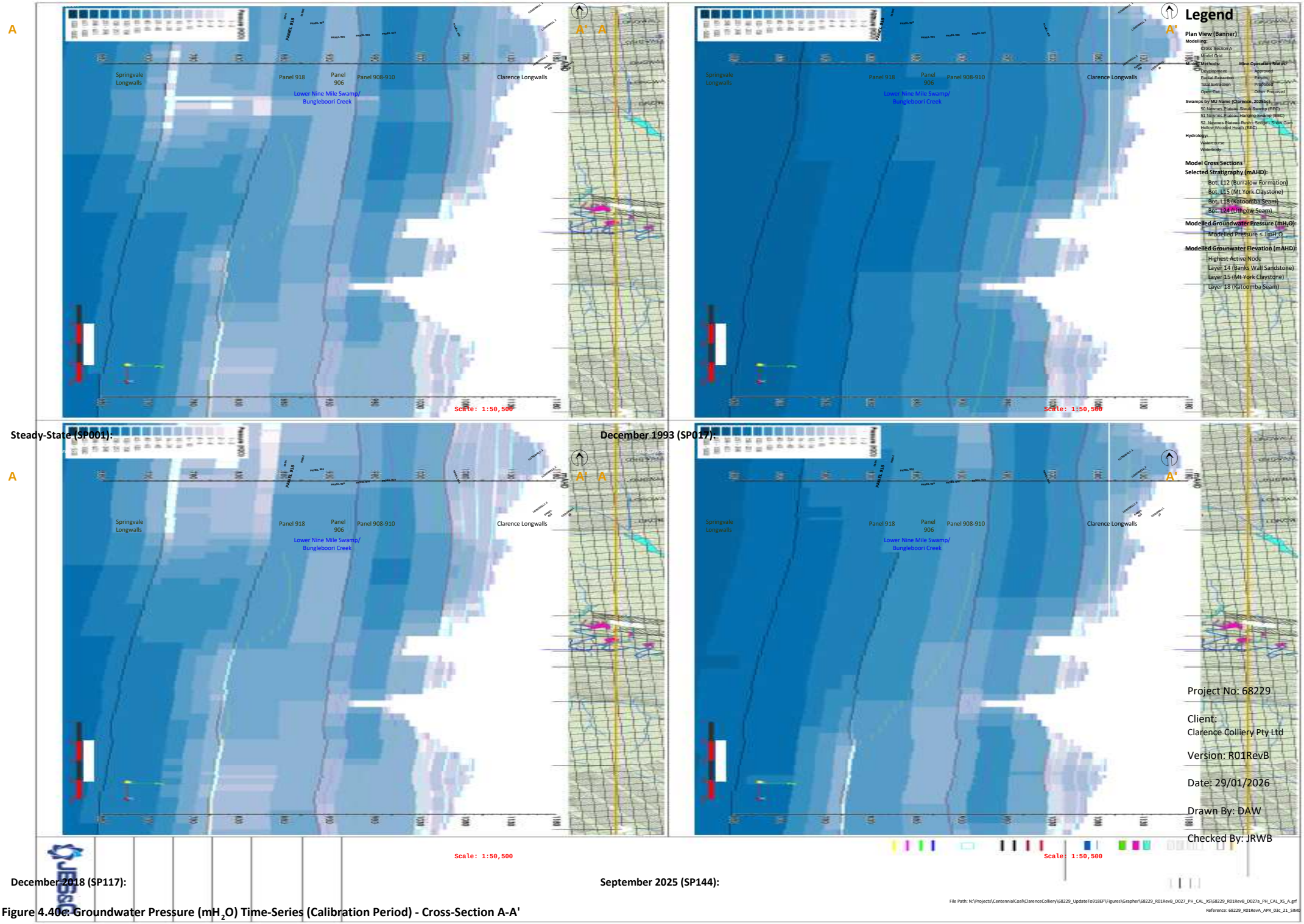


Figure 4.40c: Groundwater Pressure (mH_2O) Time-Series (Calibration Period) - Cross-Section A-A'

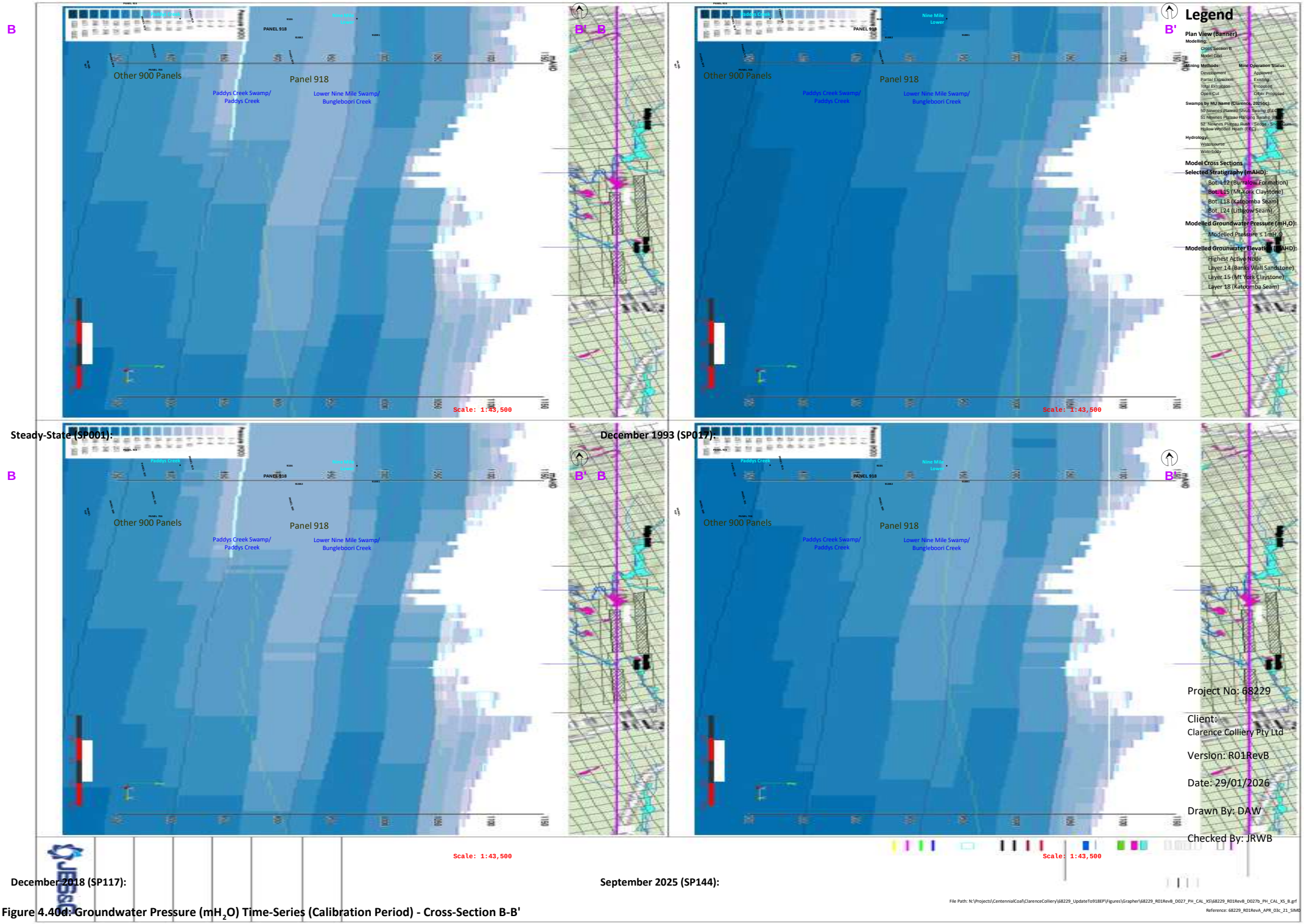


Figure 4.40d: Groundwater Pressure (mH_2O) Time-Series (Calibration Period) - Cross-Section B-B'

4.12.4.7 Mine Dewatering Rate

Figure 4-41 presents the modelled and observed dewatering rate (ML/d) and relative cumulative dewatering volume (ML) at Springvale Mine, Angus Place Colliery and Clarence Colliery. As indicated in **Figure 4-41**, cumulative volume was relative because it commenced at a specified time. It is also highlighted that the target seam at Clarence Colliery is the Katoomba Seam (Layer 18), whereas at Springvale Mine and Angus Place Colliery, the target seam is the Lithgow Seam (Layer 24).

From **Figure 4-41**, the fit to observed dewatering rate and relative cumulative volume is considered to be good.

Calibration statistics were generated using weighted residual, based on the measurement error stated in **Section 3.7.3**. The same weighting was used for dewatering rate and cumulative dewatering volume.

Analysis indicates that:

For Springvale Mine, the RMS of dewatering rate was 1.6ML/d, with a sRMS of 5.0%. The RMS of relative cumulative dewatering volume was 5979ML, with a sRMS of 4.2%.

For Angus Place Colliery, the RMS of dewatering rate was 1.3ML/d, with a sRMS of 12.2%. The RMS of relative cumulative dewatering volume was 1830ML, with a sRMS of 4.3%.

For Clarence Colliery, the RMS of dewatering rate was 2.2ML/d, with a sRMS of 19.2%. The RMS of relative cumulative dewatering volume was 4002ML, with a sRMS of 13.0%.

Greater inflows at Clarence Colliery are considered to be conservative. This is an improvement to the previous version of the groundwater model where inflows were less than observed (JBS&G, 2025ab). The improvement is considered to be due to inclusion of change to storage (specific yield, Sy) and change to Caley Formation (Layer 17) and Farmers Creek Formation (Layer 19) hydrogeological categorisation from shale to siltstone.

4.12.4.8 External Array Outputs

There has been limited hydraulic testing undertaken in the region. The location of tests (Packer Tests) that were undertaken are presented in **Figure 3-10**.

In general, Packer Tests provide more of an indication of horizontal hydraulic conductivity, rather than vertical hydraulic conductivity, due to the nature of the test procedure.

Table 4-26 presents the comparison between observed and modelled hydraulic conductivity at SPR1101.

From **Table 4-26**, calibrated values of hydraulic conductivity at SPR1101 are consistent with those obtained from hydraulic testing. This is, generally, expected due to the use of literature ranges (refer **Section 3.5.5**).

Table 4-27 and **Table 4-28** presents the results from the aquifer disturbance study undertaken at Springvale Mine at LW415 and LW416 (DGS, 2015), including modelled values of hydraulic conductivity (both horizontal and vertical hydraulic conductivity). **Table 4-26** presents pre-mining testing, whereas **Table 4-27** and **Table 4-28** present post-mining testing.

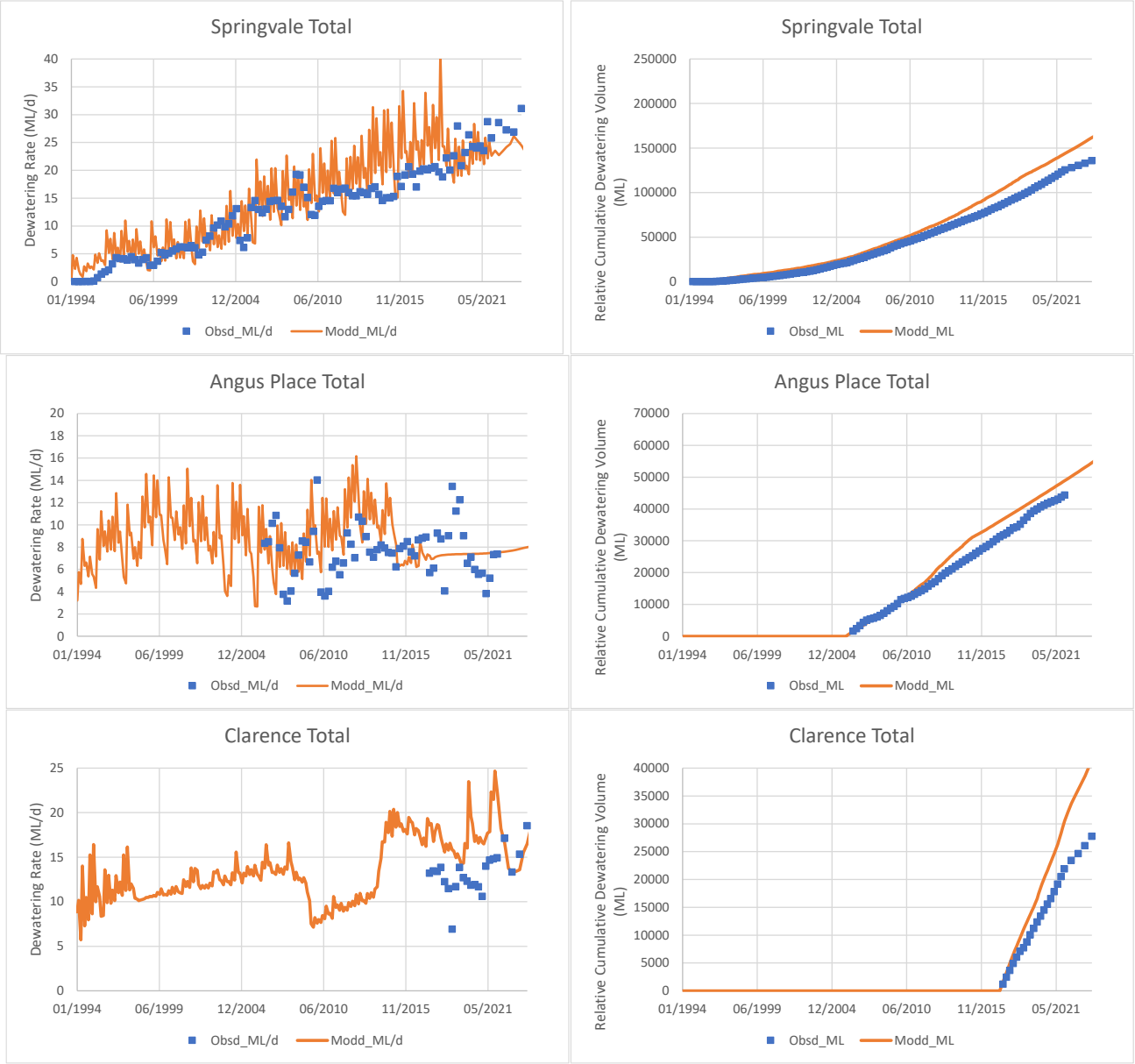


Figure 4-41: Dewatering Rate (ML/d) and Relative Cumulative Dewatering Volume (ML) – Calibration Period (Approved Case)

Table 4-26: Comparison to Estimated Hydraulic Conductivity – Packer Test (SPR1101(L01Node 10034); Pre-Mining)

Test Interval (mBGL)	Estimated Hydraulic Conductivity (m/s)	Layer	Unit	Calibrated(Kh, Kv) (m/s)
15	5.8E-08	5	Sandstone (between YS2 and YS3)	1.82E-07, 2.47E-08
21	1.2E-07	5	Sandstone (between YS2 and YS3)	“”
27	9.0E-08	7	Sandstone (between YS3 and YS4)	1.18E-07 1.47E-08
36	5.3E-08	7	Sandstone (between YS3 and YS4)	“”
53	1.4E-07	9	Sandstone (between YS4 and YS5)	1.26E-07, 1.54E-08
68	2.4E-08	9	Sandstone (between YS4 and YS5)	“”
78	2.0E-08	11	Sandstone (between YS5 and YS6)	4.35E-08, 4.30E-09

Test Interval (mBGL)	Estimated Hydraulic Conductivity (m/s)	Layer	Unit	Calibrated(Kh, Kv) (m/s)
90	9.4E-09	11	Sandstone (between YS5 and YS6)	“”
99.5	2.2E-08	12	Shale (YS6)	9.17E-09, 5.20E-10

Table 4-27: Comparison to Estimated Hydraulic Conductivity – Packer Test (LW416: SPR1401 (L01Node 10037); Post-Mining)

Test Interval (mBGL)	Estimated Hydraulic Conductivity (m/s)	Layer	Unit	Calibrated(Kh, Kv) (m/s)
47	1.6E-06	7	Sandstone (between YS3 and YS4)	5.27E-07, 2.20E-08
52	1.2E-06	8	Shale (YS4)	2.78E-08, 1.88E-09
72	2.1E-06	9	Sandstone (between YS4 and YS5)	9.18E-07, 2.77E-08
81	2.2E-07	11	Sandstone (between YS5 and YS6)	3.72E-07, 8.83E-09

Table 4-28: Comparison to Estimated Hydraulic Conductivity – Packer Test (LW415: SPR1402 (L01Node 10026); Post-Mining)

Test Interval (mBGL)	Estimated Hydraulic Conductivity (m/s)	Layer	Unit	Calibrated(Kh, Kv) (m/s)
62	2.4E-06	9	Sandstone (between YS4 and YS5)	1.49E-06, 3.99E-08
67	2.6E-06	9	Sandstone (between YS4 and YS5)	“”
74	8.8E-07	10	Shale (YS5)	6.85E-08, 2.83E-09
80	7.6E-07	11	Sandstone (between YS5 and YS6)	9.10E-07, 2.04E-08
89	4.9E-07	11	Sandstone (between YS5 and YS6)	“”

From **Table 4-27** and **Table 4-28**, the post-mining values of hydraulic conductivity at SPR1401 and SPR1402 are generally equivalent to or lower than the results obtained from hydraulic testing.

Table 4-29 and **Table 4-30** presents a comparison between calibrated values of hydraulic conductivity and the outcome of Packer Testing in the vicinity of Angus Place Colliery. The observed values presented in **Table 4-29** and **Table 4-30** are pre-mining values.

Table 4-29: Comparison to Estimated Hydraulic Conductivity – Packer Test (AP1PR (L01Node 5674); Pre-Mining)

Test Interval (mBGL)	Estimated Hydraulic Conductivity (m/s)	Layer	Unit	Calibrated(Kh, Kv) (m/s)
73.1 to 84.2	3.8E-07 to 6.0E-07	11	Sandstone (between YS5 and YS6)	1.73E-07, 2.77E-08
85.1 to 96.2	2.0E-07 to 5.1E-07	11	Sandstone (between YS5 and YS6)	“”
96.2 to 108.2	5.6E-08 to 7.6E-08	12	Sandstone/Shale (YS6)	9.91E-09, 7.11E-10
108.2 to 120.2	1.1E-07 to 8.5E-07	13	Banks Walls Sandstone	1.76E-07, 3.30E-08

Test Interval (mBGL)	Estimated Hydraulic Conductivity (m/s)	Layer	Unit	Calibrated(Kh, Kv) (m/s)
120.2 to 132.2	9.5E-08 to 1.1E-07	13	Banks Walls Sandstone	“”
132.2 to 144.2	6.9E-08 to 8.6E-08	13	Banks Walls Sandstone	“”
144.2 to 156.2	5.4E-08 to 6.9E-08	14	Banks Walls Sandstone	9.06E-08, 1.28E-08
156.2 to 168.2	3.4E-08 to 5.1E-08	14	Banks Walls Sandstone	“”
168.2 to 180.2	3.8E-08 to 4.5E-08	14	Banks Walls Sandstone	“”
180.2 to 186.2	5.9E-07 to 7.7E-07	14	Banks Walls Sandstone	“”

Table 4-30: Comparison to Estimated Hydraulic Conductivity – Packer Test (AP1109 (L01Node 3758); Pre-Mining)

Test Interval (mBGL)	Estimated Hydraulic Conductivity (m/s)	Layer	Unit	Calibrated(Kh, Kv) (m/s)
103.1 to 115.1	1.4E-09 to 3.8E-09 (DTW assumed to be 50m)	14	Banks Walls Sandstone	1.03E-07, 1.89E-08
131.8 to 143.8	8.4E-09 to 1.2E-08 (DTW assumed to be 84m)	15	Mount York Claystone	2.90E-09, 2.13E-10
143.5 to 155.5	5.6E-09 to 7.0E-09 (DTW assumed to be 84m)	15	Mount York Claystone	“”
166.4 to 178.4	6.6E-09 to 7.8E-09 (DTW assumed to be 84m)	16	Burra-Moko Head Sandstone	5.28E-08, 6.86E-09
302.6 to 314.6	5.6E-09 to 1.6E-08 (DTW assumed to be 84m)	22	Glen Davis/Long Swamp Formation	2.34E-08, 1.16E-09

From **Table 4-29** and **Table 4-30**, the modelled values are generally consistent with observed.

Table 4-31 and **Table 4-32** presents a comparison between calibrated values of hydraulic conductivity against hydraulic testing at Clarence Colliery at CLRP15 and at CLPR40. These tests were undertaken prior to mining.

Table 4-31: Comparison to Estimated Hydraulic Conductivity – Packer Test (CLRP15 (L01Node 23701); Pre-Mining)

Test Interval (mBGL)	Estimated Hydraulic Conductivity (m/s)	Layer	Unit	Calibrated(Kh, Kv) (m/s)
57.0 to 63.0	3.9E-08	14	Banks Wall Sandstone	1.40E-07, 2.35E-08
63.0 to 69.0	1.1E-07	14	Banks Wall Sandstone	“”
69.0 to 75.0	6.4E-08	14	Banks Wall Sandstone	“”
75.0 to 81.0	3.9E-07	14	Banks Wall Sandstone	“”
81.0 to 87.0	1.7E-07	14	Banks Wall Sandstone	“”
87.0 to 93.0	1.4E-07	14	Banks Wall Sandstone	“”
93.0 to 99.0	9.0E-08	15	Mount York Claystone	7.29E-09, 1.12E-09
99.0 to 105.0	7.0E-08	15	Mount York Claystone	“”
105.0 to 111.0	9.3E-08	15	Mount York Claystone	“”
111.0 to 117.0	1.7E-07	15	Mount York Claystone	“”
117.0 to 123.0	2.3E-07	15	Mount York Claystone	“”
123.0 to 129.0	1.3E-07	16	Burra-Moko Head Sandstone	9.80E-08, 1.38E-08

Test Interval (mBGL)	Estimated Hydraulic Conductivity (m/s)	Layer	Unit	Calibrated(Kh, Kv) (m/s)
129.0 to 135.0	5.8E-07	16	Burra-Moko Head Sandstone	“”
135.0 to 141.0	3.3E-07	16	Burra-Moko Head Sandstone	“”
141.0 to 147.0	2.1E-07	16	Burra-Moko Head Sandstone	“”
147.0 to 153.0	1.8E-07	16	Burra-Moko Head Sandstone	“”
153.0 to 159.0	1.1E-07	17	Caley Formation	7.50E-08, 8.81E-09
159.0 to 165.0	9.9E-08	17	Caley Formation	“”

Table 4-32: Comparison to Estimated Hydraulic Conductivity – Packer Test (CLRP40 (L01Node 14412); Pre-Mining)

Test Interval (mBGL)	Estimated Hydraulic Conductivity (m/s)	Layer	Unit	Calibrated(Kh, Kv) (m/s)
70.5 to 79.9	1.2E-09	14	Banks Wall Sandstone	8.53E-08, 9.30E-09
110.0 to 120.1	1.2E-08	14	Banks Wall Sandstone	“”
125.0 to 140.1	2.3E-08	15	Mount York Claystone	1.26E-09, 7.18E-11
149.5 to 160.0	6.9E-09	16	Burra-Moko Head Sandstone	9.09E-08, 1.38E-08
170.0 to 180.1	1.2E-08	16	Burra-Moko Head Sandstone	“”
212.5 to 220.1	2.3E-08	17	Caley Formation	3.38E-08, 2.21E-09
232.5 to 249.1	1.2E-08	17	Caley Formation	“”

From **Table 4-31** and **Table 4-32**, the modelled values are, again, generally consistent with observation.

By virtue of the nature of Packer Tests, more permeable joints (horizontally) within the tested interval will tend to dominate the hydraulic response. A further constraint is then the question of connectivity of those more permeable joints in the larger/bulk rock mass.

In summary, modelled values of hydraulic conductivity are generally consistent with observed values, or are lower by about one order of magnitude than the observation dataset, which is considered reasonable.

4.13 Relative Parameter Uncertainty Variance Reduction

Section 10.3.2 of Doherty (2025) explains that relative parameter uncertainty variance reduction is "*…the ability (or otherwise) of a history-matching dataset to reduce the uncertainty of a particular parameter.*"

Doherty (2025) notes that relative parameter uncertainty variance reduction ranges between zero and one, like parameter identifiability (Doherty and Hunt, 2009), but that relative parameter uncertainty variance reduction is a more robust statistic than parameter identifiability, as it does not depend on the selection of the singular value at which to divide solution space and null space.

GENLINPRED of Watermark Numerical Computing (2024) was used on the calibrated model.

Figure 4-42 presents a column chart of relative parameter uncertainty variance reduction with respect to each parameter used in the model. As noted above, there were 11354 parameters, of which 4 were fixed. Accordingly, 11350 parameters were relevant to relative parameter uncertainty variance reduction.

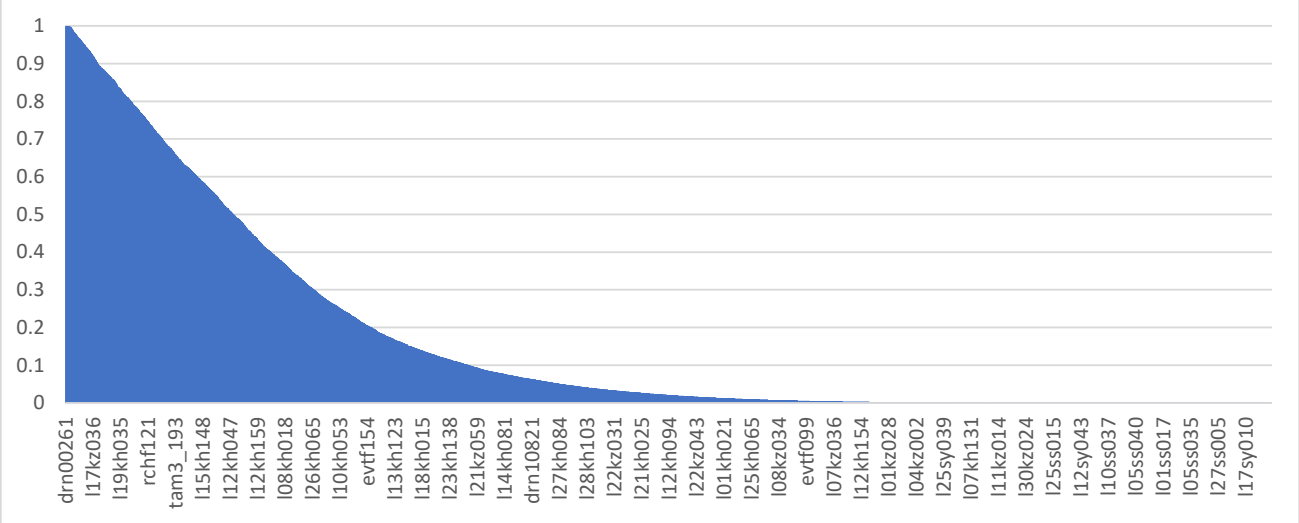


Figure 4-42: Relative Parameter Uncertainty Variance Reduction - All Parameters

From **Figure 4-42**, approximately 50% of the parameters have been adjusted during history-matching (a relative parameter uncertainty variance reduction of 0.05). From **Figure 4-42**, approximately 20% of the parameters have a relative parameter uncertainty variance reduction of greater than 0.4.

Column charts for the various parameter groups or tables, as relevant, are presented in **Appendix G**.

4.14 Sensitivity Analysis

The approach to presenting sensitivity analysis in this report is consistent with the Australian Modelling Guidelines (Barnett et. al., 2012), as per the following:

"***Guiding Principle 5.5:*** *Sensitivity analysis should be performed to compare model outputs with different sets of reasonable parameter estimates, both during the period of calibration (the past) and during predictions (in the future).*" [Page 57, Barnett et. al., 2012].

4.14.1 Approach to Uncertainty in Groundwater Model Simulations

CTH IESC (2023a) presents an Information Guideline Explanatory Note on potential approaches to the treatment of uncertainty in groundwater model simulations.

CTH IESC (2023a) categorises the approach to managing uncertainty into three main groups:

- scenario analysis
- linear error propagation
- ensemble methods.

The approach used in this report is an adaptation of the Calibration-Constrained Null Space Monte Carlo (NSMC) method of Doherty (2025). The "ensemble methods" group is the most sophisticated and the NSMC method sits within that group. PESTPP-iES (White, 2018 and USGS, 2020) is a 'fully' ensemble method.

300 sets of randomised parameters were generated via the Latin Hypercube Sampling technique (Watermark Numerical Computing, 2024) facilitated by the PEST utility PEST2LHS and RunLHS. The intent of Latin Hypercube Sampling is to generate a thoroughly and comprehensively randomised parameter sets. This is necessary since, without use of Latin Hypercube Sampling, tens of thousands to hundreds of thousands of samples would otherwise be required to demonstrate uncertainty analysis convergence. The generated parameter sets were centred on the calibrated parameter set, as is the requirement for PEST2LHS.

Appendix L presents the input data to the PEST2LHS utility, namely the standard deviation of each parameter. It is noted that all parameters were log-transformed. In **Appendix L**, for those parameters that consider a covariance matrix, those matrices include zones of bearing and anisotropy, as relevant, so as to incorporate regional 'trends'.

After generation of the 300 sets of randomised parameter values, 'calibration knowledge' was then superimposed using the PEST utility PNULPAR (Watermark Numerical Computing, 2024). In doing so, where there was 'calibration knowledge', that knowledge is reflected in a reduced range of values of a particular parameter, including consideration of covariance matrices, as relevant. **Section 4.13** presents further detail of the relative parameter uncertainty variance reduction due to model calibration.

Table 4-33: Adopted Standard Deviations for Latin Hypercube Sampling of Parameter Values

Parameter	Example Lower of Range	Example Upper of Range	Standard Deviation (in Log Space)	Units	Covariance Matrix[2]
Evapotranspiration (EVT):					
Evapotranspiration Factor Pilot Point	0.4550	0.5450	0.0196	-	Yes[3]
Evapotranspiration Extinction Depth Pilot Point (m)	1.28	1.73	0.0330	m	Yes
Recharge (RCH):					
Recharge Factor Pilot Point	0.160	0.240	0.0440	-	Yes
Enhanced Recharge, Recharge Factor Adjustment Factor (Addition) – Open Cut	1.120	1.180	0.00434	-	No

Parameter	Example Lower of Range	Example Upper of Range	Standard Deviation (in Log Space)	Units	Covariance Matrix[2]
Enhanced Recharge, Recharge Factor Adjustment Factor (Addition) – Low W/H	1.0043	1.0558	0.00543	-	No
Enhanced Recharge, Recharge Factor Adjustment Factor (Addition) – Medium W/H	1.0049	1.0252	0.00217	-	No
Enhanced Recharge, Recharge Factor Adjustment Factor (Addition) – High W/H	1.0780	1.1220	0.00434	-	No
River (RIV):					
Streambed hydraulic conductivity	4.00E-08	2.50E-07	0.199	m/s	No
General Head Boundary (GHB)					
Global Head Change in Layer	17.00	23.00	0.0328	m	No
Global Conductance in Layer	1.83	2.47	0.0328	m^2/d	No
Head Adjustment at Segment Vertex within Layer	8.50	11.50	0.0328	m	No
Scaling Factor to Conductance at Segment Vertex within Layer[4]	0.850	1.150	0.0328	-	No
Drain (DRN):					
Global Conductance (Stacked Drain) - Top	1.500	3.500	0.0920	m^2/d	No
Global Conductance (Stacked Drain) – Bottom	35.00	65.00	0.0672	m^2/d	No
Global Conductance (Seep, General Dewatering)	80.00	120.0	0.0440	m^2/d	No
Global Conductance (Mine Water Management)	60.0	140.0	0.0920	m^2/d	No
Scaling Factor to Conductance of Seepage Face[4]	0.480	1.120	0.0920	-	No
Scaling Factor to Conductance of Stacked Drains[4]	0.7000	1.3000	0.0672	-	No
Scaling Factor to Conductance of Mine Water Management[4]	0.6000	1.4000	0.0920	-	No
Streambed Hydraulic Conductivity (Strahler Order 1)	2.00E-07	1.25E-06	0.1990	m/s	No
Sequence Multipliers of Streambed Hydraulic Conductivity (Strahler Order 2 through 5 and above)	1.1944	1.7916	0.0440	-	No
Hydraulic Properties:					
Horizontal Hydraulic Conductivity, Kh Pilot Point	2.76E-03	1.73E-02	0.1990	m/d	Yes
Vertical Hydraulic Conductivity Adjustment Factor, KvF Pilot Point[4,5]	0.7500	1.2500	0.0555	-	Yes
Specific Storage, Ss Adjustment Factor, SsF Pilot Point[4,5]	0.9000	1.1000	0.0218	-	Yes
Specific Yield, Sy Adjustment Factor, SyF Pilot Point[4,5]	0.9620	1.1180	0.0163	-	Yes
Unsaturated Hydraulic Properties Scaling Factor to position within Range of Horizontal Hydraulic Conductivity[4]	0.950	1.050	0.0109	-	No
Lineament Type 1 Vertical Hydraulic Conductivity	2.50E-09	1.00E-08	0.1505	m/s	No
Lineament Type 2 Vertical Hydraulic Conductivity to Lineament Type 1 Vertical Hydraulic Conductivity Sequential Multiplier	0.740	0.860	0.0163	-	No

Parameter	Example Lower of Range	Example Upper of Range	Standard Deviation (in Log Space)	Units	Covariance Matrix[2]
Lineament Type 3 Vertical Hydraulic Conductivity to Lineament Type 2 Vertical Hydraulic Conductivity Sequential Multiplier	0.740	0.860	0.0163	-	No
Depth-Dependent Multiplication of Horizontal Hydraulic Conductivity (Ground Surface) at 1mBGL	1.91	2.59	0.0328	-	No
Depth-Dependent Multiplication of Horizontal Hydraulic Conductivity (Top of Group) at 1mBGL	2.13	2.88	0.0328	-	No
Time-Varying-Materials (TVM)[8]:					
Ramp Function for Model Mining Method 5 (extraction; longwall method, with extraction ratios greater than 85%; full goafing). Direct values and sequential multipliers of horizontal and vertical hydraulic conductivity:					
TVM61_KH01 through TVM61_KH10	1.530	1.870	0.0218	-	No
TVM61_KH11[6]	175.0	325.0	0.0672	-	No
TVM61_KH13[6]	1.480	1.716	0.0161	-	No
TVM61_KV01 through TVM61_KV10	1.530	1.870	0.0218	-	No
TVM61_KV11[6]	175.0	325.0	0.0672	-	No
TVM61_KV13[6]	1.480	1.716	0.0161	-	No
TVM61_SY10	1.0050	1.0090	0.000216	-	No
TVM61_SY11	1.0300	1.0500	0.000431	-	No
TVM61_SY13	1.0003	1.0005	0.002088	-	No
Ramp Function for Model Mining Method 1 (development; non-goafing). Direct values of horizontal and vertical hydraulic conductivity:					
TVM01_KH10	1.77	2.16	0.0174	-	No
TVM01_KH11	48.8	73.2	0.0352	-	No
TVM01_KV10	1.91	2.34	0.0174	-	No
TVM01_KV11	48.8	73.2	0.0352	-	No
TVM01_SY10	1.0020	1.0040	0.0161	-	No
TVM01_SY11	1.0700	1.1300	0.000216	-	No
Ramp Function for Model Mining Method 1 (development, individual additional bords; non-goafing). Sequential multiplier of Ramp Function for development:					
TVM11_KH10	1.0043	1.0558	0.0043	-	No
TVM11_KH11	0.990	1.210	0.0174	-	No
TVM11_KV10	1.662	2.031	0.0174	-	No
TVM11_KV11	1.095	1.338	0.0174	-	No
TVM11_SY10	1.0007	1.0013	0.00592	-	No
TVM11_SY11	1.0020	1.0040	0.000065	-	No
Other parameters:					
TVM_SYFACT	0.4600	0.5400	0.000022	-	No
TAM3 Pilot Point	2.1243	2.1457	0.00109	-	Yes
TAM5 Pilot Point	192.0	208.0	0.0087	-	Yes

Parameter	Example Lower of Range	Example Upper of Range	Standard Deviation (in Log Space)	Units	Covariance Matrix[2]
TVM_MTH4 – adjustment to height of HA2 for extraction (Model Mining Method 4) from extraction (Model Mining Method 5)	0.8775	0.9225	0.0054	-	No
TVM_FILLKH and TVM_FILLKV – assumed values of hydraulic conductivity for backfilled open cut (Model Mining Method 6)	5.00E-05	2.00E-04	0.1505	m/d	No
TVM_KMAX01 through TVM_KMAX03 – upper limit (partially reconsolidated) for hydraulic conductivity for Goaf (Caved Zone and Mined Seam), Zone A and Above Zone A respectively	3.20E-06	2.00E-05	0.1505	m/s	No
TVM_MODS_01 – scaling factor of ramp function for development (Model Mining Method 1)	1.0043	1.0558	0.00543	-	No
TVM_MODS_21 – scaling factor of ramp function for extraction (Model Mining Method 2)	1.0450	1.1550	0.01087	-	No
TVM_MOD3161[10] – scaling factor of ramp function from extraction (Model Mining Method 5) to extraction (Model Mining Method 4)	0.630	0.770	0.02179	-	No
TVM_MOD2131 – scaling factor of ramp function from extraction (Model Mining Method 4) to extraction (Model Mining Method 2)	0.160	0.240	0.0440	-	No
TVM_BASEK – minimum change base value (hydraulic conductivity) due to extraction (Model Mining Method 4 and 5 only)	5.00E-10	2.00E-09	0.1505	m/s	No
TVM_REF21 – reference width-to-height ratios for extraction (Model Mining Method 2).	0.090	0.110	0.02179	-	No
TVM_REF31[9] – reference width-to-height ratios for extraction (Model Mining Method 4).	0.360	0.440	0.02179	-	No
TVM_REF61[9] – reference width-to-height ratios for extraction (Model Mining Method 5).	0.630	0.770	0.02179	-	No
TVM_SC_LIN – scaling parameter for ScaleFactor (nominated in GIS file) of lineaments (Model Mining Method 3, 4 and 5)	0.765	0.935	0.02179	-	No
TVM_SC_EXT – scaling parameter for ScaleFactor (nominated in GIS file) of lineament reactivation (extraction (Model Mining Method 4 and 5) only)	0.675	0.825	0.02179	-	No
TVM_SC_LINMX - adjustment factor for influence of lineaments (all Model Mining Methods)	0.6750	0.8250	0.02179	-	No

Notes. 2) Covariance matrices prepared on a layer-by-layer basis. i.e. they are 2D matrices, rather than 3D matrices.; 3) Uses the same location of Pilot Points as Recharge Factor.; 4) Scaling factor, centred on 1.0.; 5) Pilot Points of adjustment factors share the same location.; 6) Direct values, rather than sequential multipliers, used for TVM61_KH02, TVM61_KH11 and TVM61_KH13.; 7) TVM61_KH08, TVM61_KV08, TVM61_KH05 and TVM61_KV05 were fixed in PEST.; 8) Changes to hydraulic conductivity only.; 9) The values are used for adjustment of Scale Factor (read from GIS).; 10) It is noted that Model Mining Method 3 is an adaptation of Model Mining Method 4, therefore separate parameterisation was not required.

A copy of the parameter uncertainty file is provided in **Appendix L**.

It noted that 're-calibration' of the NSMC simulations was not undertaken. This is conservative approach, since it leads to greater uncertainty. Due to the use of PNULPAR, which is the basis of the NSMC method, model simulations incorporating uncertainty analysis are already close to calibration and hence a 'calibration reject methodology' is not required.

4.14.1.1 Prior and Posterior Histograms

To demonstrate the effect of model calibration (history-matching), a second set of model parameters were generated via the Latin Hypercube Sampling methodology. Those parameters used the same parameter uncertainty file and covariance matrices, where relevant, but with an amended PEST control file (.PST), where uncalibrated, initial values were used. The initial values were typically centred between the lower and upper bound, but adjusted where appropriate.

Prior and posterior histograms for selected model parameters from various parameter groups are presented below, in **Figure 4-43** to **Figure 4-50**, for the purpose of illustration.

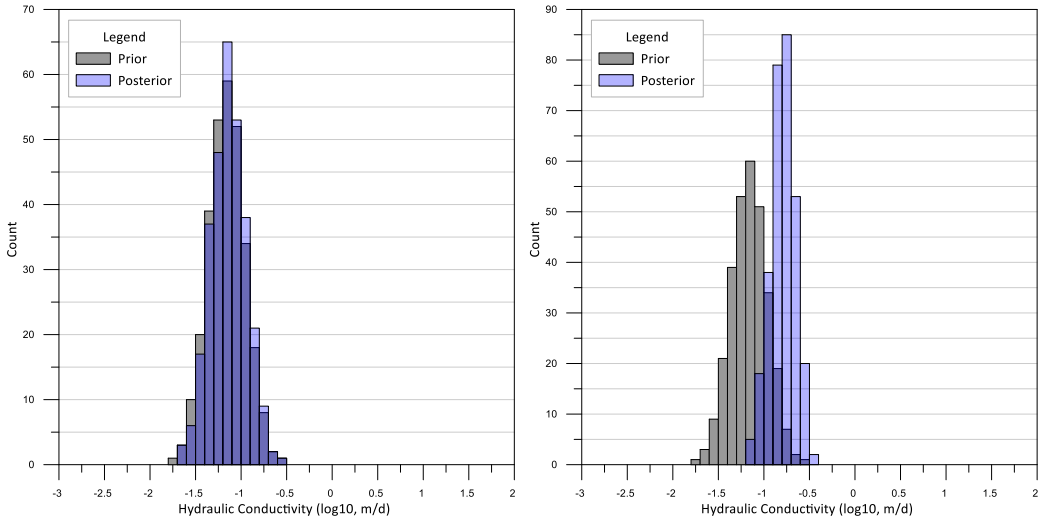


Figure 4-43: Horizontal Hydraulic Conductivity, Kh Pilot Point (l18kh095 and l18kh039)

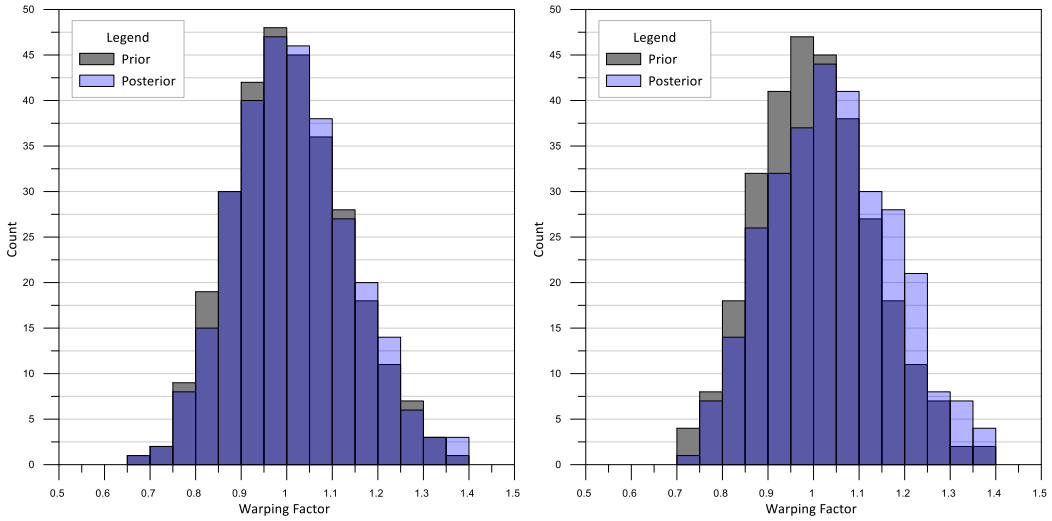


Figure 4-44: Vertical Hydraulic Conductivity Warping Factor, KvF Pilot Point (l18kz034 and l18kz020)

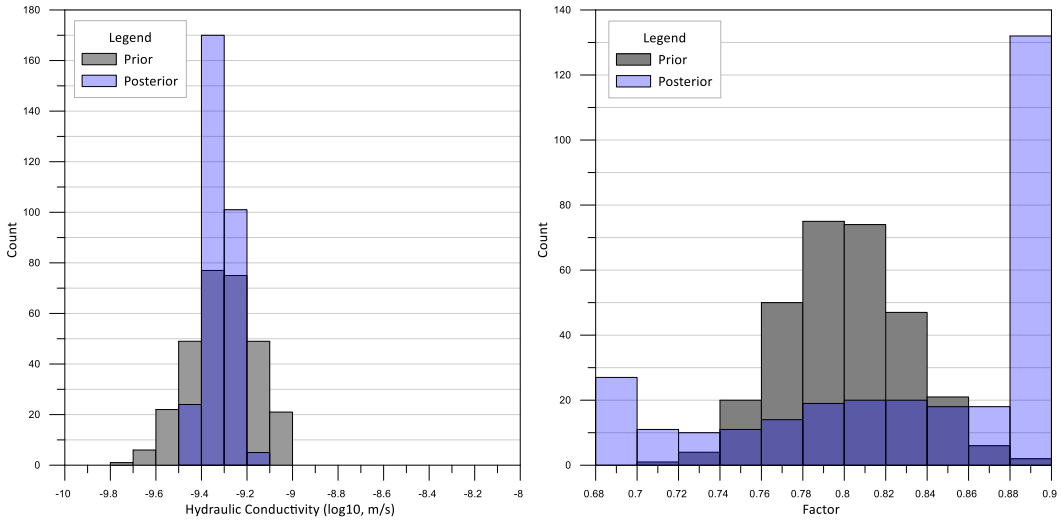


Figure 4-45: Type 1 Lineament Vertical Hydraulic Conductivity and Type 2 to Type 1 Sequential Multiplier (lmtkv_t1 and lmtkvf_t2t1)

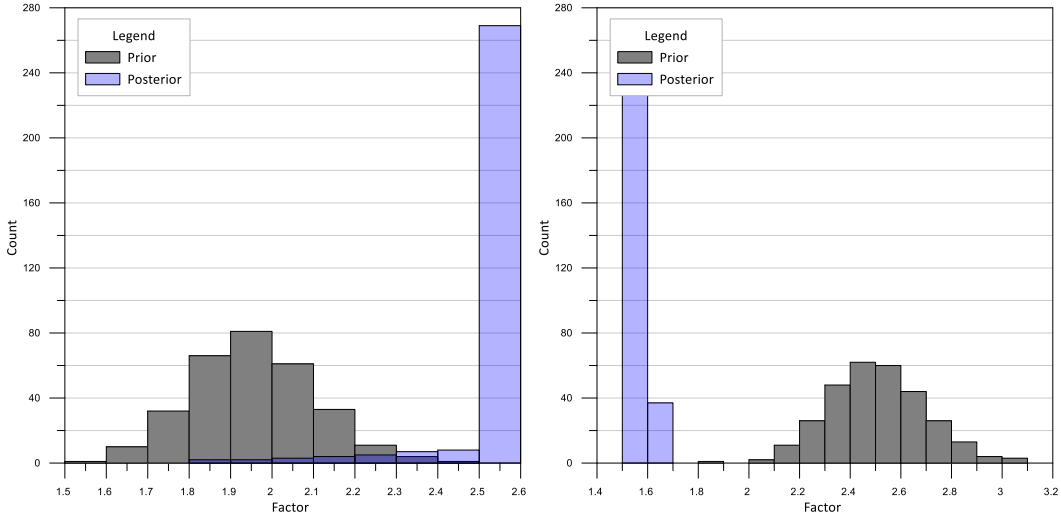


Figure 4-46: Depth-Dependent Modification Factor (Top of Group) and Depth-Dependent Modification Factor (Ground Surface) (dd_tg02 and dd_gs04)

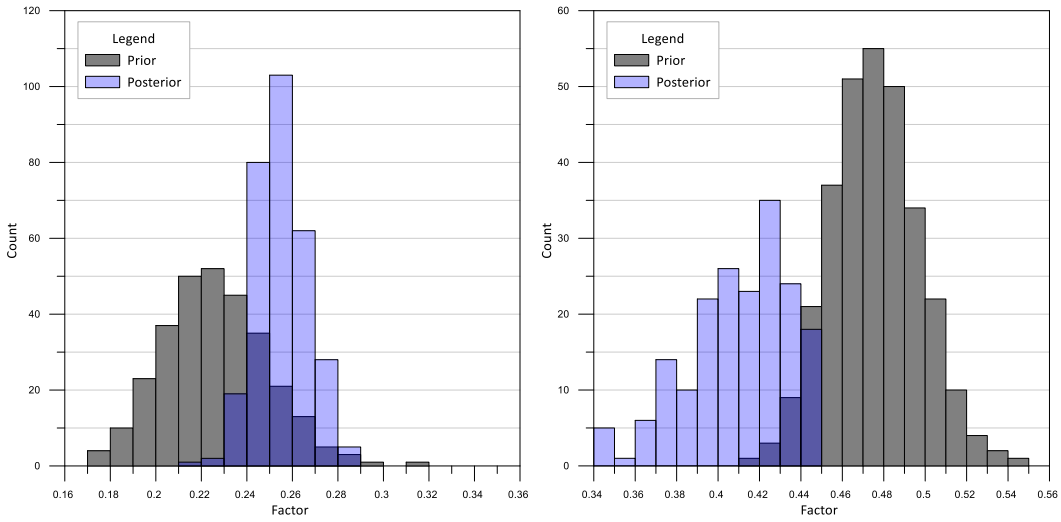


Figure 4-47: Recharge Factor Pilot Point (rchf141) and Evapotranspiration Factor Pilot Point (evtf156)

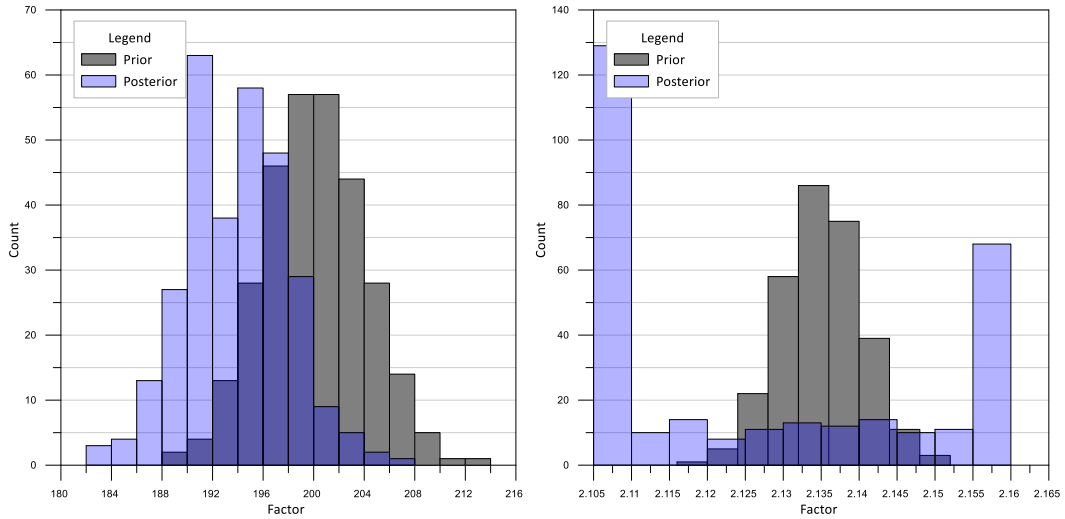


Figure 4-48: Height of Top of Zone A (Model Mining Method 3, 4 and 5) Pilot Point (tam5_039) and Height of Top of Zone A (Model Mining Method 2) Pilot Point (tam3_084)

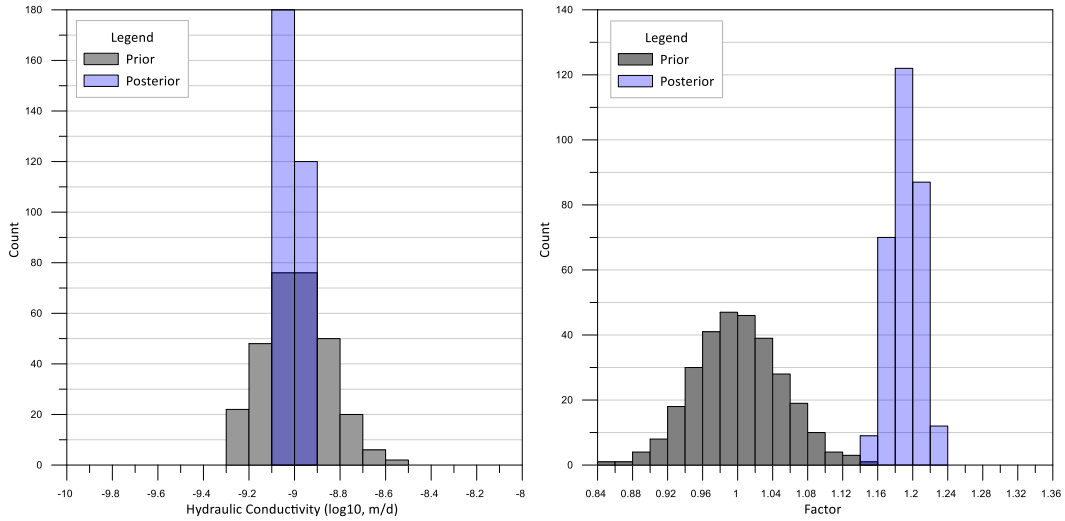


Figure 4-49: Base minimum resultant hydraulic conductivity (tvm_basek) and Global Scaling Factor of influence of Lineaments by Extraction Cells (tvm_sc_ext)

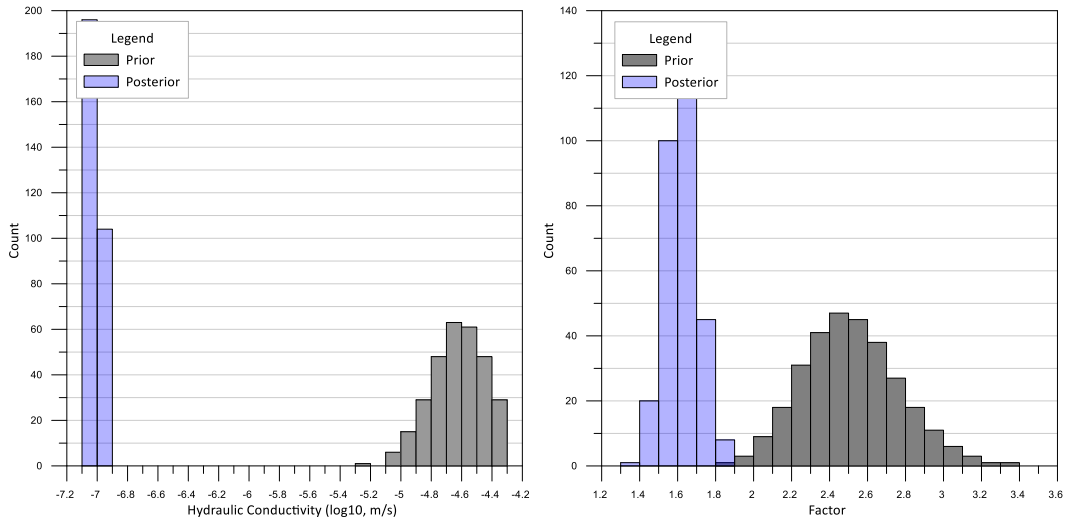


Figure 4-50: Streambed hydraulic conductivity of Strahler Order 1 ephemeral watercourse (drn_k_so1) and Sequential Multiplier of Strahler Order 2 compared to Strahler Order 1(drn_k_so2)

4.14.2 Approach to Processing Stochastic Model Results

300 sets of model simulations were prepared. These include the Approved Case (APR) and Proposed Case (PRO). The definitions of Approved Case and Proposed Case are provided in **Section 4.15.3** below.

After completion of the simulations, the integrity of each set of simulations (Approved Case and Proposed Case) was reviewed.

For the State Mine Complex, recovery from previous dewatering (represented by drain (DRN) boundary conditions) and the introduction of the general head boundary (GHB) (refer **Section 4.10.2.8**) led to localised convergence difficulty in many of the stochastic simulations. That difficulty did not propagate to other stress periods and did not led to cell-by-cell budget mass balance error issues. To resolve this issue, model output at SP12TS10, SP13TS10 and SP17TS10 were excised from head (.HDS) files.

Following review, 286 of the 300 sets of simulations were utilised in this report. Sets of simulations (after excising the abovementioned model output times) were excluded if any particular model did not converge, and the residual was more than 0.5m, at a particular stress period.

For the 286 valid sets of simulations, the following approach has been used with respect to processing:

- Groundwater Elevation
    - Groundwater elevations for the Approved Case (APR) for the Calibration Period were ranked in order of smallest to largest, at each model node (at each stored model time), with the 10th percentile and 90th percentile values recorded. These ranked groundwater elevations are referred to as R10 and R90, respectively.

Whilst all 286 sets of simulations were used, as they were available, it is necessary to demonstrate that this number of simulations is sufficient to achieve uncertainty analysis convergence. Uncertainty analysis convergence is demonstrated in **Appendix I**, using change in groundwater elevation at Clarence Colliery, which shows that increasing number of simulations, beyond 200 simulations, does not lead to significant change to the modelled change to groundwater elevation (10th and 90th percentile ranked change).

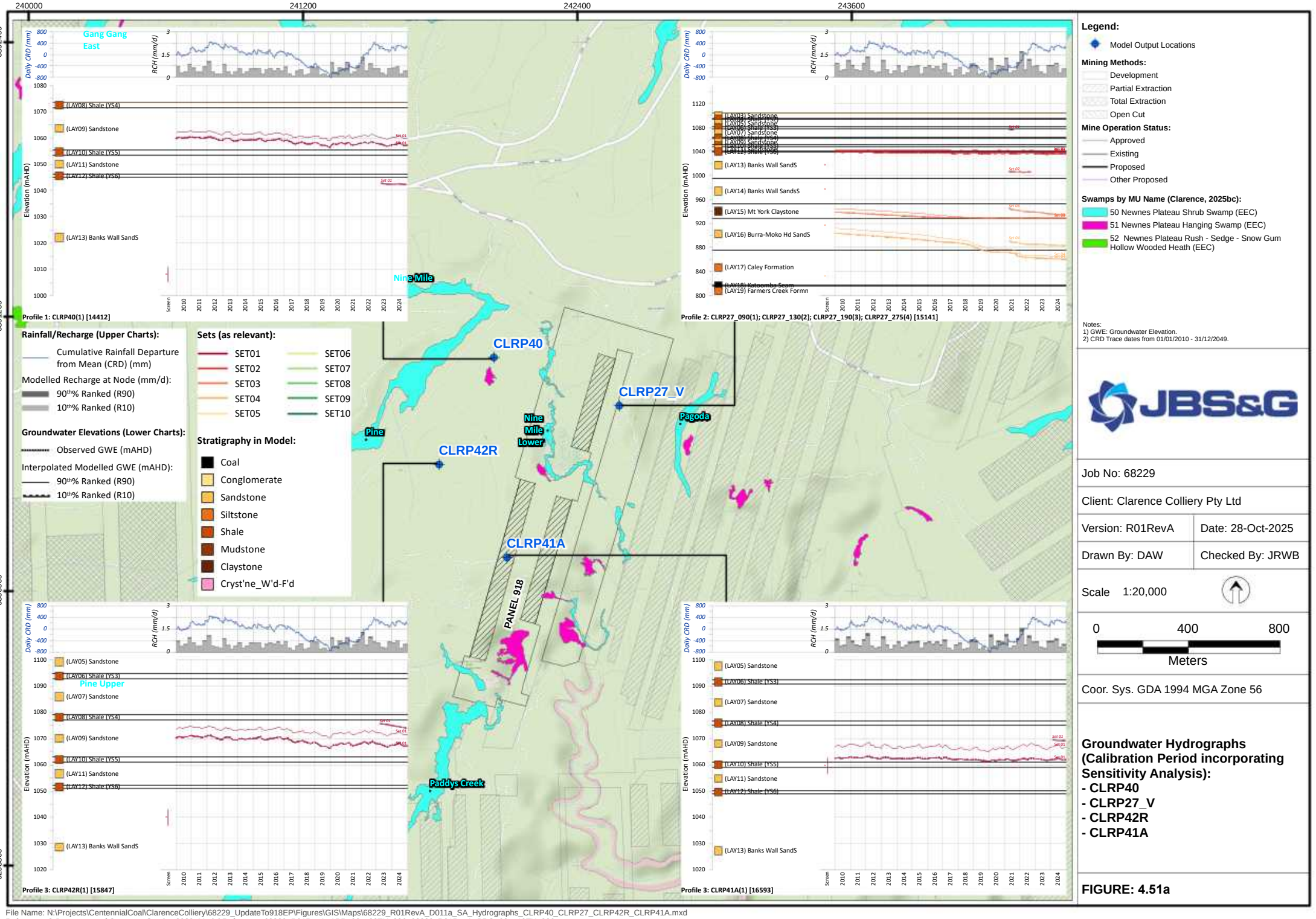
4.14.3 Groundwater Hydrographs

Groundwater hydrographs were prepared for the same monitoring piezometers as presented for model calibration (refer **Section 4.12.4.4**) and presented in **Figure 4-51**. It is noted that model output was interpolated in three-dimensions in **Figure 4-51**, as per the approach used in **Section 4.12.4.4**.

From **Figure 4-51a**, the difference groundwater elevation in the hydrograph for CLRP40 is about 4m, between the R10 and R90 model output. As per the interpretation presented in **Section 4.12.4.4**, the groundwater model is high at this location compared to observation. From **Figure 4-51a**, at CLRP27_V, the range between R10 and R90 model output is more pronounced below the Mount York Claystone (Layer 15), being about 10m, but that difference diminishes as groundwater elevation decline. The groundwater elevation decline in the deep groundwater system reflects influence of depressurisation of 908-910 Panel Area and 906 Panel. From **Figure 4-51a**, the range of model output at CLRP42R is about 5m and the modelled fit to observed groundwater elevation is considered reasonable. From **Figure 4-51a**, the range between R10 and R90 model at CLRP41A is 5m. Model output is consistent with observed, inclusive of sensitivity analysis.

From **Figure 4-51b**, the range between R10 and R90 at CLRP29_V is about 5m for Sensor#1 and is about 10m for Sensors #2 through #4. It is interpreted that, as CLRP29_V is located at distance from existing Clarence and Springvale mine workings, Sensors #2 through #4 do not coalesce over time, as was evident in CLRP27_V (refer **Figure 4-51a**). From **Figure 4-51b**, the range of model output at CLRP28 is about 7m and at CLRP18_V, the range is about 5m. From **Figure 4-51b**, for CLR22_V, there is coalescence of groundwater elevation both Sensor #1 and #2.

From **Figure 4-51c**, the range of model output for CLRP14_V is about 4m for Sensor #1 and #2. For Sensor#3 and #4, the range of model output is 10m, which reduces to about 1m from 2014 onward. From **Figure 4-51c**,



Job No: 68229

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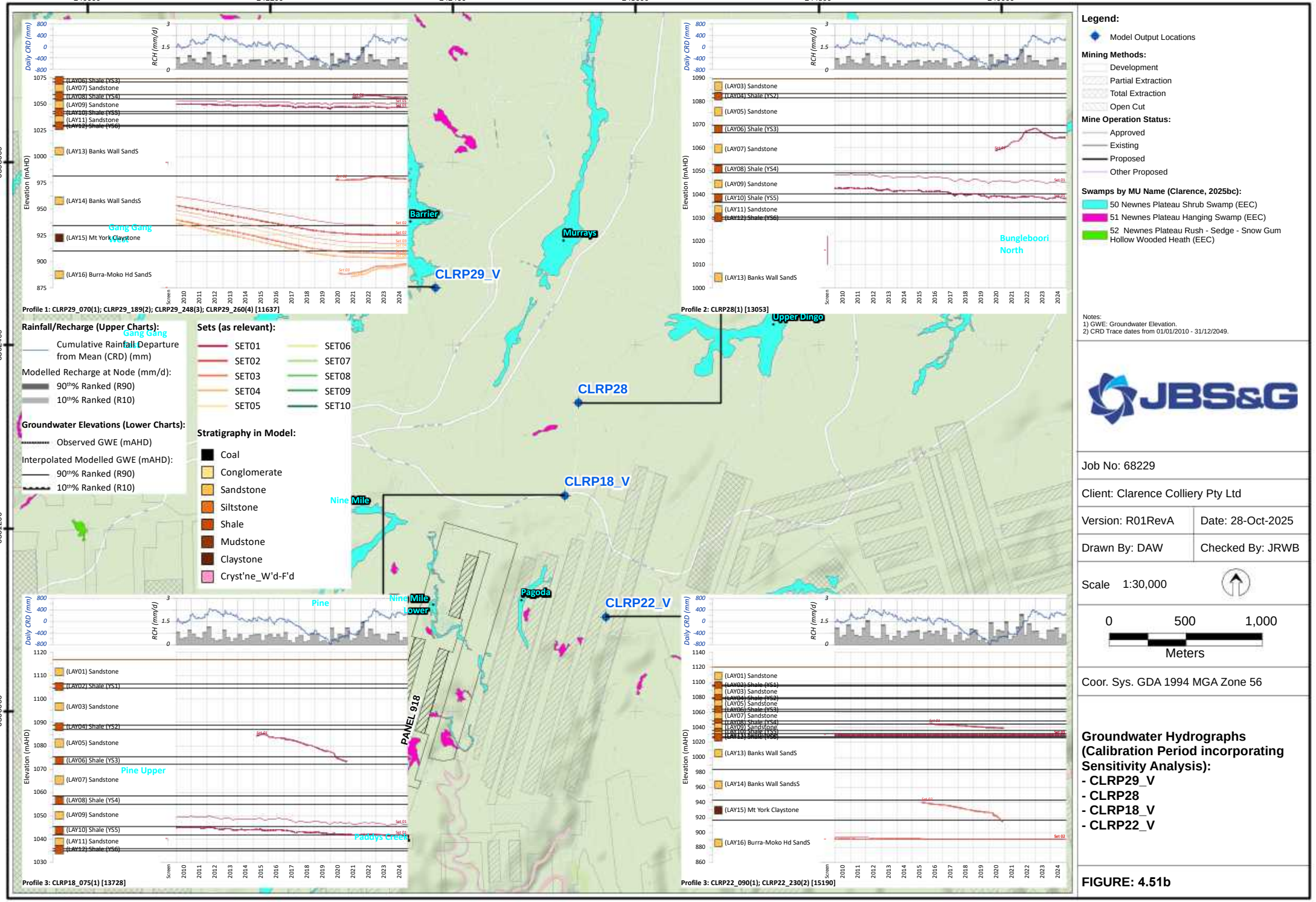
Coor. Sys. GDA 1994 MGA Zone 56

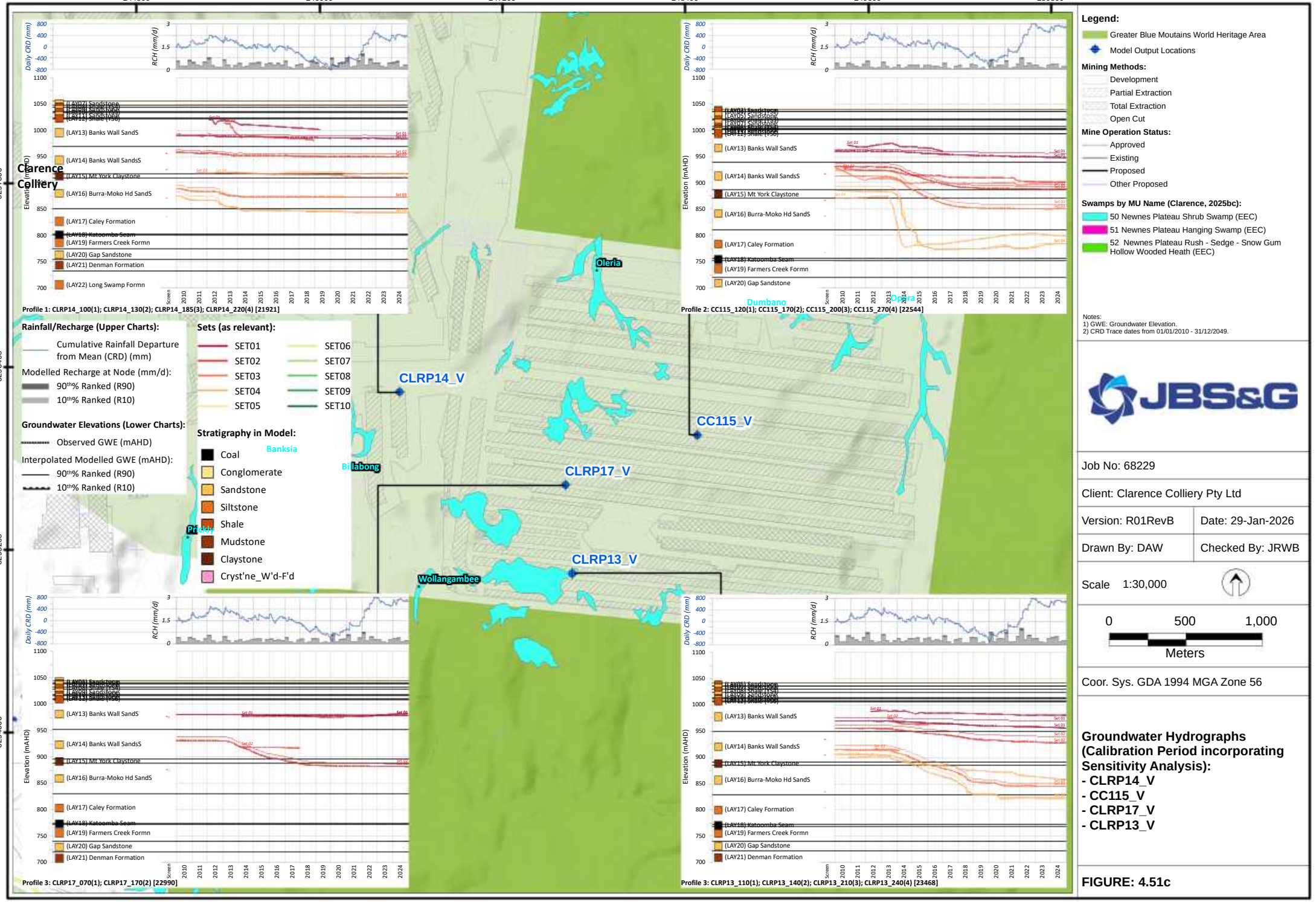
Groundwater Hydrographs (Calibration Period incorporating Sensitivity Analysis):
- CLRP40
- CLRP27_V
- CLRP42R
- CLRP41A

FIGURE: 4.51a

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D011a_SA_Hydrographs_CLRP40_CLRP27_CLRP42R_CLRP41A.mxd



File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D011b_SA_Hydrographs_CLRP29_CLRP28_CLRP18_CLRP22.mxd
Reference: © Department of Customer Service 2020; Model Reference: 68229_R01RevA_APR_03c_90TH_286, 68229_R01RevA_PRO_02a_10TH_286.



Job No: 68229

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Drawn By: DAW | Checked By: JRWB

Scale 1:30,000

Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Calibration Period incorporating Sensitivity Analysis):
- CLRP14_V
- CC115_V
- CLRP17_V
- CLRP13_V

FIGURE: 4.51c

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevB_D011c_SA_Hydrographs_CLRP14_CC115_CLRP17_CLRP13.mxd

From **Figure 4-51c**, at CC115_V, which is located above the 800 Panel Area, at Sensor#4, has a minimal range in groundwater elevation. For Sensor#2 and #3, the range is 5m, and is also 5m for Sensor#1. From **Figure 4-51c**, stochastic model output is quite consistent in terms of response to dewatering of the mined seam in this area. From **Figure 4-51c**, the range of model output for CLRP17_V is about 2m for Sensor#1 and is about 5m for Sensor#2, with both being consistent with observation. From **Figure 4-51c**, at CLRP13_V, the range of model for Sensor#1 and #2 is about 10m and is 5m in Sensor#3 and is minimal for Sensor#4.

Figure 4-51d presents outcomes of sensitivity analysis for CLRP33_V, CLRP2_V, CLRP3_V and CLRP19_V. CLRP33_V is located to the north of the 300 Panel Area, with CLRP2_V and CLRP3_V located above the 300 Panel Area. CLRP19_V is located above the 800 Panel Area. From **Figure 4-51d**, the range of model output, which is consistent with observation, is about 5m for the upper sensors and is up to 10m for the lower sensors. From **Figure 4-51d**, there is a 5m range for Sensor#2 and #3, a range of about 2m for Sensor#1 and a minimal range for Sensor#4. If there is a minimal range (e.g. Sensor#4), this is considered to be caused by two factors. The first is that the parameters that inform groundwater response at that depth have a limited range ('calibration knowledge' imparted to parameter values through the PEST utility, PNULPAR) and the second is that the strength of the drain (DRN) boundary conditions, which represent dewatering, dominate the hydrogeologic response (this is expected).

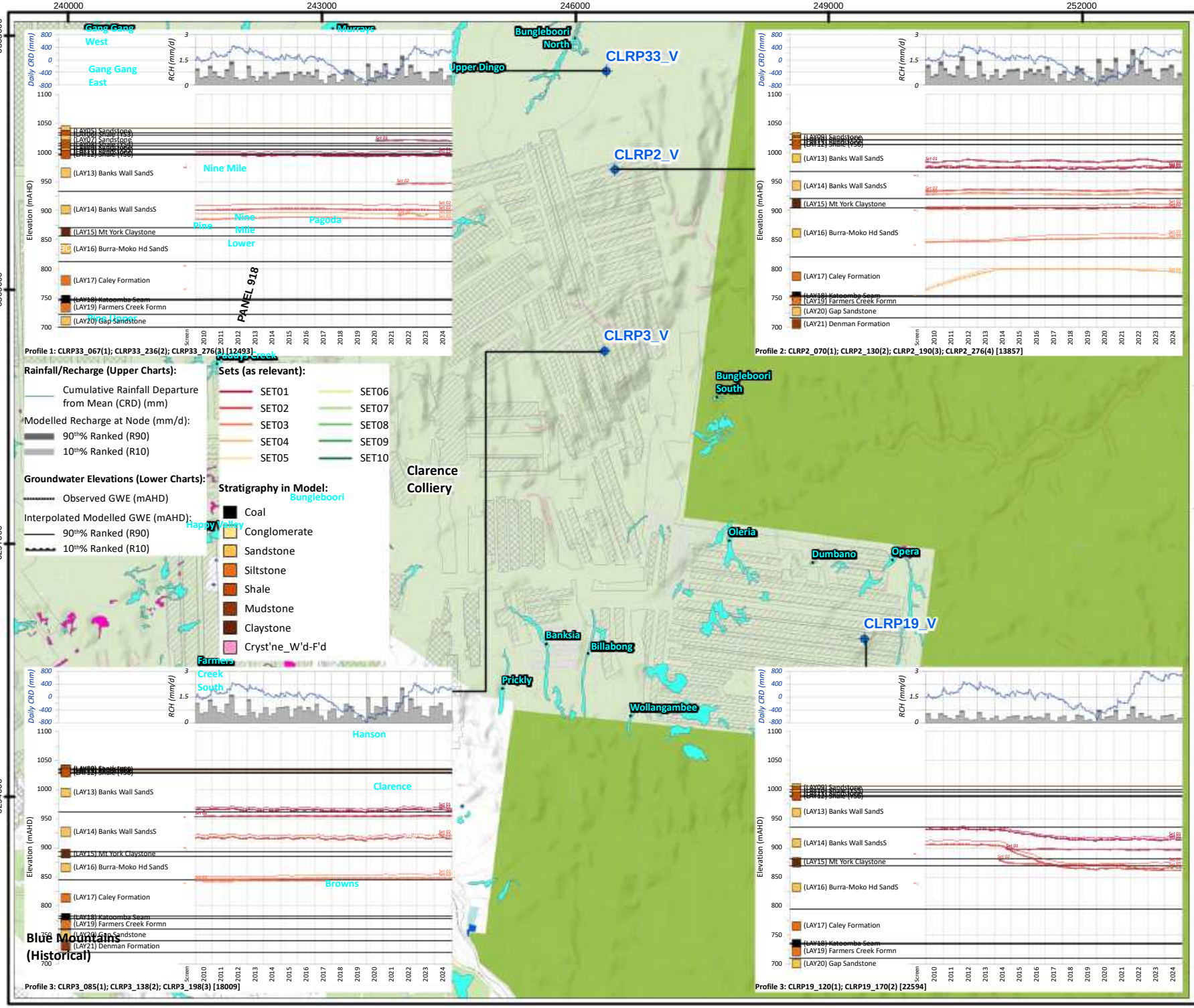
Figure 4-51e presents interpolated groundwater elevation from vibrating wire piezometers installed at Springvale Mine. From **Figure 4-51e**, the range of model output at these sensors is small, being 5m or less. As discussed with respect to **Figure 4-51d**, the drain (DRN) boundary conditions will dominate hydrogeologic response.

From **Figure 4-51f**, the range of modelled groundwater elevation at the NSW DCCEEW monitoring locations is about 10m at each of the sensors. From **Figure 4-51f**, there is minimal range for CSP9, and also at CSP8. This will be due to the presence of a drain (DRN) boundary condition at that elevation in the model, the strength of which (even though the conductance is set at a moderately for these swamps and ephemeral watercourses) dominates the groundwater elevation response. From **Figure 4-51f**, at CLRP31, the range in model output at Sensor#1 is about 10m.

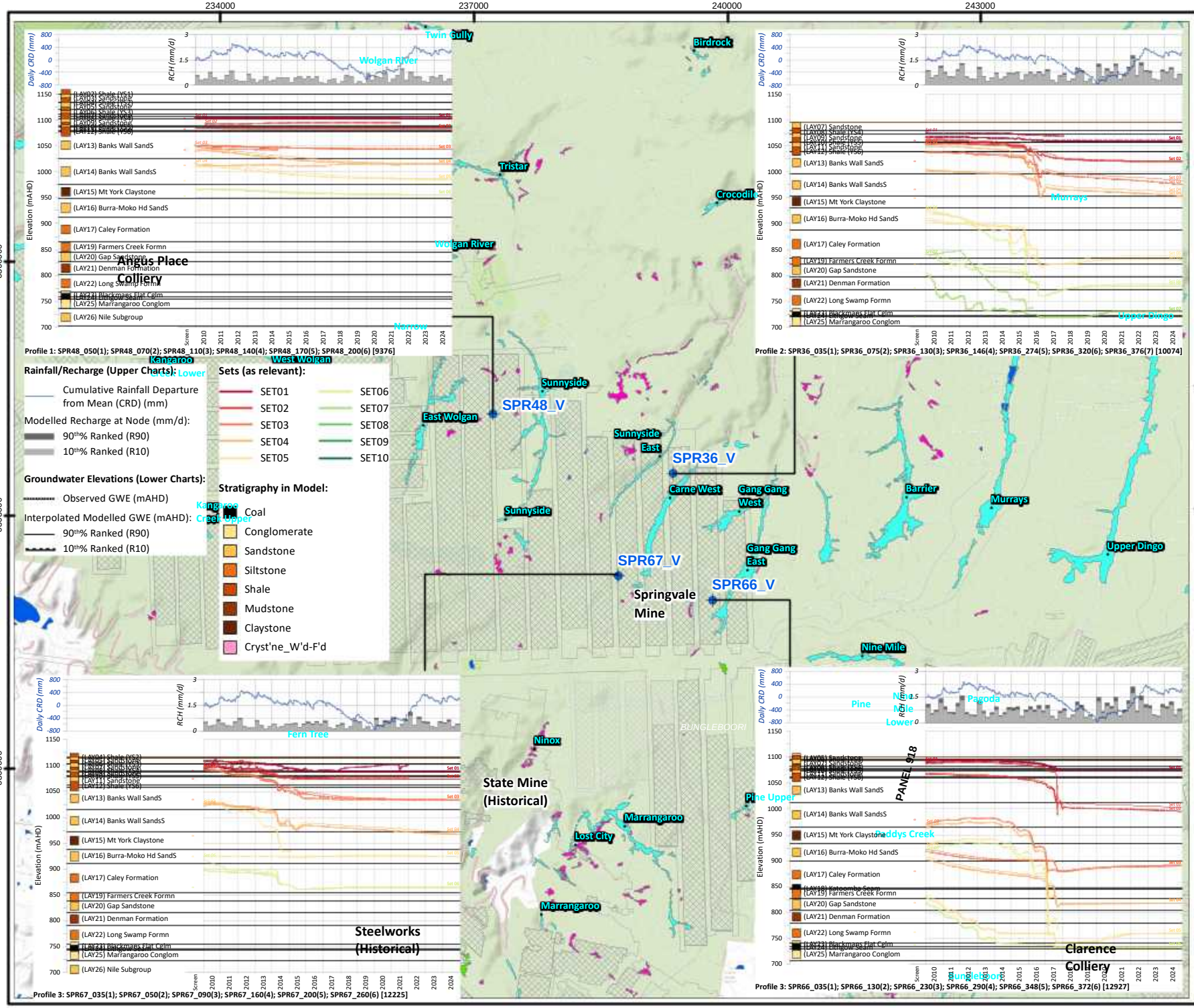
From **Figure 4-51g**, the range of model for CSP1 is minimal, and is about 1m. This is expected, since CSP1, in the groundwater model, will be collocated at a drain (DRN) boundary condition. A similar response is noted for CSP2. From **Figure 4-51g**, for PG1 and PG2, neither of which fit particularly well, the range is about 5m.

From **Figure 4-51h**, at CSP6, the range in model output is about 1m. From **Figure 4-51h**, modelled output at CSP34 also has a range of about 1m. From **Figure 4-51h**, at PSE1, the modelled range is 1m. PSE2 in **Figure 4-51h**, has a range of model output of about 2m. PSE2 is not particularly well matched.

Figure 4-51i presents output for the selected cells at Paddys Creek Shrub Swamp, Paddys Creek Hanging Swamp and Lower Nine Mile Hanging Swamp (refer **Section 4.12.4.4**). From **Figure 4-51i**, the range of model out is about 1m at [17238] and at [16620] and is about 1.5m at [17232].



File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D011d_SA_Hydrographs_CLRP33_CLRP02_CLRP03_CLRP19.mxd



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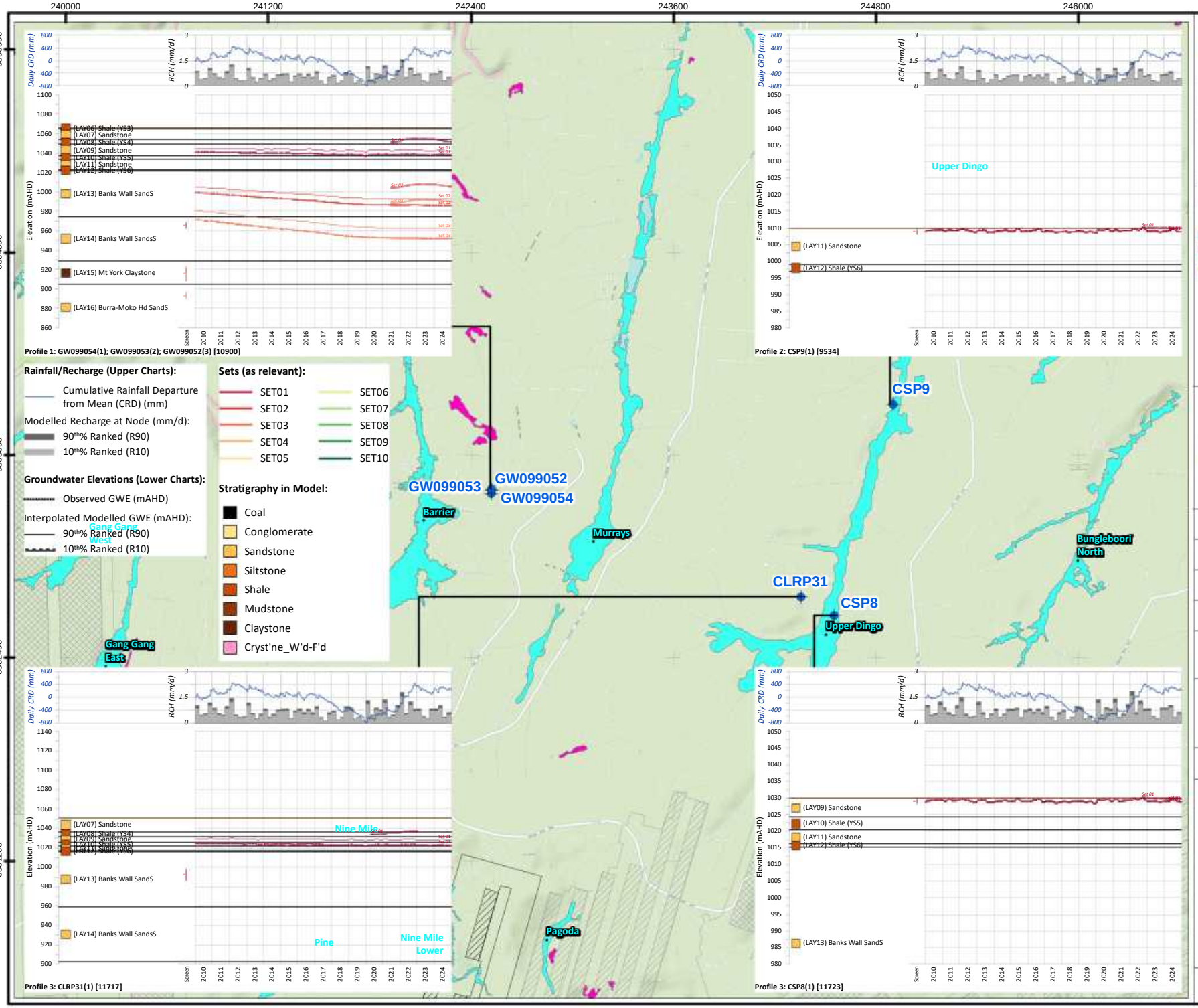
Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Calibration Period incorporating Sensivity Analysis):
- SPR48_V
- SPR36_V
- SPR67_V
- SPR66_V

FIGURE: 4.51e

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D011e_SA_Hydrographs_SPR48_SPR36_SPR67_SPR66.mxd



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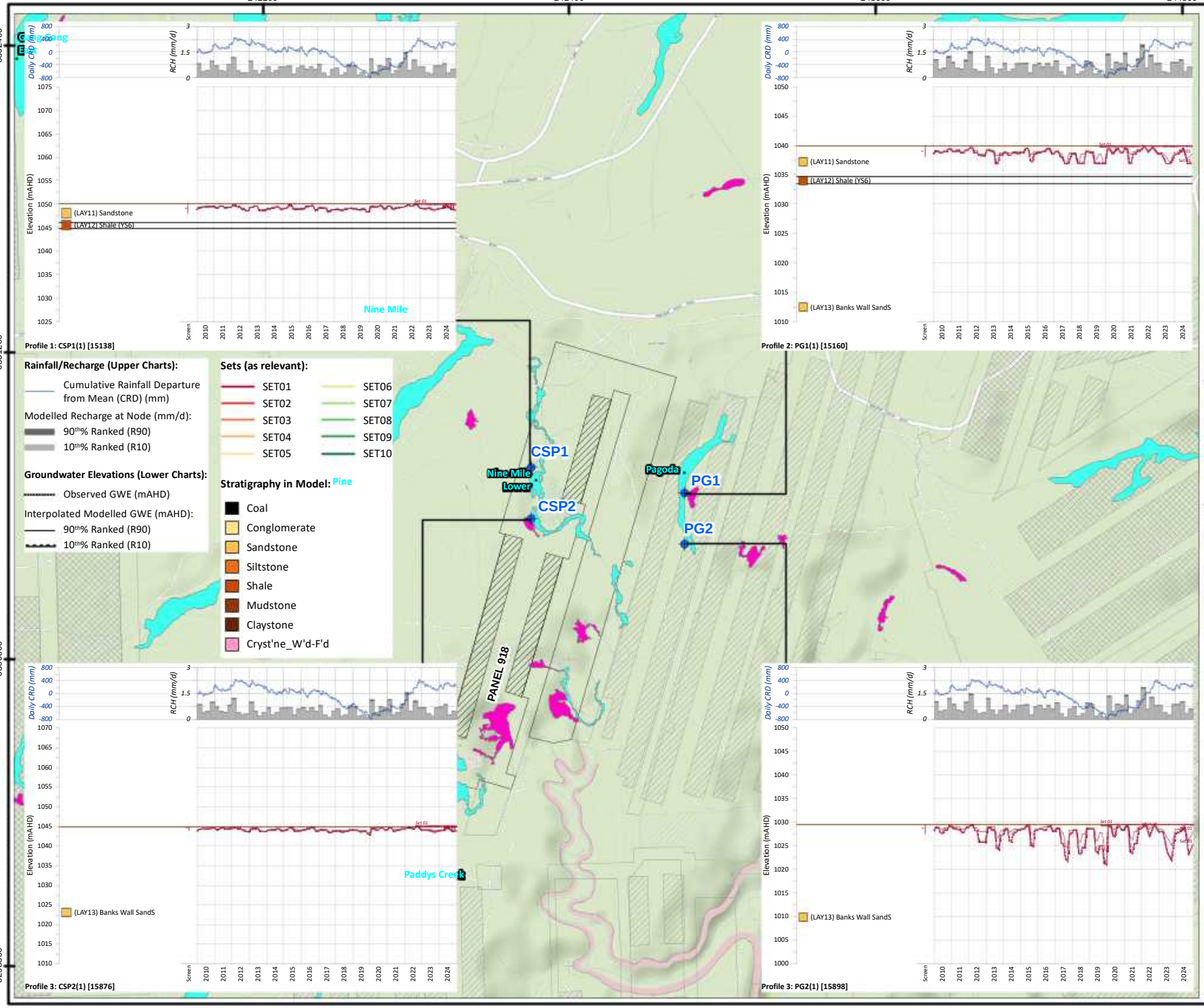
Scale 1:30,000

Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Calibration Period incorporating Sensitivity Analysis):
- **GW09905X**
- **CSP9**
- **CLRP31**
- **CSP8**

FIGURE: 4.51f

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D011f_SA_Hydrographs_GW_CSP9_CLRP31_CSP8.mxd



Legend:

- Model Output Locations

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):

- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Notes:
1) GWE: Groundwater Elevation.
2) CRD Trace dates from 01/01/2010 - 31/12/2049.

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Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevB	Date: 29-Jan-2026
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Scale 1:20,000

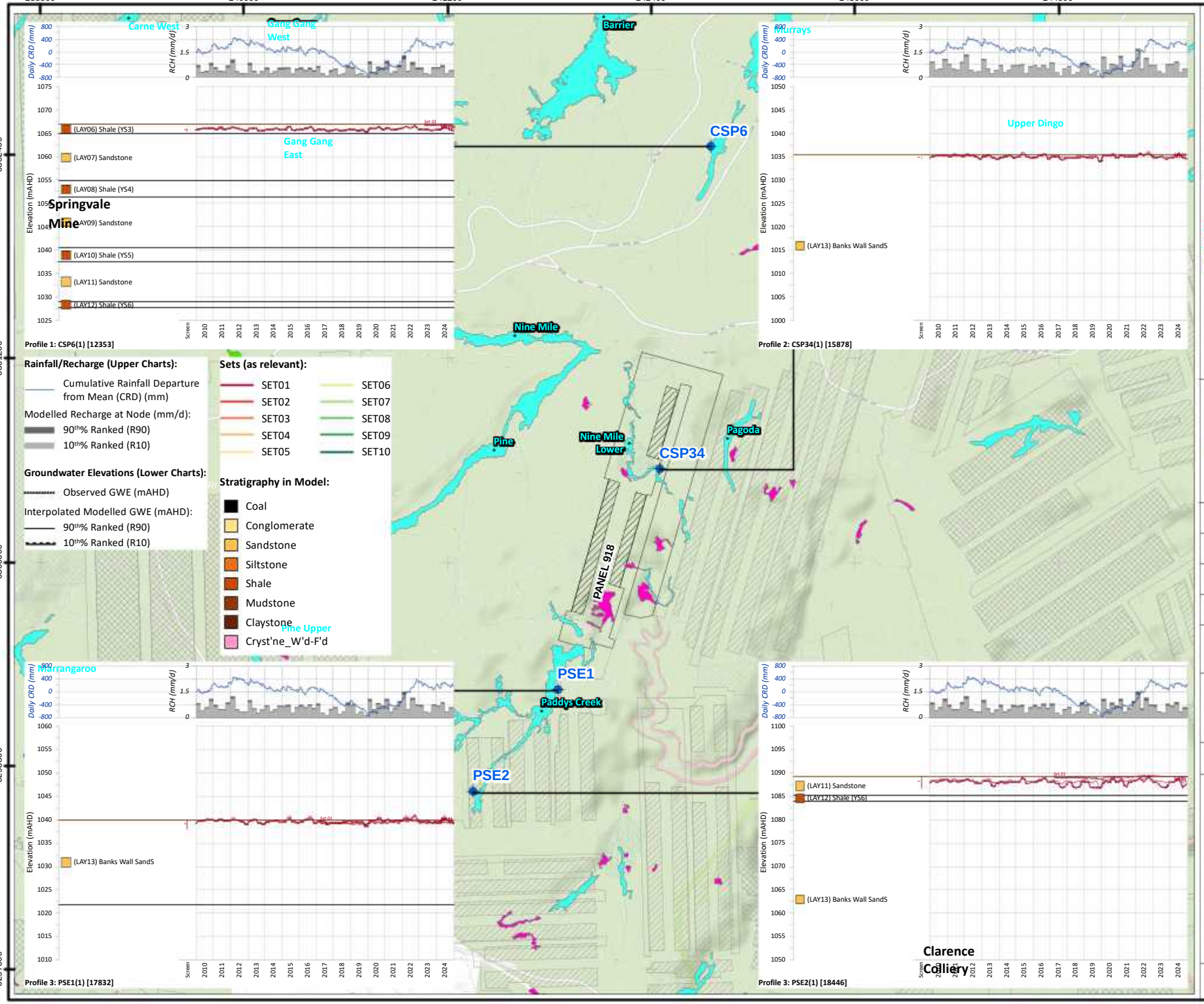
0 250 500
Meters

Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Calibration Period incorporating Sensitivity Analysis):
- CSP1
- PG1
- CSP2
- PG2

FIGURE: 4.51g

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevB_D011g_SA_Hydrographs_CSP1_PG1_CSP2_PG2.mxd



Legend:

- Model Output Locations

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):

- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Notes:
1) GWE: Groundwater Elevation.
2) CRD Trace dates from 01/01/2010 - 31/12/2049.

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 28-Oct-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:30,000

0 500 1,000
Meters

Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Calibration Period incorporating Sensitivity Analysis):
- CSP6
- CSP34
- PSE1
- PSE2

FIGURE: 4.51h

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D011h_SA_Hydrographs_CSP6_CSP34_PSE1_PSE2.mxd

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D011i_SA_Hydrographs_CSP36_CSP4_CSP35.mxd

4.15 Model Results incorporating Predictive Uncertainty

4.15.1 Approach to Cumulative Change

All surrounding existing and historical mining operations in the Western Coalfields are included in the numerical groundwater model. A list of mining operations is presented in **Table 4-24**. The location of these works in the vicinity of Clarence Colliery is presented in **Figure 1-1** and **Figure 1-2**.

Significant projects in the vicinity of Clarence Colliery include:

- Springvale Mine (existing)
  - Located to the west of Clarence Colliery
  - Mines the Lithgow Seam.
- Angus Place Colliery (existing)
  - Located to the north of Springvale Mine
  - Currently in Care and Maintenance.
- Historical Workings.
  - A myriad of former workings, including significant areas of total extraction exist to the southwest of Clarence Colliery and to the south of Springvale Mine
  - Of particular note is State Mine, which has been confirmed as being filled with groundwater.

CTH DCCEEW (2022) presents the Significant Impact Guidelines for the assessment of impact on water resources. Section 4.5.1 of CTH DCCEEW (2022) presents what is required to be considered in the assessment of cumulative impact.

"*The definitions of CSG development and large coal mining development refer to the action having a significant impact 'when considered with other developments, whether past, present or reasonably foreseeable developments'. This means that a significant impact on water resources may be caused by one CSG development or large coal mining development, or the cumulative impact of other developments in the area.*

The consideration of cumulative impacts is not limited to impacts from CSG and large coal mining development, nor is it limited to the immediate project area or only those developments that occur upstream from the proposed action. Cumulative impacts should be considered at the local, aquifer or catchment, and regional scale.

The term 'cumulative impacts' refers to the impacts of a number of different actions or other broader influences on a matter of national environmental significance which, when considered together, have a greater impact on that matter than each action or broader influence considered individually. Therefore, in considering whether an action has, or is likely to have, a significant impact, the seriousness or intensity of the relevant impacts should be considered in context.

This context may include existing developments that have an impact on particular water resources, reasonably foreseeable developments which may have an impact on particular water resources and/or the overall development of a region. Therefore, the potential for the impact of an action to be significant is likely to be greater in a more developed system, or where a number of existing or proposed developments are or will be using or impacting upon a water resource."

[pp 14, CTH DCCEEW, 2022]

The approach adopted by JBS&G is consistent with Section 4.5.1 of CTH DCCEEW (2022), namely that the assessment of impact of change to elevation of the highest water table, groundwater contribution to surface water, groundwater elevation and mine dewatering rate must be in context of changes due to other, already approved, operations.

In application, and consistent with the approach in NSW Aquifer Interference Policy (NSW DCCEEW, 2012), a small change, when assessed in isolation, may be insignificant; however, in the context of already approved changes, a small change can instead be significant.

4.15.2 Approach to Uncertainty in Groundwater Model Simulations

As presented in **Section 4.14.1**, the approach to treatment of uncertainty in groundwater model simulations in this report is "ensemble methods", where the "ensemble methods" is the most sophisticated.

The standard deviation for each model parameter is presented in **Table 4-33** of **Section 4.14.1**.

After completion of the Prediction Period simulations, the integrity of each set of simulations (Approved and Proposed, which will be defined below) were reviewed and simulations discarded as relevant. In total, 286 of the 300 sets of simulations were utilised in this report. Sets of simulations were excluded if any particular model did not converge, and the residual was more than 0.5m, at a particular stress period. Some sets were also excluded where model output files were missing due to failure to transfer those files to the storage server for unknown reasons.

Whilst all 286 sets of simulations were used, as they were available, it is necessary to demonstrate that this number of simulations is sufficient to achieve uncertainty analysis convergence. Uncertainty analysis convergence is demonstrated in **Appendix I**, using change in groundwater elevation at Clarence Colliery, which shows that increasing number of simulations, beyond 200 simulations, does not lead to significant change to simulated dewatering rate (10^{th} percentile ranked change in groundwater elevation and 90^{th} percentile ranked change in groundwater elevation).

4.15.3 Model Setup

For the Prediction Period simulations, the following cases were developed, with associated assumptions:

Approved Case

- Mining at Clarence Colliery will continue as currently approved
- Mining at Springvale Mine occurs including existing operations up to and including LW501-503
- Angus Place Colliery is currently in Care and Maintenance, with groundwater being stored underground in previous workings. It is assumed that this situation will be maintained
- Angus Place West (proposed and not yet approved) is a development extension to Angus Place Colliery. It is assumed to commence on 1 January 2025 (start of SP142) and continue through to the end of simulation on 31 December 2032 (end of SP173). It is noted that Angus Place West continues until December 2040 (end of SP205) and then commences Care and Maintenance
- The hydraulic control on elevation of groundwater stored in historical workings located to the south of Springvale Mine is being maintained by an adit to the southeast of the Vale of Clywdd. It is assumed the hydraulic control will be maintained.

Proposed Case

- Mining at Clarence Colliery will continue as currently approved as well as the development and extraction of 918 Panel
- Mining at Springvale Mine occurs including existing operations up to and including LW501-503
- Mining of LW501-503 to occur at a mining height of 3.25m with development commencing in July 2025 (start of SP144) and extraction concluding by December 2028 (end of SP157)
- Angus Place West (proposed and not yet approved) is a development extension to Angus Place Colliery. It is assumed to commence on 1 January 2025 (start of SP142) and continue through to the

end of simulation on 31 December 2032 (end of SP173). It is noted that Angus Place West continues until December 2040 (end of SP205) and then commences Care and Maintenance

- The hydraulic control on elevation of groundwater stored in historical workings located to the south of Springvale Mine is being maintained by an adit to the southeast of the Vale of Clywdd. It is assumed the hydraulic control will be maintained.

It is emphasised that assumptions presented in this section with respect to the Groundwater Model are relevant to its intent, which is to calculate modelled change to groundwater elevation, highest active node, groundwater contribution to surface water and mine dewatering rate. As such, some assumptions may be more conservative, such as timing of various project elements, than that presented in the Water Management Plan and Subsidence Management Plan.

Figure 4-52a through **Figure 4-52f** present the modelled mine design parameters. It is noted that only extraction mining cells are presented in **Figure 4-52a** through **Figure 4-52f**.

Figure 4-52a presents the modelled mine height (m) for the Proposed Case.

From **Figure 4-52a**, the modelled mine height in 918 Panel ranges between 1.92m and 2.26m. These modelled mine heights are smaller than those encountered in 906 Panel and the 908-910 Panel Area.

Figure 4-52b presents the modelled height of Zone A ('Fractured'), H_{A2}, above the top of the mined seam for the Proposed Case.

From **Figure 4-52b**, the H_{A2} above 918 Panel (extraction) ranges between 28m and 41m. These modelled heights are comparable to Model Mining Method 3 (Double-Sided Lifting) in the 908-910 Panel Area (where a minimum of 10m is deployed) and Model Mining Method 2 (Partial Extraction) throughout the rest of Clarence Colliery. From **Figure 4-52b**, in contrast to H_{A2} above 918 Panel, H_{A2} above the Model Mining Method 5 (Longwall Extraction) at Clarence ranges between ~140m and ~240m. Similarly, in **Figure 4-52b**, H_{A2} above Model Mining Method 4 (Total Extraction) ranges between ~80 and ~160m.

Figure 4-52c presents the modelled cover depth above 918 Panel, as well as historical extraction at Clarence and historical and proposed extraction at adjacent operations. The depth of cover with respect to the Extraction Plan for 918 Panel is 174 to 329m, with the model being, necessarily, a simplification.

From **Figure 4-52c**, the modelled cover depth (extraction) ranges between 224m and 286m above 918 Panel. From **Figure 4-52c**, the modelled cover depth (extraction) in the 908-910 Panel Area is comparable, being about 250m.

Figure 4-52d presents the depth to Zone A/Zone B interface above 918 Panel (extraction).

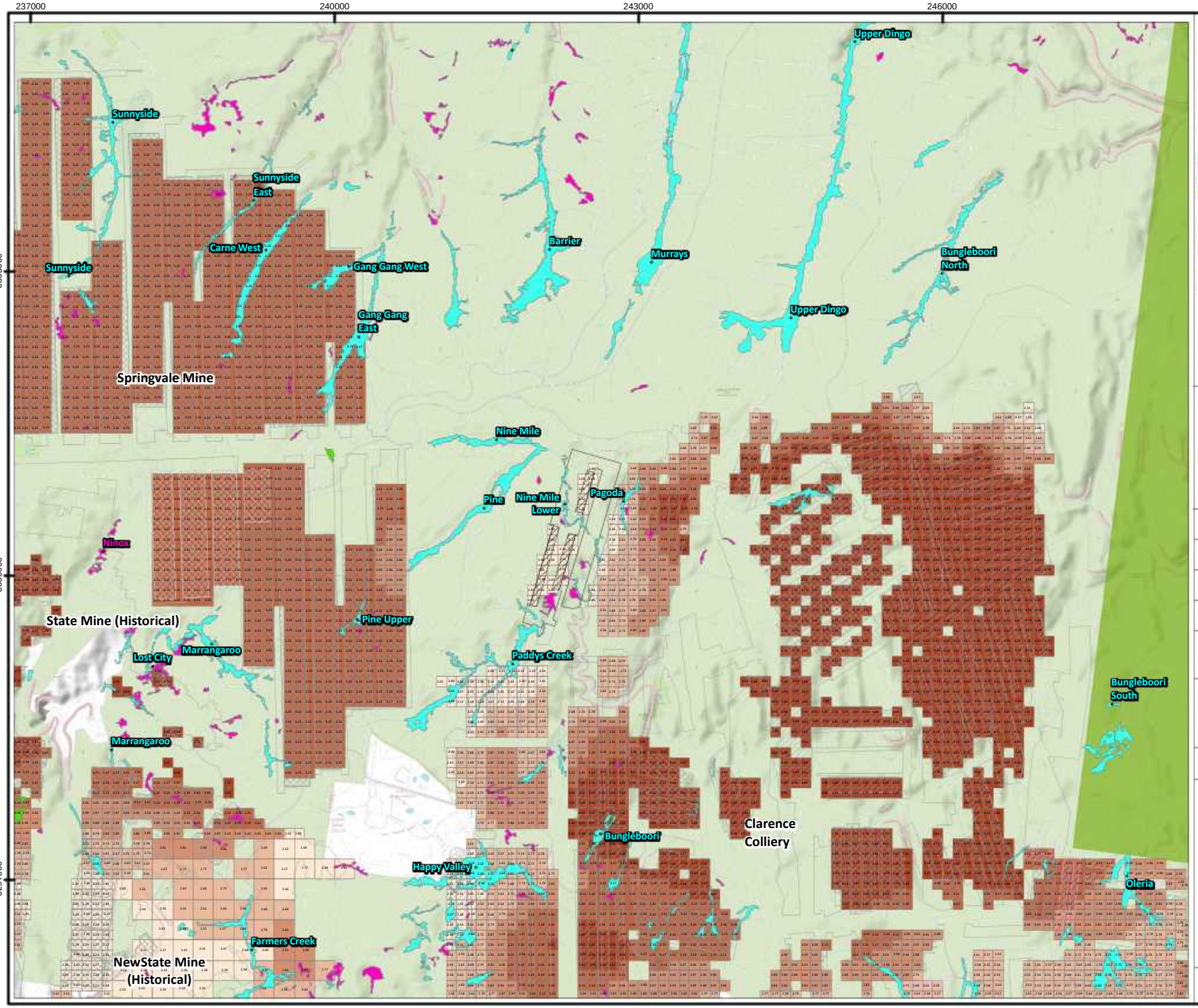
From **Figure 4-52d**, the depth to the interface between Zone A and Zone B ranges between 197m and 254m above 918 Panel. From **Figure 4-52d**, this is a comparable depth to that above 908-910 Panel Area.

Figure 4-52e presents the width-to-height ratio of extraction cells at Clarence Colliery, including adjacent operations.

From **Figure 4-52e**, the width-to-height ratio for 918 Panel ranges between 0.27 and 0.34 and is therefore considered low (being < 0.4). From **Figure 4-52e**, the width-to-height ratio above the 908-910 Panel Area is comparable, being about 0.22, therefore also considered to be low.

Figure 4-52f presents the modelled panel width in the Proposed Case.

From **Figure 4-52f**, the modelled panel width for 918 Panel is 83m for the northern subpanel (single) and is 75m for the southern subpanels (two).



Legend:

Greater Blue Moutains World Heritage Area

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):
- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Mining Height (m):
- Less than 2.5m
- 2.5 to 2.8m
- 2.8 to 3.1m
- 3.1 to 3.4m
- Greater than 3.4m

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 11-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:50,000

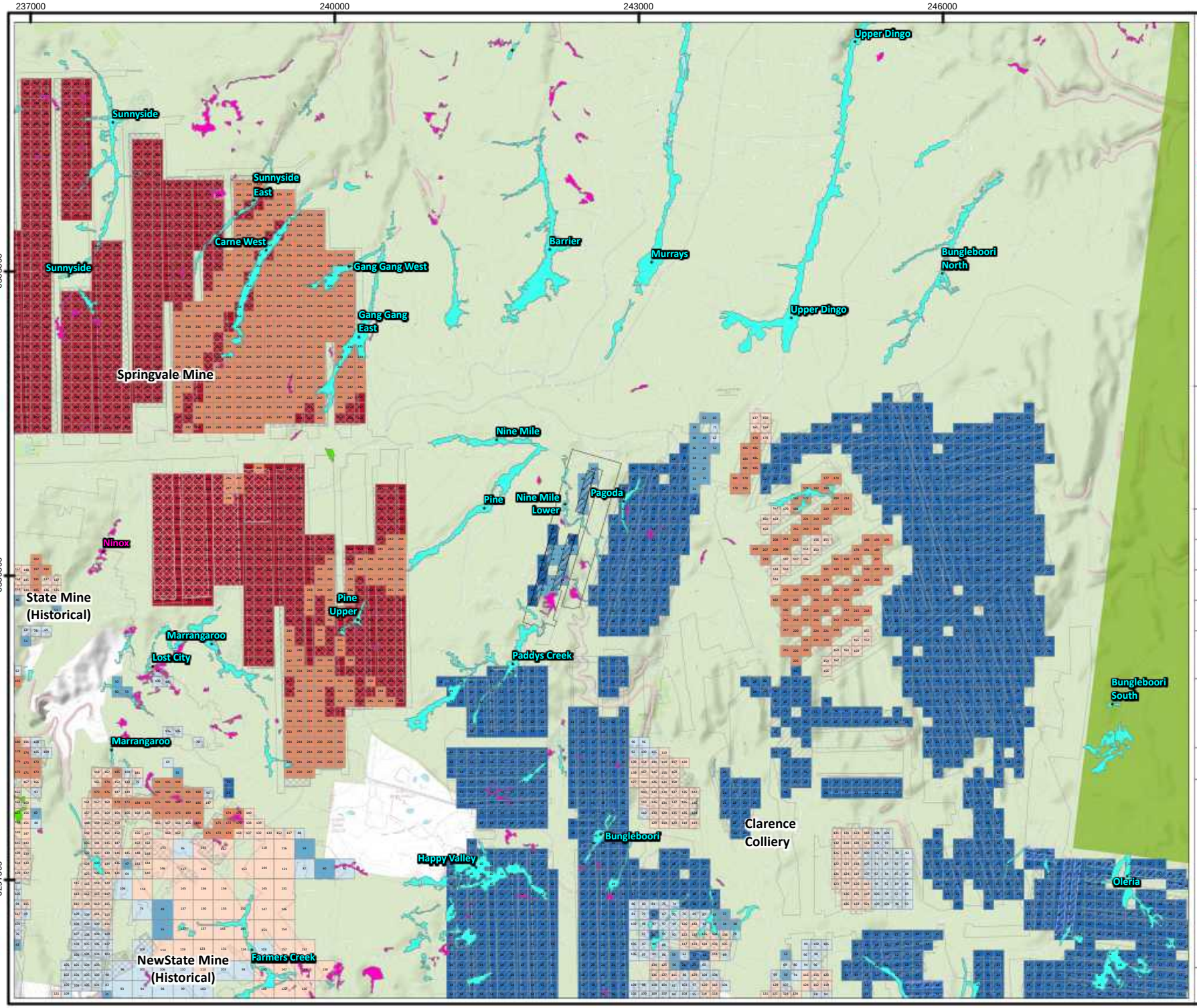
0 1 2
km

Coor. Sys. GDA 1994 MGA Zone 56

Modelled Mine Design (Extraction) - Mining Height (m)

FIGURE: 4.52a

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D044a_MMD_MiningHeight.mxd



Legend:

Greater Blue Moutains World Heritage Area

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):
- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Height of Top of Zone A above Top of Mined Seam:
- Less than 30m
- 30 to 60m
- 60 to 110m
- 110 to 170m
- 170 to 250m
- Greater than 250m

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 11-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:50,000

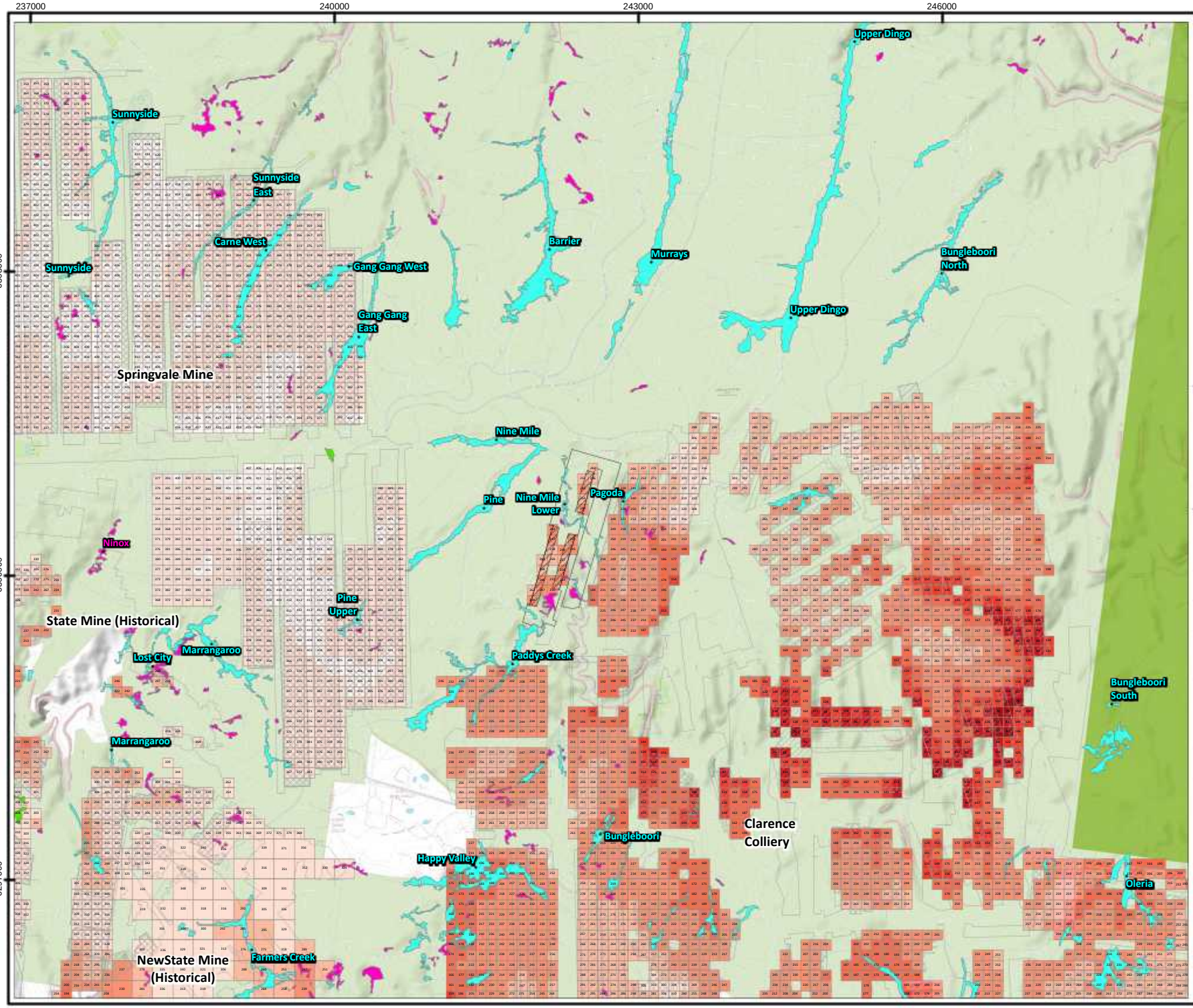
0 1 2
km

Coor. Sys. GDA 1994 MGA Zone 56

Modelled Mine Design (Extraction) - Height of Top of Zone A above Top of Mined Seam (m)

FIGURE: 4.52b

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D044b_MMD_HeightTopZoneA.mxd



Legend:

Greater Blue Moutains World Heritage Area

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):
- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

CoverDepth:
- <50m
- 50 to 80m
- 80 to 120m
- 120 to 160m
- 160 to 200m
- 200 to 250m
- 250 to 300m
- 300 to 400m
- >400m

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 11-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:50,000

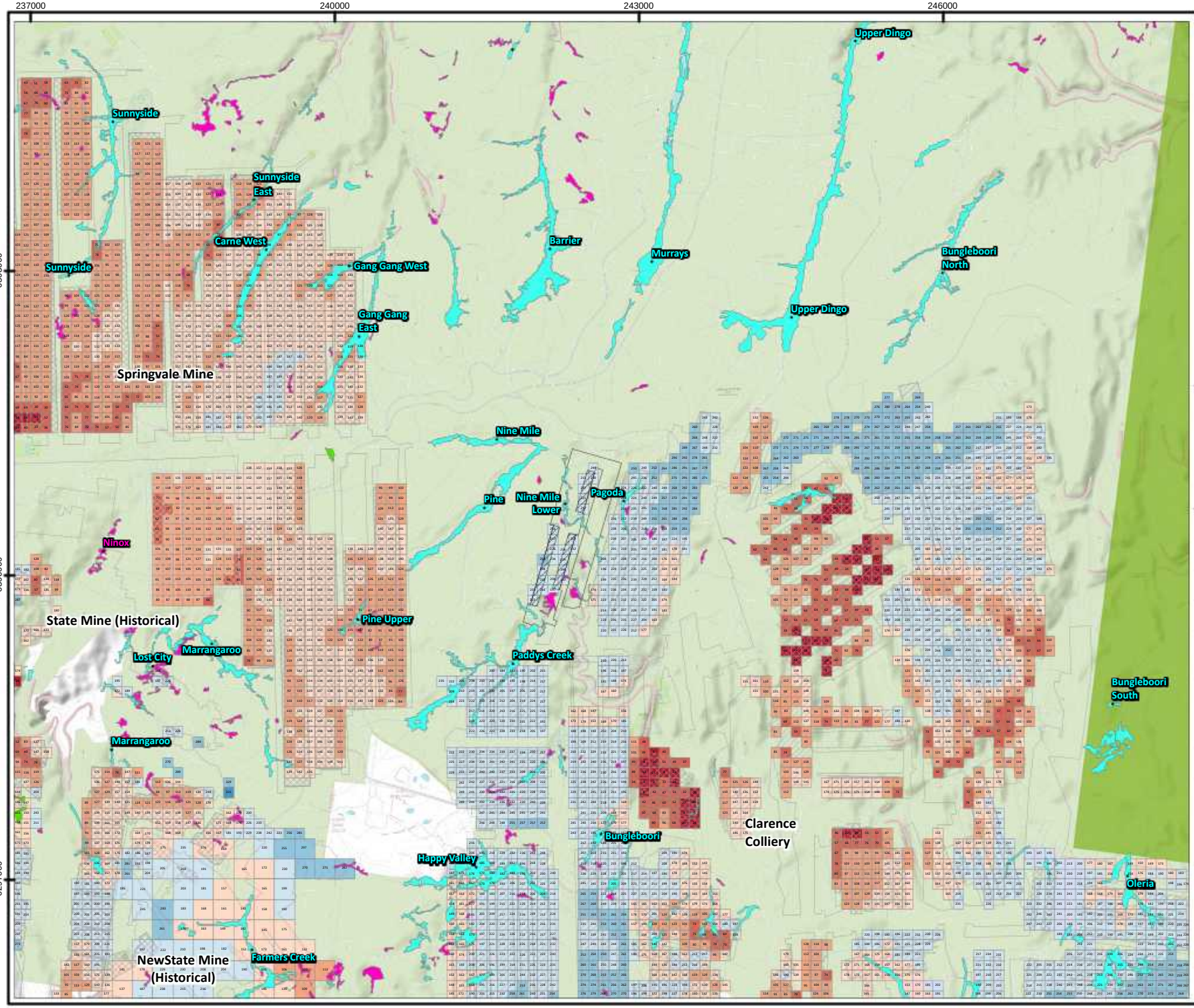
0 1 2
km

Coor. Sys. GDA 1994 MGA Zone 56

Modelled Mine Design (Extraction) - Cover Depth (m)

FIGURE: 4.52c

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D044c_MMD_CoverDepth.mxd



Legend:

- Greater Blue Moutains World Heritage Area

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):

- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Depth to Zone A/Zone B Interface:

- Less than 30m
- 30 to 80m
- 80 to 130m
- 130 to 180m
- 180 to 250m
- 250 to 330m
- 330 to 430m
- Greater than 430m

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 11-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:50,000

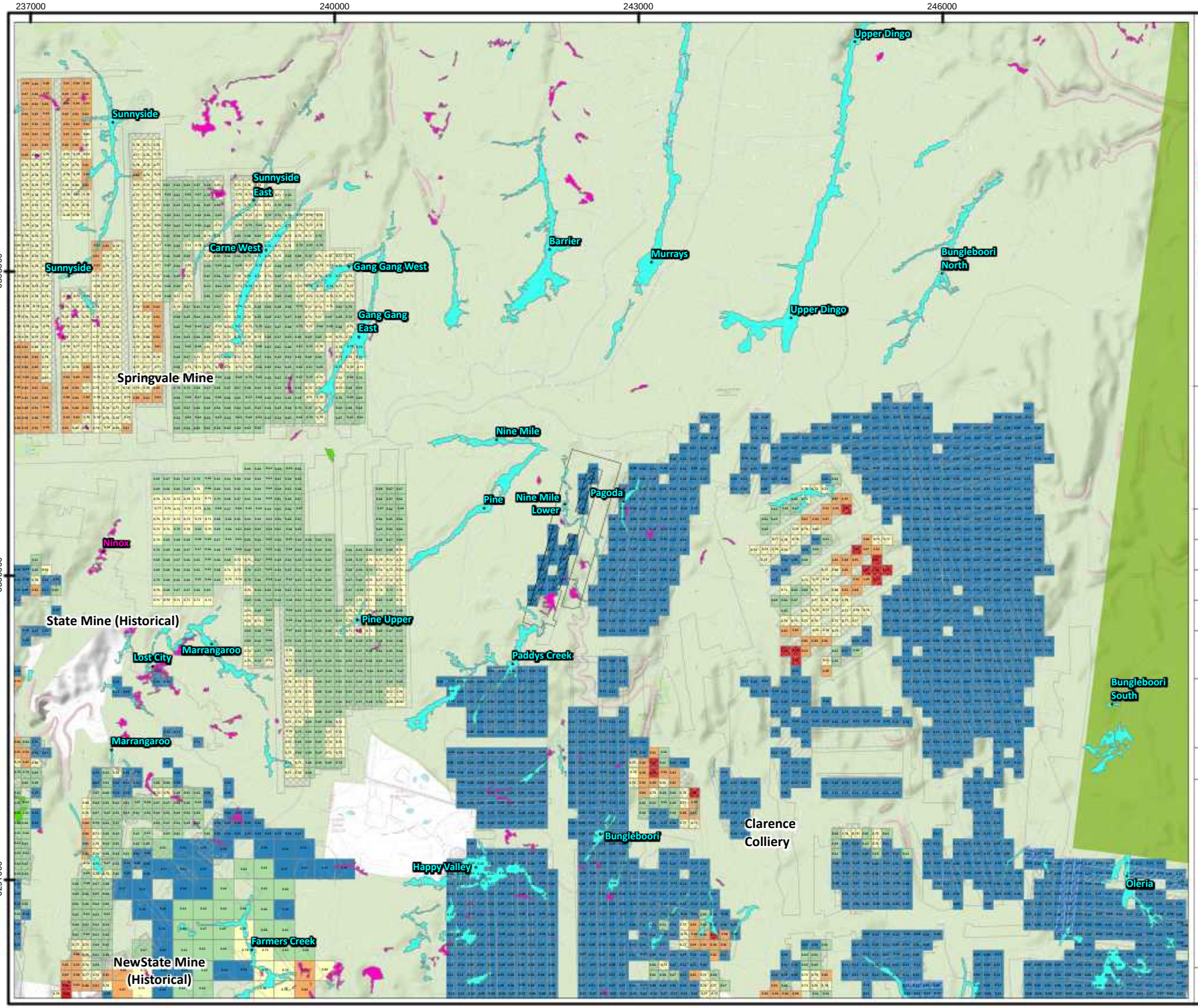
0 1 2
km

Coor. Sys. GDA 1994 MGA Zone 56

Modelled Mine Design (Extraction) - Depth to Zone A/Zone B Interface (mBGL)

FIGURE: 4.52d

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D044d_MMD_DepthABInterface.mxd



Legend:

Greater Blue Moutains World Heritage Area

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):
- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Width to Height Ratio:
- Less than 0.6
- 0.6 to 0.7
- 0.7 to 0.8
- 0.8 to 1.0
- Greater than 1.0

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 11-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:50,000

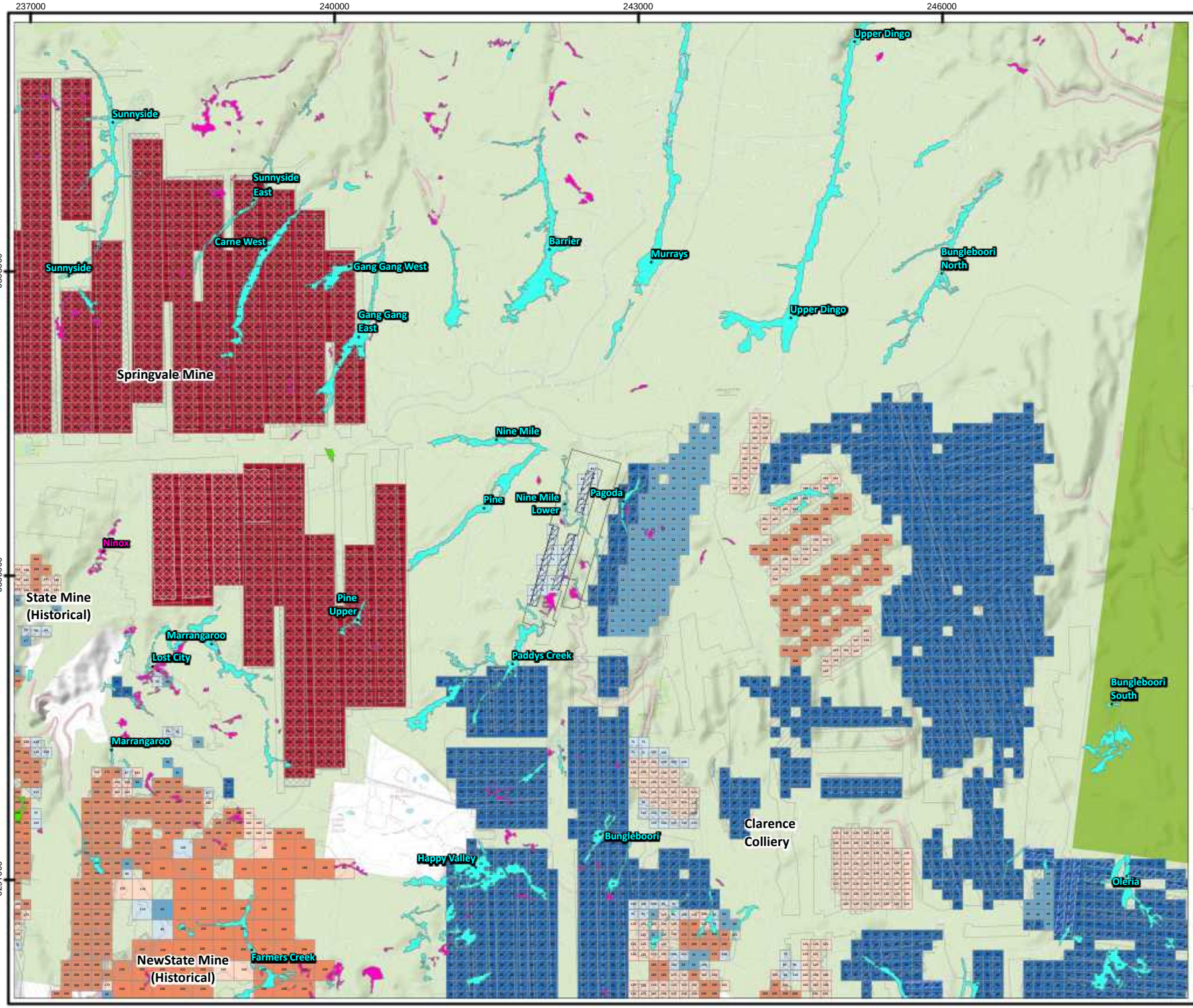
0 1 2
km

Coor. Sys. GDA 1994 MGA Zone 56

Modelled Mine Design (Extraction) - Width to Height Ratio

FIGURE: 4.52e

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D044e_MMD_WidthHeightRatio.mxd



Legend:

Greater Blue Moutains World Heritage Area

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):
- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Panel Width:
- Less than 30m
- 30 to 60m
- 60 to 110m
- 110 to 170m
- 170 to 250m
- Greater than 250m

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 11-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:50,000

0 1 2
km

Coor. Sys. GDA 1994 MGA Zone 56

Modelled Mine Design (Extraction) - Panel Width (m)

FIGURE: 4.52f

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D044f_MMD_PanelWidth.mxd

4.15.4 Model Parameters

4.15.4.1 General

Section 4.15.2 presents the approach to deriving model parameters that were used in Prediction Simulations.

4.15.4.2 Spatial Distribution of Hydraulic Properties

Appendix E presents the spatial distribution of hydraulic properties, on a layer-by-layer basis for horizontal hydraulic conductivity, Kh, vertical hydraulic conductivity, Kv, specific storage, Ss, and specific yield, Sy.

Stochastic values of the Pilot Points used to generate those layer-by-layer hydraulic property fields were generated, using the standard deviations presented in **Section 4.14.1**.

Appendix L presents the PEST parameter uncertainty files used to used to generate the stochastic values.

4.15.4.3 Subsidence-Induced Change to Hydraulic Properties

The method developed and used to change the values of hydraulic properties in response to mining-induced subsidence is presented in **Section 4.11**.

Figure 4-53 presents the locations of selected time-varying material model nodes to illustrate the implementation of the 'ramp function' in the groundwater model.

Model output was extracted from the following selected model nodes:

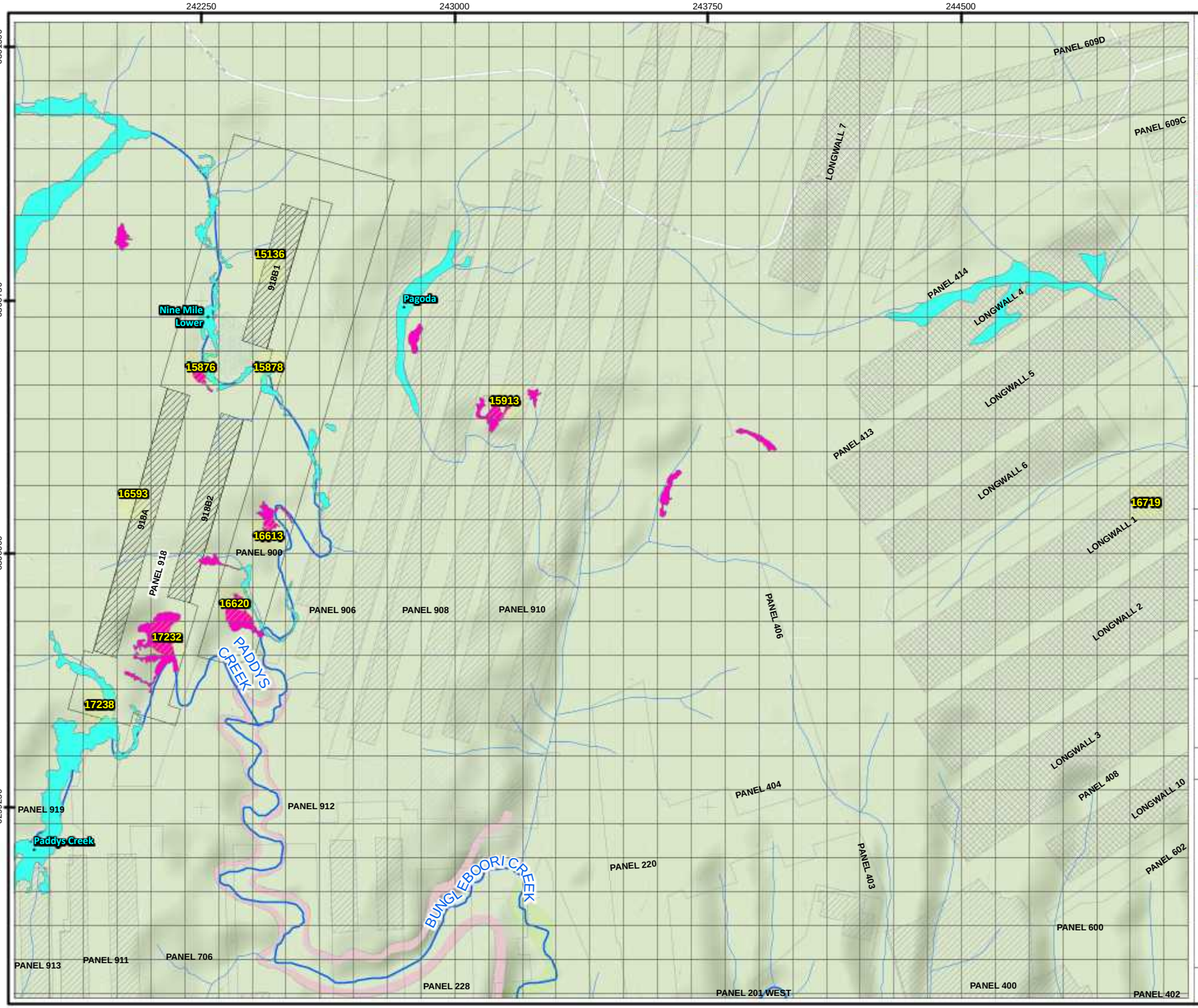
- Longwall 1 (L01Node 16719) (**Figure 4-54**)
- 908 Panel (L01Node 15913) (**Figure 4-55**)
- Sub Panel 918A (L01Node 16593) (**Figure 4-56**)
- Sub Panel 918B1 (L01Node 15136) (**Figure 4-57**)
- Lower Nine Mile Swamp between Sub Panel 918A and Sub Panel 918B1 (L01Node 15876) (**Figure 4-58**).

Figure 4-54a presents the ramp function for Model Mining Method 5 (Longwall Extraction) at Clarence, with **Figure 4-54b** presenting the translation of the ramp function onto model geometry. **Figure 4-54c** presents vertical profiles of resultant hydraulic properties.

From **Figure 4-54a**, at the reported model cell, the top of Zone A is almost at ground surface. From **Figure 4-54b**, when **Figure 4-54a** is translated onto model geometry, the calibrated Subsidence Model, leads to the multiplicative factor applied to the Mount York Claystone (Layer 15) being 35x for horizontal hydraulic conductivity, Kh, and 5.5x for vertical hydraulic conductivity.

There is no change to specific storage, Ss, included in the Subsidence Model, but there is change to specific yield, Sy. From **Figure 4-54b**, the change to specific yield, Sy is an increase of 0.005 in the Mount York Claystone. As presented in **Section 4.11**, due to a limitation of change in storage only being able to be applied where LAYTYP = 4 (saturated flow), and not LAYTYP = 5 (variably saturated flow), the change to specific yield, Sy, is dropped when calculating the resultant hydraulic properties (refer **Figure 4-54c**).

From **Figure 4-54c**, the vertical hydraulic conductivity, Kv, in the Mount York Claystone (Layer 15), following extraction, is 5.5E-09m/s, compared to a pre-mining value of 2.0E-10m/s. This is a 27.5x times increase. That increase is larger than the value presented in **Figure 4-54b**. This is because of the effect of the minimum resultant hydraulic conductivity (MRHC) hypothesis. From **Figure 4-54b**, there is a 5.5x increase (informed by the calibrated Subsidence Model), but if the resultant vertical hydraulic conductivity is less than the minimum change base hydraulic conductivity (parameter tvm_basek) multiplied 5.5x, the resultant value is overridden.



Legend:

Modelling:
- Model Grid
- Selected Time-Varying Material Cells

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):
- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Hydrology:
- Watercourse
- Waterbody

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 05-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:15,000

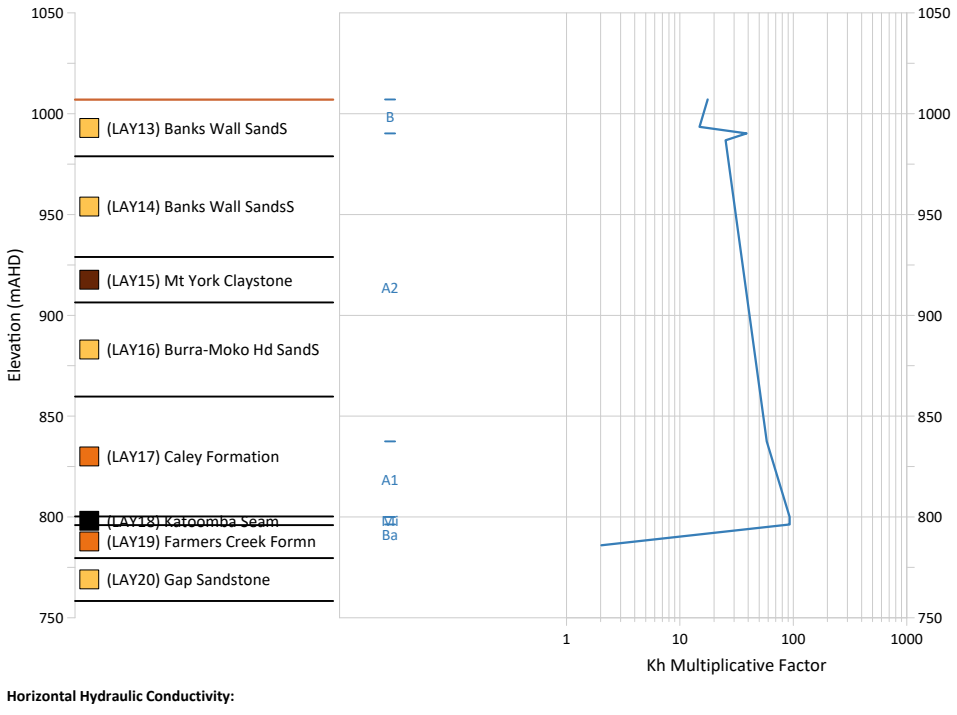
0 250 500
Meters

Coor. Sys. GDA 1994 MGA Zone 56

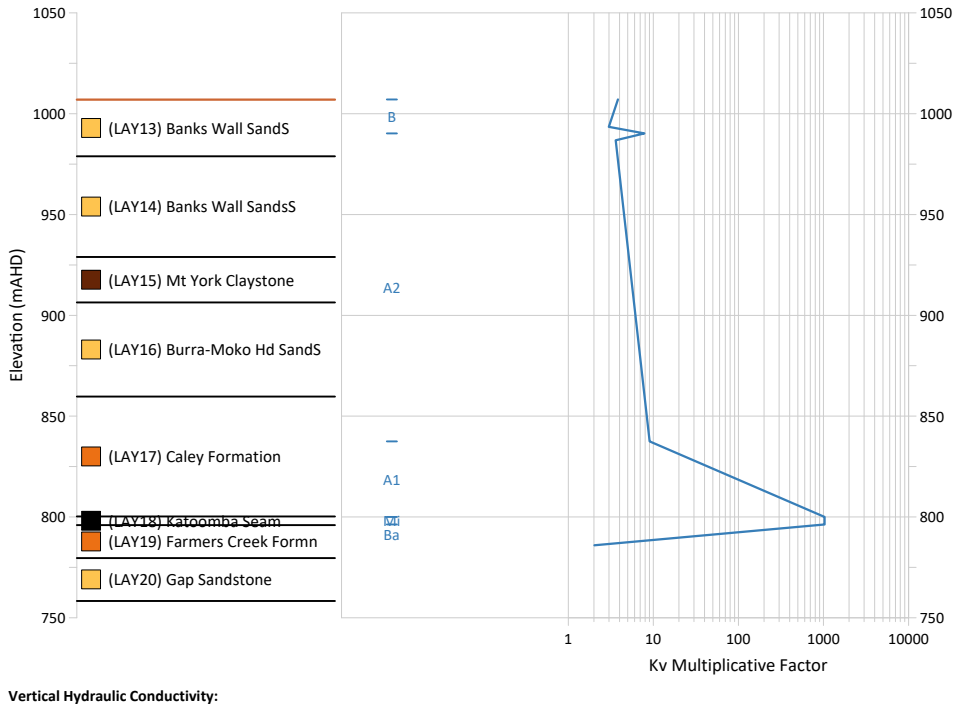
Location of Selected Time-Varying Material Cells

FIGURE: 4.53

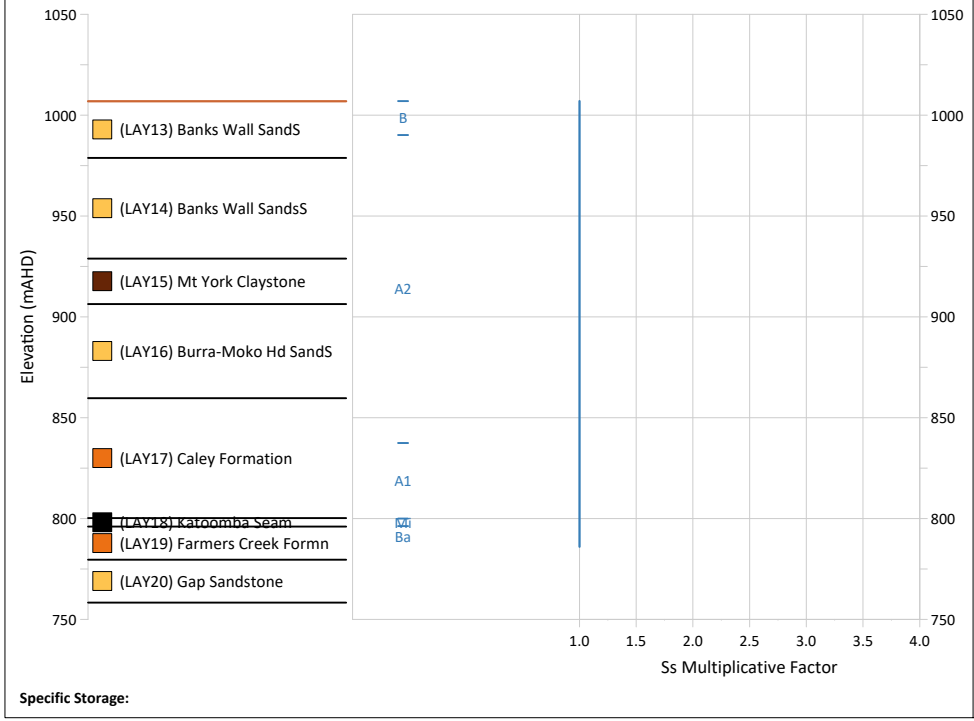
File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D045_ModelGrid_TVMCells.mxd



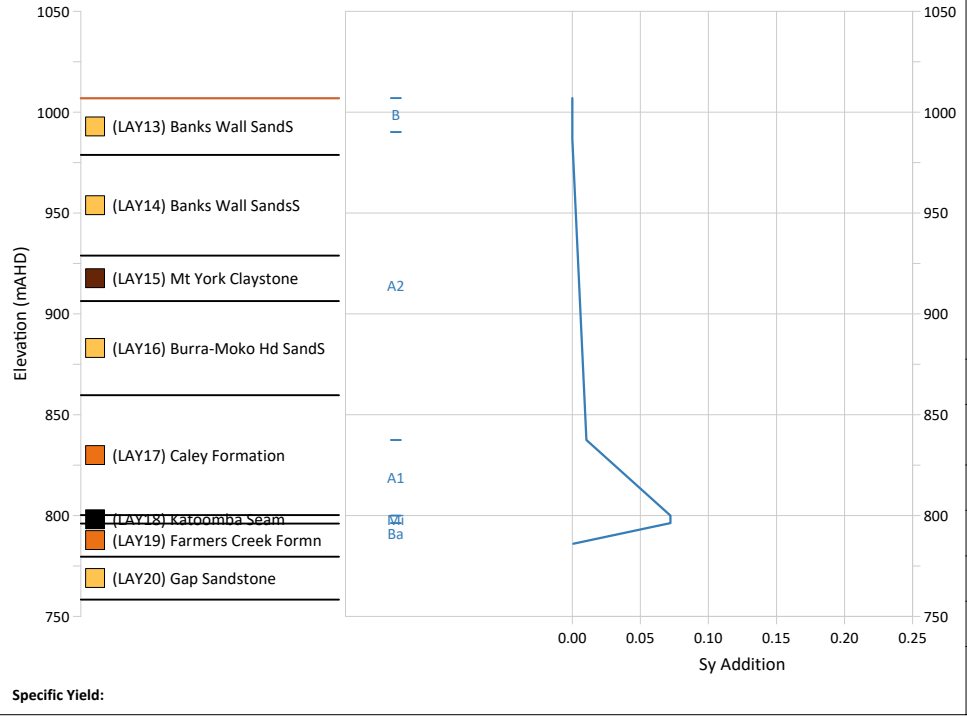
Horizontal Hydraulic Conductivity:



Vertical Hydraulic Conductivity:



Specific Storage:



Specific Yield:

Legend

Subsidence Zones:

D - D (Surface)
C - C (Elastic)
B - B (Constrained)
A2 - A (Fractured)
A1 - A (Caved)
Mi - Mined Seam
Ba - Basement

Profiles:

31/12/1867 (SP001)
n/a
Mar 1994 (SP018)
2nd_Longwall_1.060
n/a
n/a
n/a
n/a
n/a
n/a
n/a

Stratigraphy in Model:

Coal
Conglomerate
Sandstone
Siltstone
Shale
Mudstone
Claystone
Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.

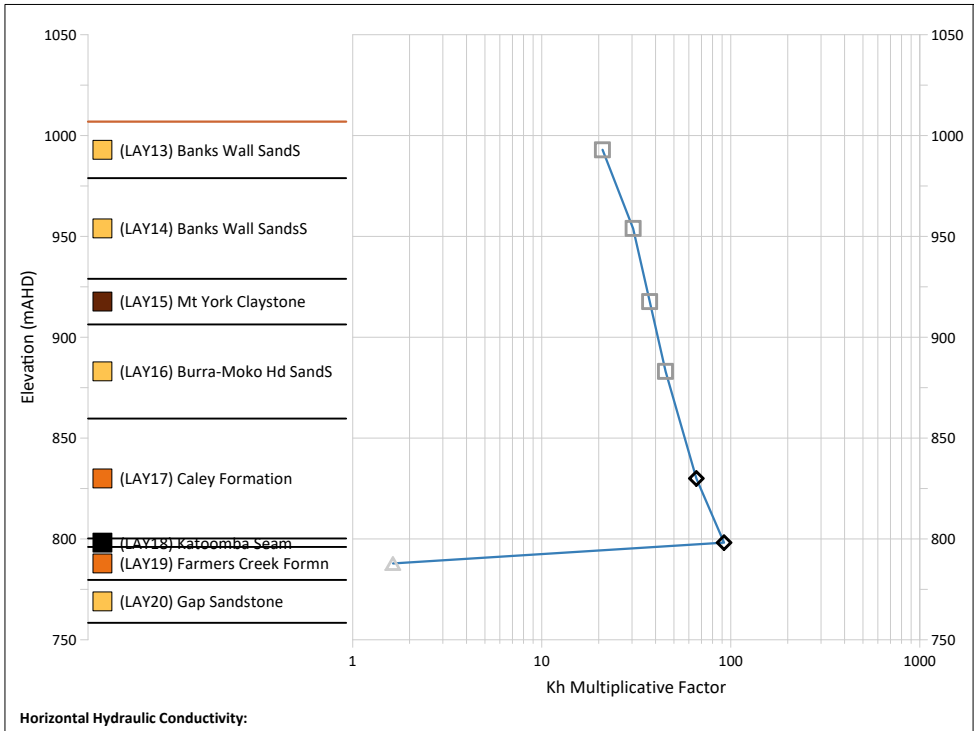
Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 05/11/2025	
Drawn By: DAW	
Checked By: JRWB	

JBS&G

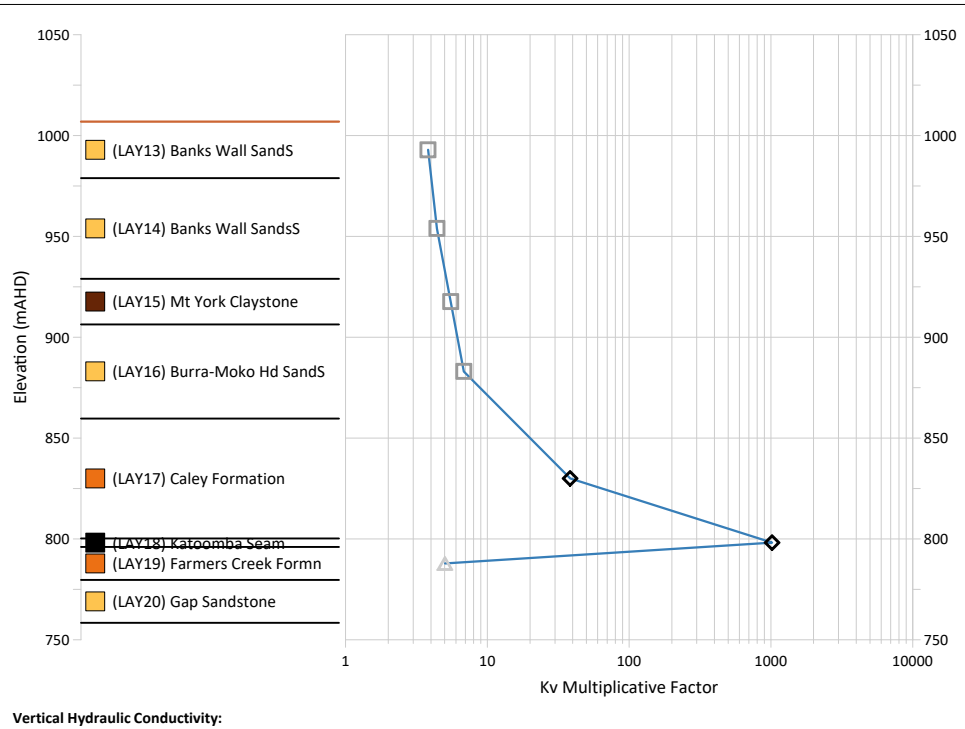
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D046_TVMProfile_16719\Plotting_16719_01_Ramp\68229_R01RevA_D046a_TVMPEST_USG_ProfileChange_Ramp_16719.grf

Reference: 68229_R01RevA_PRO_02a_21_SIM0

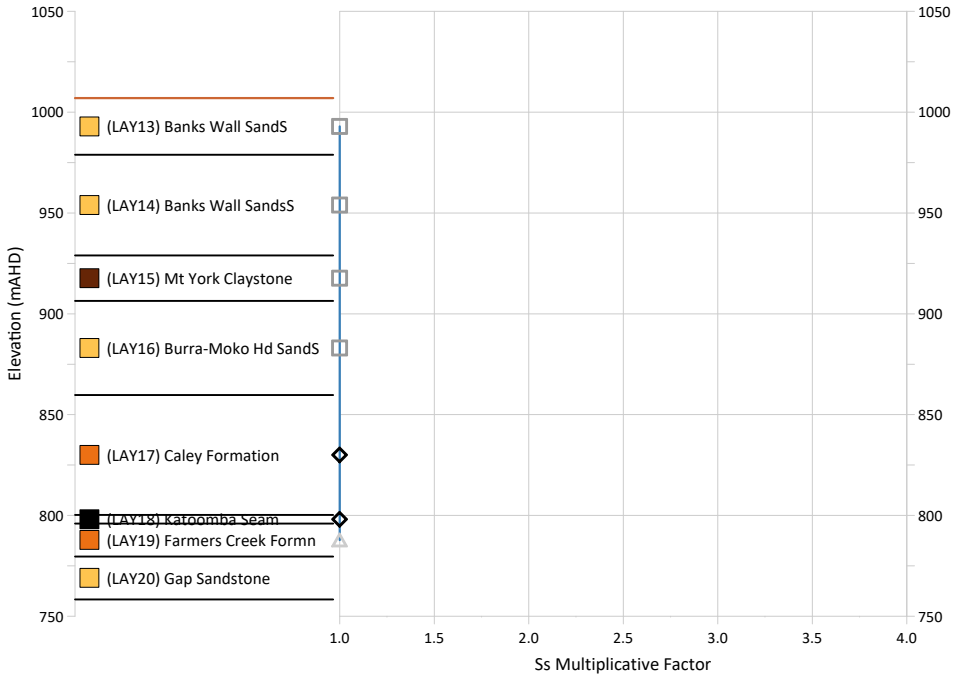
Figure 4.54a: Time-Varying Change to Hydraulic Properties (Ramp Function) - Vertical Profile (L01 Node 16719)



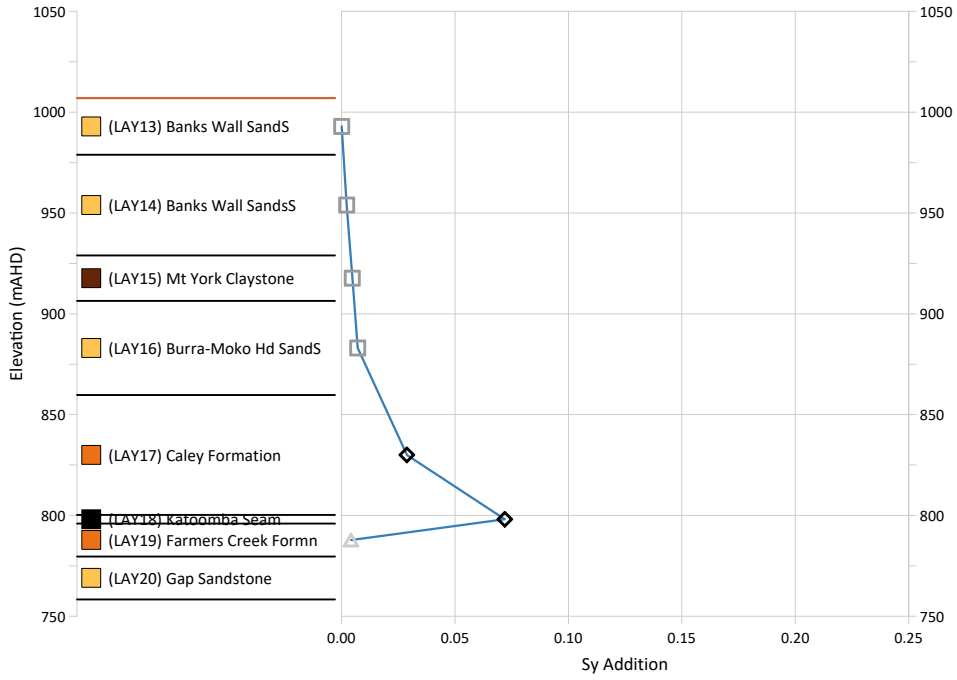
Horizontal Hydraulic Conductivity:



Vertical Hydraulic Conductivity:



Specific Storage:



Specific Yield:

Legend

Layer Zone Assignment:

- Above Zone A
- Zone A
- Caved Zone

Profiles:

- 31/12/1867 (SP001) n/a
- Mar 1994 (SP018) 2nd_Longwall_1.060
- n/a n/a
- n/a n/a
- n/a n/a
- n/a n/a
- n/a n/a
- n/a n/a

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 05/11/2025	
Drawn By: DAW	
Checked By: JRWB	

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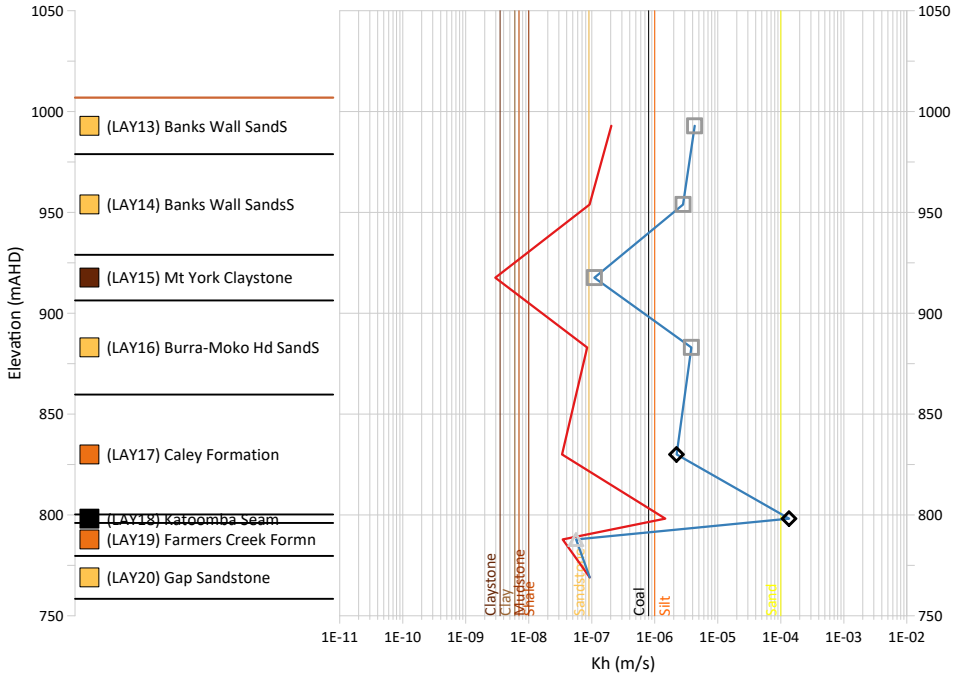
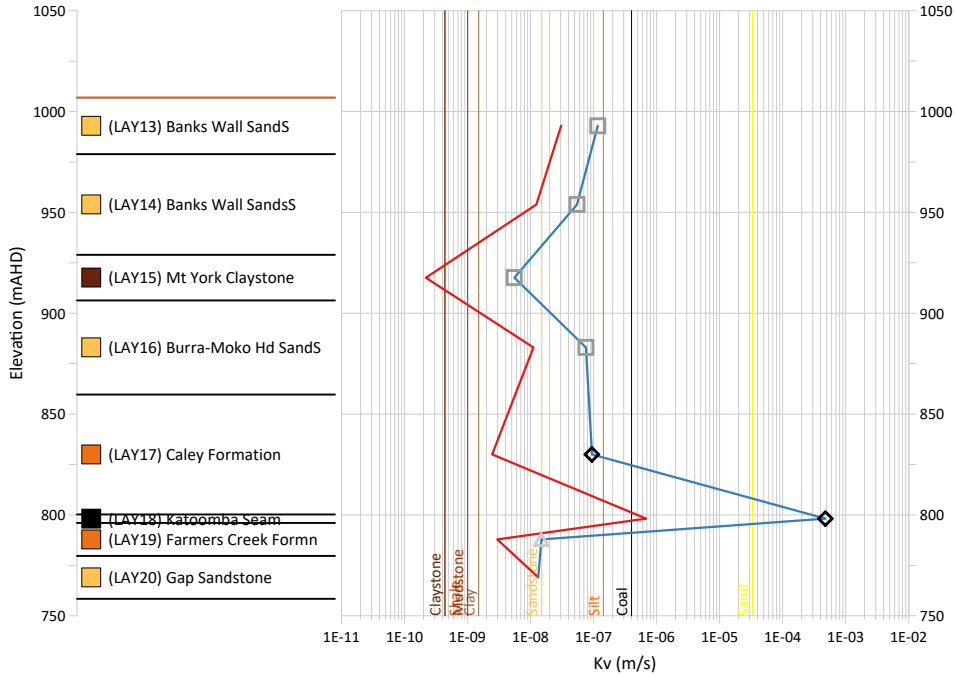
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D046_TVMProfile_16719\Plotting_16719_02_Multip\68229_R01RevA_D046b_TVMPEST_USG_ProfileChange_Multip_16719.grf

Reference: 68229_R01RevA_PRO_02a_21_SIM0

Figure 4.54b: Time-Varying Change to Hydraulic Properties (Factors Apllied to Layers) - Vertical Profile (L01 Node 16719)



Horizontal Hydraulic Conductivity (m/s):



Vertical Hydraulic Conductivity (m/s):

Legend

Layer Zone Assignment:

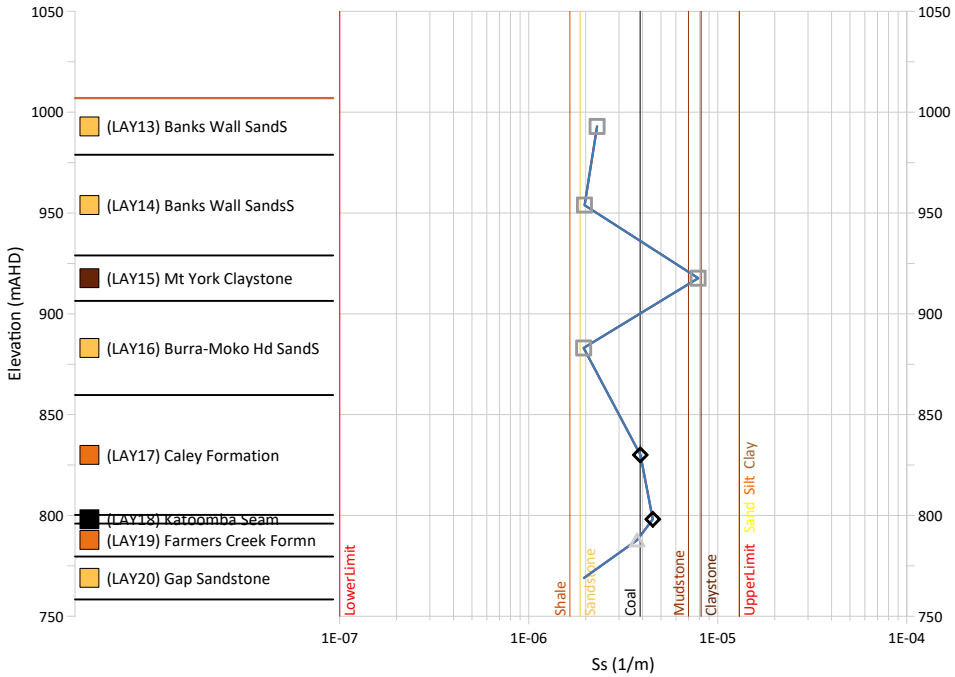
- Above Zone A
- Zone A
- Caved Zone

Profiles:

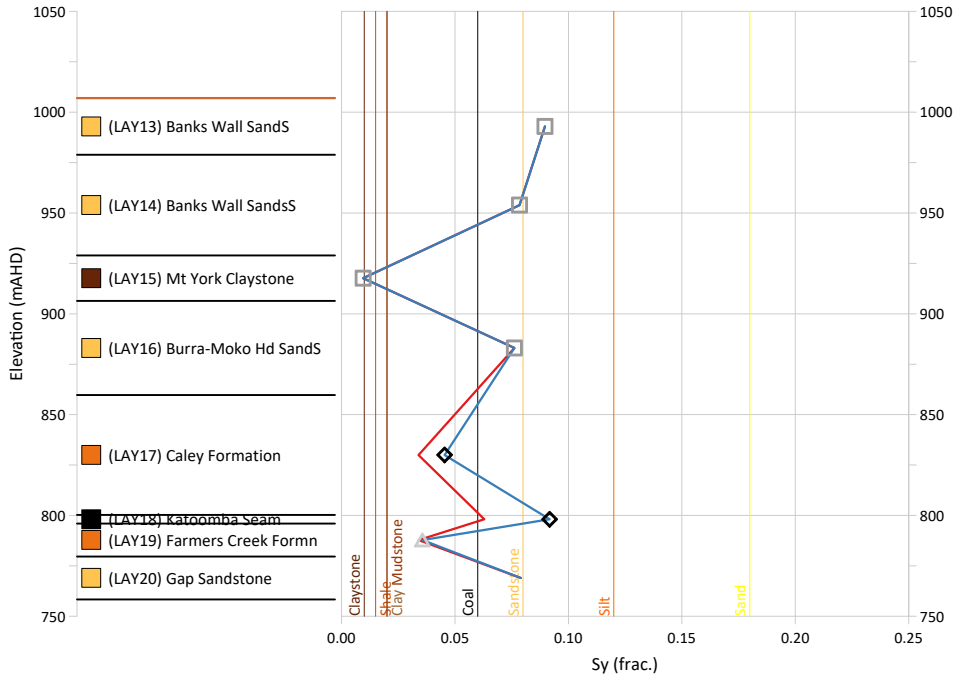
- 31/12/1867 (SP001) n/a
- Mar 1994 (SP018) 2nd_Longwall_1.060
- n/a n/a
- n/a n/a
- n/a n/a
- n/a n/a
- n/a n/a
- n/a n/a

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd



Specific Storage (1/m):



Specific Yield (frac.):

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 05/11/2025	
Drawn By: DAW	
Checked By: JRWB	

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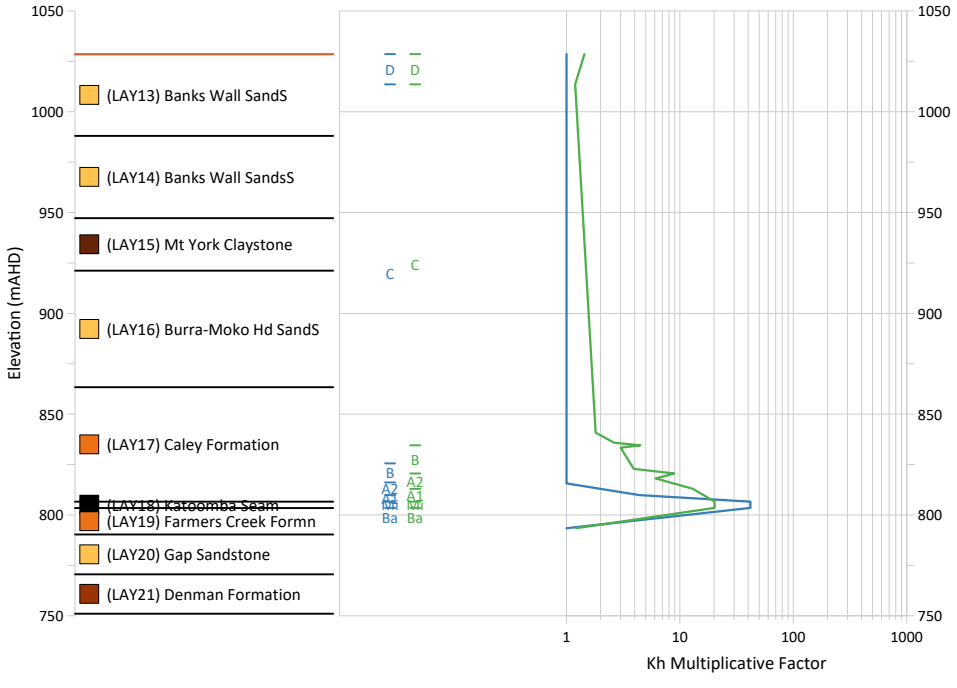
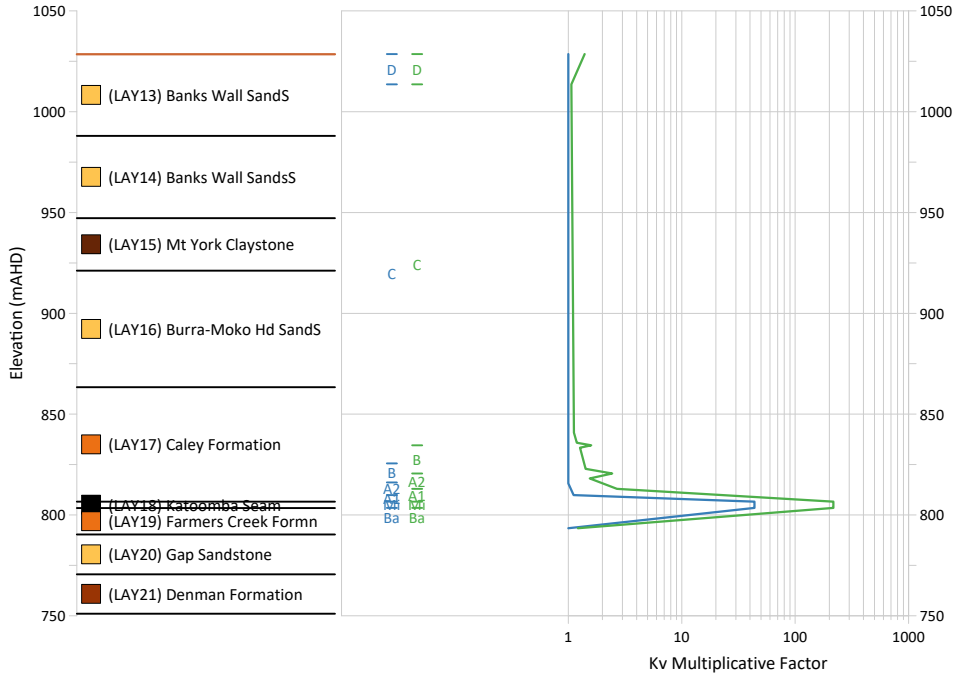
Reference: 68229_R01RevA_PRO_02a_21_SIM0

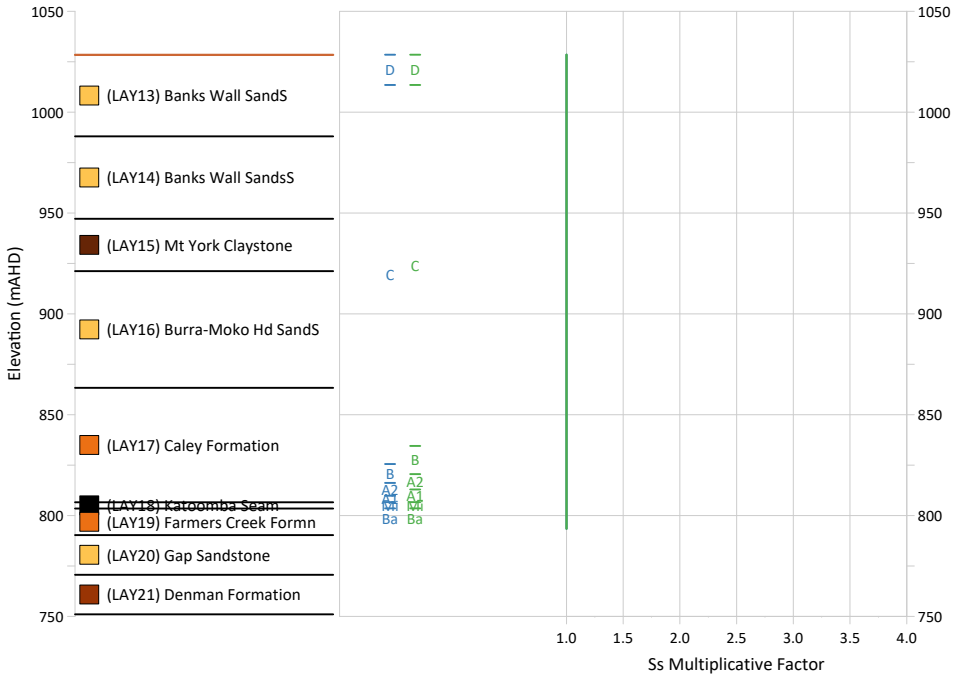
Figure 4.54c: Time-Varying Change to Hydraulic Properties - Vertical Profile (L01 Node 16719)



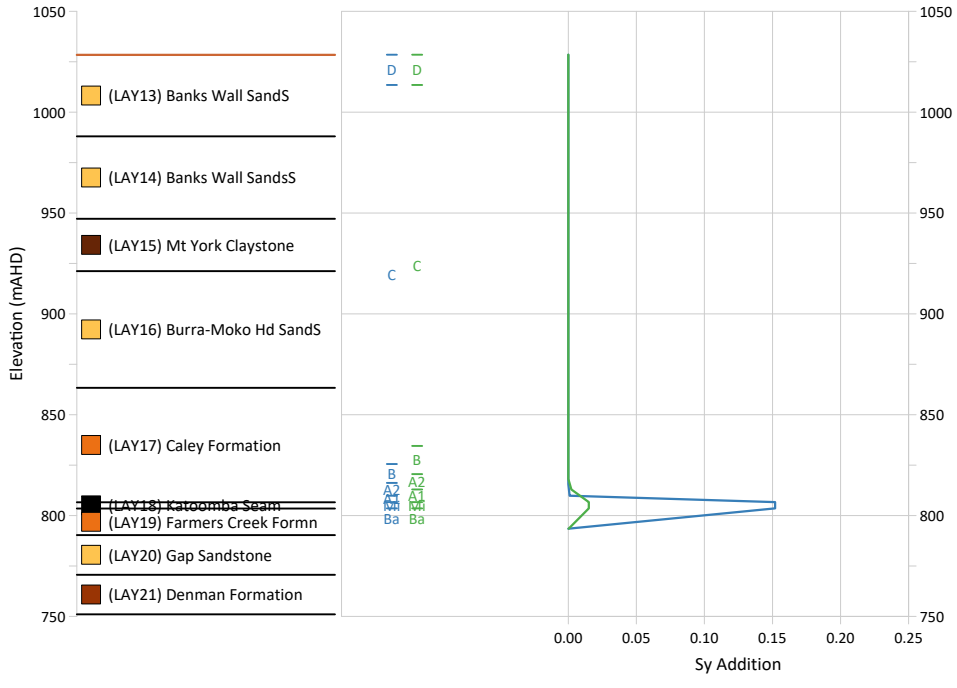
Horizontal Hydraulic Conductivity:



Vertical Hydraulic Conductivity:



Specific Storage:



Specific Yield:

Legend

Subsidence Zones:

D - D (Surface)
C - C (Elastic)
B - B (Constrained)
A2 - A (Fractured)
A1 - A (Caved)
Mi - Mined Seam
Ba - Basement

Profiles:

31/12/1867 (SP001)
n/a
Mar 2019 (SP118)
1st_1.000
Sep 2020 (SP124)
2nd_Total_1.000
n/a
n/a
n/a
n/a
n/a
n/a
n/a
n/a
n/a
n/a

Stratigraphy in Model:

Coal
Conglomerate
Sandstone
Siltstone
Shale
Mudstone
Claystone
Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.

Project No: 68229

Client:
Clarence Colliery Pty Ltd

Version: R01RevA

Date: 05/11/2025

Drawn By: DAW

Checked By: JRWB

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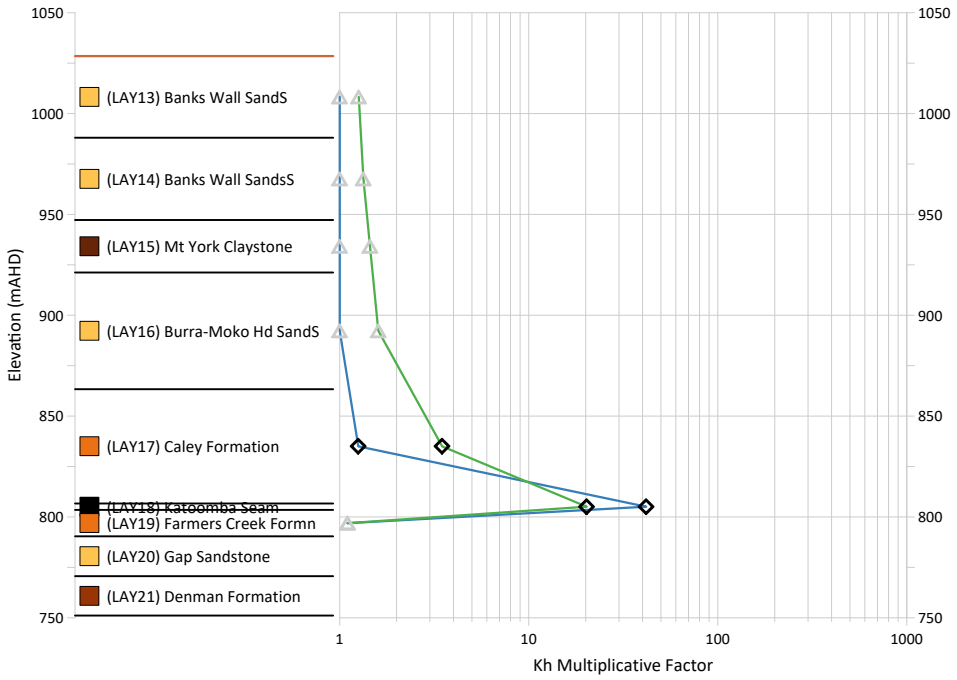
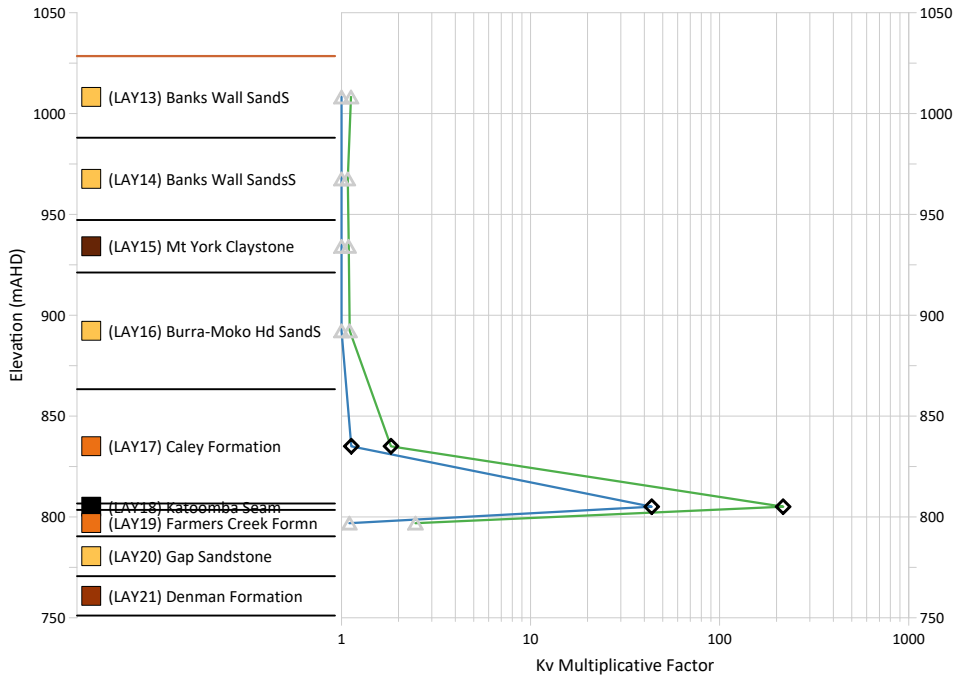
Reference: 68229_R01RevA_PRO_02a_21_SIM0

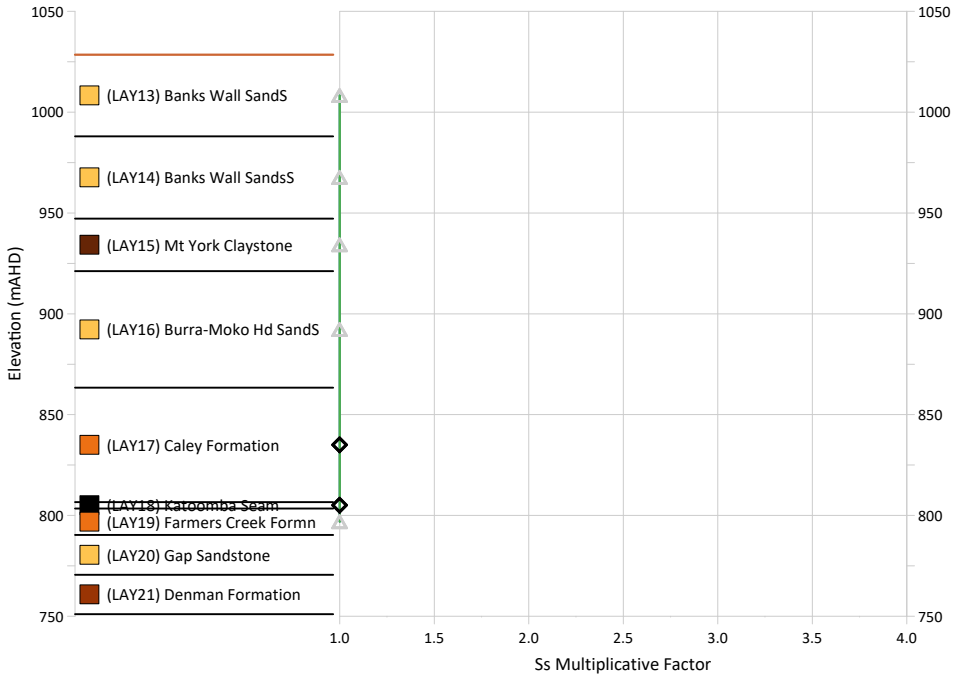
Figure 4.55a: Time-Varying Change to Hydraulic Properties (Ramp Function) - Vertical Profile (L01 Node 15913)



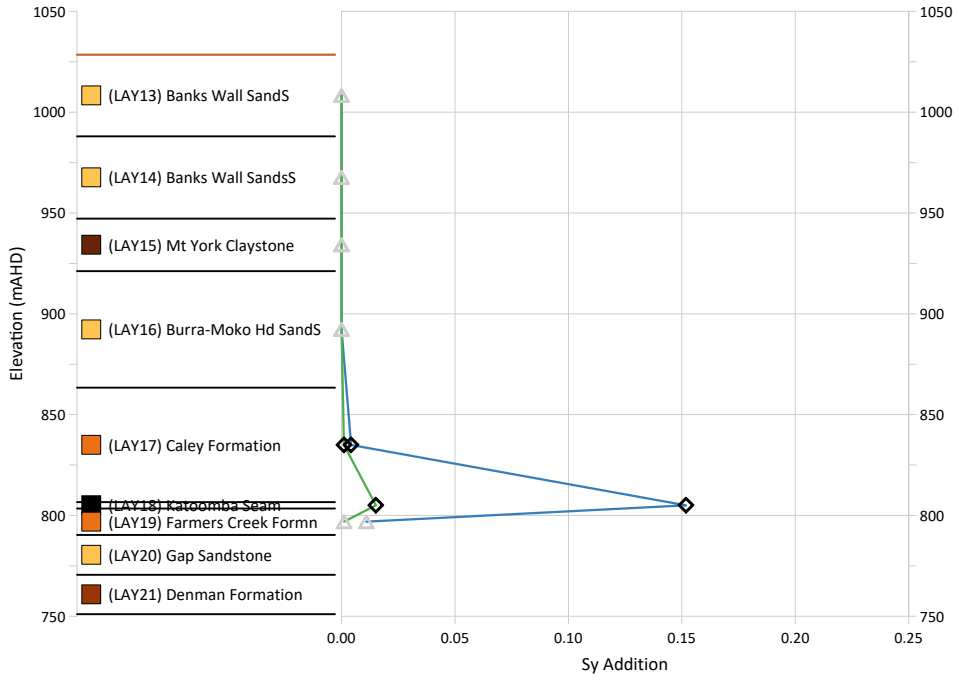
Horizontal Hydraulic Conductivity:



Vertical Hydraulic Conductivity:



Specific Storage:



Specific Yield:

Legend

Layer Zone Assignment:

- Above Zone A
- Zone A
- Caved Zone

Profiles:

- 31/12/1867 (SP001)
  n/a
- Mar 2019 (SP118)
  1st_1.000
- Sep 2020 (SP124)
  2nd_Total_1.000
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 05/11/2025	
Drawn By: DAW	
Checked By: JRWB	

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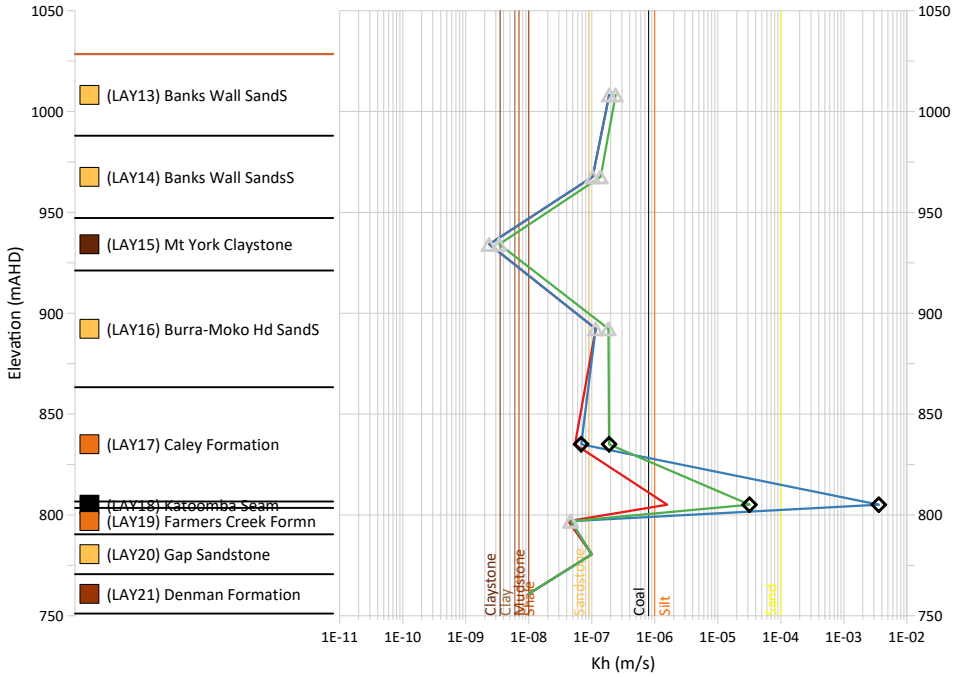
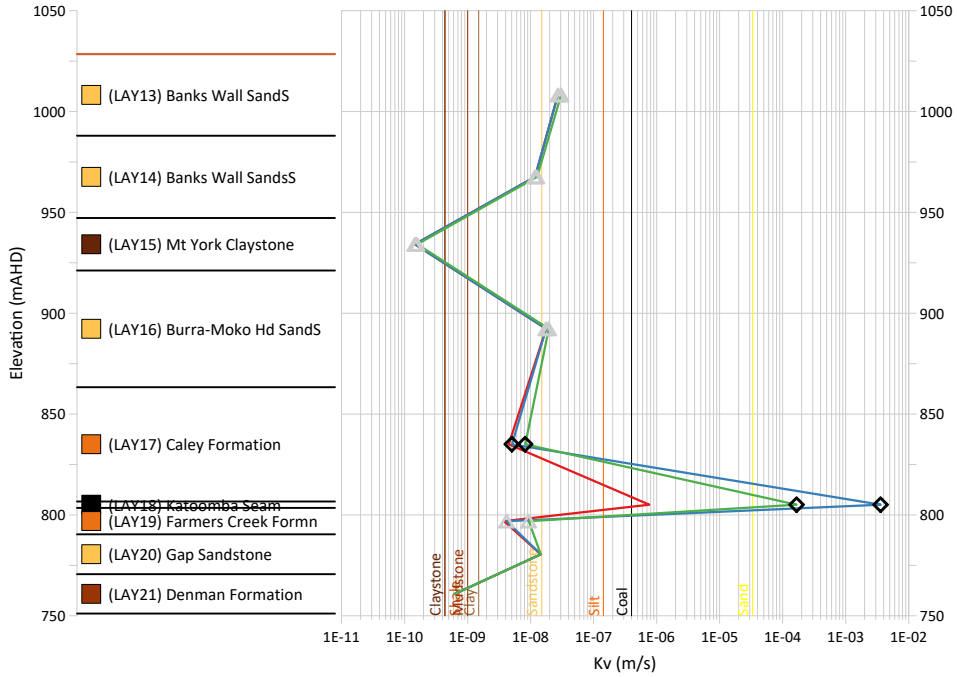
Reference: 68229_R01RevA_PRO_02a_21_SIM0

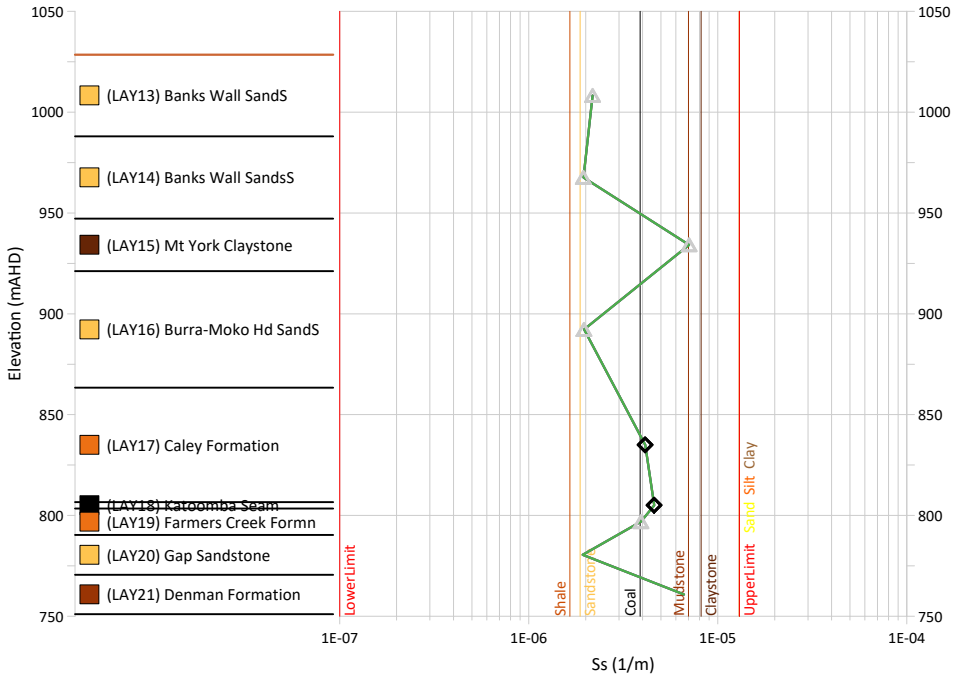
Figure 4.55b: Time-Varying Change to Hydraulic Properties (Factors Apllied to Layers) - Vertical Profile (L01 Node 15913)



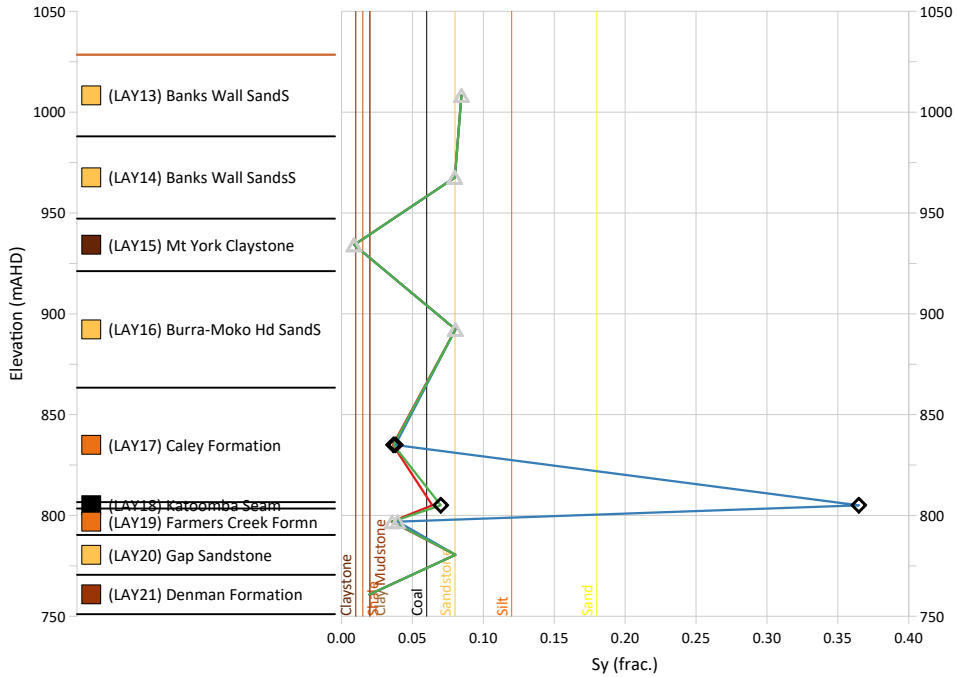
Horizontal Hydraulic Conductivity (m/s):



Vertical Hydraulic Conductivity (m/s):



Specific Storage (1/m):



Specific Yield (frac.):

Legend

Layer Zone Assignment:

- Above Zone A
- Zone A
- Caved Zone

Profiles:

- 31/12/1867 (SP001) — n/a
- Mar 2019 (SP118) — 1st_1.000
- Sep 2020 (SP124) — 2nd_Total_1.000
- n/a — n/a
- n/a — n/a
- n/a — n/a
- n/a — n/a
- n/a — n/a

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

Project No: 68229	
Client:	Clarence Colliery Pty Ltd
Version: R01RevA	
Date: 05/11/2025	
Drawn By: DAW	
Checked By: JRWB	

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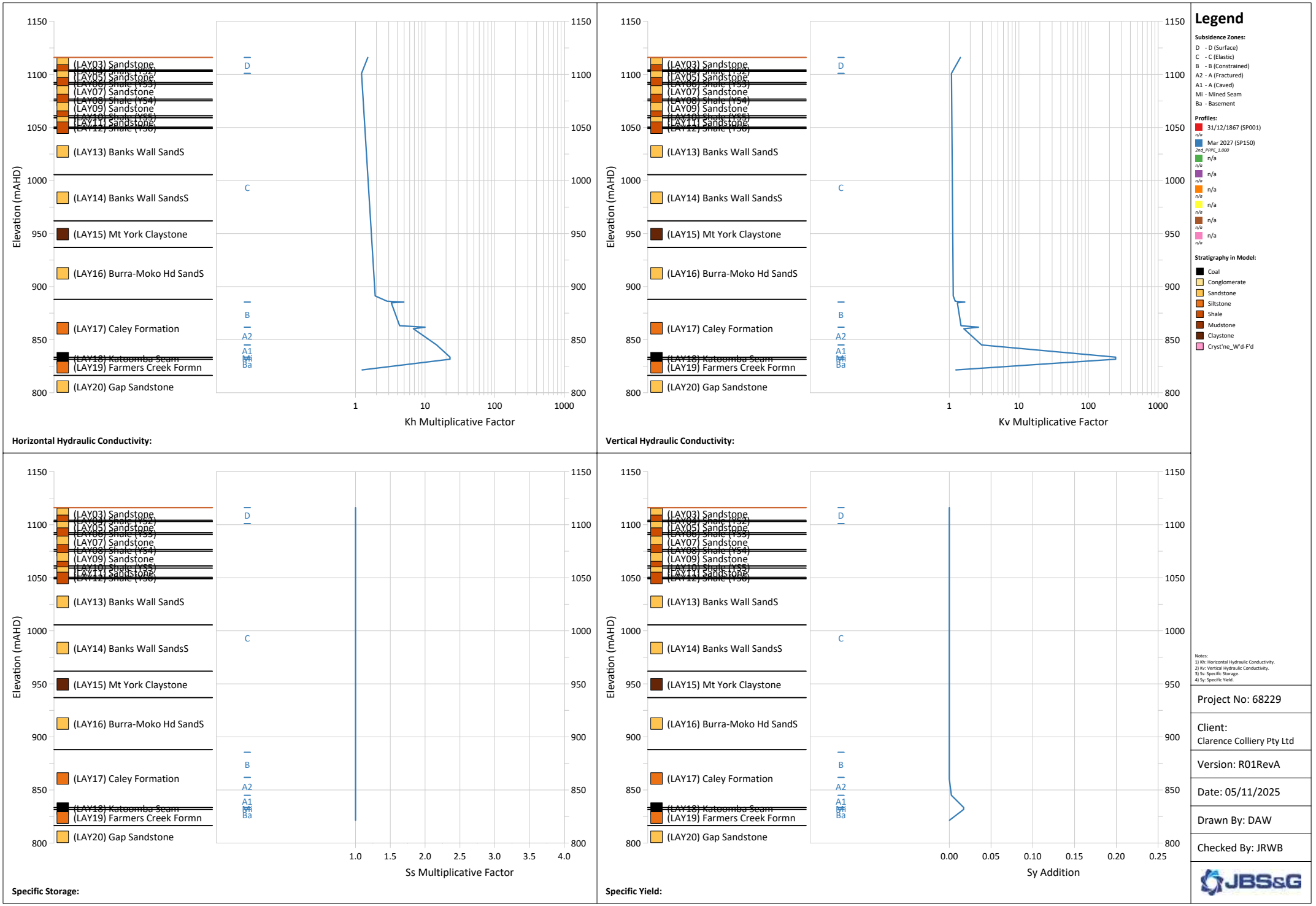
Reference: 68229_R01RevA_PRO_02a_21_SIM0

Figure 4.55c: Time-Varying Change to Hydraulic Properties - Vertical Profile (L01 Node 15913)



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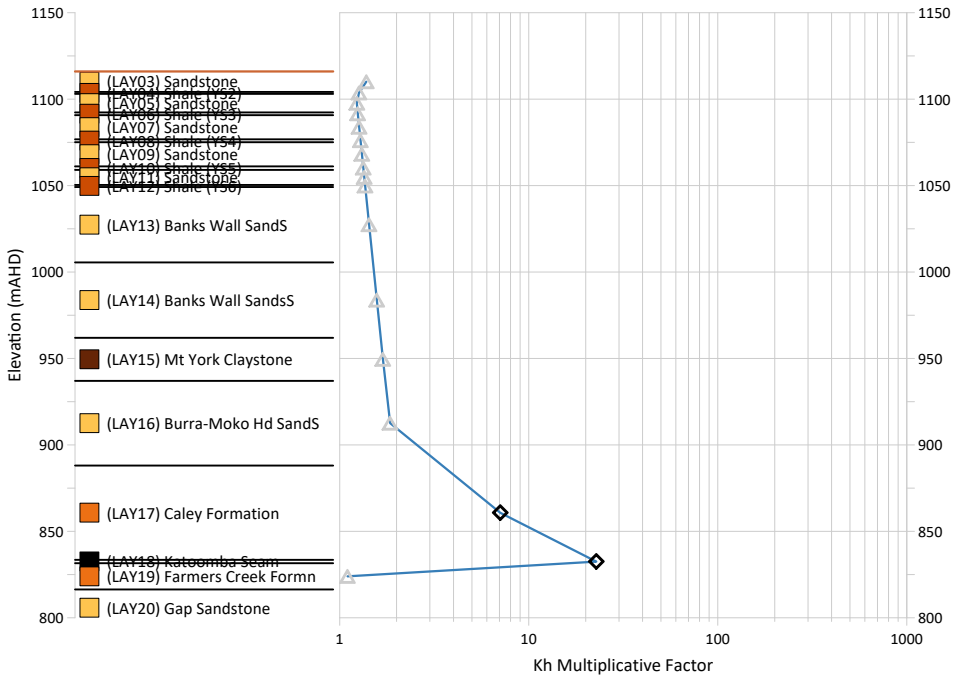
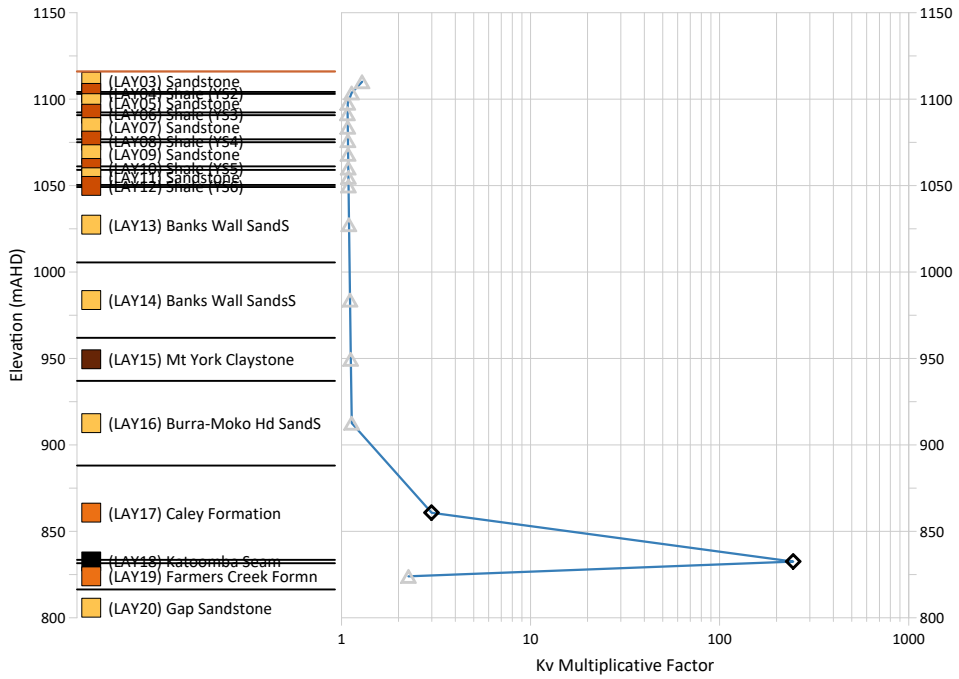
Reference: 68229_R01RevA_PRO_02a_21_SIM0

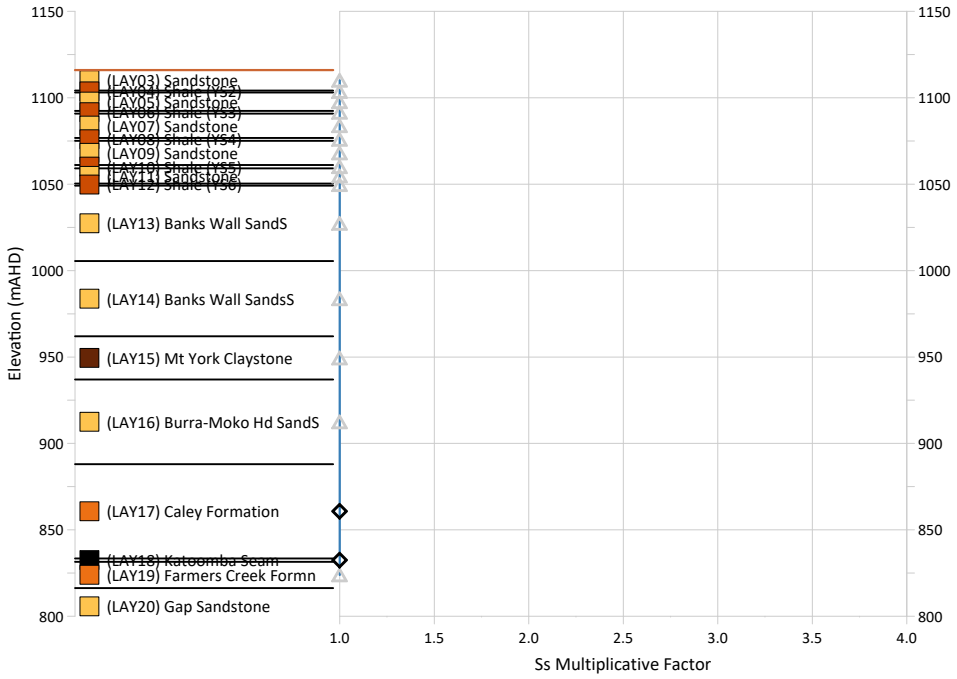
Figure 4.56a: Time-Varying Change to Hydraulic Properties (Ramp Function) - Vertical Profile (L01 Node 16593)



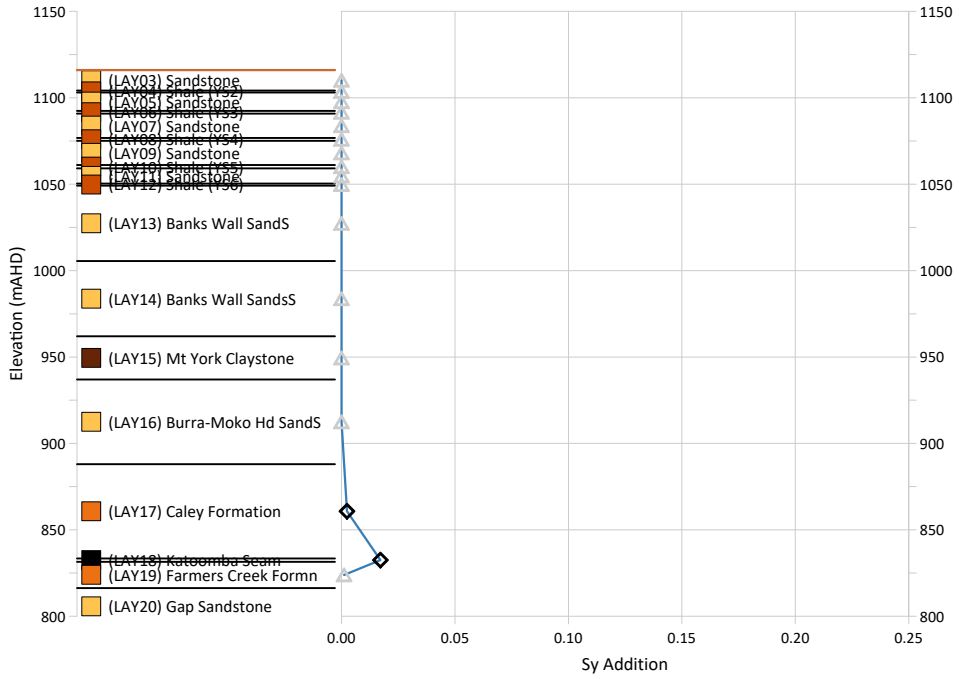
Horizontal Hydraulic Conductivity:



Vertical Hydraulic Conductivity:



Specific Storage:



Specific Yield:

Legend

Layer Zone Assignment:
- Above Zone A
- Zone A
- Caved Zone

Profiles:
- 31/12/1867 (SP001)
- Mar 2027 (SP150)
- n/a

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

Project No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA

Date: 05/11/2025

Drawn By: DAW

Checked By: JRWB

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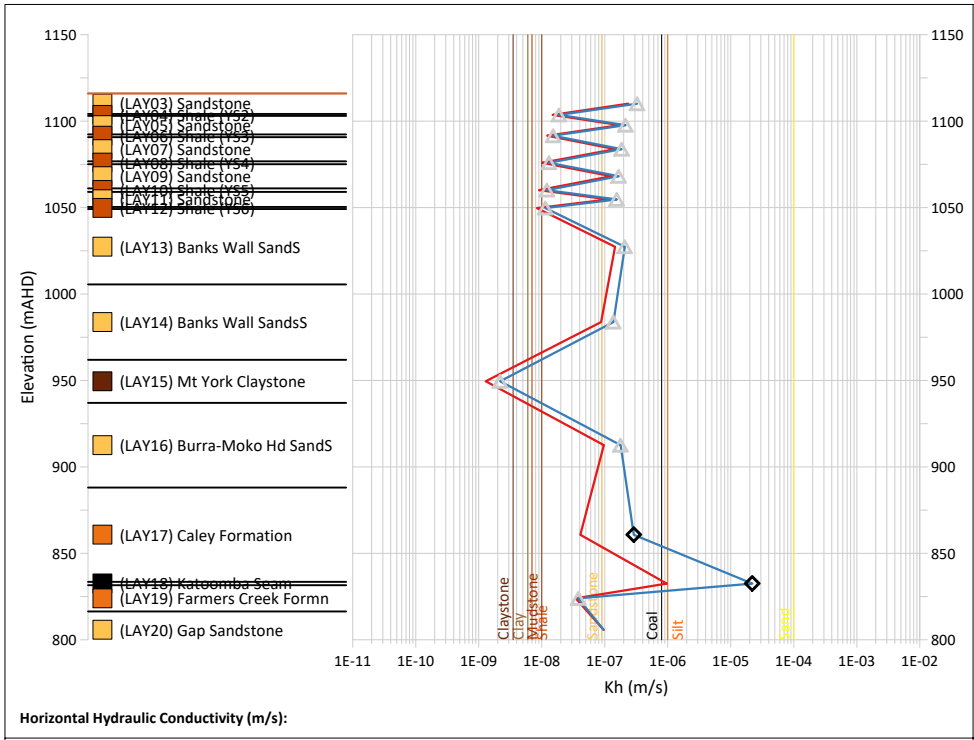
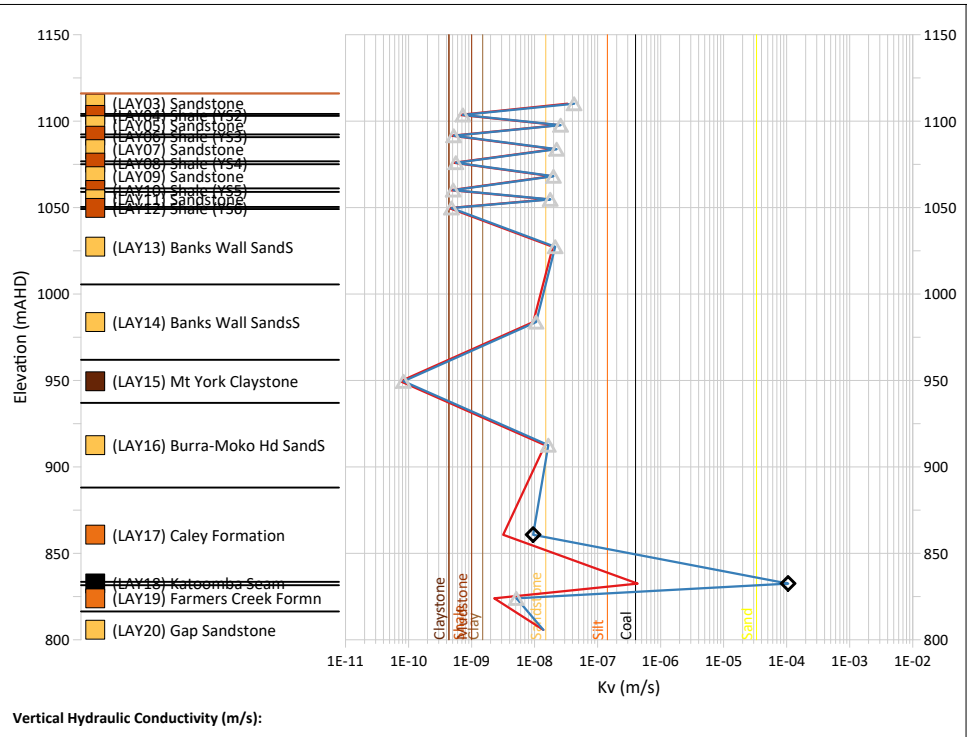
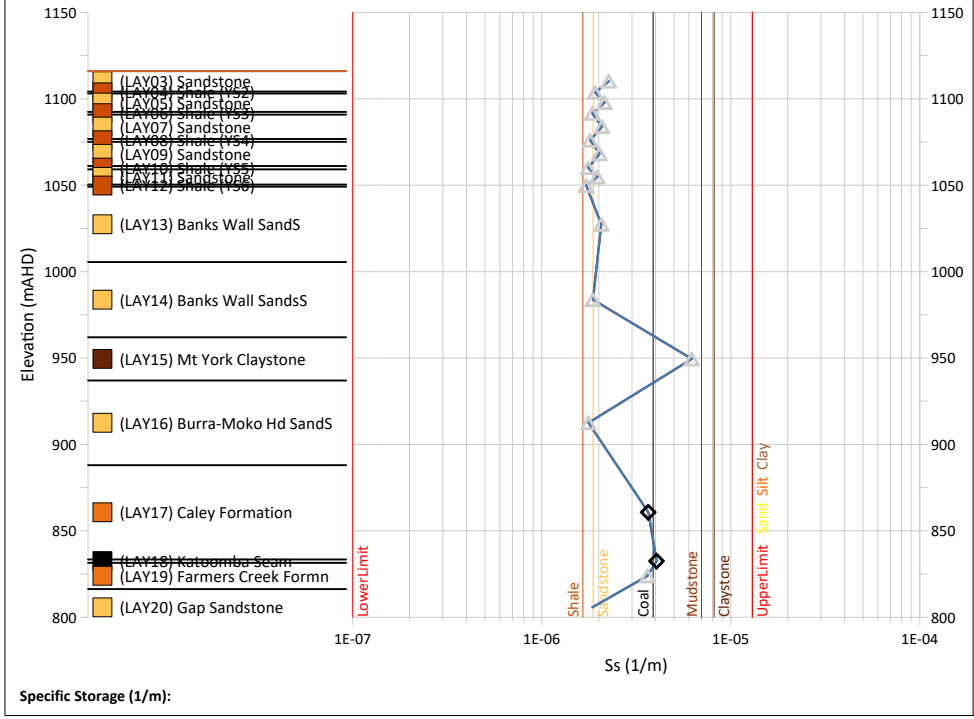
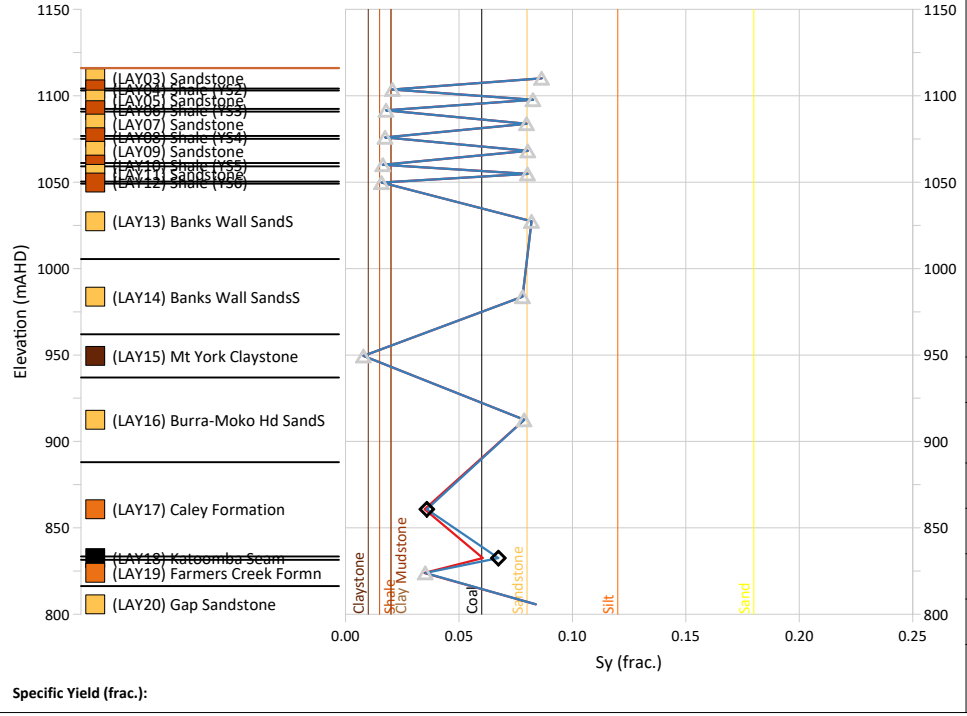
Reference: 68229_R01RevA_PRO_02a_21_SIM0

Figure 4.56b: Time-Varying Change to Hydraulic Properties (Factors Apllied to Layers) - Vertical Profile (L01 Node 16593)









Legend

Layer Zone Assignment:

- Above Zone A
- Zone A
- Caved Zone

Profiles:

- 31/12/1867 (SP001)
- Mar 2027 (SP150)
- n/a
- n/a
- n/a
- n/a
- n/a
- n/a

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 05/11/2025	
Drawn By: DAW	
Checked By: JRWB	

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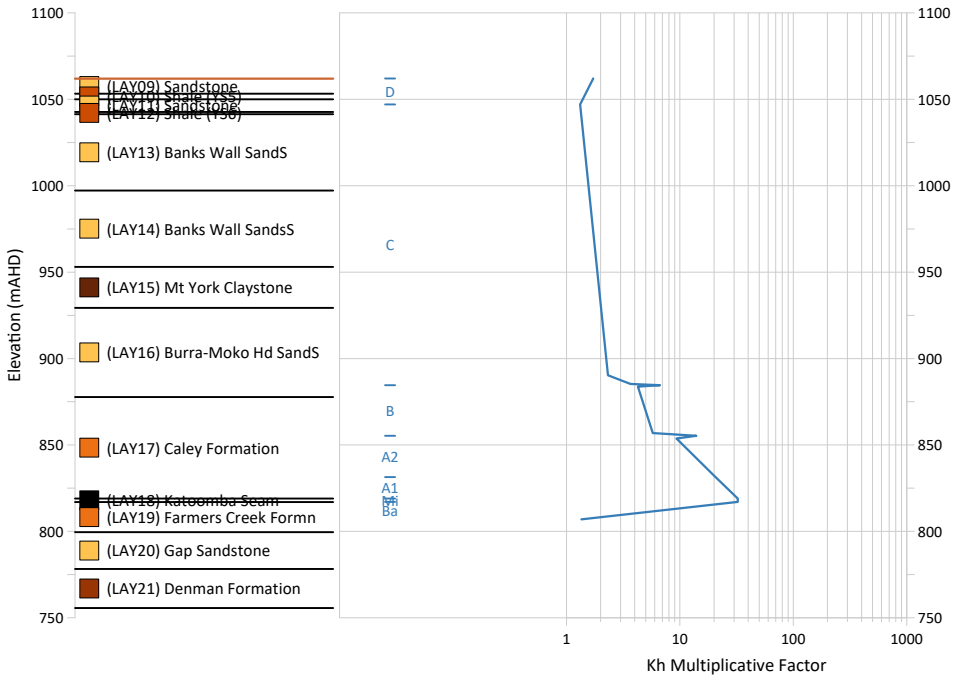
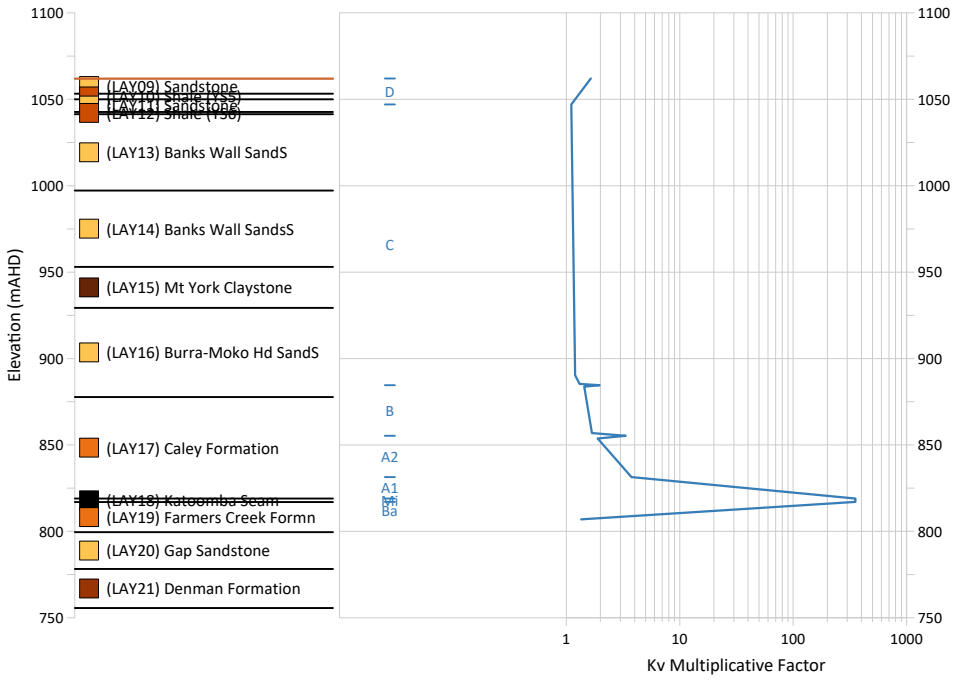
Reference: 68229_R01RevA_PRO_02a_21_SIM0

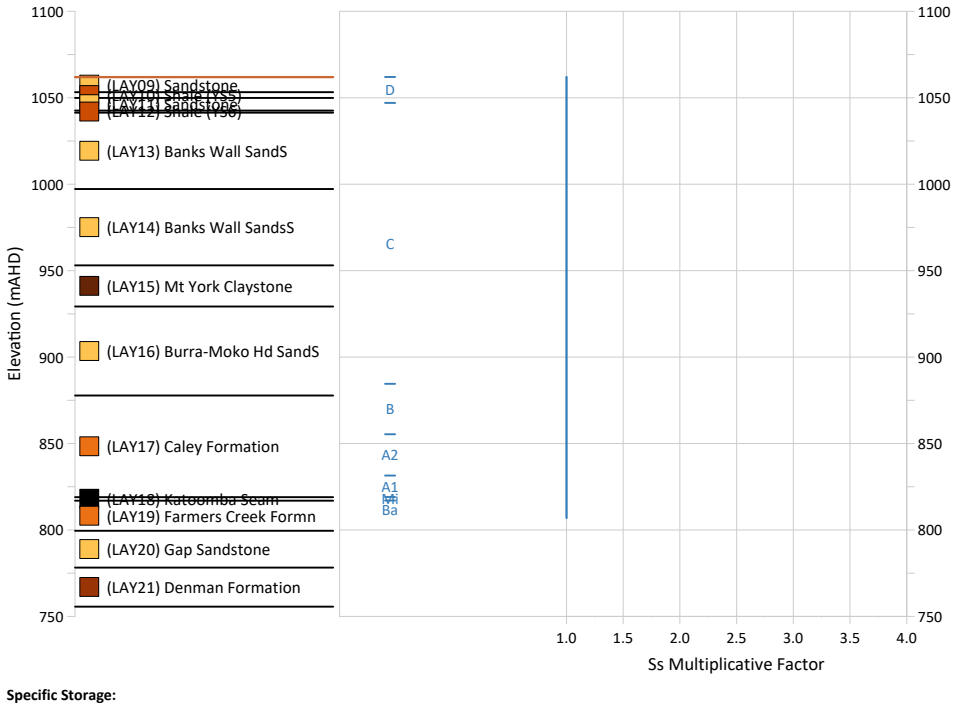
Figure 4.56c: Time-Varying Change to Hydraulic Properties - Vertical Profile (L01 Node 16593)



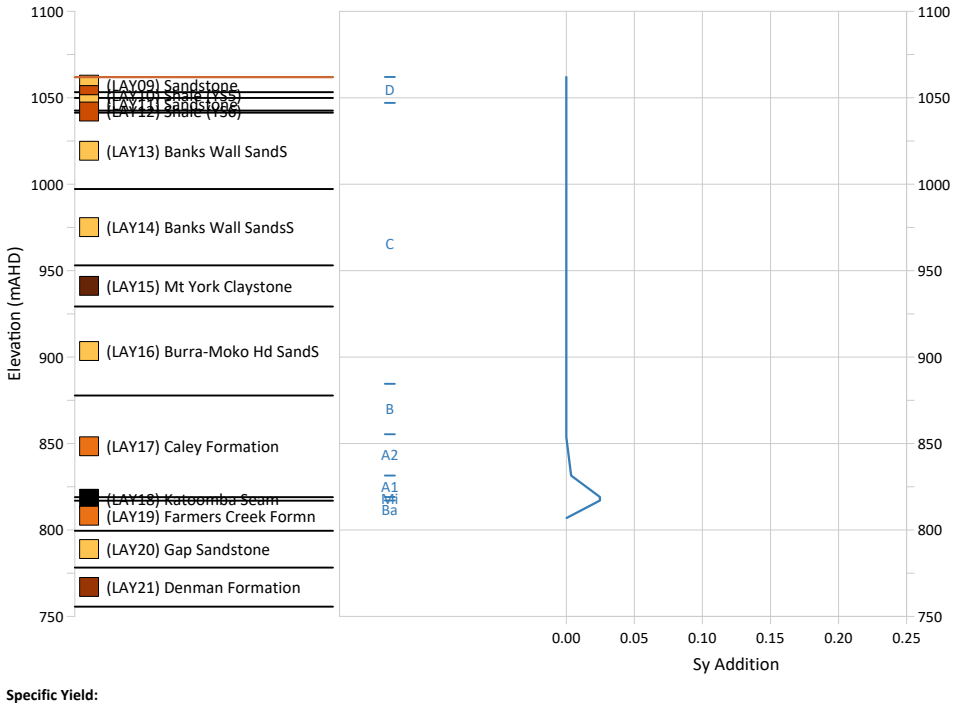
Horizontal Hydraulic Conductivity:



Vertical Hydraulic Conductivity:



Specific Storage:



Specific Yield:

Legend

Subsidence Zones:

D - D (Surface)
C - C (Elastic)
B - B (Constrained)
A2 - A (Fractured)
A1 - A (Caved)
Mi - Mined Seam
Ba - Basement

Profiles:

31/12/1867 (SP001)
n/a
Sep 2027 (SP152)
2nd_PPPE_1.119
n/a
n/a
n/a
n/a
n/a
n/a

Stratigraphy in Model:

Coal
Conglomerate
Sandstone
Siltstone
Shale
Mudstone
Claystone
Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 05/11/2025	
Drawn By: DAW	
Checked By: JRWB	

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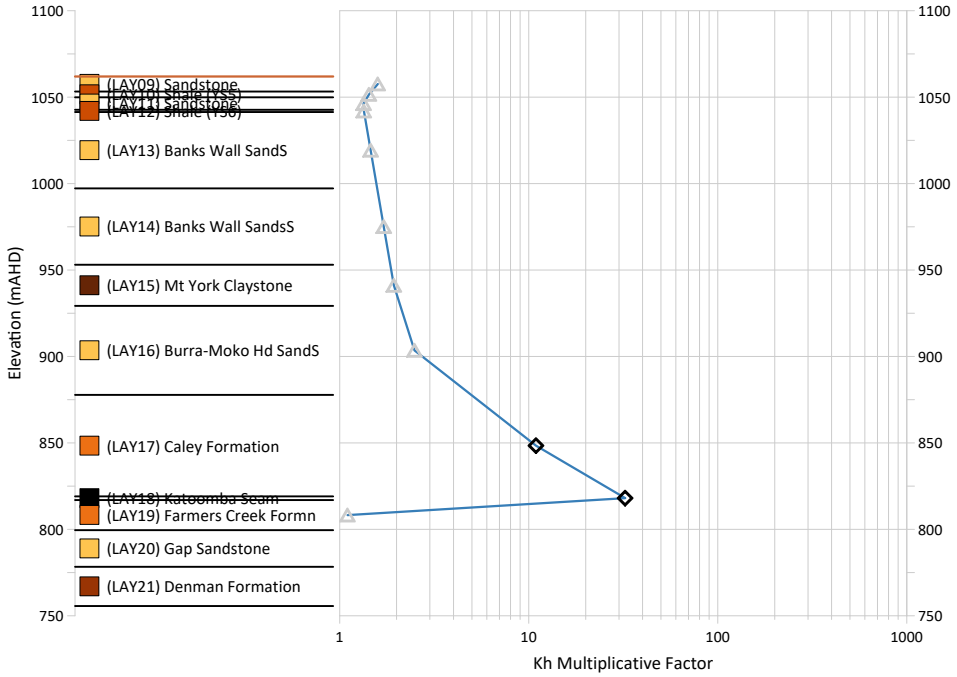
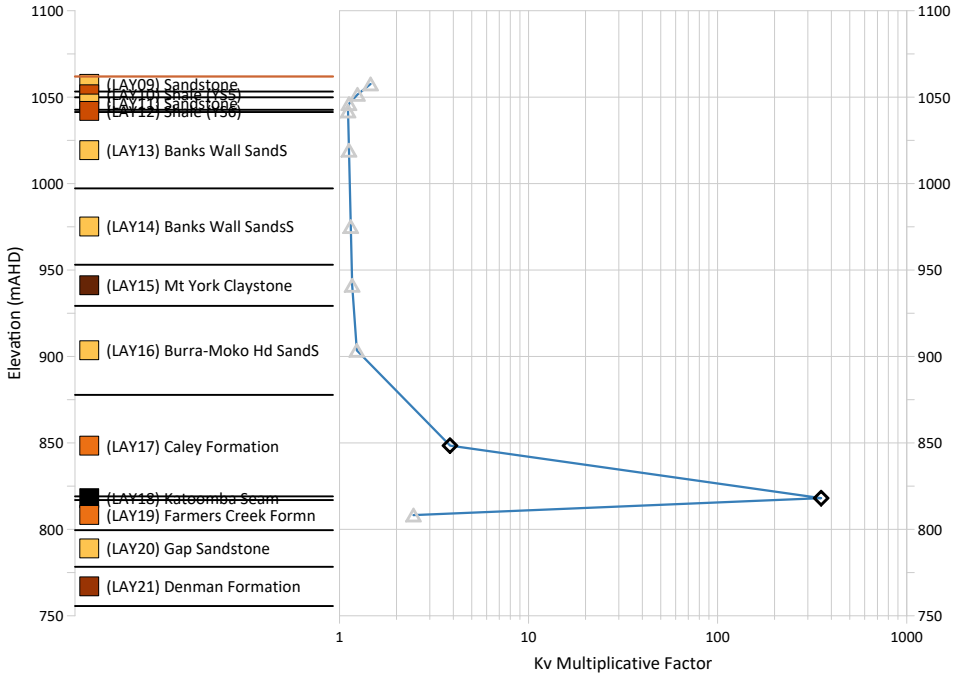
Reference: 68229_R01RevA_PRO_02a_21_SIM0

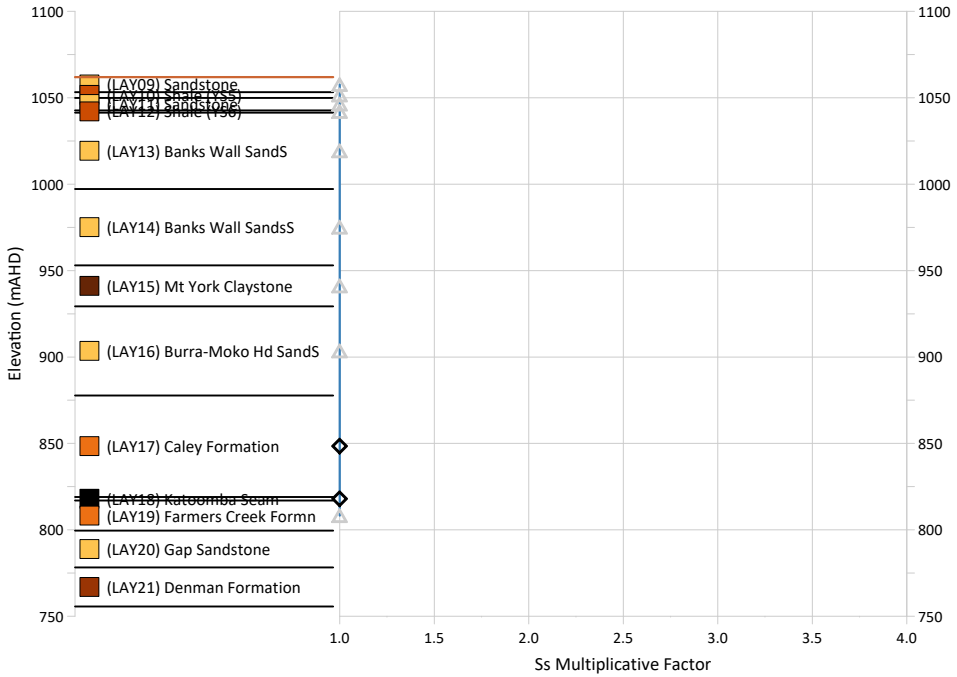
Figure 4.57a: Time-Varying Change to Hydraulic Properties (Ramp Function) - Vertical Profile (L01 Node 15136)



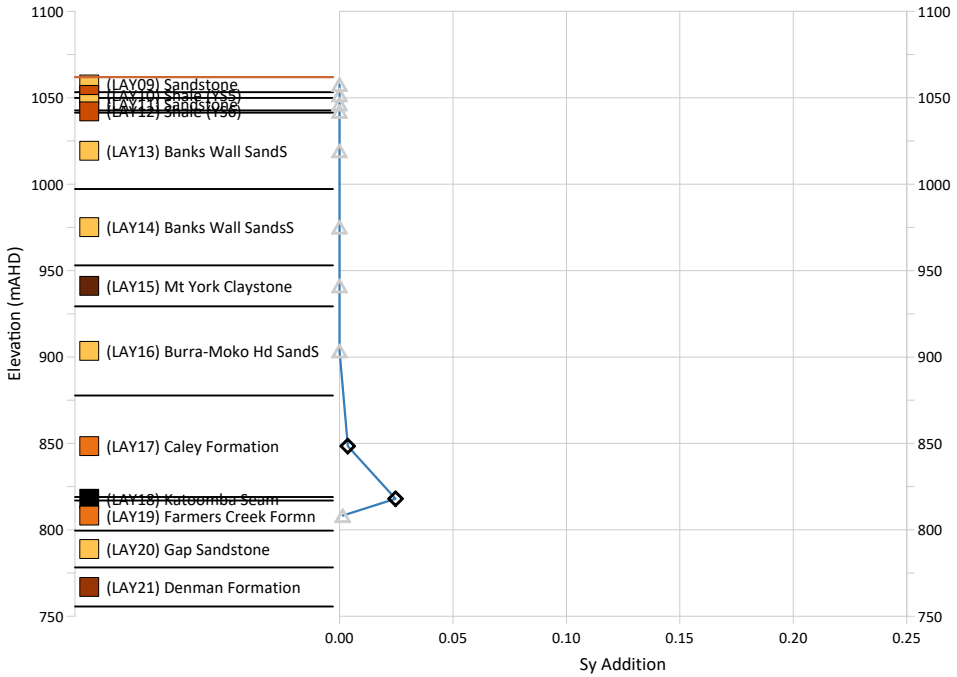
Horizontal Hydraulic Conductivity:



Vertical Hydraulic Conductivity:



Specific Storage:



Specific Yield:

Legend

Layer Zone Assignment:
- Above Zone A
- Zone A
- Caved Zone

Profiles:
- 31/12/1867 (SP001)
  n/a
- Sep 2027 (SP152)
  2nd_PPPE_1.119
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
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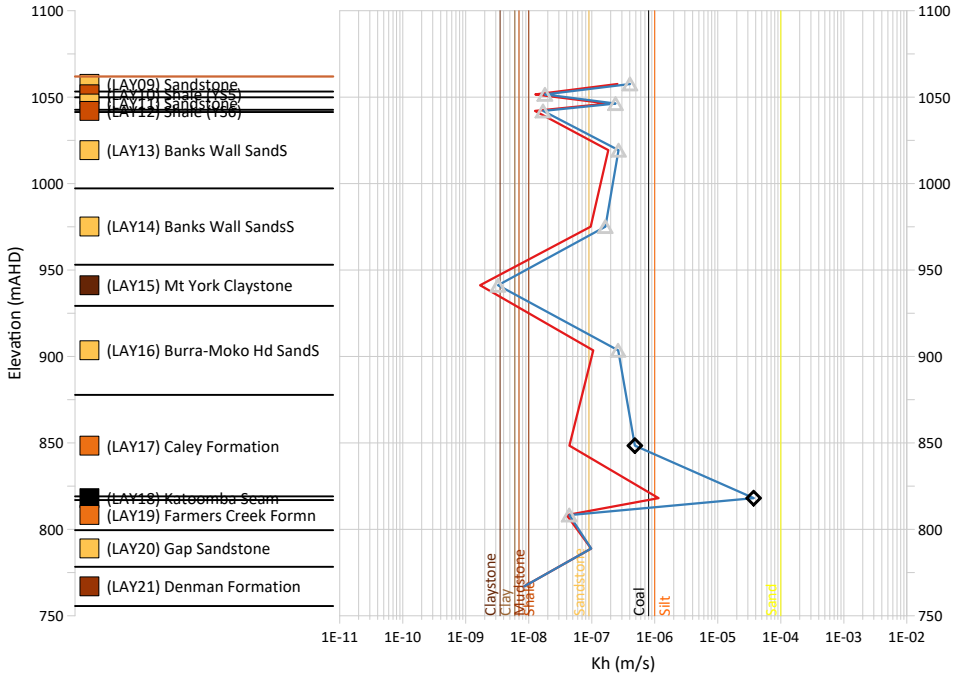
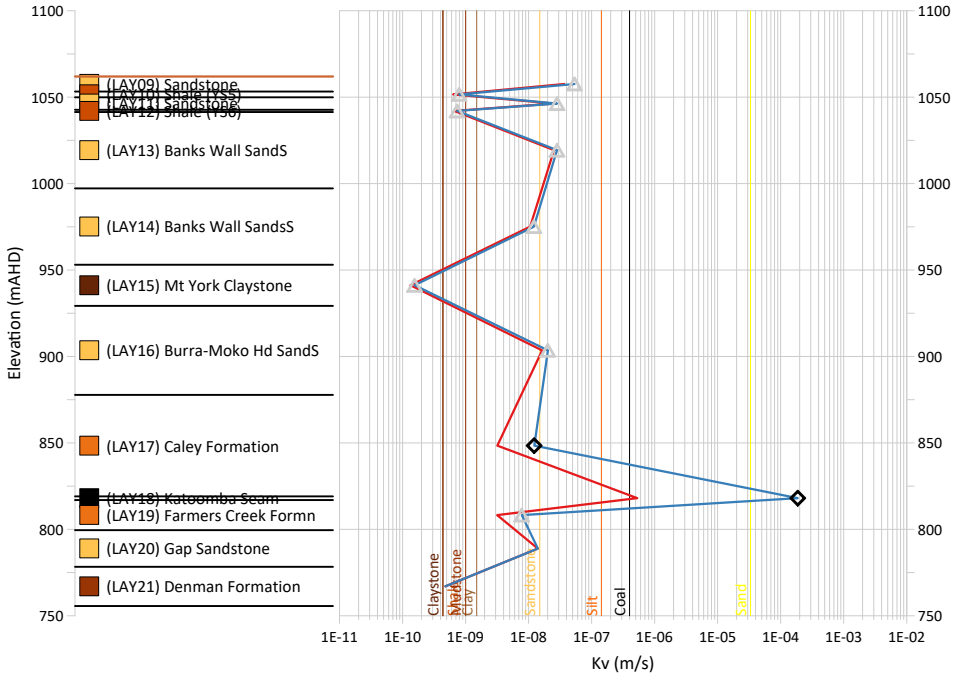
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D049_TVMProfile_15136\Plotting_15136_02_Multip\68229_R01RevA_D049b_TVMPEST_USG_ProfileChange_Multip_15136.grf

Reference: 68229_R01RevA_PRO_02a_21_SIM0

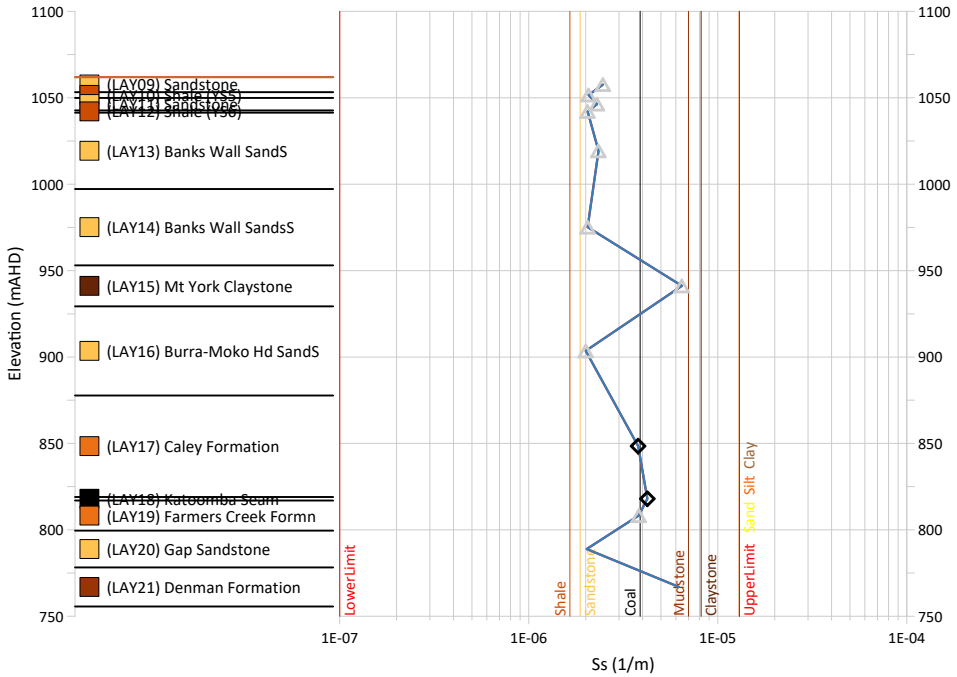
Figure 4.57b: Time-Varying Change to Hydraulic Properties (Factors Apllied to Layers) - Vertical Profile (L01 Node 15136)



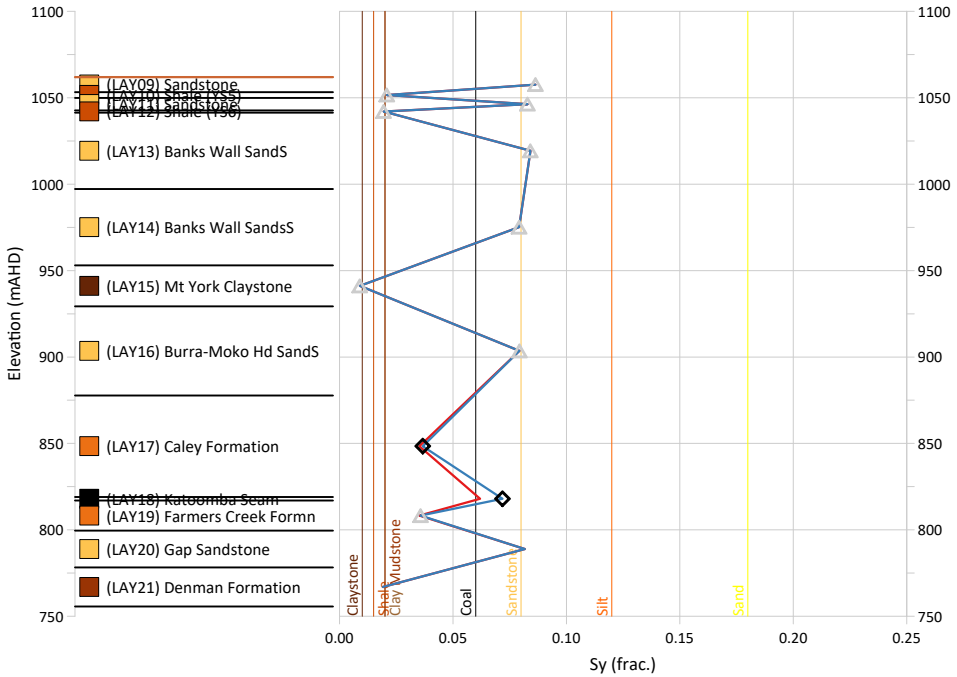
Horizontal Hydraulic Conductivity (m/s):



Vertical Hydraulic Conductivity (m/s):



Specific Storage (1/m):



Specific Yield (frac.):

Legend

Layer Zone Assignment:

- Above Zone A
- Zone A
- Caved Zone

Profiles:

- 31/12/1867 (SP001) n/a
- Sep 2027 (SP152) 2nd_PPPE_1.119
- n/a
- n/a
- n/a
- n/a
- n/a
- n/a

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

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Client: Clarence Colliery Pty Ltd

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Drawn By: DAW

Checked By: JRWB

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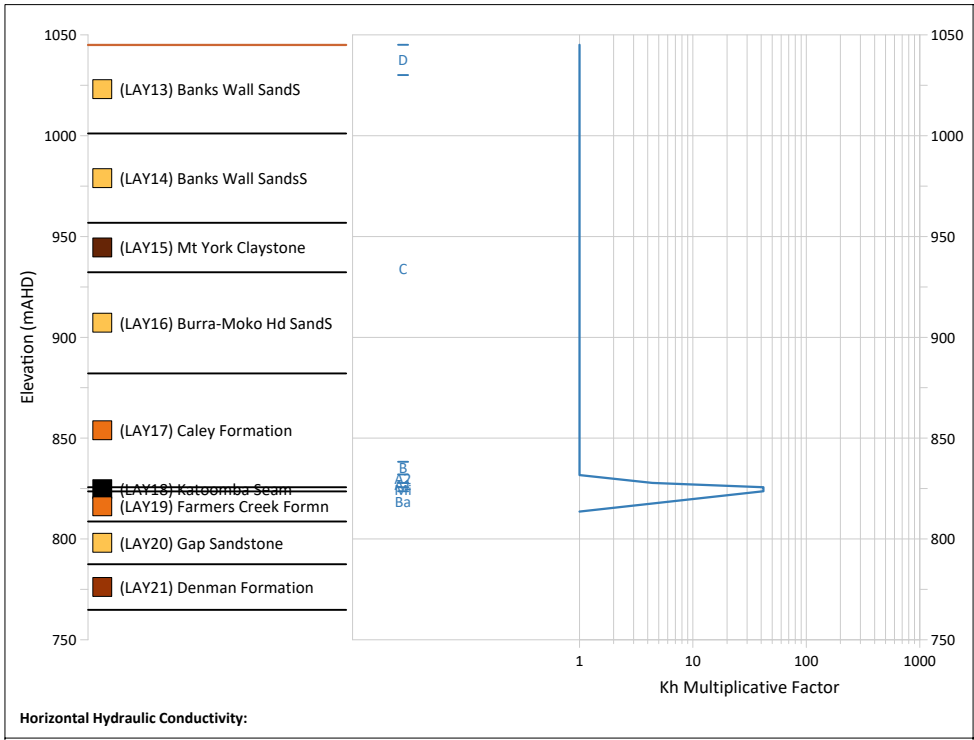
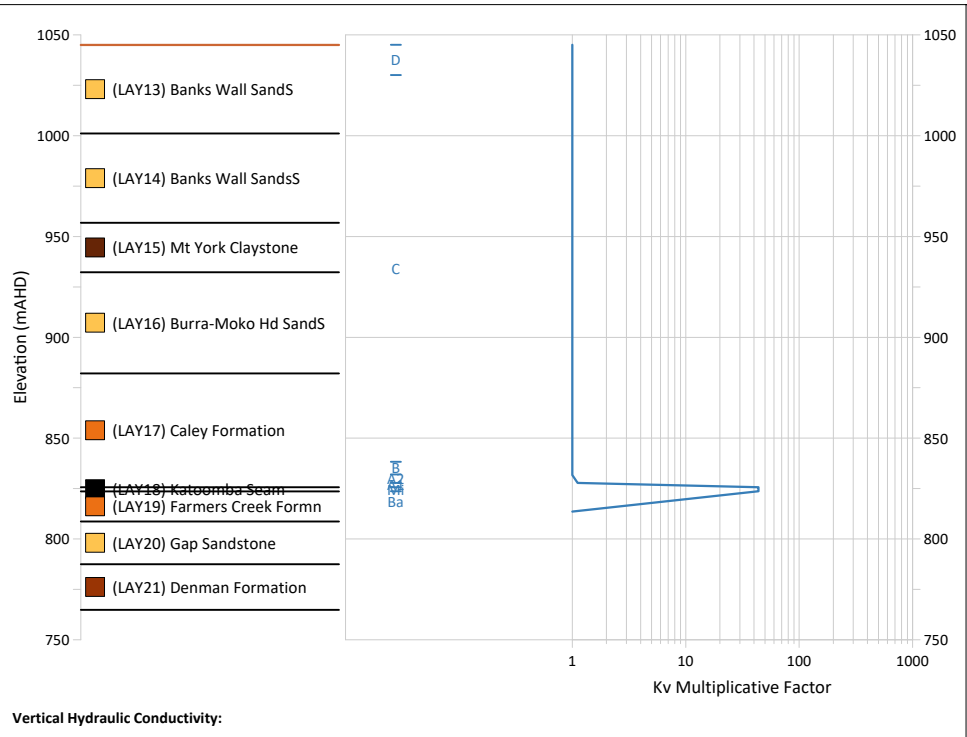
Reference: 68229_R01RevA_PRO_02a_21_SIM0

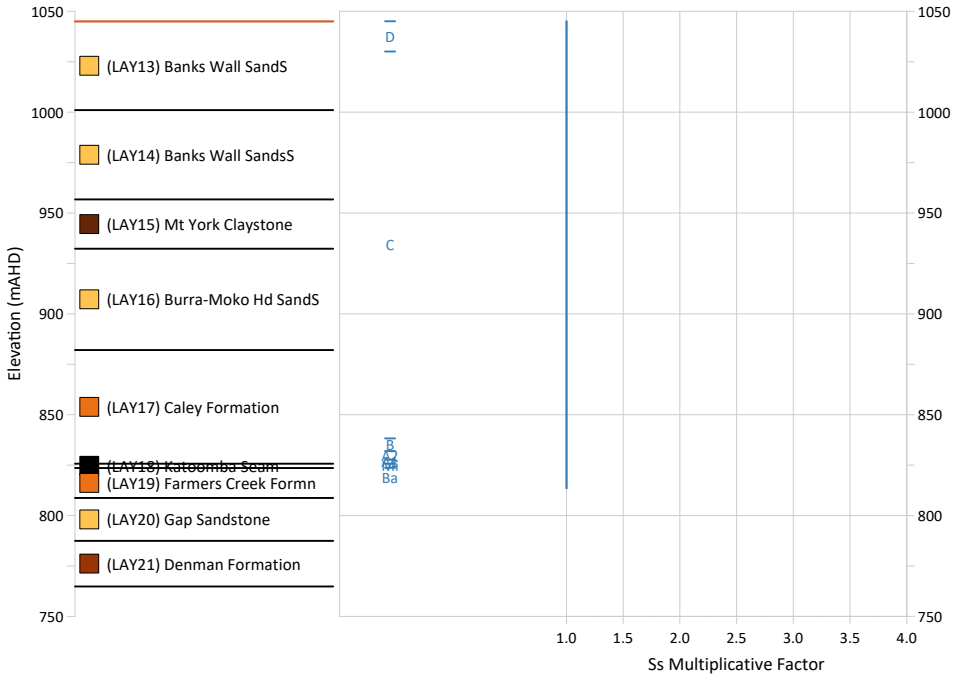
Figure 4.57c: Time-Varying Change to Hydraulic Properties - Vertical Profile (L01 Node 15136)



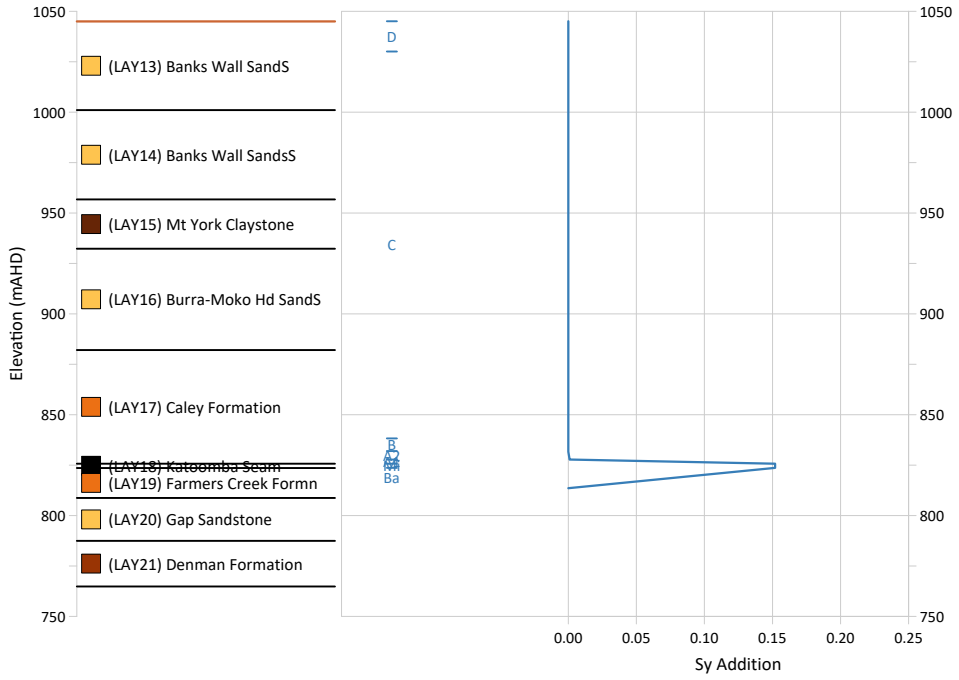
Horizontal Hydraulic Conductivity:



Vertical Hydraulic Conductivity:



Specific Storage:



Specific Yield:

Legend

Subsidence Zones:

D - D (Surface)
C - C (Elastic)
B - B (Constrained)
A2 - A (Fractured)
A1 - A (Caved)
Mi - Mined Seam
Ba - Basement

Profiles:

31/12/1867 (SP001)
n/a
Jun 2026 (SP147)
1st_t.000
n/a
n/a
n/a
n/a
n/a
n/a
n/a

Stratigraphy in Model:

Coal
Conglomerate
Sandstone
Siltstone
Shale
Mudstone
Claystone
Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.

Project No: 68229

Client:
Clarence Colliery Pty Ltd

Version: R01RevA

Date: 11/11/2025

Drawn By: DAW

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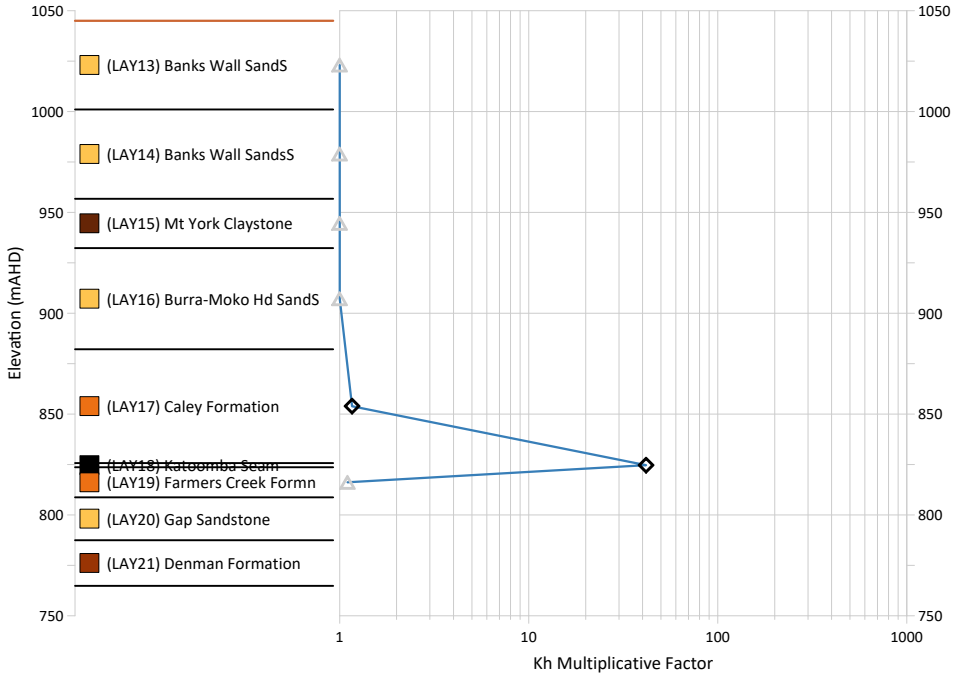
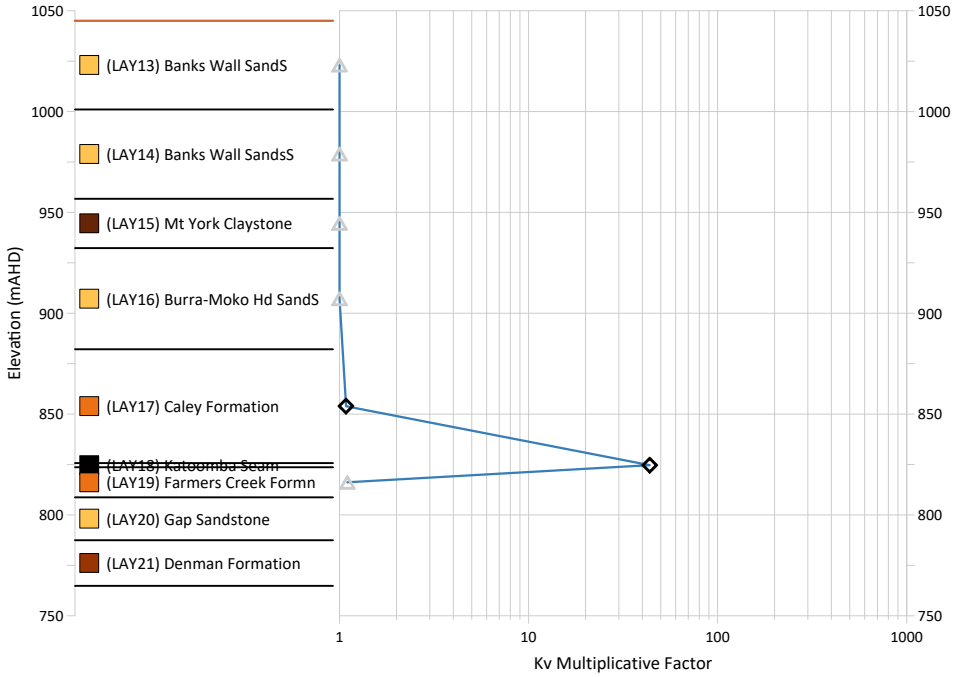
Reference: 68229_R01RevA_PRO_02a_21_SIM0

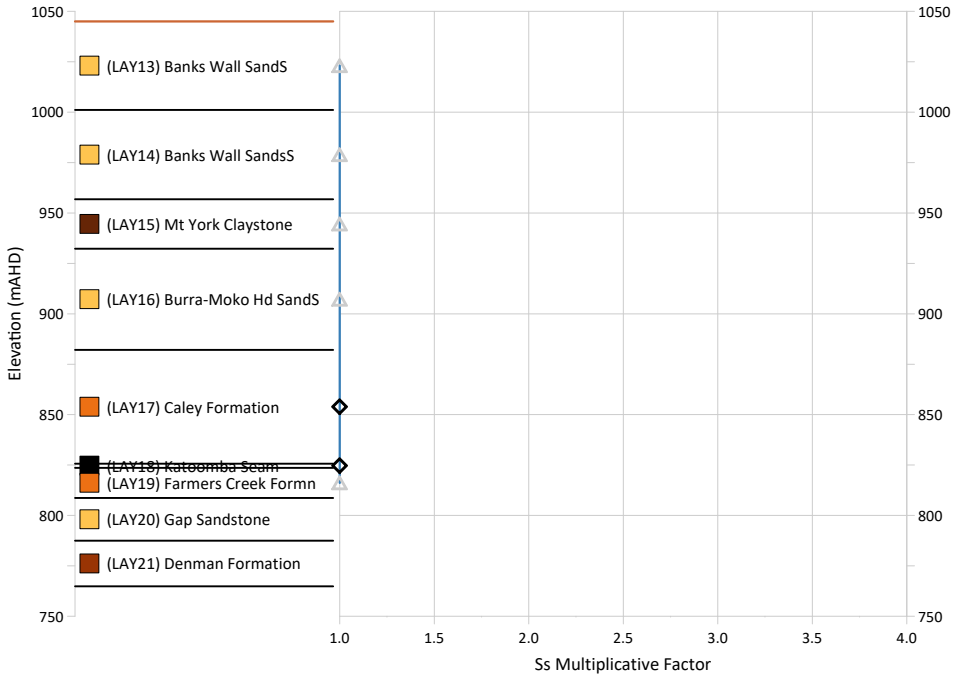
Figure 4.58a: Time-Varying Change to Hydraulic Properties (Ramp Function) - Vertical Profile (L01 Node 15876)



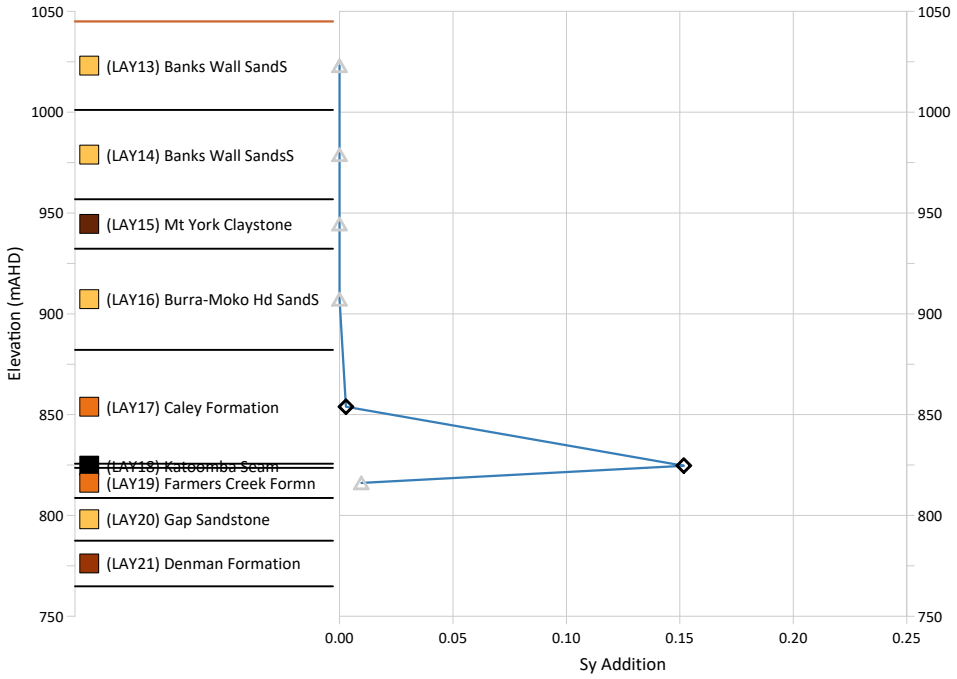
Horizontal Hydraulic Conductivity:



Vertical Hydraulic Conductivity:



Specific Storage:



Specific Yield:

Legend

Layer Zone Assignment:

- Above Zone A
- Zone A
- Caved Zone

Profiles:

- 31/12/1867 (SP001)
  n/a
- Jun 2026 (SP147)
  1st_1.000
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

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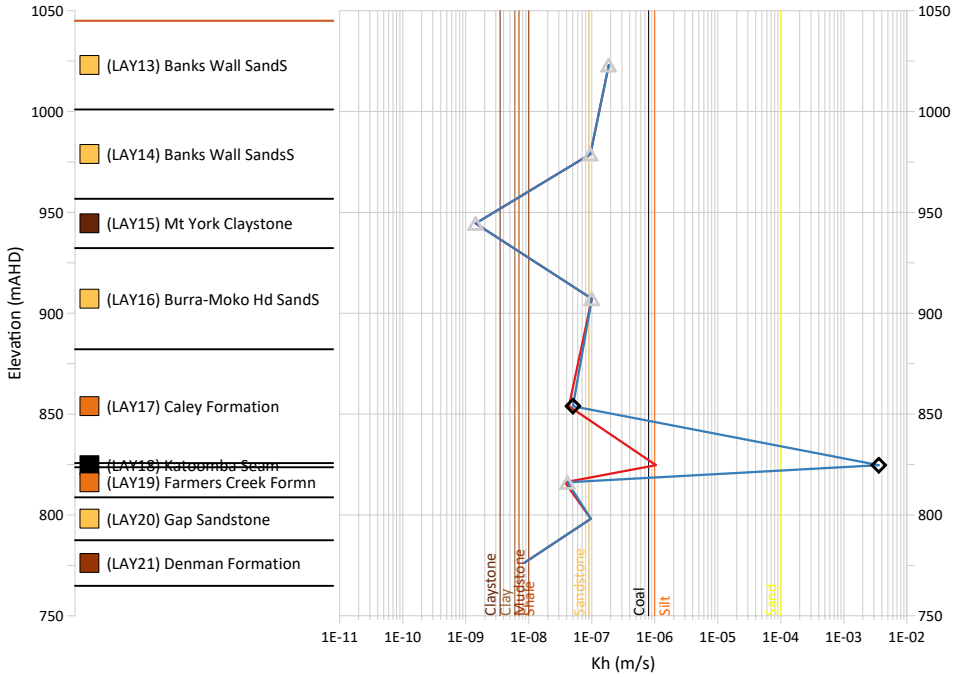
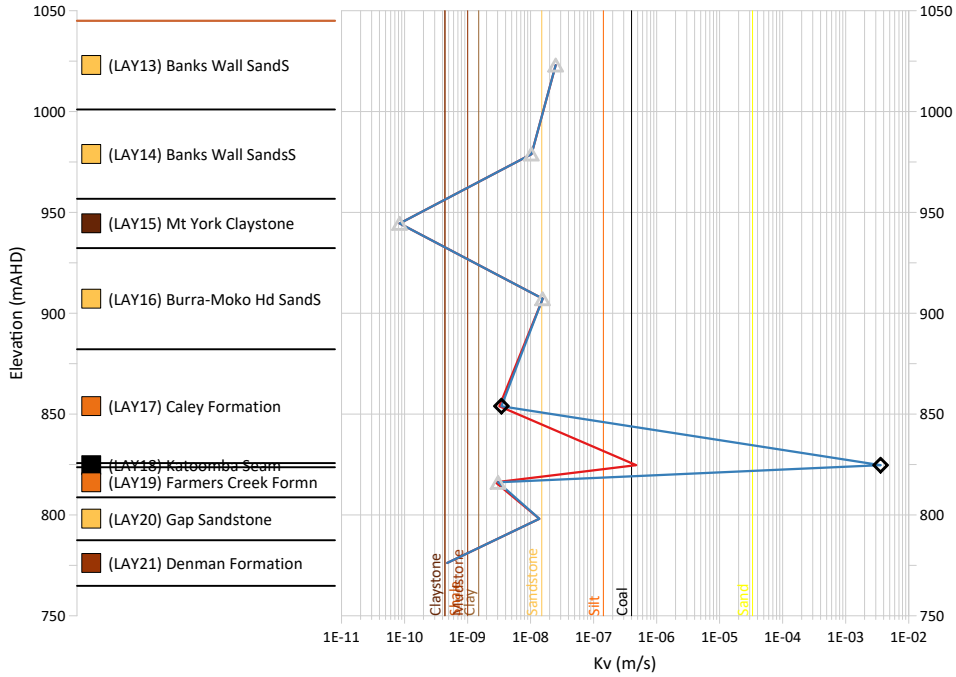
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D050_TVMProfile_15876\Plotting_15876_02_Multip\68229_R01RevA_D050b_TVMPEST_USG_ProfileChange_Multip_15876.grf

Reference: 68229_R01RevA_PRO_02a_21_SIM0

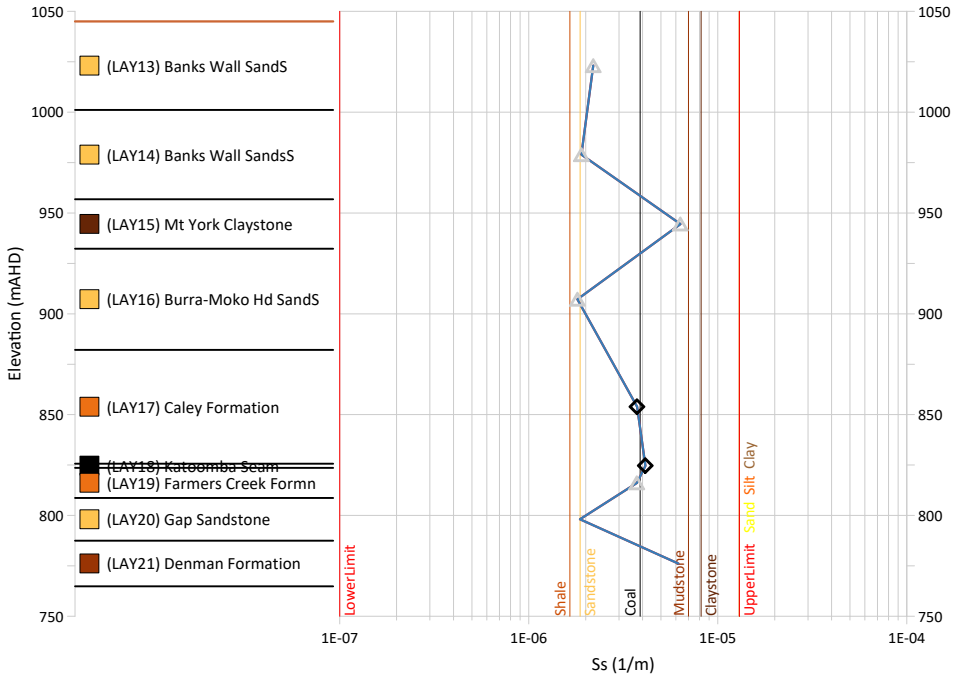
Figure 4.58b: Time-Varying Change to Hydraulic Properties (Factors Apllied to Layers) - Vertical Profile (L01 Node 15876)



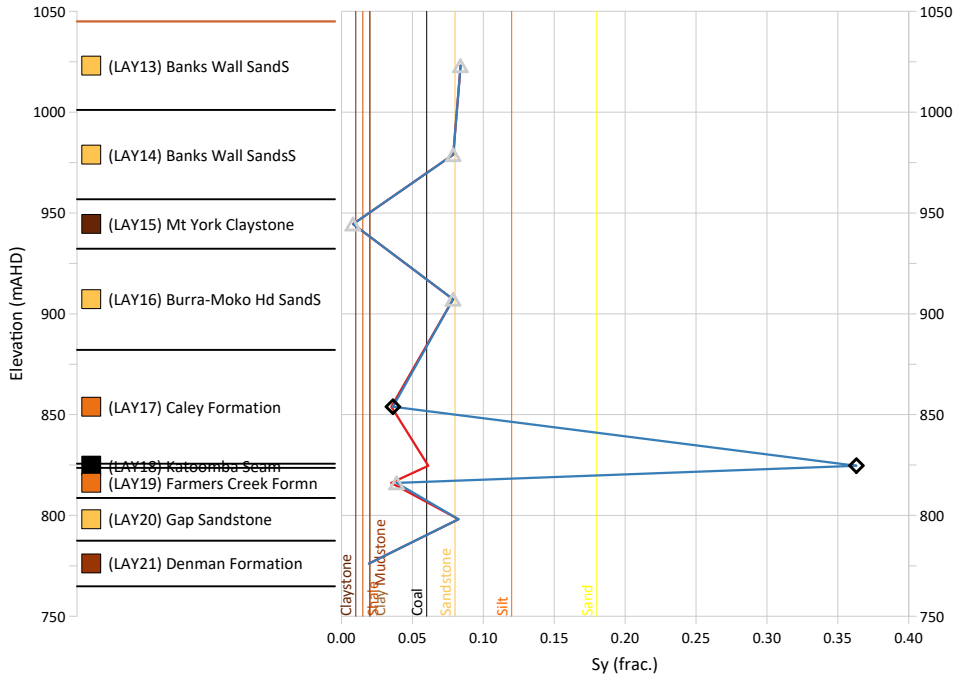
Horizontal Hydraulic Conductivity (m/s):



Vertical Hydraulic Conductivity (m/s):



Specific Storage (1/m):



Specific Yield (frac.):

Legend

Layer Zone Assignment:
- Above Zone A
- Zone A
- Caved Zone

Profiles:
- 31/12/1867 (SP001) n/a
- Jun 2026 (SP147) 1st_1.000
- n/a n/a
- n/a n/a
- n/a n/a
- n/a n/a
- n/a n/a
- n/a n/a

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

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Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 05/11/2025	
Drawn By: DAW	
Checked By: JRWB	

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Reference: 68229_R01RevA_PRO_02a_21_SIM0

Figure 4.58c: Time-Varying Change to Hydraulic Properties - Vertical Profile (L01 Node 15876)

e.g. if the pre-mining value is 2.0E-10m/s and the ramp function, when applied to model geometry leads to a 5.5x increase, then the altered value of vertical hydraulic conductivity would be 2.0E-10m/s * 5.5 = 1.1E-09m/s; but this is less than the minimum change base hydraulic conductivity of 1.0E-09m/s multiplied by 5.5x, so 1.0E-09m/s * 5.5 = 5.5E-09m/s. Accordingly, 5.5E-09m/s is used.

From **Figure 4-54c**, for horizontal hydraulic conductivity, Kh, the minimum resultant hydraulic conductivity (MRHC) does not get triggered. This is because the pre-mining horizontal hydraulic conductivity, Kh, is 3E-09m/s. From **Figure 4-54b**, the applied ramp function is an increase of 35x. The resultant hydraulic conductivity is 3E-09m/s * 35 = 1.05E-07m/s. This is bigger than minimum change base hydraulic conductivity of 1.0E-09m/s multiplied by 35x, so 1.0E-09m/s * 35 = 3.5E-08m/s, hence 1.05E-07m/s.

Figure 4-55 presents the ramp function, application of the ramp function to model geometry and resultant hydraulic properties for an extraction cell at 908 Panel (Model Mining Method 3: PPPE or Double-Sided Lifting).

From **Figure 4-55a**, at this location, Zone A through to Zone D is present in the ramp function. The time-varying-material changes at this location comprise development and extraction. From **Figure 4-55b**, the multiplicative factor of hydraulic conductivity are small, being 2x for horizontal hydraulic conductivity, Kh, in the Mount York Claystone (Layer 15) and 1.2x for vertical hydraulic conductivity, Kv.

In **Figure 4-55c**, due to Model Mining Method 3 being a 'low' subsidence mining method, the minimum resultant hydraulic conductivity (MHRC) hypothesis is not applied, hence the change to hydraulic conductivity in the Mount York Claystone (Layer 15) is small. As already noted, changes to specific yield, Sy, were calculated using the ramp function applied to model geometry, but only applied to layers set to LAYTYP = 4 (Layer 17 through 19, being of relevance to Clarence).

From **Figure 4-55c**, because Model Mining Method 3 assumes goafing, albeit limited insofar as what happens physically underground, the ramp function applied to model geometry uses the original hydraulic property values when extraction occurs, so as to manage, in the model, the transition from direct void space (development) and goaf (extraction). This aspect is explained in further detail in **Section 4.11**.

Figure 4-56 presents the modelled change to hydraulic properties in 918 Panel in the one of the southern subpanels, SubPanel 918A.

From **Figure 4-56a**, Zone A through to Zone D is present in the ramp function. In **Figure 4-56b**, the changes to horizontal hydraulic conductivity, Kh, ranges between 2x in the Burra-Moko Head Sandstone (Layer 16) down to 1.5x in the Burralow Formation (Layer 03 through to Layer 12) is present in the model at this location. From **Figure 4-56b**, the changes to vertical hydraulic conductivity, Kv, ranges between 1.2x in the Burra-Moko Head Sandstone (Layer 16) through to 1.1x in the Burralow Formation (Layer 03 through to Layer 12).

From **Figure 4-56c**, goafing due to Model Mining Method 3 leads to small change in horizontal hydraulic conductivity in the Mount York Claystone (Layer 15) in the model and an even smaller in vertical hydraulic conductivity. As per **Figure 4-55c**, due to Model Mining Method 3 being a 'low' subsidence mining method, the minimum resultant hydraulic conductivity (MRHC) is not applied.

Figure 4-57 presents the modelled change to hydraulic properties in 918 Panel in SubPanel 918B1.

From **Figure 4-57a**, the ramp function has Zone A through to Zone D present. As expected, the ramp function is consistent with that for SubPanel 918A. From **Figure 4-57a**, the hydraulic conductivity multiplicative factors in the goaf is high.

Figure 4-57b presents the application of the ramp function to model geometry. From **Figure 4-57b**, there is a 2x increase in horizontal hydraulic conductivity in the Burra-Moko Head Sandstone (Layer 16) through to 1.5x increase within the Burralow Formation (Layer 09 to Layer 12 present at this location). From **Figure 4-57b**, there is a 1.2x increase in vertical hydraulic conductivity in the Burra-Moko Head Sandstone (Layer 16) and this reduces to 1.1x in the Burralow Formation (Layer 09 to Layer 12).

From **Figure 4-57c**, the resultant hydraulic properties indicate a small change in horizontal hydraulic conductivity, Kh, through the Burra-Moko Head Sandstone (Layer 16) up into the Burralow Formation. The

change to vertical hydraulic conductivity is negligible through the profile. As per **Figure 4-56c**, the minimum resultant hydraulic conductivity (MRHC) hypothesis is not applied because Model Mining Method 3 is a 'low' subsidence mining method.

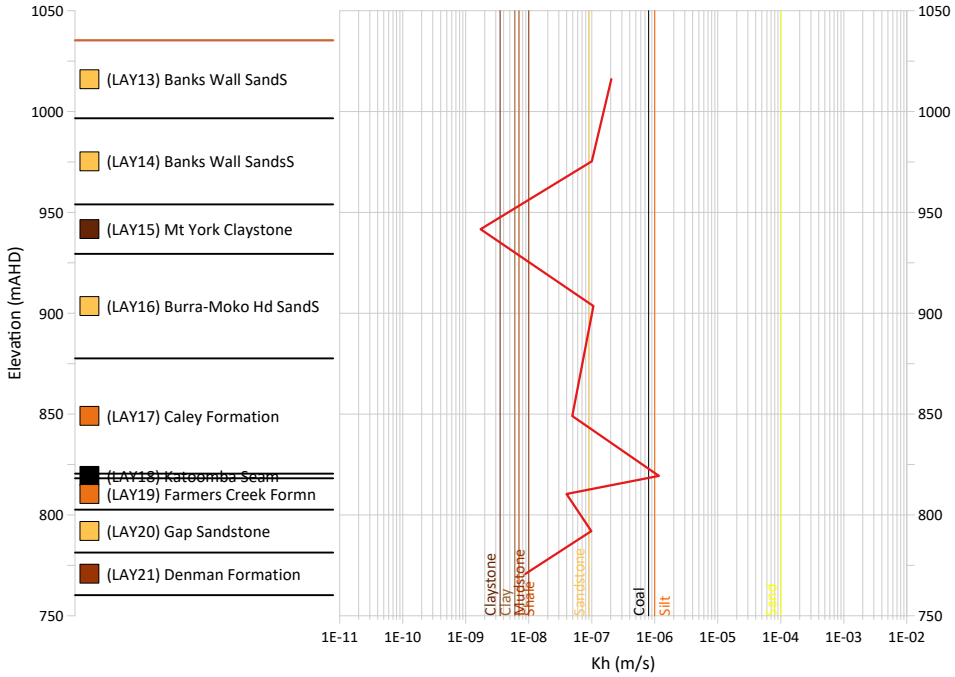
From **Figure 4-58a**, there is only development at this location. The ramp function is limited to immediately above the mined seam. From **Figure 4-58b**, as per the intent, there are no changes in the 'Above Zone A' for development cells. From **Figure 4-58b**, the multiplicative factor for Kh and Kv (which reflects the direct void space calculation (refer **Section 4.11.3**)) is approximately 40x, reflects the composite hydraulic properties calculated in accordance with the method of Freeze and Cherry (1979); namely the ((area of void * hydraulic properties of void) + ((area of cell – area of void) * previous value of hydraulic property))/(area of cell).

As per current methodology, there is a change to storage (specific yield, Sy), but not specific storage, Ss. This decision is not consequential however, as depressurisation ahead of mining (development or extraction) will lead to unconfined conditions, therefore the value of specific storage, Ss is not relevant in that circumstance. From **Figure 4-58b**, the increase in specific yield, Sy is to add 0.15 to the previous value. As noted in **Section 4.11.3**, the specific yield, Sy of void is 0.99.

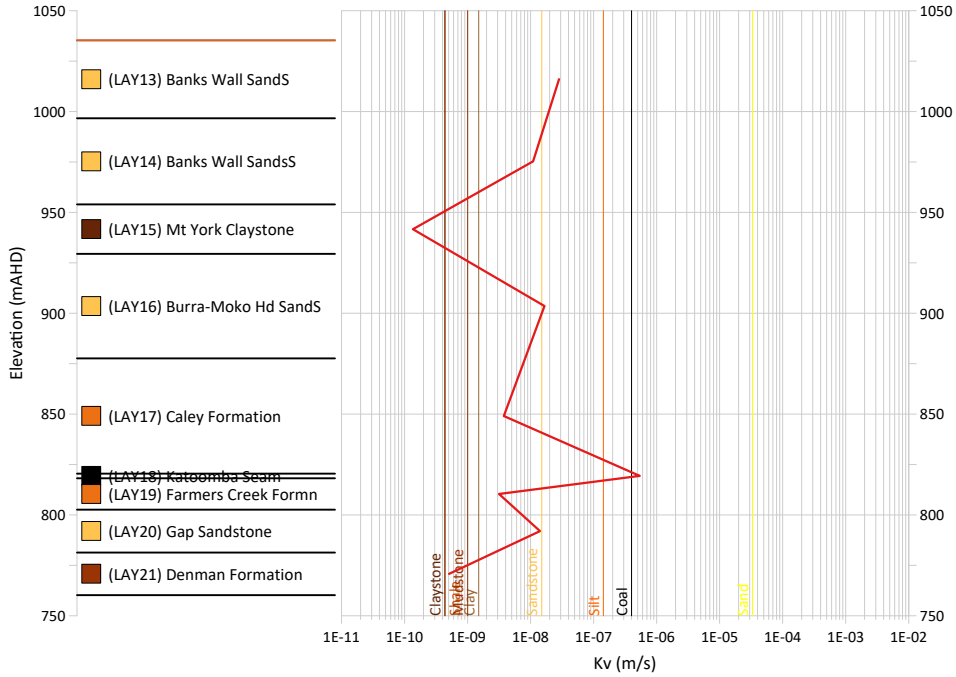
From **Figure 4-58c**, there is a large change in horizontal and vertical hydraulic conductivity due to development, however, there is no change 'Above Zone A'. This is consistent with observation that development is stable in the long-term and does not lead to measurable subsidence at ground surface, nor should it lead to change to hydraulic properties overlying those development workings. From **Figure 4-58c**, the resultant specific yield, Sy, is 0.37.

Additional vertical profiles of hydraulic properties are presented for the following swamp locations (refer **Figure 4-53**). These outputs are just the resultant hydraulic properties, and the ramp function and application of ramp function to the model. These profiles are provided for the purpose of reference, since the noted locations are where detail model output has been prepared. It is noted that some of these locations are not subject to any change to hydraulic properties:

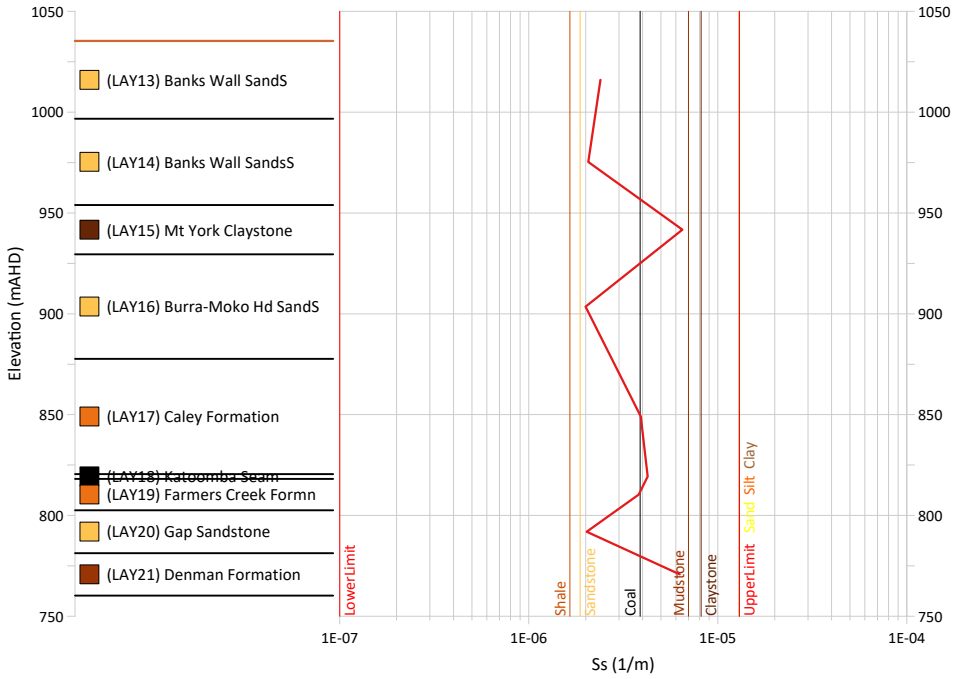
- Lower Nine Mile Swamp between Sub Panel 918B1 and Sub Panel 918B2 (L01Node 15878) (**Figure 4-59a**)
- Lower Nine Mile Swamp east of Sub Panel 918B2 (L01Node 16613) (**Figure 4-59b**)
- Lower Nine Mile Swamp tributary to Bungleboori Creek (L01Node 16620) (**Figure 4-59c**)
- Paddys Creek Hanging Swamp (L01Node 17232) (**Figure 4-59d**)
- Paddys Creek Shrub Swamp (L01Node 17238) (**Figure 4-59e**).



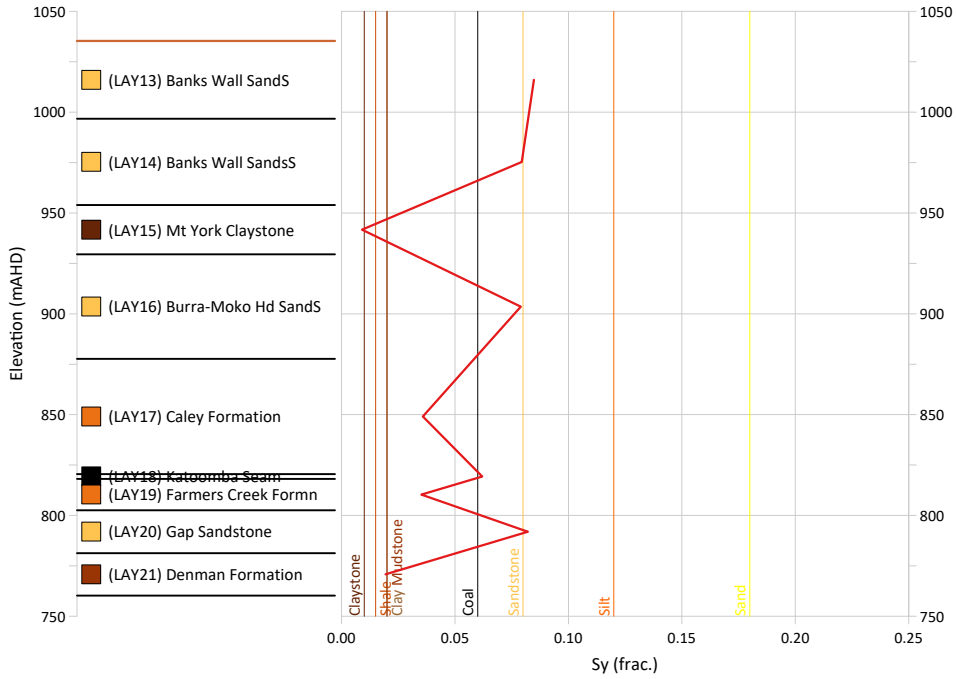
Horizontal Hydraulic Conductivity (m/s):



Vertical Hydraulic Conductivity (m/s):



Specific Storage (1/m):



Specific Yield (frac.):

Legend

Layer Zone Assignment:

- Above Zone A
- Zone A
- Caved Zone

Profiles:

- 31/12/1867 (SP001)
- n/a
- n/a
- n/a
- n/a
- n/a
- n/a
- n/a
- n/a

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
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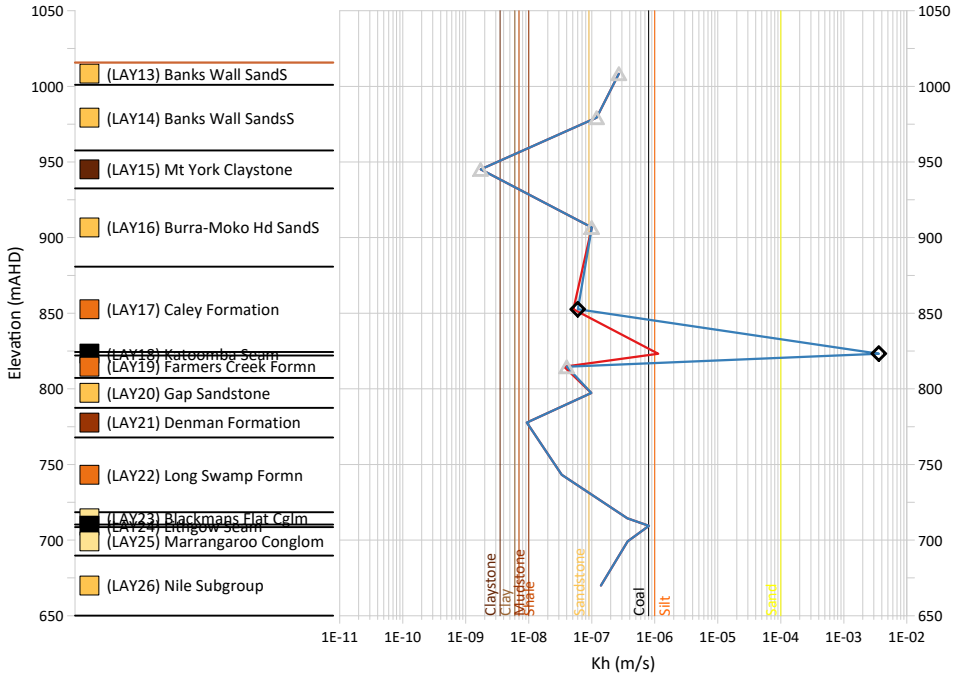
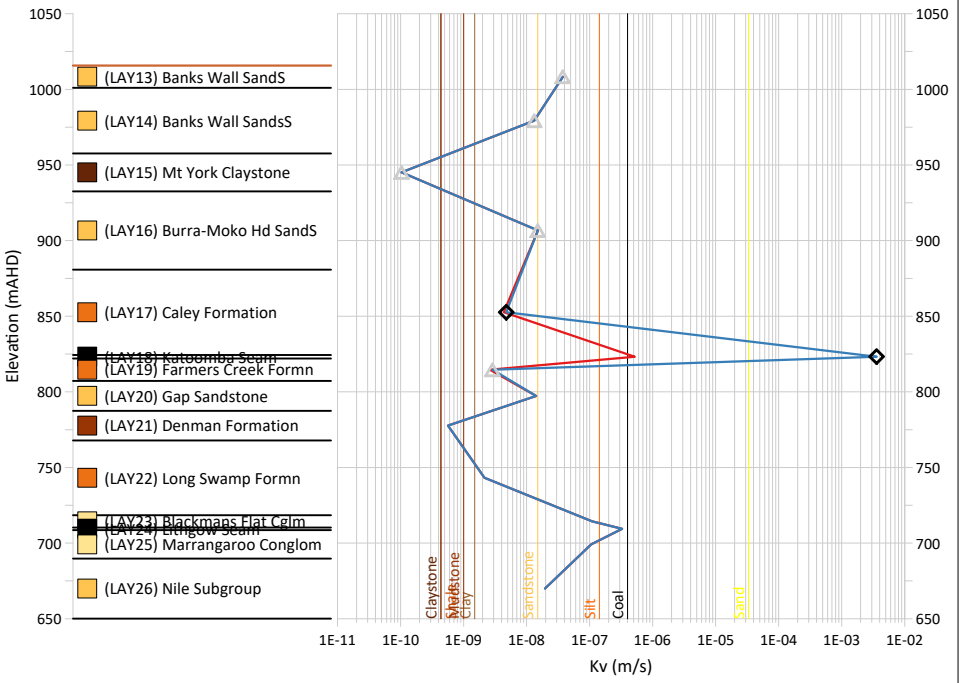
Reference: 68229_R01RevA_PRO_02a_21_SIM0

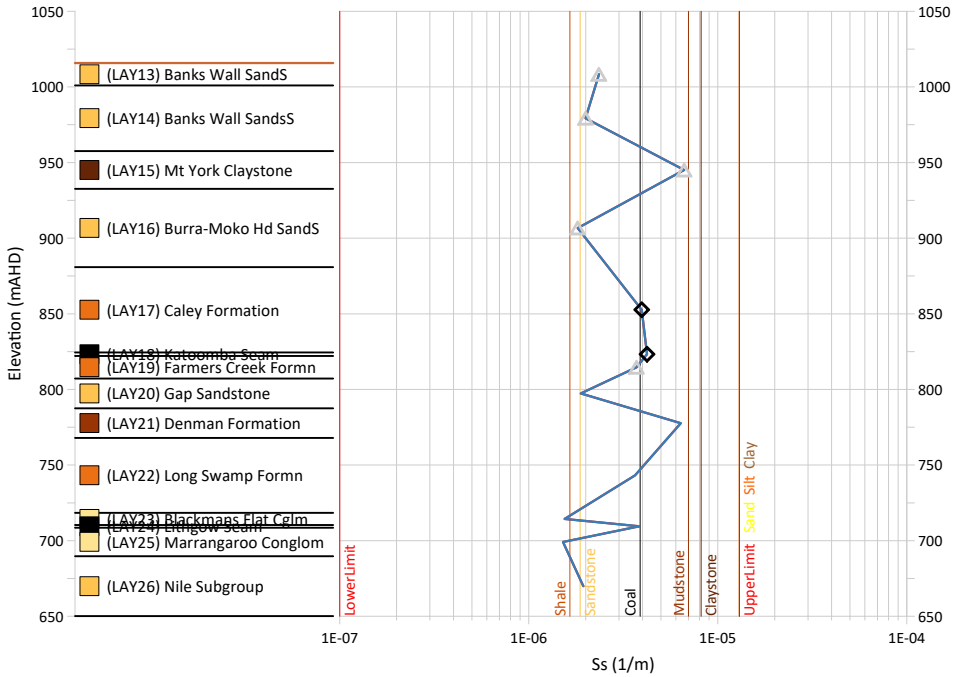
Figure 4.59a: Time-Varying Change to Hydraulic Properties - Vertical Profile (L01 Node 15878)



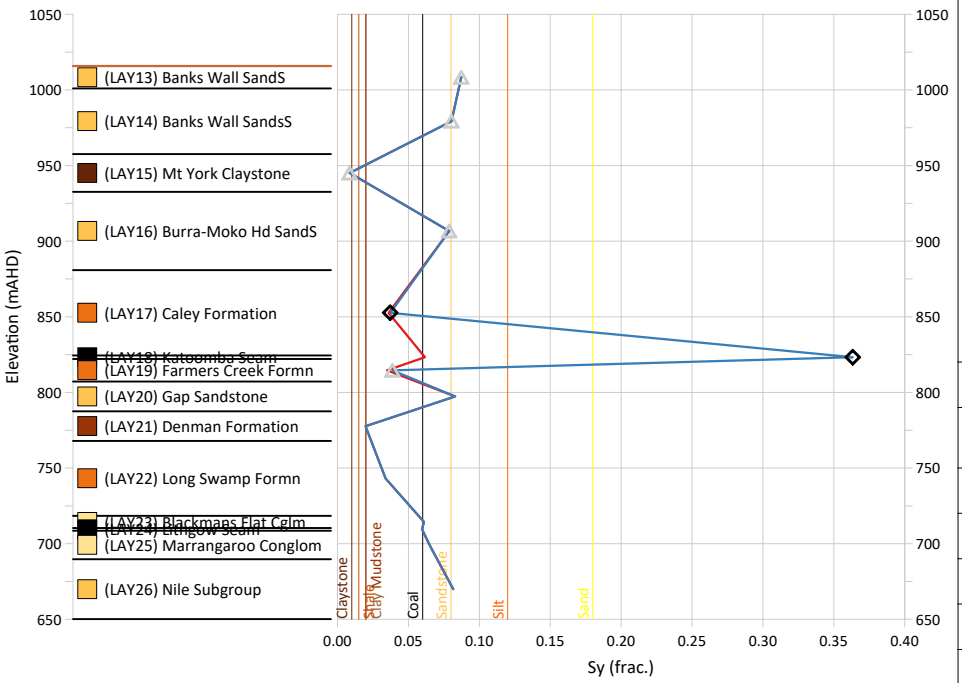
Horizontal Hydraulic Conductivity (m/s):



Vertical Hydraulic Conductivity (m/s):



Specific Storage (1/m):



Specific Yield (frac.):

Legend

Layer Zone Assignment:
- Above Zone A
- Zone A
- Caved Zone

Profiles:
- 31/12/1867 (SP001)
  n/a
- Sep 2025 (SP144)
  1st_1.000
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a
- n/a
  n/a

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

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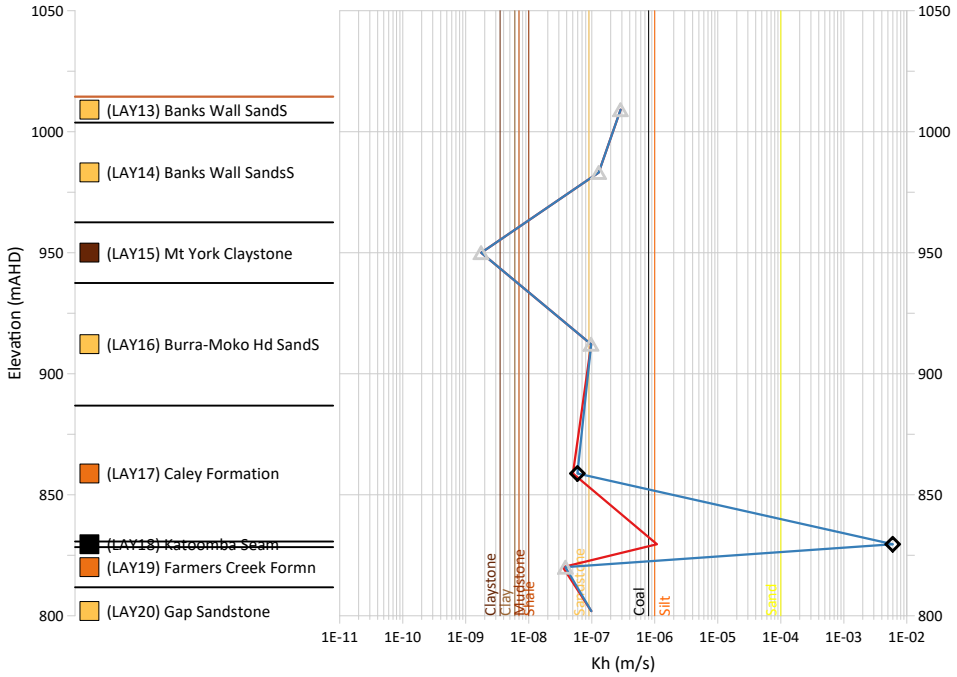
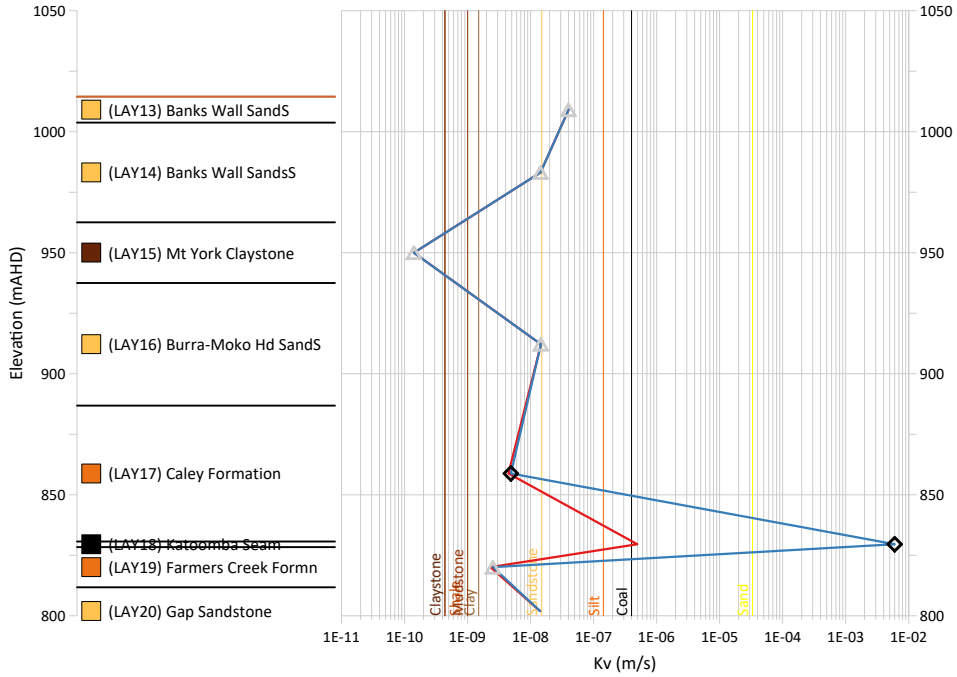
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D051_TVMProfile_Swamps\68229_R01RevA_D051b_TVMProfile_16613\68229_R01RevA_D051b_TVMProfile_16613_Result.grf

Reference: 68229_R01RevA_PRO_02a_21_SIM0

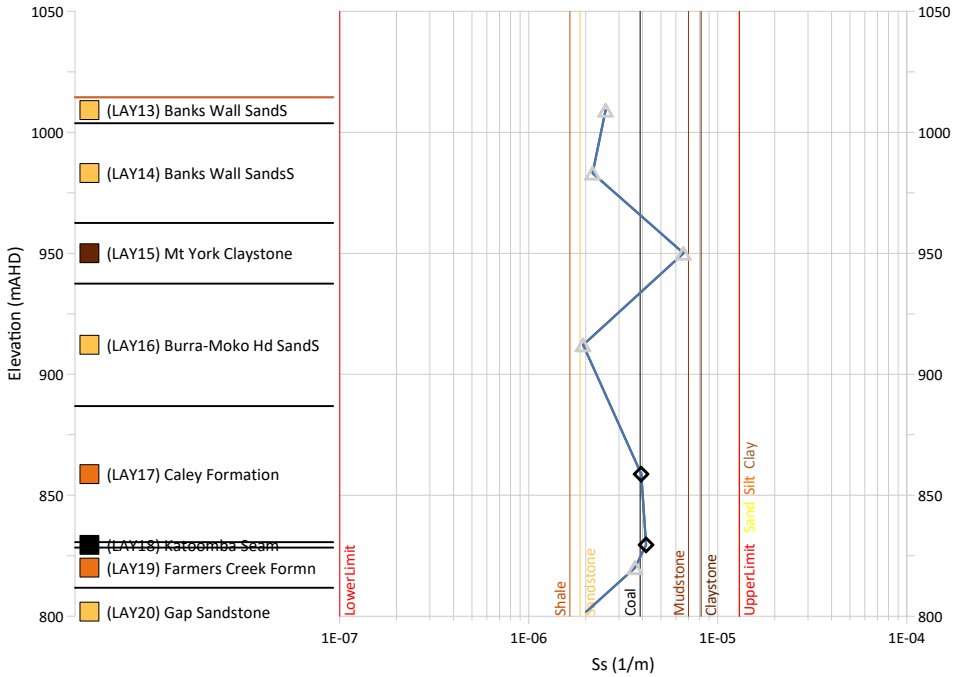
Figure 4.59b: Time-Varying Change to Hydraulic Properties - Vertical Profile (L01 Node 16613)



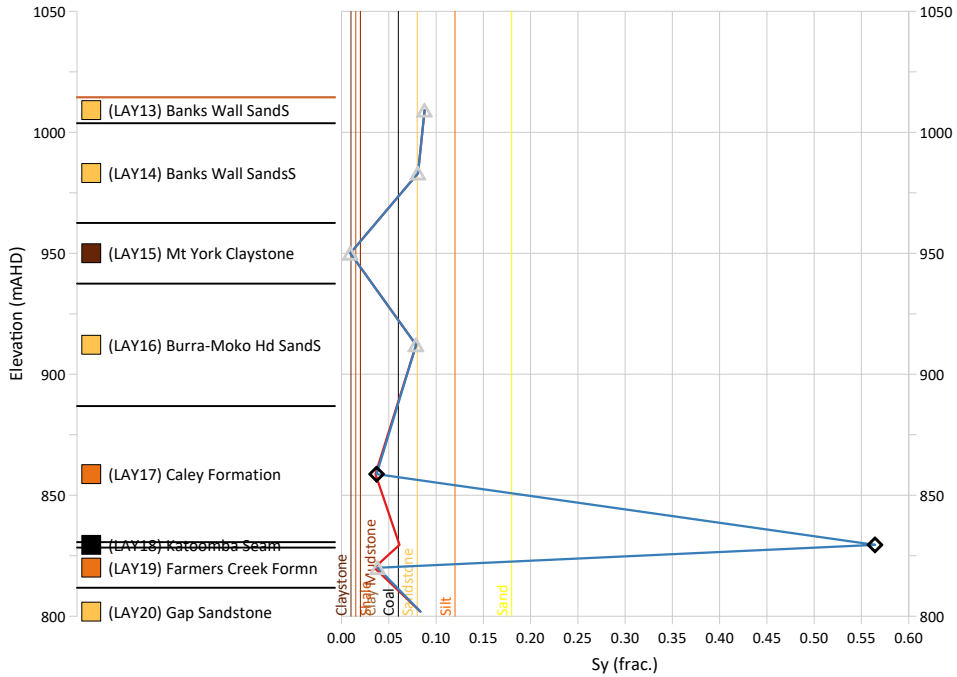
Horizontal Hydraulic Conductivity (m/s):



Vertical Hydraulic Conductivity (m/s):



Specific Storage (1/m):



Specific Yield (frac.):

Legend

Layer Zone Assignment:

- Above Zone A
- Zone A
- Caved Zone

Profiles:

- 31/12/1867 (SP001) n/a
- Jun 2025 (SP143) 1st_1.000
- n/a n/a
- n/a n/a
- n/a n/a
- n/a n/a
- n/a n/a
- n/a n/a

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

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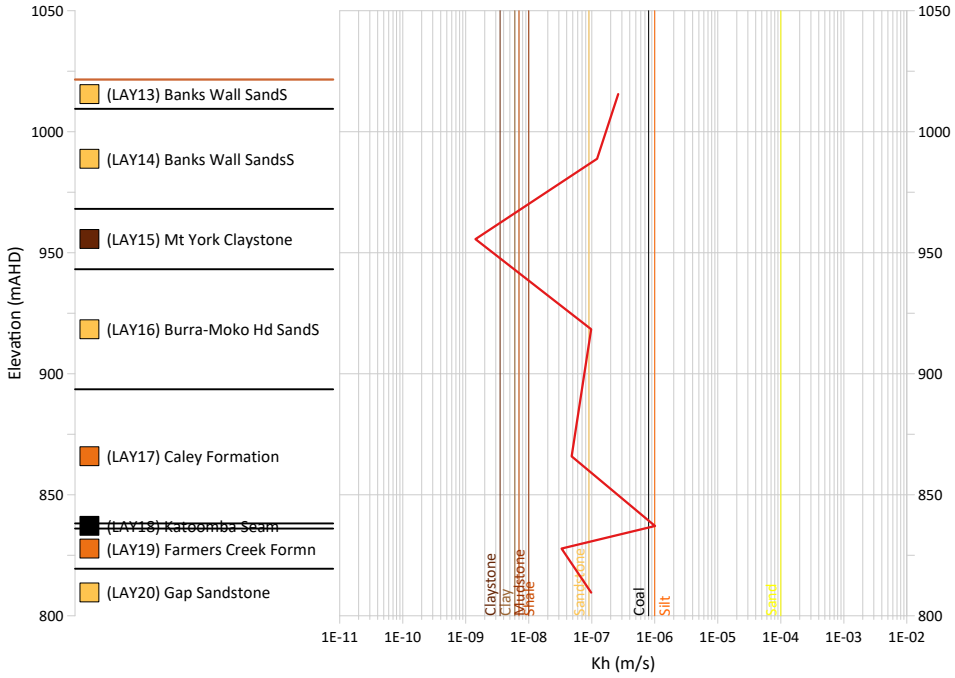
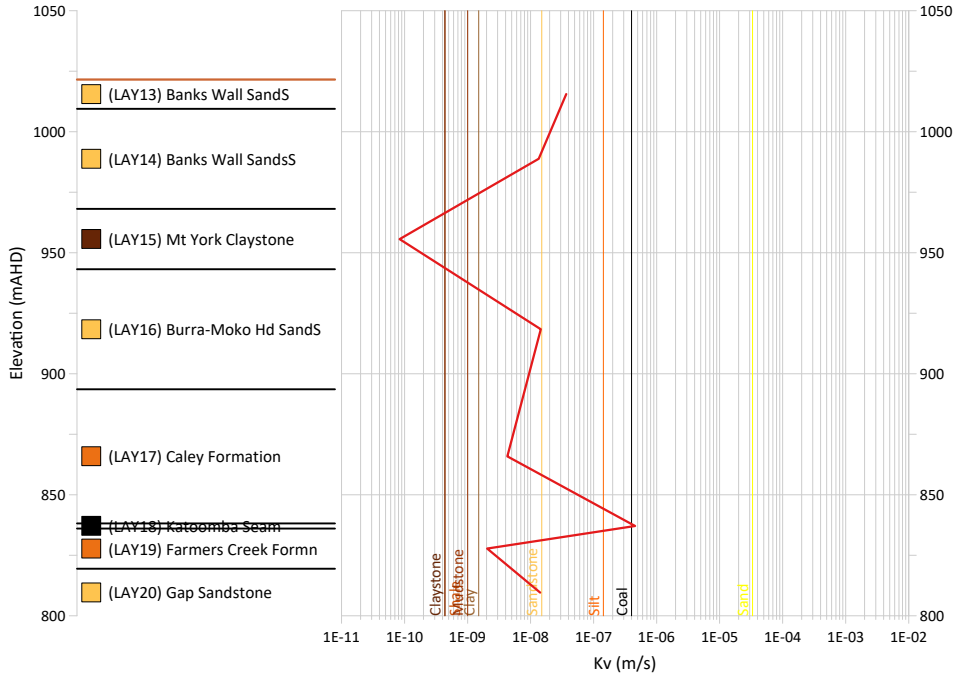
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D051_TVMProfile_Swamps\68229_R01RevA_D051d_TVMProfile_16620\68229_R01RevA_D051d_TVMProfile_16620_Result.grf

Reference: 68229_R01RevA_PRO_02a_21_SIM0

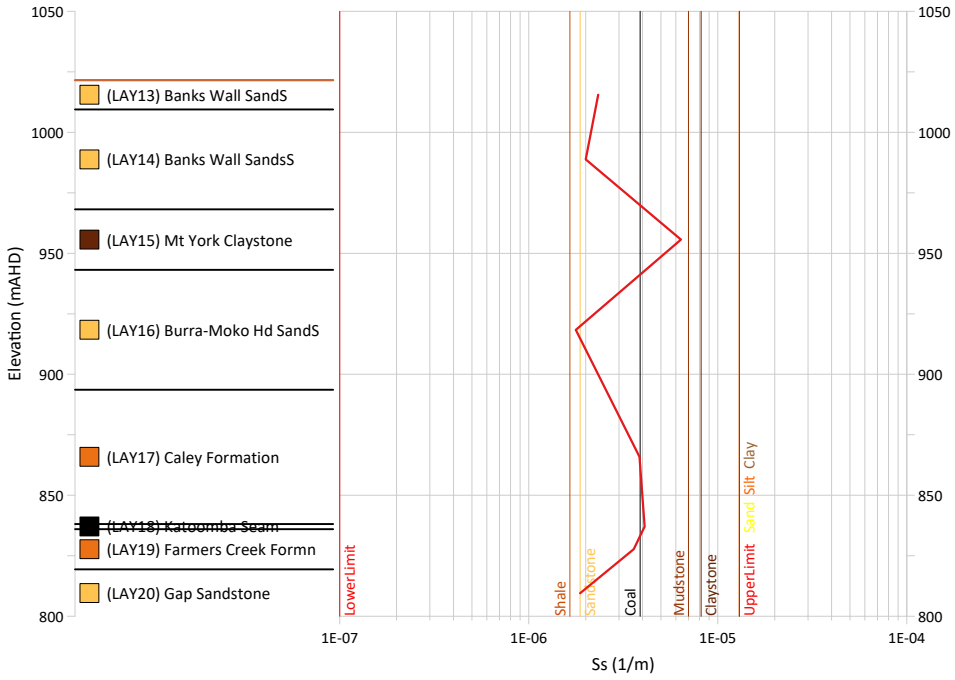
Figure 4.59c: Time-Varying Change to Hydraulic Properties - Vertical Profile (L01 Node 16620)



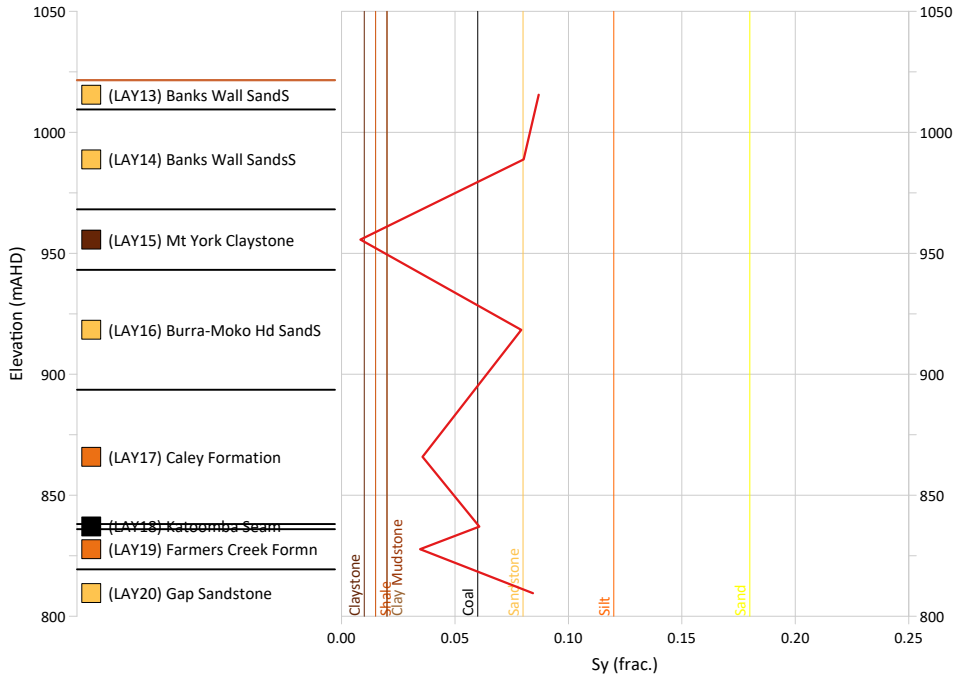
Horizontal Hydraulic Conductivity (m/s):



Vertical Hydraulic Conductivity (m/s):



Specific Storage (1/m):



Specific Yield (frac.):

Legend

Layer Zone Assignment:

- Above Zone A
- Zone A
- Caved Zone

Profiles:

- 31/12/1867 (SP001)
- n/a
- n/a
- n/a
- n/a
- n/a
- n/a
- n/a
- n/a

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

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Checked By: JRWB

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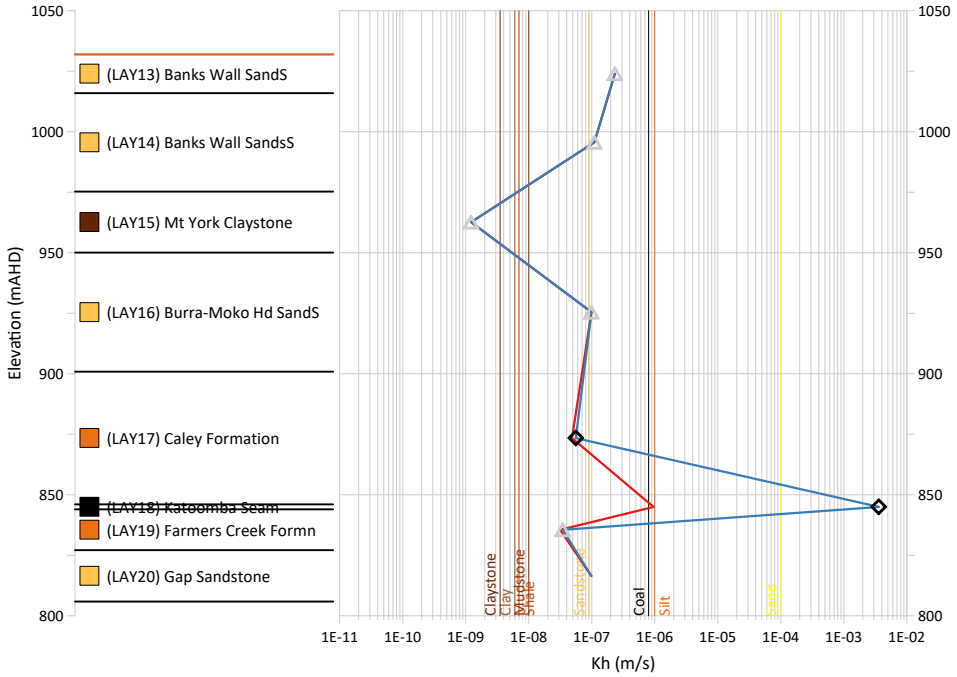
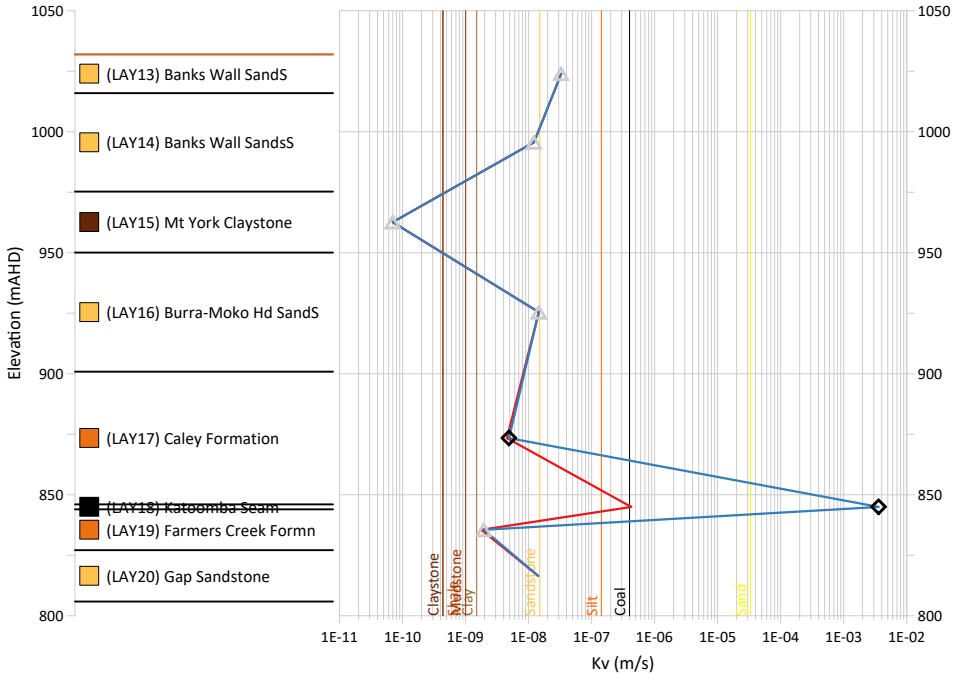
Reference: 68229_R01RevA_PRO_02a_21_SIM0

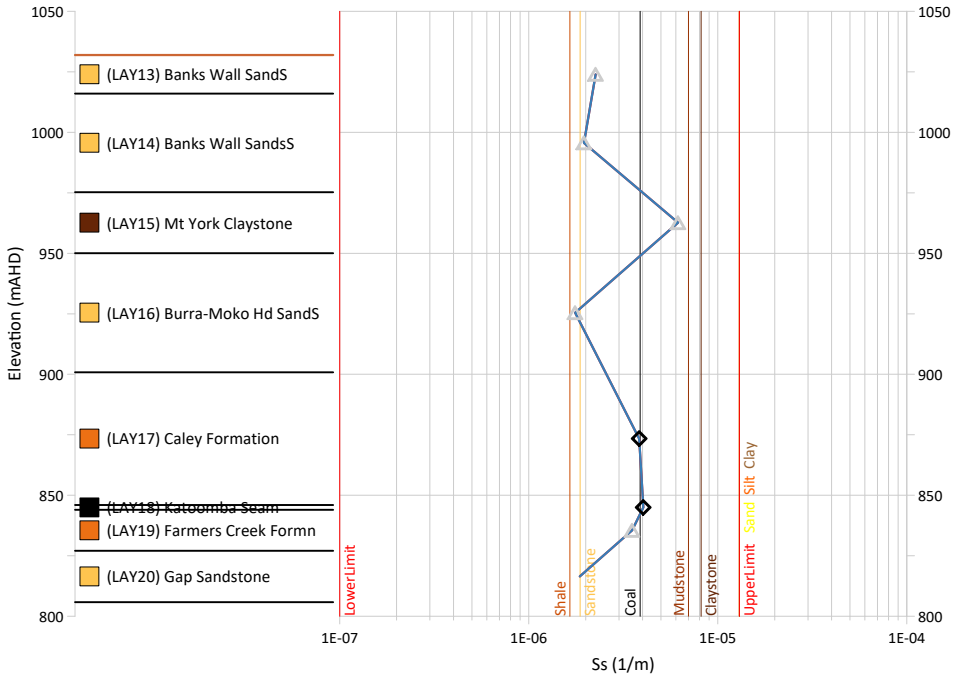
Figure 4.59d: Time-Varying Change to Hydraulic Properties - Vertical Profile (L01 Node 17232)



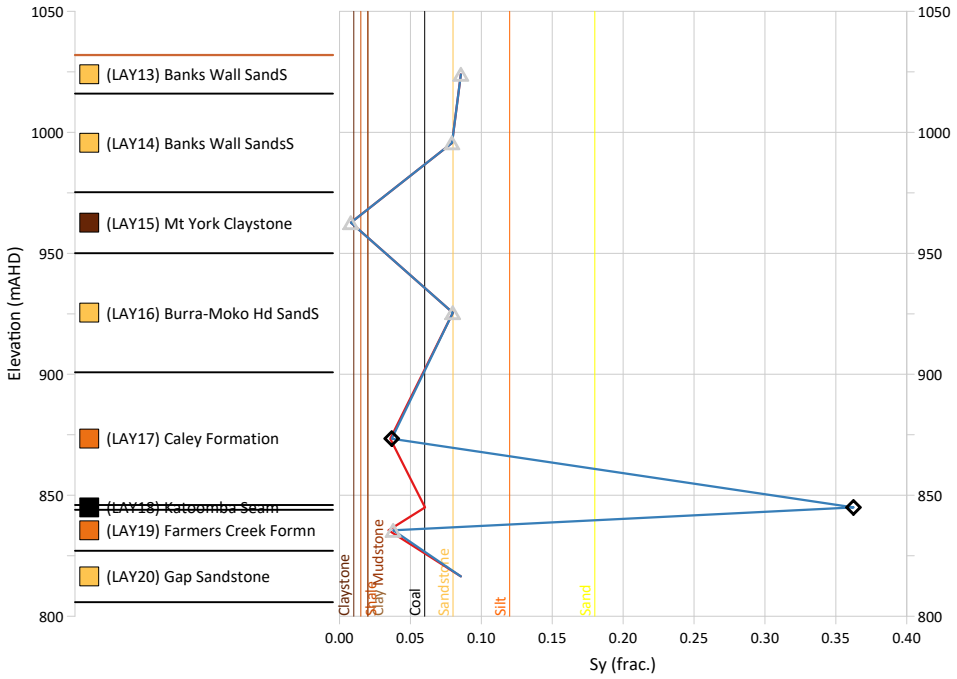
Horizontal Hydraulic Conductivity (m/s):



Vertical Hydraulic Conductivity (m/s):



Specific Storage (1/m):



Specific Yield (frac.):

Legend

Layer Zone Assignment:

- Above Zone A
- Zone A
- Caved Zone

Profiles:

- 31/12/1867 (SP001)
- Dec 2025 (SP145)
- n/a
- n/a
- n/a
- n/a
- n/a
- n/a

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:
1) Kh: Horizontal Hydraulic Conductivity.
2) Kv: Vertical Hydraulic Conductivity.
3) Ss: Specific Storage.
4) Sy: Specific Yield.
5) The layer below the Target Coal Seam is also allocated the 'Above Zone A' categorisation within the custom-developed script. That designation is for the purpose of conforming a sensible uppermost value to changes to hydraulic properties. That layer is exempt from the minimum resultant hydraulic conductivity amendment to the ramp function.

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Reference: 68229_R01RevA_PRO_02a_21_SIM0

Figure 4.59e: Time-Varying Change to Hydraulic Properties - Vertical Profile (L01 Node 17238)

4.15.5 Prediction Results

The model control files were:

- Deterministic:
  - 68229_R01RevA_APR_03c_05Soln_ManAdjust_calib05b
  - 68229_R01RevA_PRO_02a_05Soln_ManAdjust_calib05b.
- Stochastic:
  - 68229_R01RevA_APR_03c_23UnReCalNSMC_simult01a
  - 68229_R01RevA_PRO_02a_23UnReCalNSMC_simult01a.

4.15.5.1 Approach to Processing Stochastic Model Results

For the 286 valid sets of simulations, the following approach has been used with respect to processing:

- Change in Groundwater Elevation
  - the difference between PRO and APR was determined at each model node and at each stored model time
  - the differences were then ranked, in order of smallest to largest, at each model node (at each stored model time), with the 10th percentile and 90th percentile values recorded. These ranked change in groundwater elevations are referred to as R10 and R90.
    - it is highlighted that the resultant 10th percentile and 90th percentile values may, therefore, be sourced from any of the 286 sets of simulations and that at different stored model times, different simulations may be associated with the 10th percentile and 90th percentile ranked values
  - The 10th percentile minimum change in groundwater elevation is referred to in this report as the "10th percentile change in groundwater elevation"
    - It is noted that this minimum value may be a large negative number (if most results are negative) or a small positive number (if most results are positive)
    - This change could also be referred to as the maximum 'drawdown', if most results are negative, where 'drawdown', by convention, is defined as a decrease in groundwater elevation in a Proposed Case compared to existing conditions or Approved Case
    - Given that 'drawdown' can be a confusing term to non-hydrogeologists, especially 'negative drawdown', change in groundwater elevation is used instead.
  - The 90th percentile maximum change in groundwater elevation is referred to in this report as the "90th percentile change in groundwater elevation".
    - it is noted this maximum value may be a small negative number (if most results are negative) or a large positive number (if most results are positive)
    - this change could also be referred to as the minimum 'drawdown', if the change in groundwater elevation is mostly negative (or decrease), or 'negative drawdown' if the change in groundwater elevation is mostly positive (or increase)
    - given that 'drawdown' can be a confusing term to non-hydrogeologists, especially 'negative drawdown', change in groundwater elevation is used instead.
- Groundwater Elevation

- The PRO and APR groundwater elevations were ranked in order of smallest to largest, at each model node (at each stored model time), with the 10th percentile and 90th percentile values recorded. These ranked groundwater elevations are referred to as R10 and R90. This is the same methodology used in the sensitivity analysis outlined in **Section 4.14**.

- Groundwater Pressure
  - Groundwater pressure was post-processed using PRO and APR 10th percentile and 90th percentile groundwater elevation files discussed above.
    - Groundwater pressure in a layer was calculated by subtracting the groundwater elevation in a cell in a model layer from the bottom elevation of that layer.
- Groundwater/surface water interaction
  - cell-by-cell MODFLOW output was processed for surface water catchments (ephemeral watercourses and seepage faces; as perennial watercourses are not close to the area of interest of this study) throughout the model domain
  - the flow rates in the APR and PRO cases were then ranked with the 10th percentile ranked value (R10) and 90th percentile ranked value (R90) for each catchment (and at each stored model time) recorded
    - accordingly, the resultant 10th percentile and 90th percentile values may be sourced from any of the 286 sets of simulations.

4.15.5.2 Model Mass Balance

Figure 4-60 presents the model mass balance error from the Proposed Case for the Calibration and Prediction Period. As per **Section 4.12.4.1**, "STORED TIME" is MODFLOW "TOTIM" and is elapsed time (days). Model mass balance error is presented for the deterministic Simulation0 output.

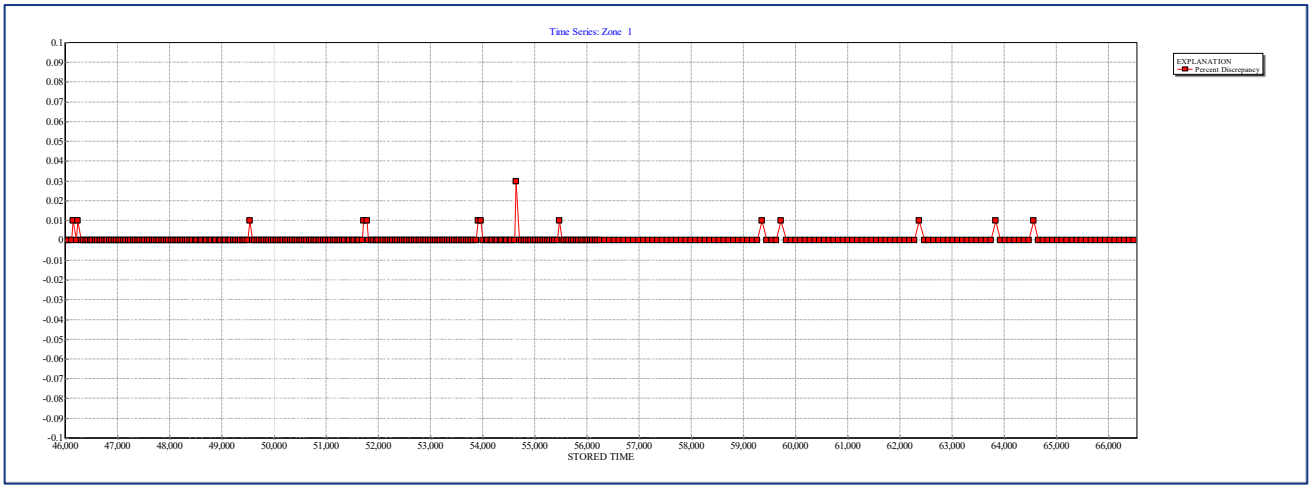


Figure 4-60: Whole Model Mass Balance Error (Percent Discrepancy) – Calibration and Prediction Period (Proposed Case)

From **Figure 4-60**, the model mass balance is 0.1%, in general, or less and therefore meets the guidance value in the Australian Groundwater Modelling Guidelines (Barnett et. al., 2012).

Figure 4-61 presents the model mass balance from the MODFLOW listing file of each of the model control files at the end of model simulations (SP241).

From **Figure 4-61**, these output are consistent with that presented in **Section 4.12.4.1**.

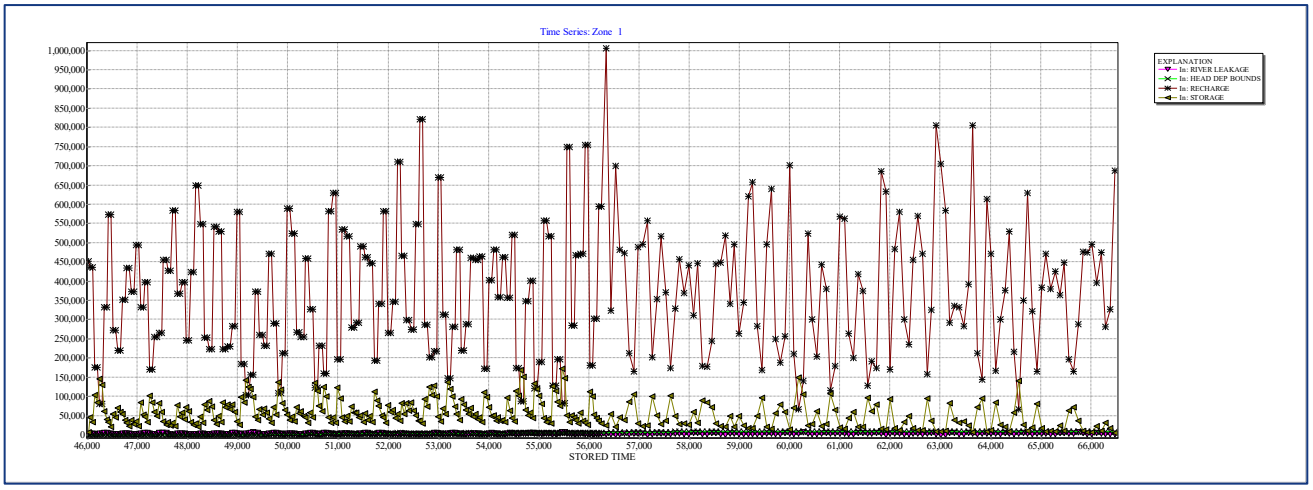


Figure 4-62 presents time-series inputs and **Figure 4-63** presents time-series outputs during the Calibration and Prediction Periods for the Proposed Case.

```
 HEAD WILL BE SAVED ON UNIT      30 AT END OF TIME STEP       5, STRESS PERIOD     241
1
  VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP       5 IN STRESS PERIOD     241
  ---------------------------------------------------------------------------------------

    CUMULATIVE VOLUMES      L**3       RATES FOR THIS TIME STEP      L**3/T
    ------------------                 ------------------------

         IN:                                IN:
         ---                                ---
           STORAGE =  1596441781.2233         STORAGE =       5615.8584
    CONSTANT HEAD =           0.0000  CONSTANT HEAD =          0.0000
             WELLS =           0.0000           WELLS =          0.0000
            DRAINS =           0.0000          DRAINS =          0.0000
     RIVER LEAKAGE =   182290279.2910   RIVER LEAKAGE =       2450.0830
                ET =           0.0000              ET =          0.0000
    HEAD DEP BOUNDS =   120939300.5633  HEAD DEP BOUNDS =       9321.0078
          RECHARGE = 25711432818.9073        RECHARGE =     688547.8750

          TOTAL IN = 27611104179.9848        TOTAL IN =     705934.8243

        OUT:                               OUT:
        ----                               ----
           STORAGE =  1057581363.6481         STORAGE =      75061.8372
    CONSTANT HEAD =           0.0000  CONSTANT HEAD =          0.0000
             WELLS =     6757714 2.8486           WELLS =       1016.5645
            DRAINS =  9841182090.2835          DRAINS =     182210.1459
     RIVER LEAKAGE =    28203844.8273   RIVER LEAKAGE =        539.8834
                ET = 15828999332.8192              ET =      429873.0312
    HEAD DEP BOUNDS =   787493703.9186  HEAD DEP BOUNDS =      18026.4199
          RECHARGE =           0.0000        RECHARGE =          0.0000

         TOTAL OUT = 27611037477.4653        TOTAL OUT =     705927.8821

           IN - OUT =      66702.5156          IN - OUT =          6.9422

PERCENT DISCREPANCY =           0.00  PERCENT DISCREPANCY =          0.00
```

```
 HEAD WILL BE SAVED ON UNIT      30 AT END OF TIME STEP       5, STRESS PERIOD     241
1
  VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP       5 IN STRESS PERIOD     241
  ---------------------------------------------------------------------------------------

    CUMULATIVE VOLUMES      L**3       RATES FOR THIS TIME STEP      L**3/T
    ------------------                 ------------------------

         IN:                                IN:
         ---                                ---
           STORAGE =  1598837157.1611         STORAGE =       5672.4985
    CONSTANT HEAD =           0.0000  CONSTANT HEAD =          0.0000
             WELLS =           0.0000           WELLS =          0.0000
            DRAINS =           0.0000          DRAINS =          0.0000
     RIVER LEAKAGE =   182290315.2950   RIVER LEAKAGE =       2450.0889
                ET =           0.0000              ET =          0.0000
    HEAD DEP BOUNDS =   120943834.6713  HEAD DEP BOUNDS =       9321.5781
          RECHARGE = 25711512010.7975        RECHARGE =     688564.9375

          TOTAL IN = 27613583317.9249        TOTAL IN =     706009.1030

        OUT:                               OUT:
        ----                               ----
           STORAGE =  1057901713.2399         STORAGE =      75069.2632
    CONSTANT HEAD =           0.0000  CONSTANT HEAD =          0.0000
             WELLS =     6757714 2.8486           WELLS =       1016.5645
            DRAINS =  9843428445.4610          DRAINS =     182294.4336
     RIVER LEAKAGE =    28203842.1236   RIVER LEAKAGE =        539.8833
                ET = 15828917129.0525              ET =      429056.3438
    HEAD DEP BOUNDS =   787488813.4743  HEAD DEP BOUNDS =      18025.6816
          RECHARGE =           0.0000        RECHARGE =          0.0000

         TOTAL OUT = 27613517086.1998        TOTAL OUT =     706002.1700

           IN - OUT =      66231.7266          IN - OUT =          6.9330

PERCENT DISCREPANCY =           0.00  PERCENT DISCREPANCY =          0.00
```

Figure 4-61: Excerpts of Model Mass Balance – Prediction Period (Deterministic) (L: Approved Case; R: Proposed Case)

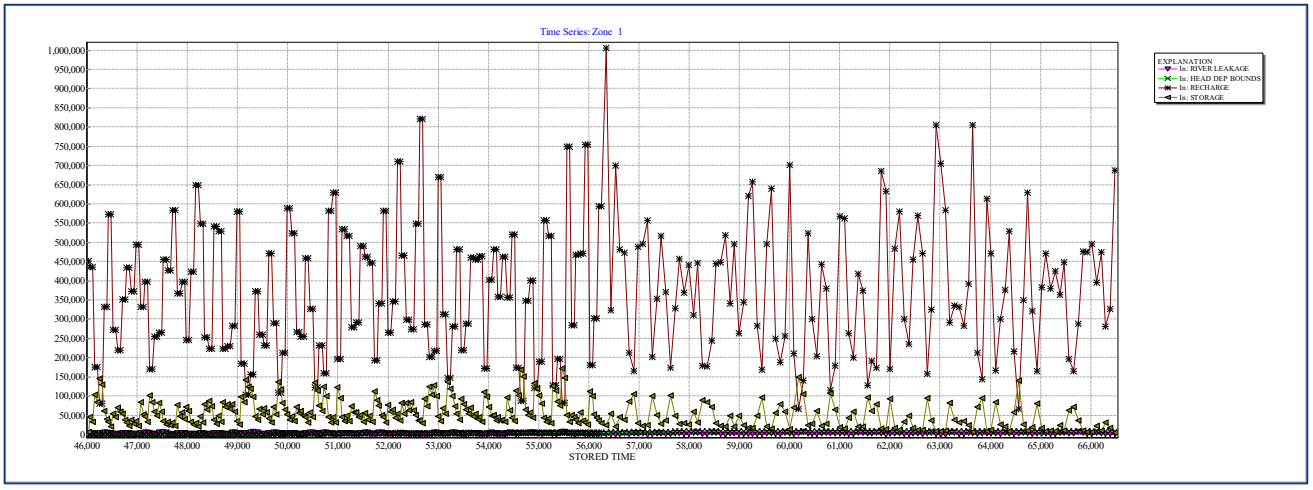


Figure 4-62: Model Water Balance - Time-Series Inputs (m3/d) - Calibration and Prediction Period (Proposed Case)

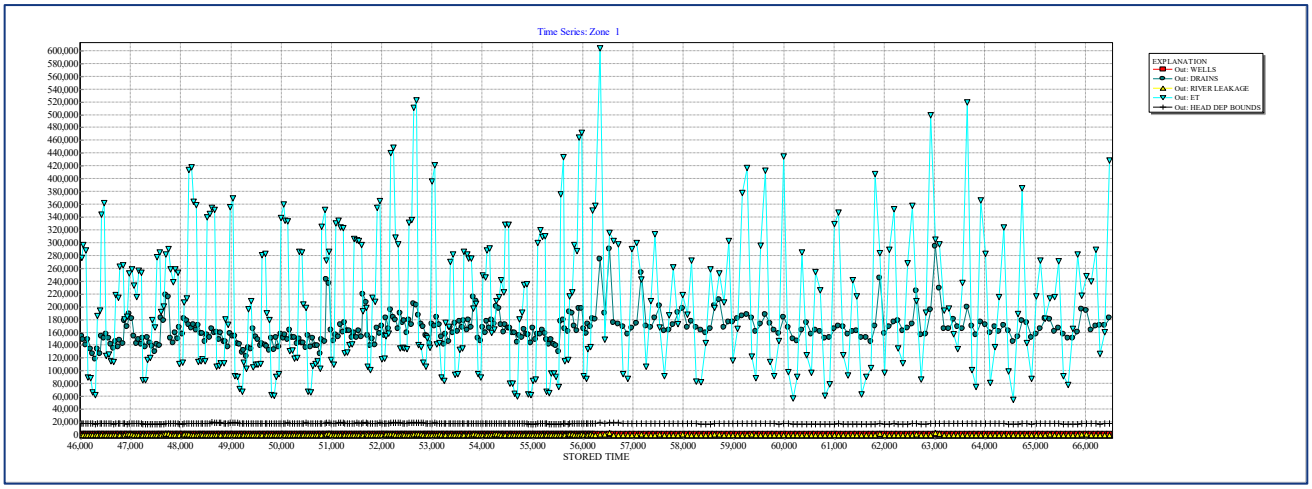


Figure 4-63: Model Water Balance - Time-Series Outputs (m3/d) - Calibration and Prediction Period (Proposed Case)

4.15.5.3 Mine Dewatering Rate

Figure 4-64 presents the mine dewatering rate (ML/d) and cumulative dewatering volume (ML) for Springvale Mine, Angus Place Colliery and at Clarence Colliery for the Proposed Case. Mine dewatering rate is presented for the deterministic Simulation0 output.

From **Figure 4-64**, modelled mine dewatering rate at Springvale Mine is expected to be maintained at approximately 27ML/d. Modelled dewatering rate at Angus Place Colliery is expected to be maintained at approximately 10ML/d. It is noted that observed mine dewatering rate at Springvale Mine is currently 30ML/d, compared to the modelled value of 27ML/d.

From **Figure 4-64**, modelled mine dewatering rate at Clarence Colliery is expected to be maintained at 16ML/d.

A comparison between mine dewatering rate at Clarence Colliery is presented in **Figure 4-65**.

From **Figure 4-65**, there is a negligible increase (change is less than 10%) in mine dewatering rate of approximately 0.9ML/d in July 2027 (SP152) for the Proposed Case compared to the Approved Case. In the long-term there is a negligible increase in mine dewatering rate of approximately 0.2ML/d for the Proposed Case compared to the Approved Case.

The negligible increase in mine dewatering rate will be accommodated through existing site water management infrastructure, and no change to water management infrastructure will be required to enable the Extraction Plan for 918 Panel. Similarly, given the magnitude of change is negligible, implementation of the Extraction Plan for 918 Panel will not lead to a change to licensable take at Clarence Colliery.

The observed increase in mine dewatering rate for 908-910 Panel Area (double-sided lifting; Model Mining Method = 3) was an initial increase of 0.7ML/d, which then decline to near zero. This observation is consistent with that predicted for 918 Panel.

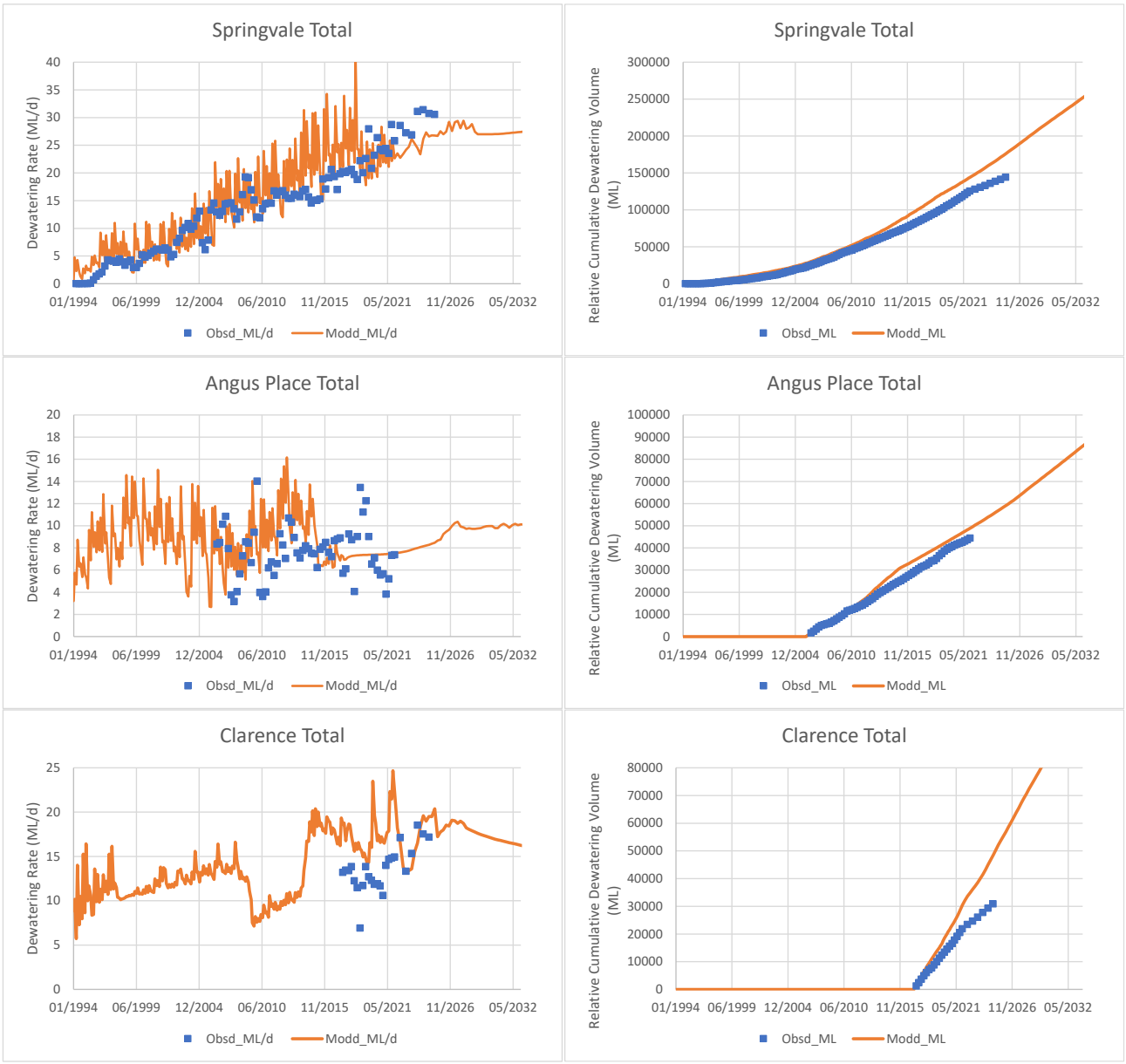


Figure 4-64: Dewatering Rate (ML/d) and Relative Cumulative Dewatering Volume (ML) – Calibration Period (Deterministic) – Proposed Case

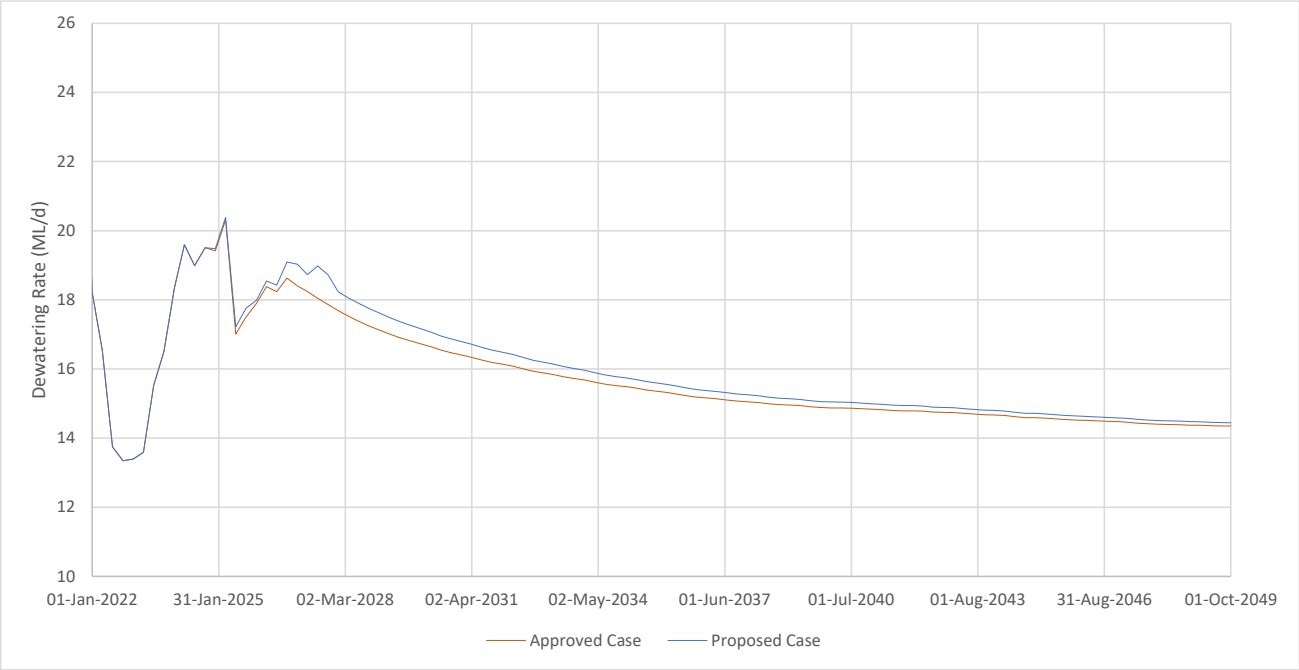


Figure 4-65: Comparison of Dewatering Rate (ML/d) - Prediction Period (Deterministic)

4.15.5.4 Subsidence-Induced Change to Hydraulic Properties

Figure 4-66 presents the change to vertical hydraulic conductivity, as well as groundwater elevation, for Cross-Section A for the Approved Case and Proposed Case. **Figure 4-67** presents model output for Cross-Section B. Vertical hydraulic conductivity cross-sections are presented for the deterministic Simulation0 output.

Model output is presented in **Figure 4-66** and **Figure 4-67** at:

- December 2025 (SP145)
- December 2028 (SP157)
- December 2032 (SP173)
- December 2049 (SP241).

Figure 4-66a presents model output for Cross-Section A for the Approved Case, with **Figure 4-66b** presenting output for the Proposed Case.

From **Figure 4-66b**, by December 2025 (SP145), development in 918 Panel, leads to a change of hydraulic properties in the Katoomba Seam (Layer 18). From **Figure 4-66b**, by December 2028 (SP157), extraction of 918 Panel, leads to a change of hydraulic properties along the vertical profile. These changes are apparent immediately above the Katoomba Seam in the Caley Formation (Layer 17).

From **Figure 4-66a** and **Figure 4-66b**, comparison of groundwater elevation throughout the vertical profile by December 2049 (SP241), shows that subsidence-induced changes to hydraulic properties leads to a decrease in groundwater elevation of the Katoomba Seam (Layer 18), Mount York Claystone (Layer 15) and Banks Wall Sandstone (Layer 14). The magnitude of these changes in plan view (layer-by-layer output), as well as with respect to depth-versus-pressure profiles is presented in further detail below.

From **Figure 4-66a** and **Figure 4-66b**, the changes to groundwater elevation diminish with vertical distance from the Katoomba Seam, and with lateral distance westward from the western edge of 918 Panel.

From **Figure 4-66a** and **Figure 4-66b**, the change to groundwater elevation of the highest active node is not discernible, which is expected.

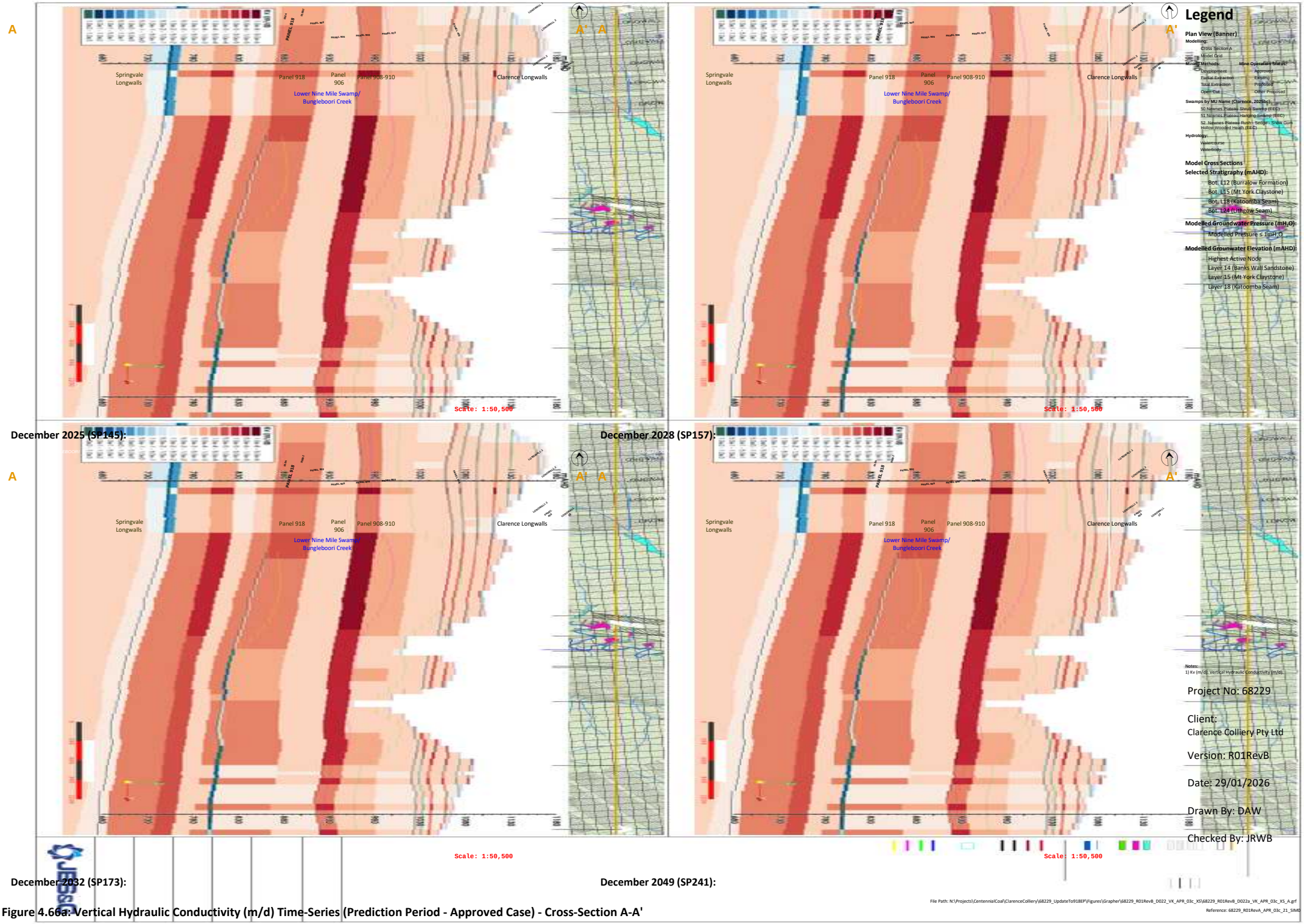


Figure 4.66a: Vertical Hydraulic Conductivity (m/d) Time-Series (Prediction Period - Approved Case) - Cross-Section A-A'

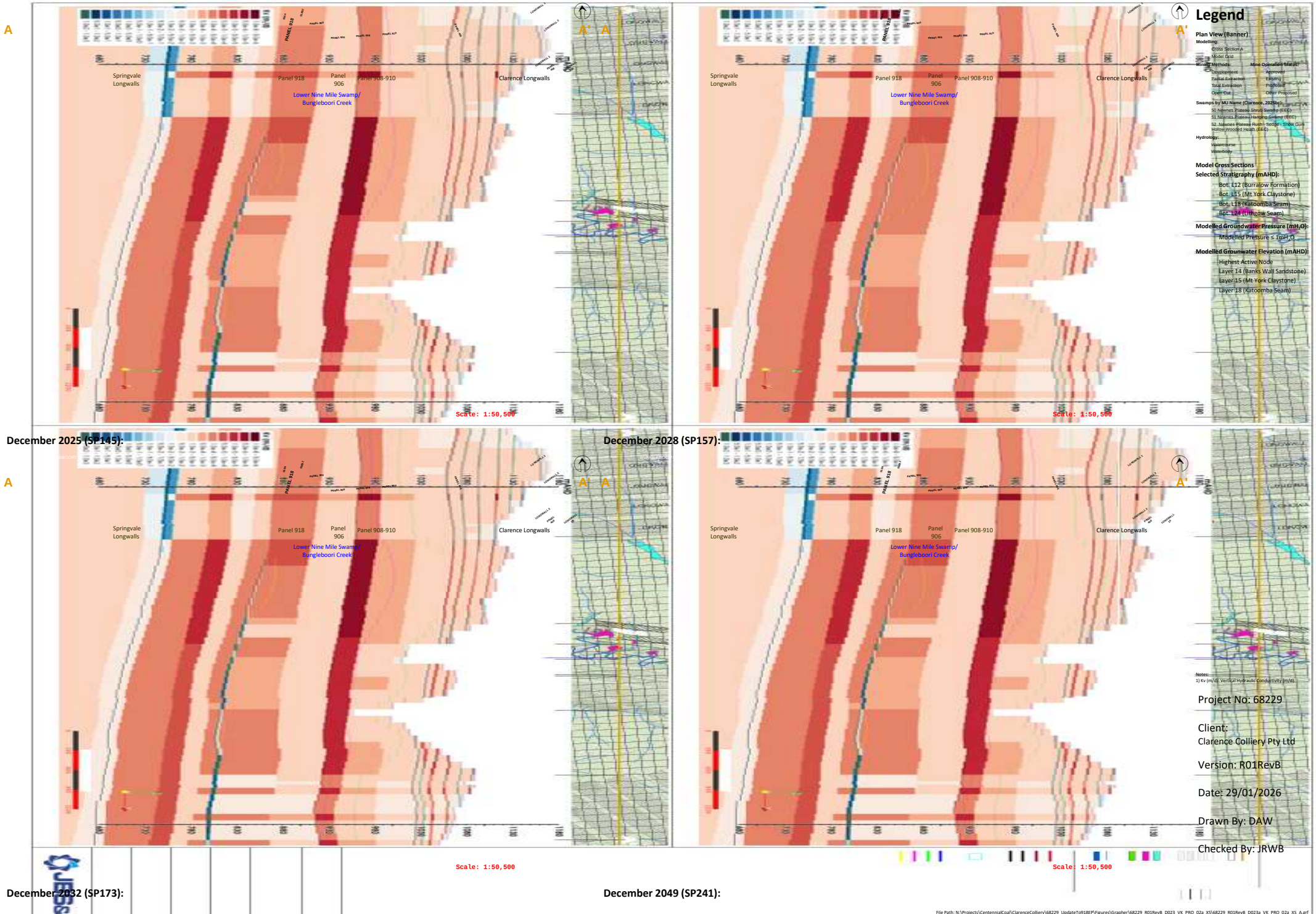


Figure 4.66b: Vertical Hydraulic Conductivity (m/d) Time-Series (Prediction Period - Proposed Case) - Cross-Section A-A'

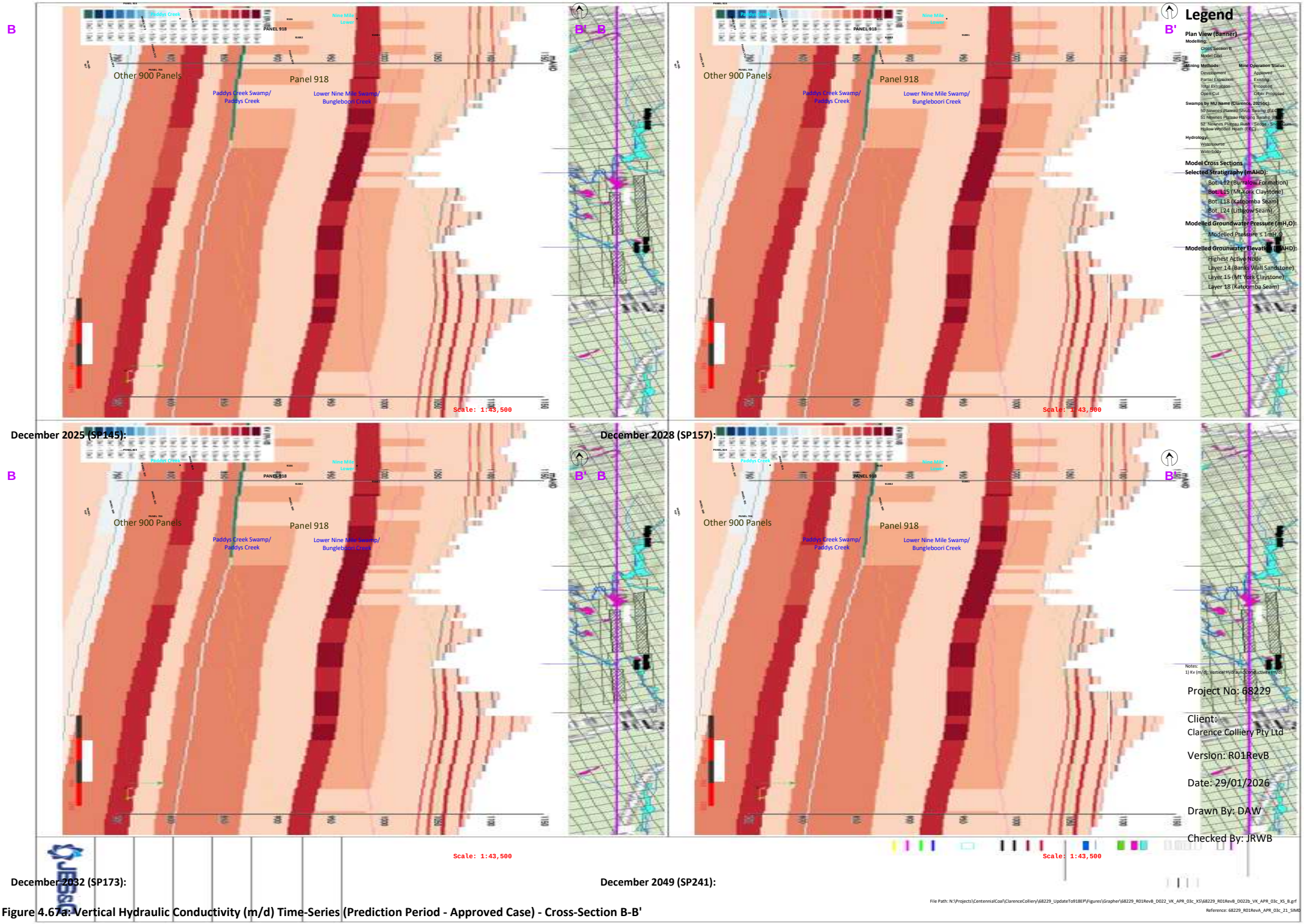


Figure 4.67a: Vertical Hydraulic Conductivity (m/d) Time-Series (Prediction Period - Approved Case) - Cross-Section B-B'

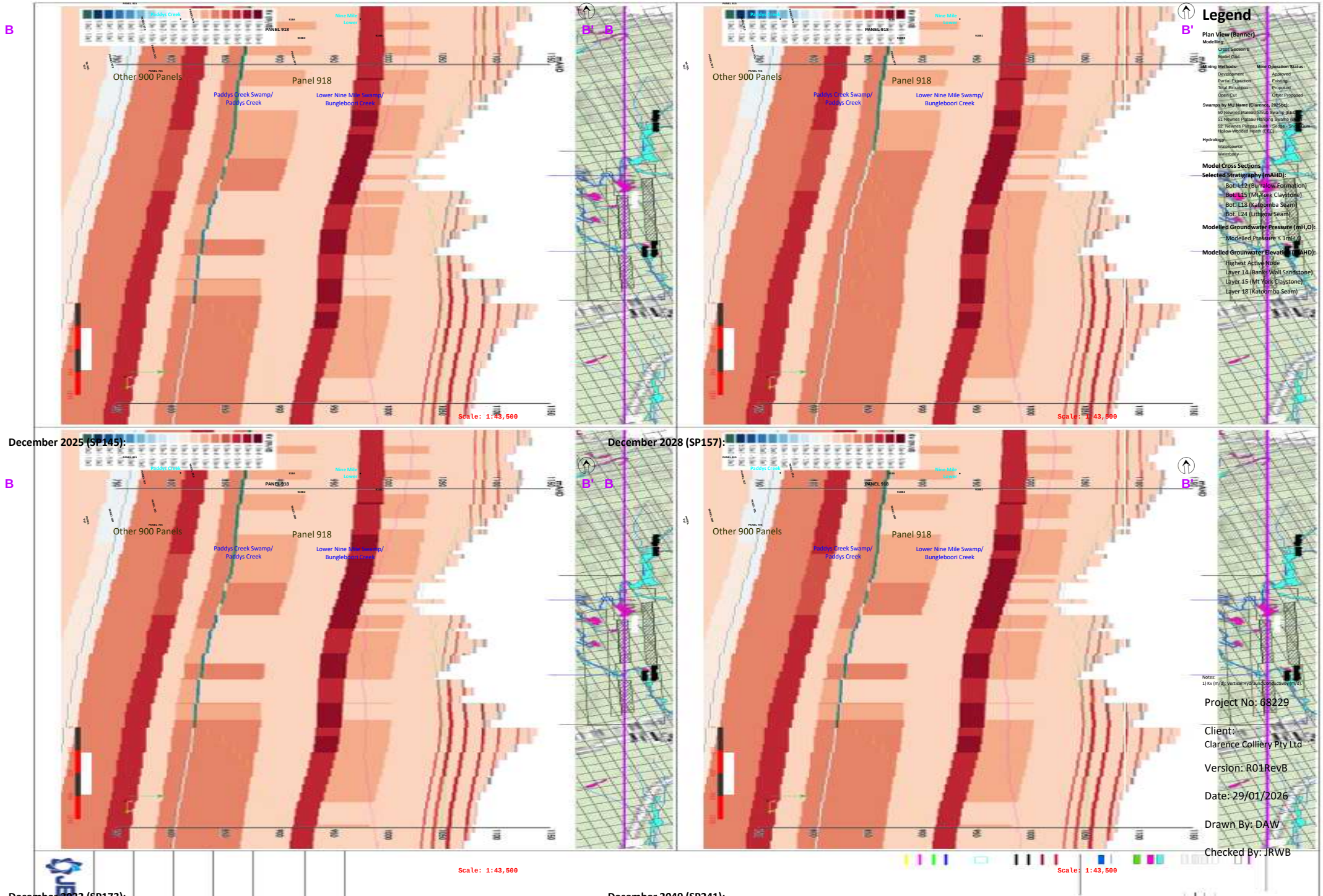


Figure 4.67b: Vertical Hydraulic Conductivity (m/d) Time-Series (Prediction Period - Proposed Case) - Cross-Section B-B'

Figure 4-67a presents model output for Cross-Section B for the Approved Case, with **Figure 4-67b** presenting output for the Proposed Case.

From **Figure 4-67b**, development and extraction of 918 Panel, leads to a change of hydraulic properties in the Katoomba Seam (Layer 18), and in overlying layers. Groundwater elevation in the Katoomba Seam (Layer 18) decreases over time, including to the north of 918 Panel.

From **Figure 4-67b**, there is a small to negligible change in the modelled groundwater elevation in the Mount York Claystone (Layer 15) and negligible change in the groundwater elevation of the highest active node.

4.15.5.5 Groundwater Elevation

Figure 4-68a presents the range of predicted groundwater elevation at the highest active node from the model. As explained in **Section 4.15.5.1**, the groundwater elevation was ranked (10th and 90th percentile). That output is presented in **Figure 4-68** for the Proposed Case and Approved Case.

Figure 4-68b presents the range of predicted groundwater elevation of the Mount York Claystone (Layer 15) and **Figure 4-68c** presents the range of predicted groundwater elevation for the Katoomba Seam (Layer 18).

From **Figure 4-68a**, the difference in groundwater elevation of the highest active node due to the development and extraction of 918 Panel is not discernible at the scale of contouring.

From **Figure 4-68b**, the difference in groundwater elevation in the Mount York Claystone (Layer 15) between the Approved Case and the Proposed Case, with respect to the 10th and 90th percentile ranked output is not discernible at the scale of contouring.

In **Figure 4-68b**, a saddle point between Springvale Mine and Clarence Colliery is evident by December 2049 (SP241). This will be due to the influence of extraction of the southern longwalls at Springvale Mine.

From **Figure 4-68c**, there is a difference in groundwater elevation in the Katoomba Seam (Layer 18) due to development and extraction of 918 Panel, as is expected. From **Figure 4-68c**, by December 2027 (SP153), the small groundwater divide between Springvale Mine and Clarence Colliery has started to dissipate and is depleted by December 2049 (SP241). As both Springvale Mine and Clarence Colliery are both mining operations, albeit mining different seams, this is not consequential.

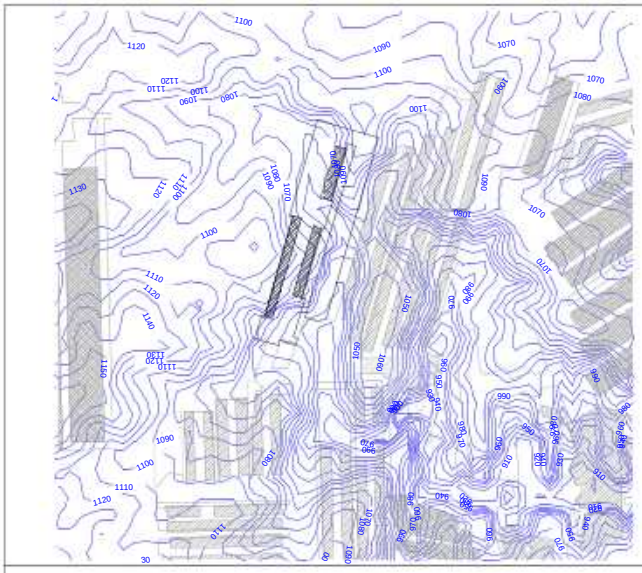
The modelled change in groundwater elevation is presented in **Section 4.15.5.7**.

Figure 4-69a presents groundwater elevation along Cross-Section A-A' (refer **Figure 4-1**) for the Approved Case. **Figure 4-69b** presents model output along that cross-section for the Proposed Case. Groundwater elevation cross-sections are presented for the deterministic Simulation0 output.

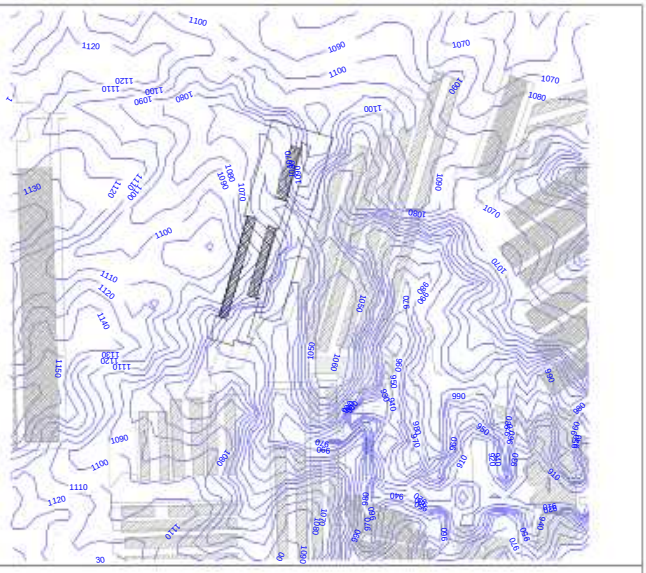
Model output is presented at the following times:

- December 2025 (SP145)
- December 2028 (SP157)
- December 2032 (SP173)
- December 2049 (SP241).

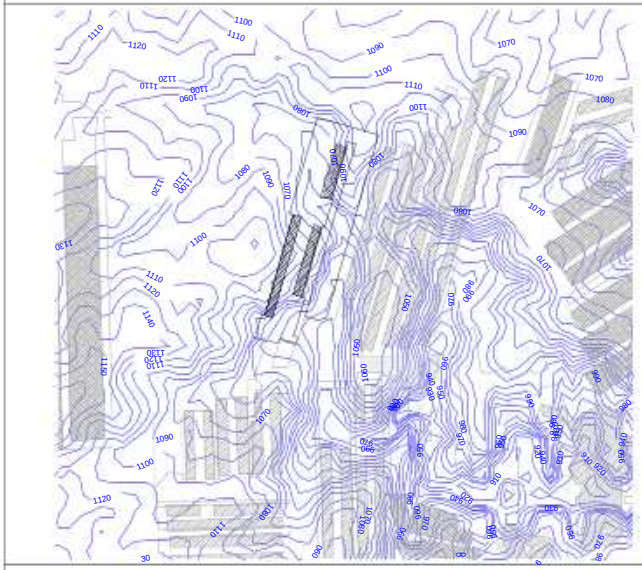
From **Figure 4-69b** compared to **Figure 4-69a**, by December 2028 (SP157), depressurisation in the Katoomba Seam (Layer 18) in the 918 Panel leads to a decrease in groundwater elevation vertically above extraction, as is expected. This change to groundwater elevation propagates upwards to the Mount York Claystone (Layer 15) and Banks Wall Sandstone (Layer 13 and 14) and to the west in the unmined area between Springvale Mine and 918 Panel at Clarence Colliery. Comparison of the Proposed Case to Approved Case, indicates there are minor fluctuations to groundwater elevation within the Burralow Formation (Layer 1 through to 12) but do not appear to be significant. Those changes are mostly due to the assumed, small, change in horizontal hydraulic conductivity, Kh, due to extraction, and is probably a conservative assumption.



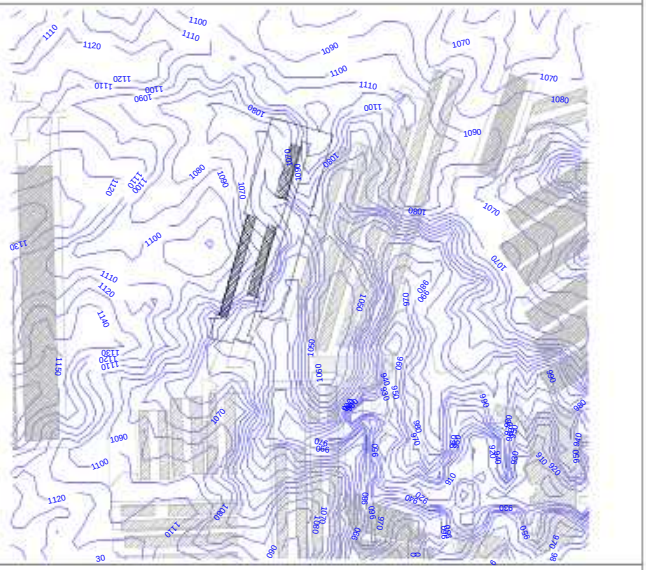
December 2025 (SP145) - Approved Case



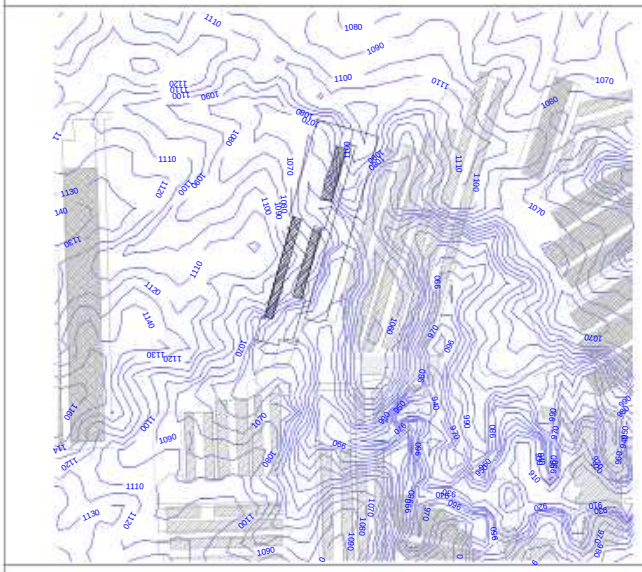
December 2025 (SP145) - Proposed Case



December 2027 (SP153) - Approved Case

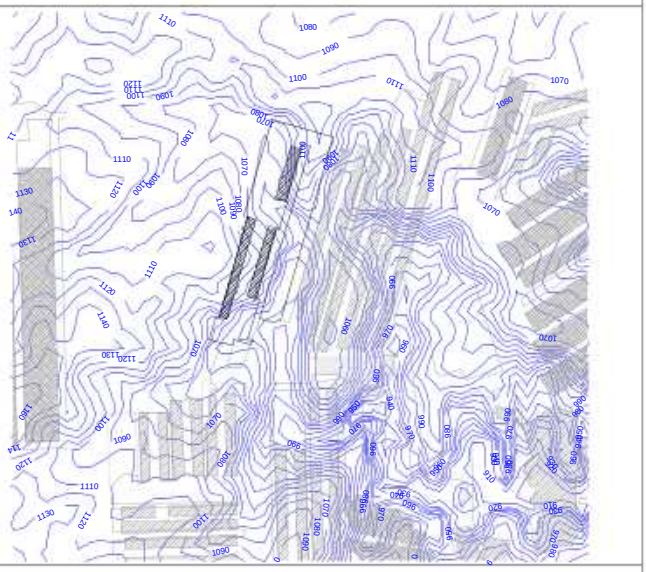


December 2027 (SP153) - Proposed Case



December 2049 (SP241) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241) - Proposed Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mAHD

Model Results:

- Modelled Groundwater Elevation (mAHD)

Job No.: 68229		**Groundwater Elevation (mAHD) - Prediction Period**
Client: Clarence Colliery Pty Ltd		Highest Active Node (10th Percentile)
Version: R01RevA	Date: 31/10/2025	
Drawn By: DAW	Checked By: JRWB	**Figure 4.68a-1**

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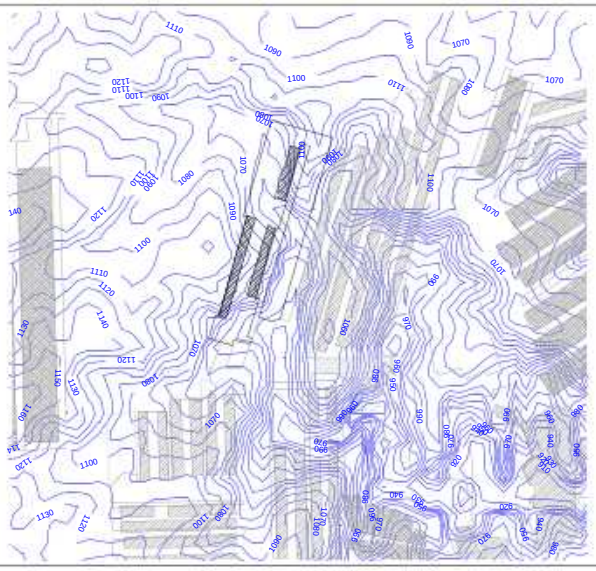
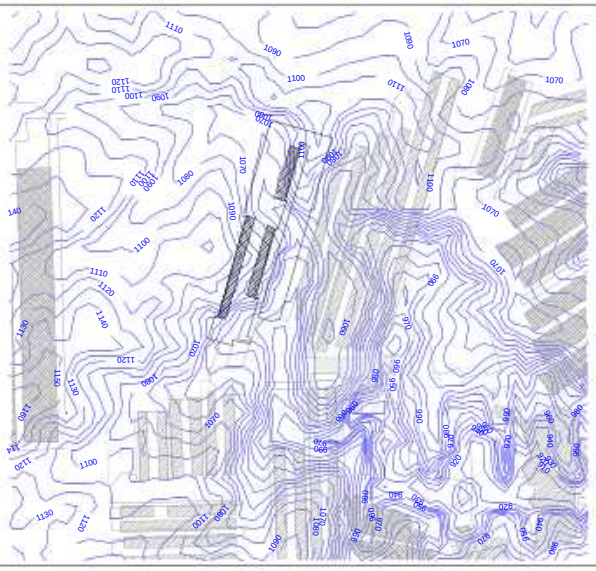
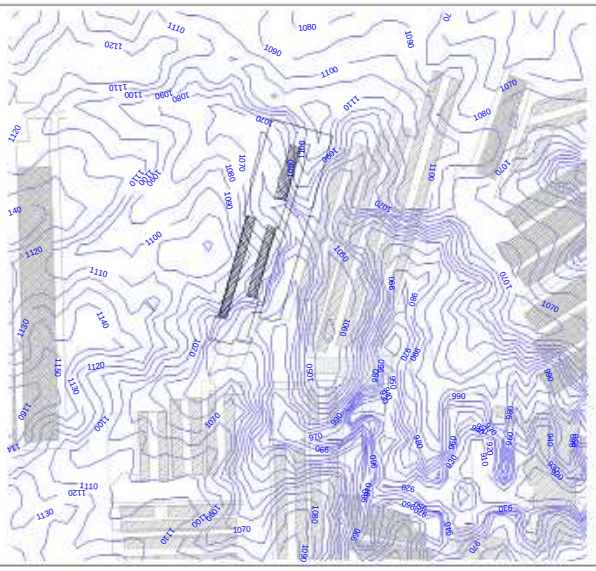


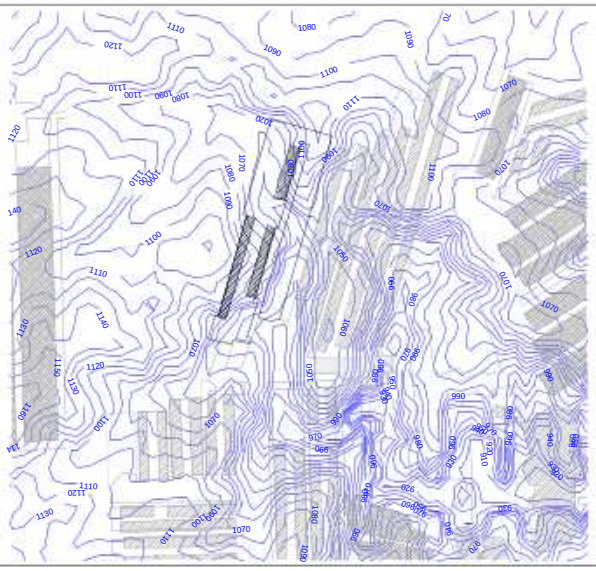
December 2025 (SP145) - Approved Case



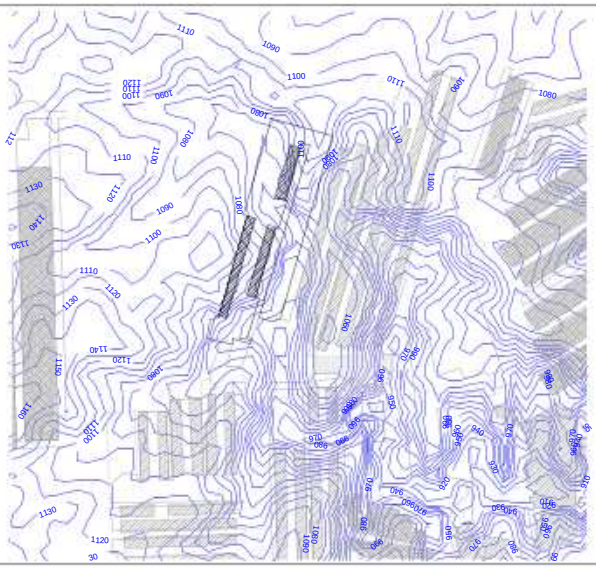
December 2025 (SP145) - Proposed Case



December 2027 (SP153) - Approved Case

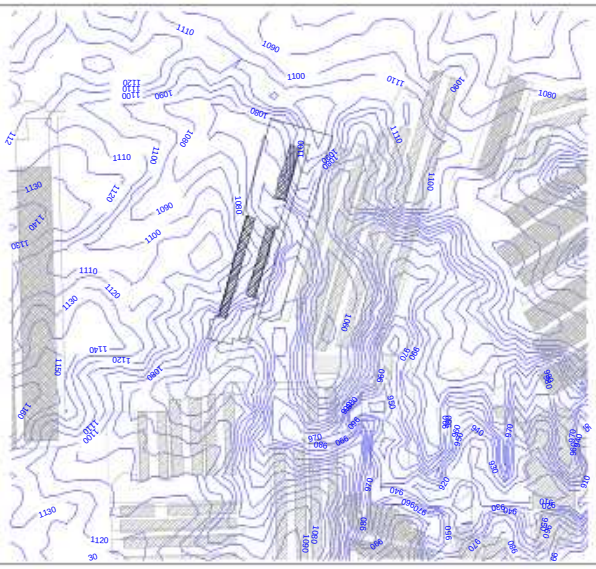


December 2027 (SP153) - Proposed Case



December 2049 (SP241) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241) - Proposed Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mAHD

Model Results:

- Modelled Groundwater Elevation (mAHD)

Job No.: 68229		**Groundwater Elevation (mAHD) - Prediction Period**
Client: Clarence Colliery Pty Ltd		Highest Active Node (90th Percentile)
Version: R01RevA	Date: 31/10/2025	
Drawn By: DAW	Checked By: JRWB	**Figure 4.68a-2**

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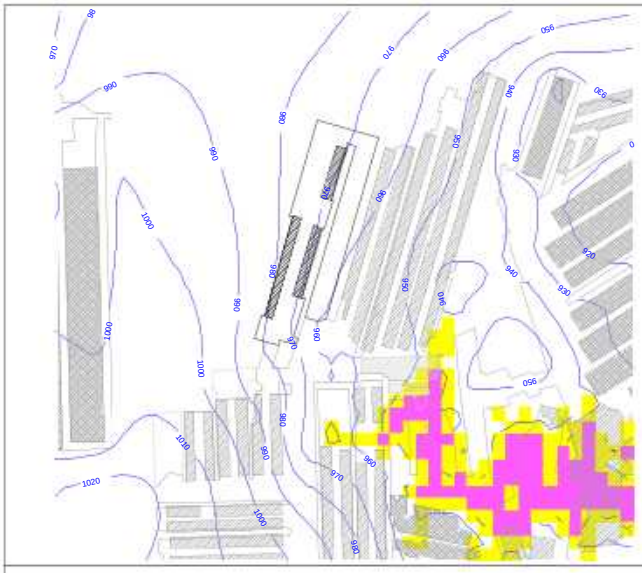
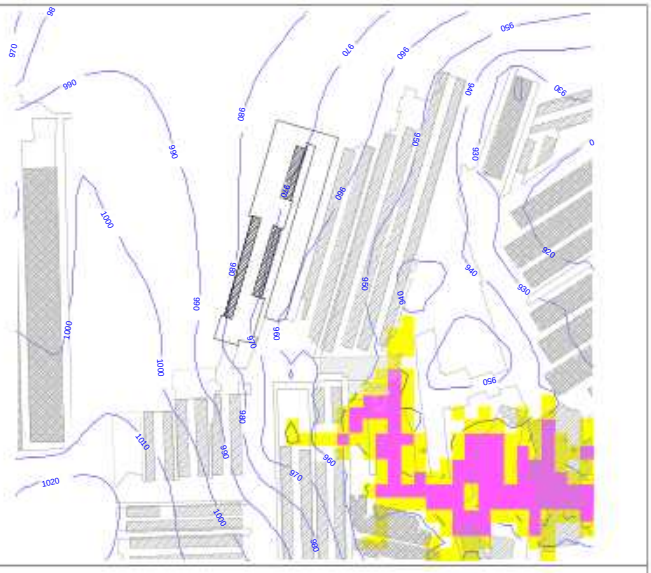
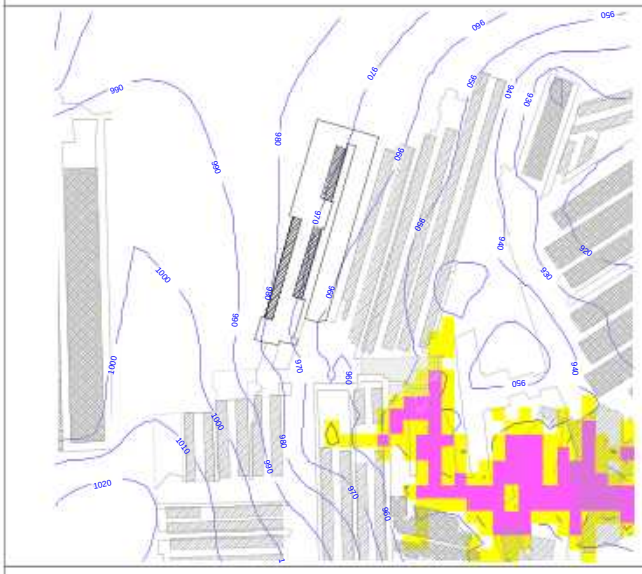


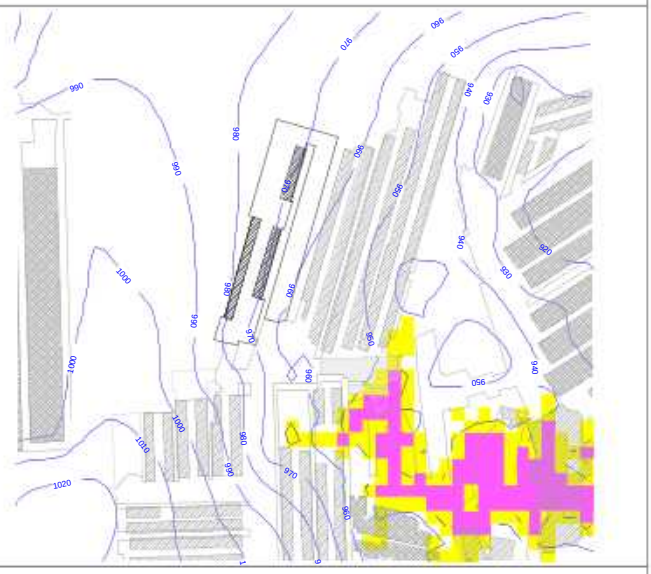
December 2025 (SP145) - Approved Case



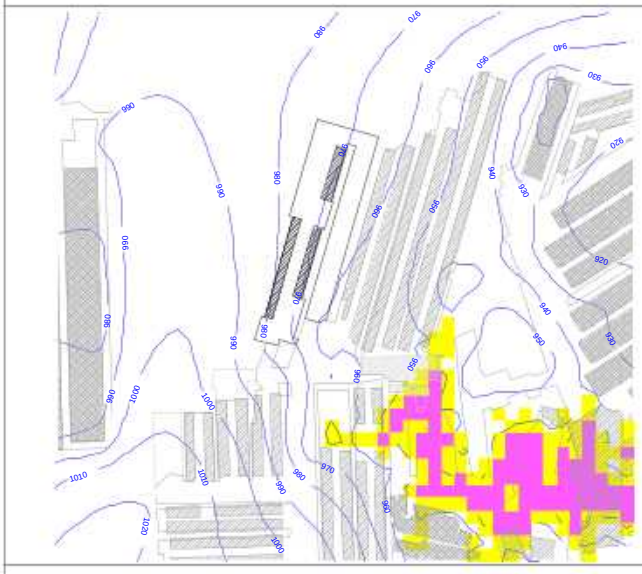
December 2025 (SP145) - Proposed Case



December 2027 (SP153) - Approved Case

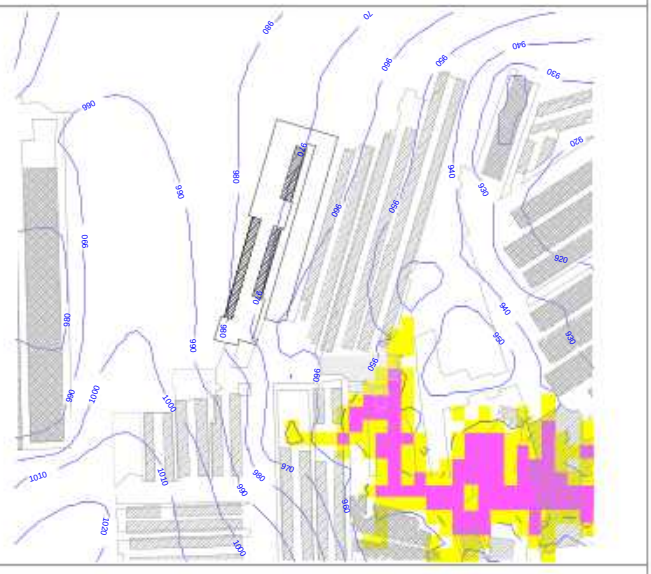


December 2027 (SP153) - Proposed Case



December 2049 (SP241) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241) - Proposed Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mAHD

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Groundwater Elevation (mAHD)

Job No.: 68229		**Groundwater Elevation (mAHD) - Prediction Period**
Client: Clarence Colliery Pty Ltd		Mount York Claystone (Layer 15) (10th Percentile)
Version: R01RevA	Date: 31/10/2025	
Drawn By: DAW	Checked By: JRWB	**Figure 4.68b-1**

JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D013_GWE_10TH\68229_R01RevA_D013b_GWE_10TH_L15\68229_R01RevA_D013b_GWE_10TH_L15.grf

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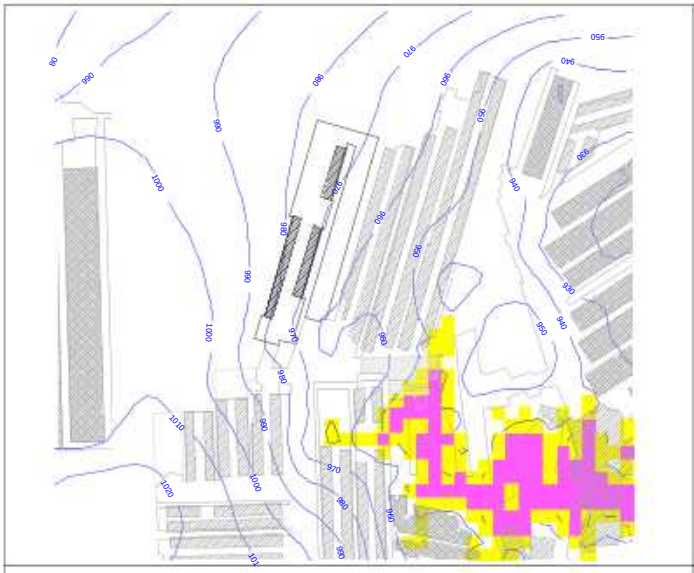
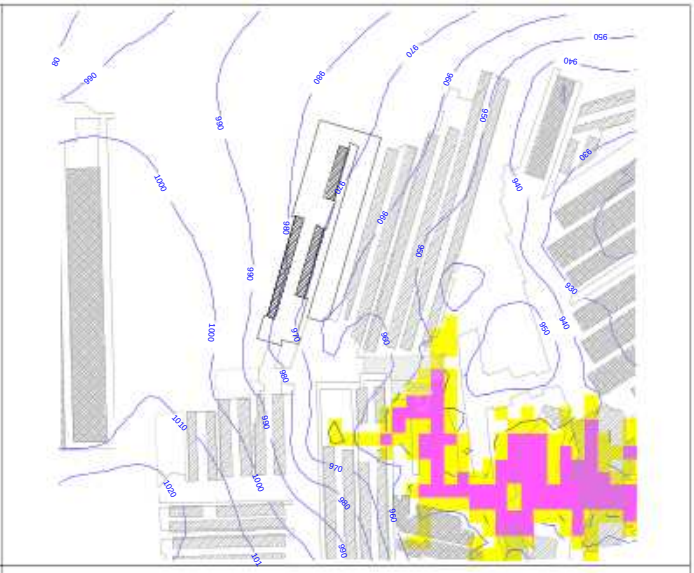
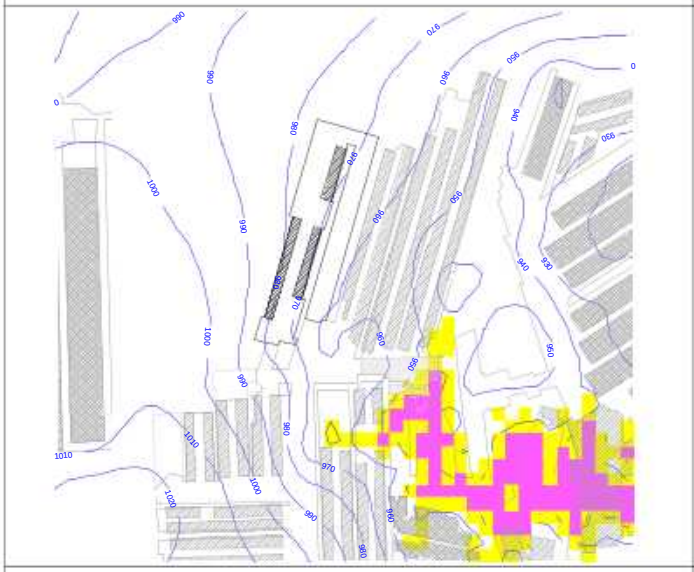


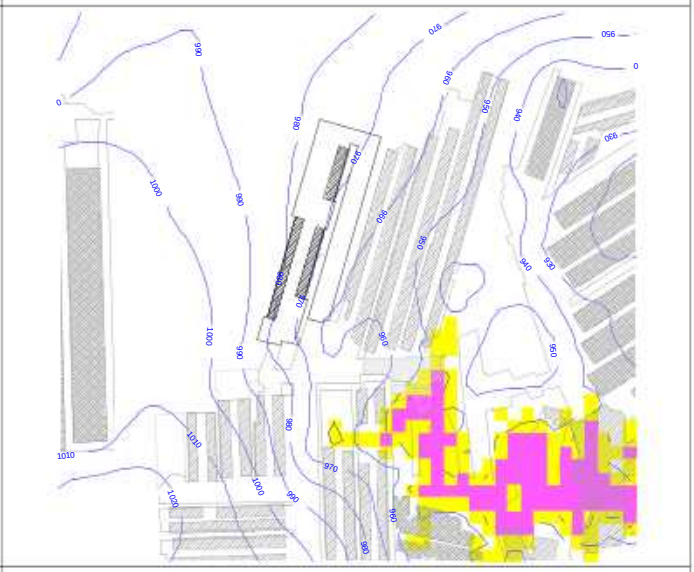
December 2025 (SP145) - Approved Case



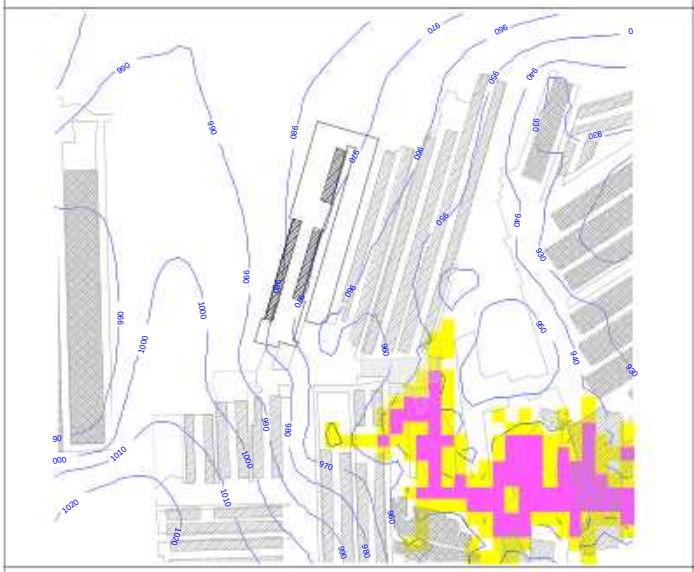
December 2025 (SP145) - Proposed Case



December 2027 (SP153) - Approved Case

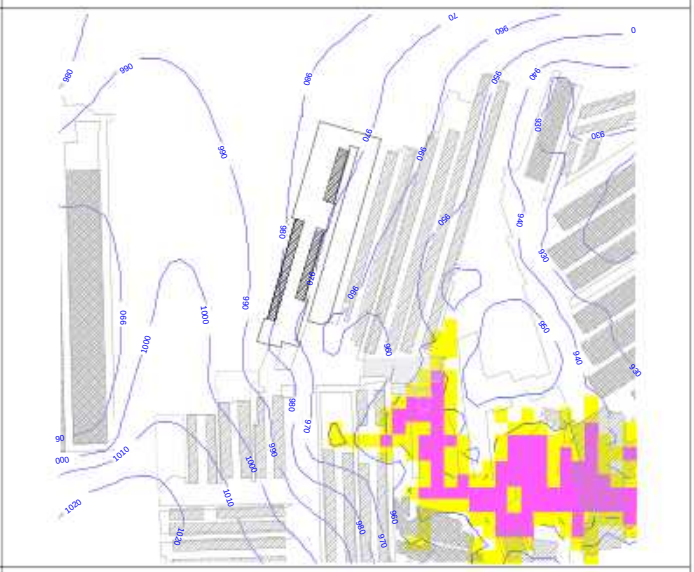


December 2027 (SP153) - Proposed Case



December 2049 (SP241) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241) - Proposed Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mAHD

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Groundwater Elevation (mAHD)

Job No.: 68229		**Groundwater Elevation (mAHD) - Prediction Period**
Client: Clarence Colliery Pty Ltd		Mount York Claystone (Layer 15) (90th Percentile)
Version: R01RevA	Date: 31/10/2025	
Drawn By: DAW	Checked By: JRWB	**Figure 4.68b-2**

JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D014_GWE_90TH\68229_R01RevA_D014b_GWE_90TH_L15\68229_R01RevA_D014b_GWE_90TH_L15.grf

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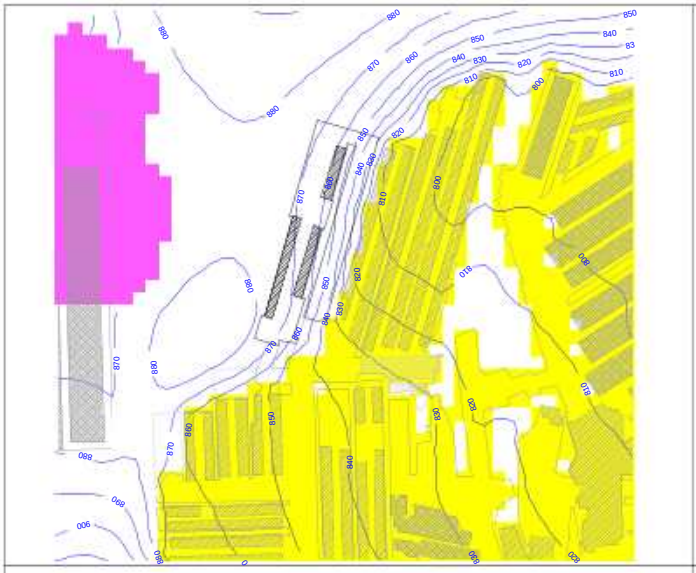
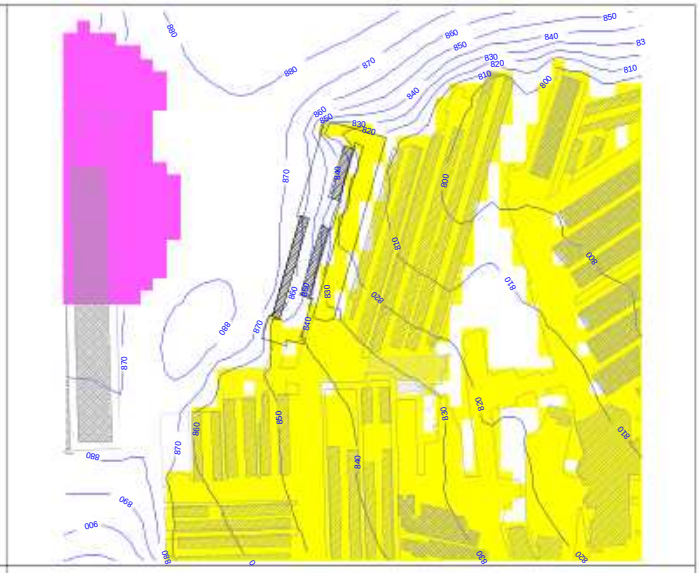
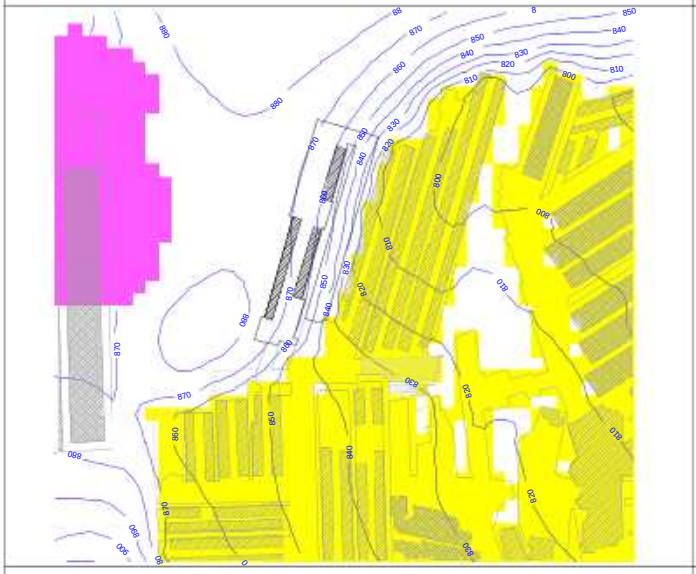


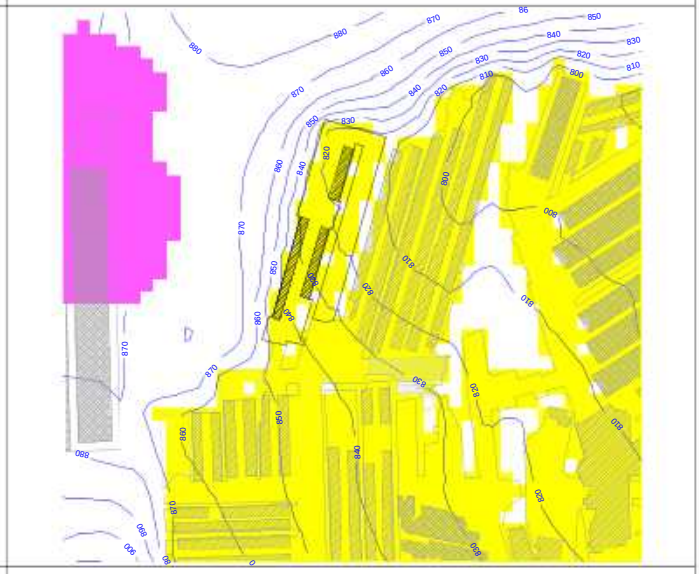
December 2025 (SP145) - Approved Case



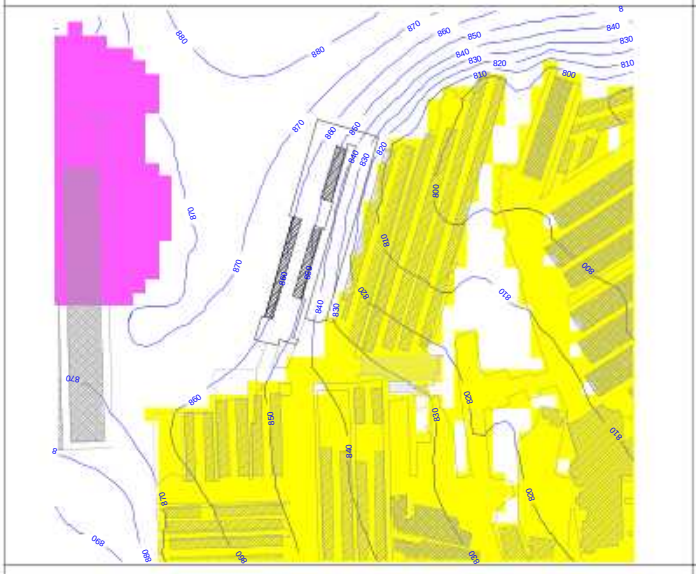
December 2025 (SP145) - Proposed Case



December 2027 (SP153) - Approved Case

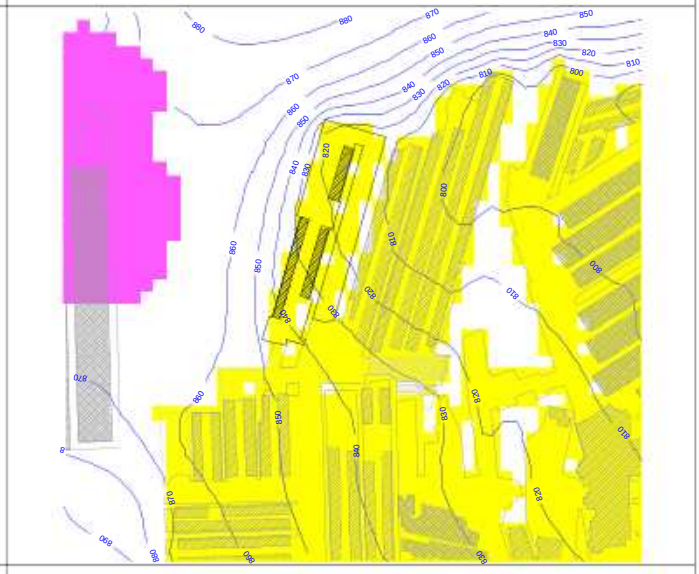


December 2027 (SP153) - Proposed Case



December 2049 (SP241) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241) - Proposed Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mAHD

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Groundwater Elevation (mAHD)

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA | Date: 31/10/2025

Drawn By: DAW | Checked By: JRWB

Groundwater Elevation (mAHD) - Prediction Period

Katoomba Seam
(Layer 18) (10th Percentile)

Figure 4.68c-1

JBS&G

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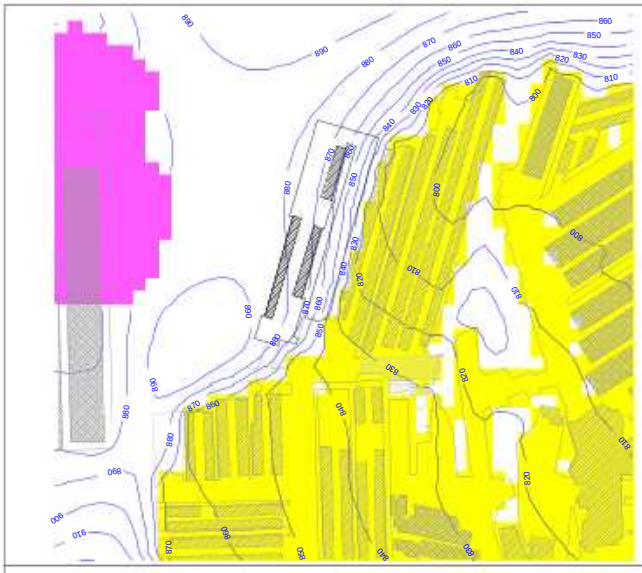
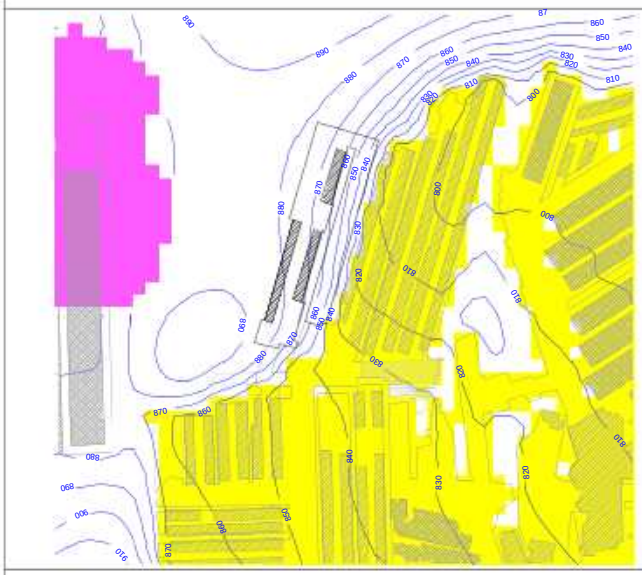
Reference: 68229_R01RevA_APR_03c_23UnReCalNSMC, 68229_R01RevA_PRO_02a_23UnReCalNSMC.



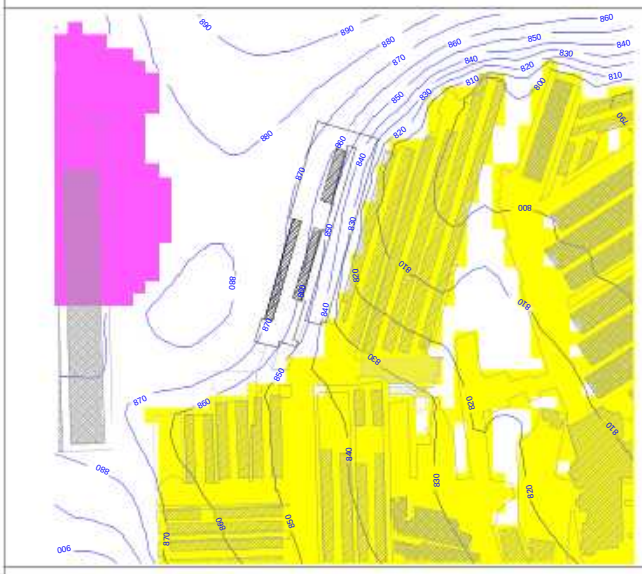
December 2025 (SP145) - Approved Case

December 2025 (SP145) - Proposed Case



December 2027 (SP153) - Approved Case

December 2027 (SP153) - Proposed Case



December 2049 (SP241) - Approved Case

Scale 1:58,080 @A4: 0 250 500m

December 2049 (SP241) - Proposed Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mAHD

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Groundwater Elevation (mAHD)

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA | Date: 31/10/2025

Drawn By: DAW | Checked By: JRWB

Groundwater Elevation (mAHD) - Prediction Period

Katoomba Seam
(Layer 18) (90th Percentile)

Figure 4.68c-2

JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D014_GWE_90TH\68229_R01RevA_D014c_GWE_90TH_L18\68229_R01RevA_D014c_GWE_90TH_L18.grf

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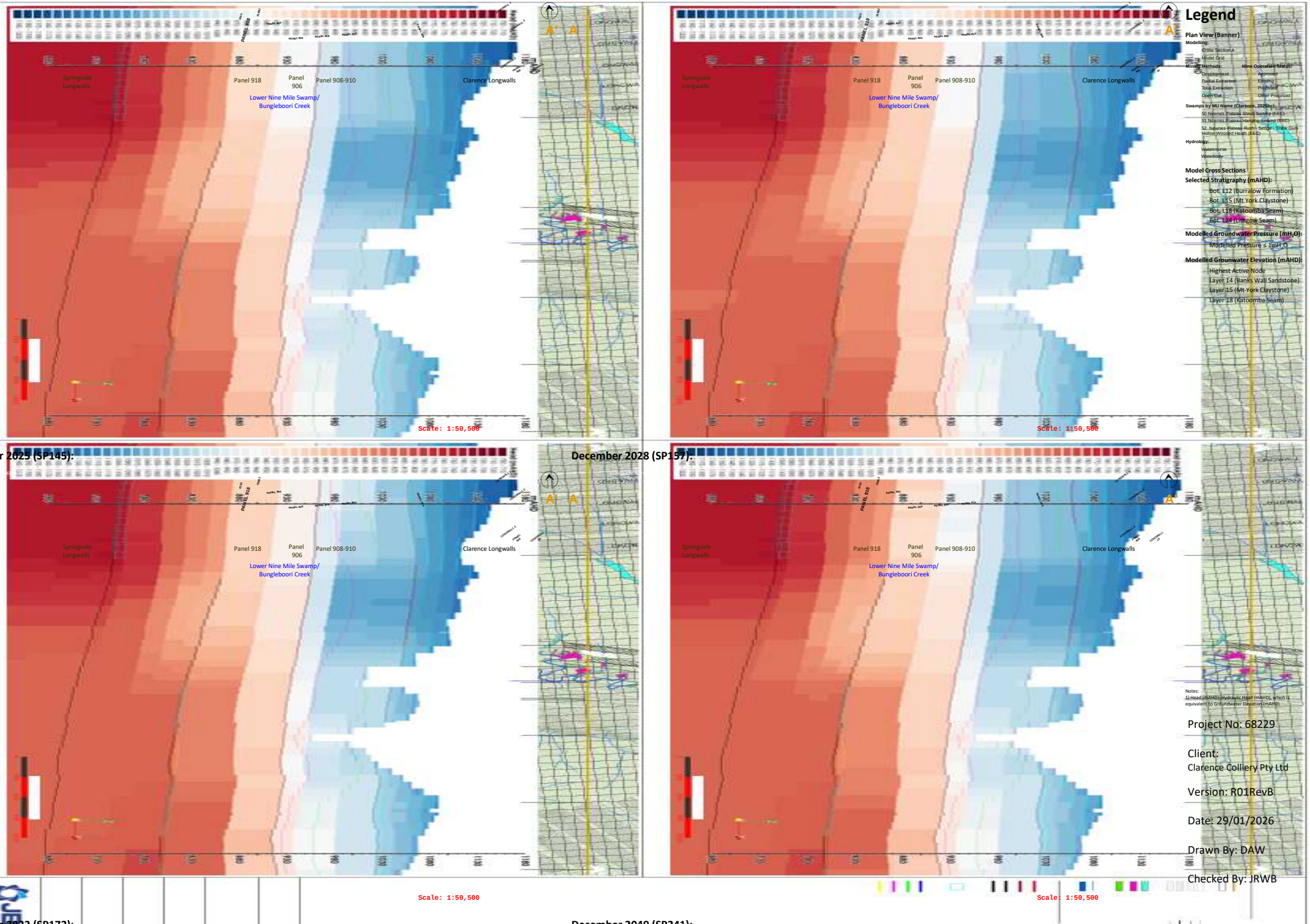


Figure 4.69a: Groundwater Elevation (mAHD) Time-Series (Prediction Period - Approved Case) - Cross-Section A-A'

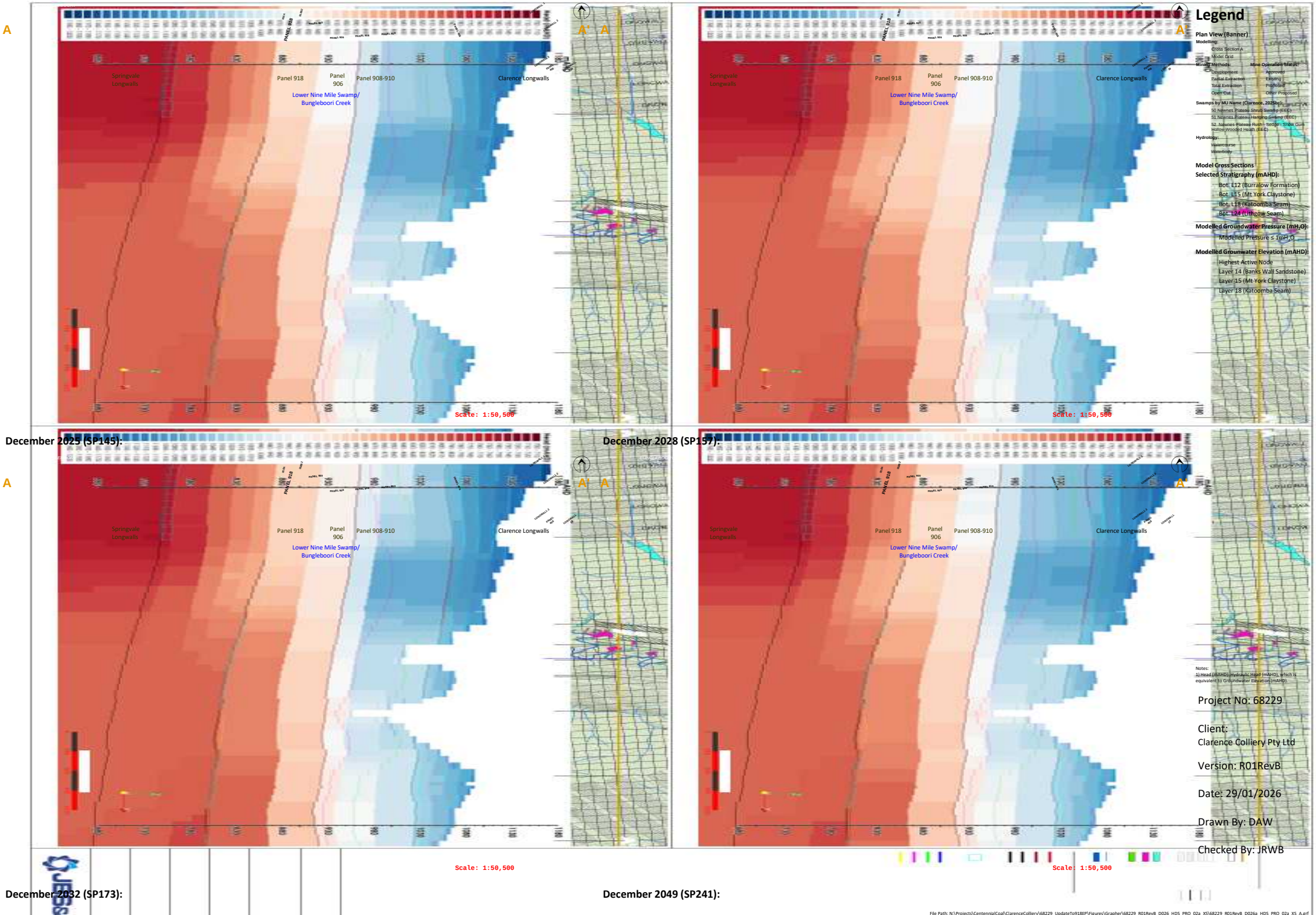


Figure 4.69b: Groundwater Elevation (mAHD) Time-Series (Prediction Period - Proposed Case) - Cross-Section A-A'

Figure 4-70a presents groundwater elevation along Cross-Section B-B' (refer **Figure 4-1**) for the Approved Case. **Figure 4-70b** presents model output along that cross-section for the Proposed Case.

From **Figure 4-70b** compared to **Figure 4-70a**, by December 2028 (SP157), depressurisation in the Katoomba Seam (Layer 18) in 918 Panel leads to a decrease in groundwater elevation vertically above extraction. This change to groundwater elevation propagates upwards to the Mount York Claystone (Layer 15) and Banks Wall Sandstone (Layer 13 and 14) and to the north in the unmined area north of Clarence Colliery. Comparison of the Proposed Case to Approved Case, indicates there are minor fluctuations to groundwater elevation within the Burralow Formation (Layer 1 through to 12), but do not appear significant. As per the discussion of **Figure 4-69ab**, this is due to the assumed change in horizontal hydraulic conductivity above the extracted SubPanels, and is probably a conservative assumption. By December 2032 (SP173) and December 2049 (SP241), there is no further change to groundwater elevation due to the Proposed Case.

4.15.5.6 Groundwater Pressure

Figure 4-71a presents groundwater pressure in the Mount York Claystone (Layer 15) for the R10 and R90 prediction model results.

From **Figure 4-71a**, the change in groundwater pressure in the Mount York Claystone (Layer 15) is not discernible at the scale of contouring.

Figure 4-71b presents groundwater pressure in the Katoomba Seam (Layer 18) for the R10 and R90 prediction model results.

From **Figure 4-71b**, the extraction at 918 Panel will lead to depressurisation (being pressure less than 1mH_2O) within the 918 Panel. In the vicinity of 918 Panel, to the west and northwest, there is a decrease in groundwater pressure that diminishes with distance from 918 Panel. From **Figure 4-71b**, by December 2049 (SP241), the higher groundwater pressure (approximately 20 to 40mH_2O) that exists between Springvale Mine and the 918 Panel has been reduced (approximately 10 to 30mH_2O). Modelling also shows that by December 2049 (SP241), in the 10th percentile ranked output, there is depressurisation that occurs between Longwall 425 at Springvale Mine and Panel 917 at Clarence Colliery.

Figure 4-72a presents groundwater pressure along Cross-Section A-A' (refer **Figure 4-1**) for the Approved Case. **Figure 4-72b** presents model output along that cross-section for the Proposed Case. Groundwater elevation cross-sections are presented for the deterministic Simulation0 output.

Model output is presented in the cross-section at the following times:

- December 2025 (SP145)
- December 2028 (SP157)
- December 2032 (SP173)
- December 2049 (SP241).

Comparing **Figure 4-72b** to **Figure 4-72a**, modelled groundwater pressure shows depressurisation in the Katoomba Seam (Layer 18) in 918 Panel, as is expected. In the Approved Case, there is a relatively higher pressure in the unmined area between Springvale Mine and 918 Panel at Clarence Colliery, which reduces in the Proposed Case. The changes to groundwater pressure propagate vertically upward in the unmined area between Springvale Mine and the 918 Panel at Clarence Colliery, diminishing towards the Burralow Formation (Layer 1 through 12).

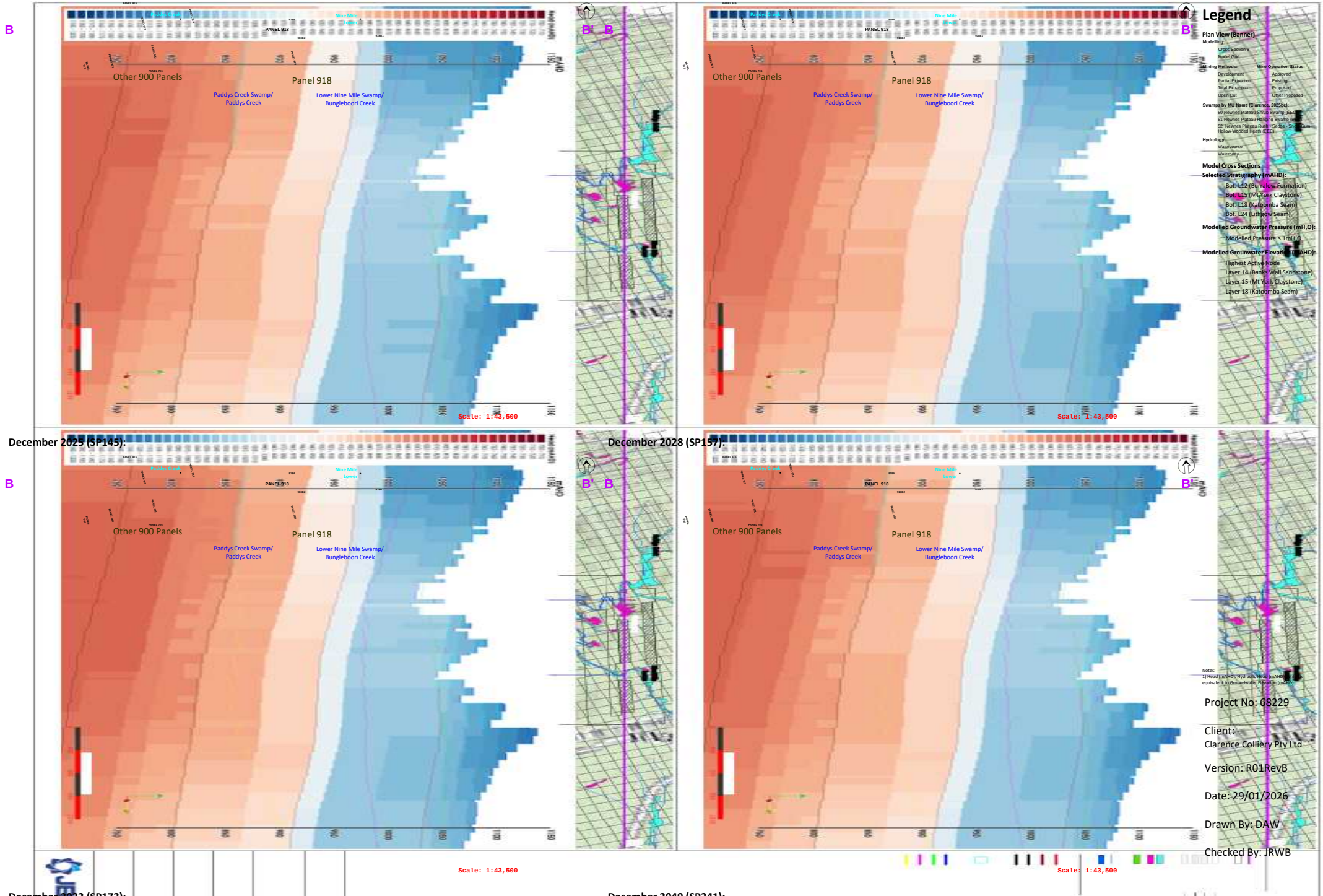


Figure 4.70a: Groundwater Elevation (mAHD) Time-Series (Prediction Period - Approved Case) - Cross-Section B-B'

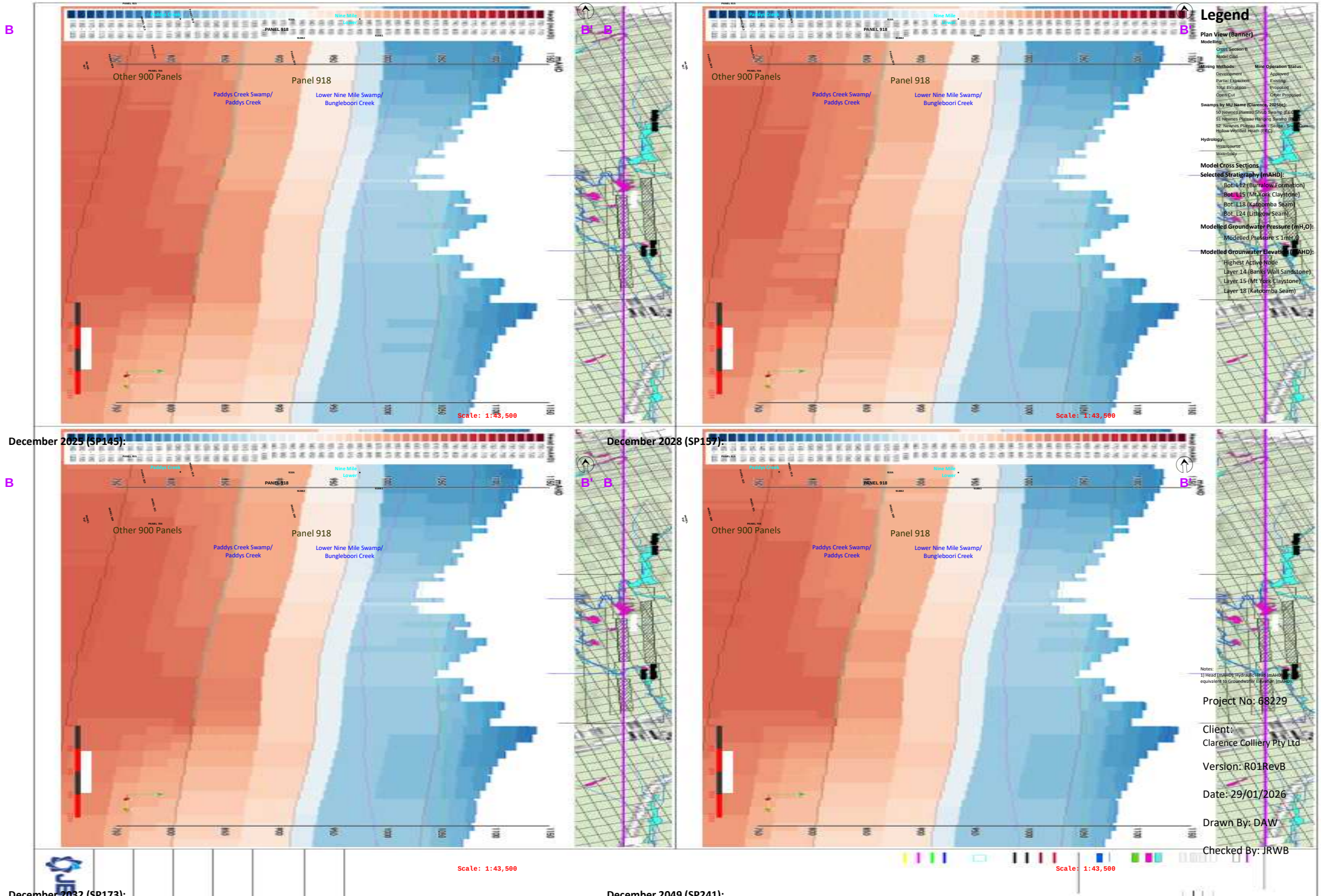
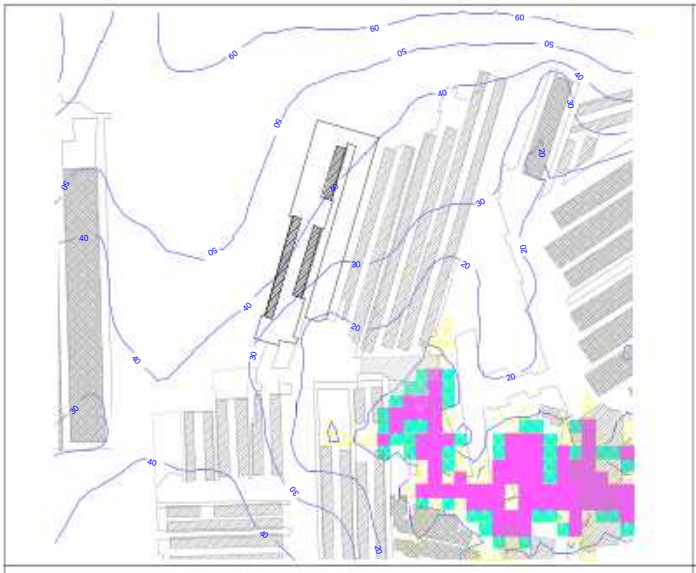
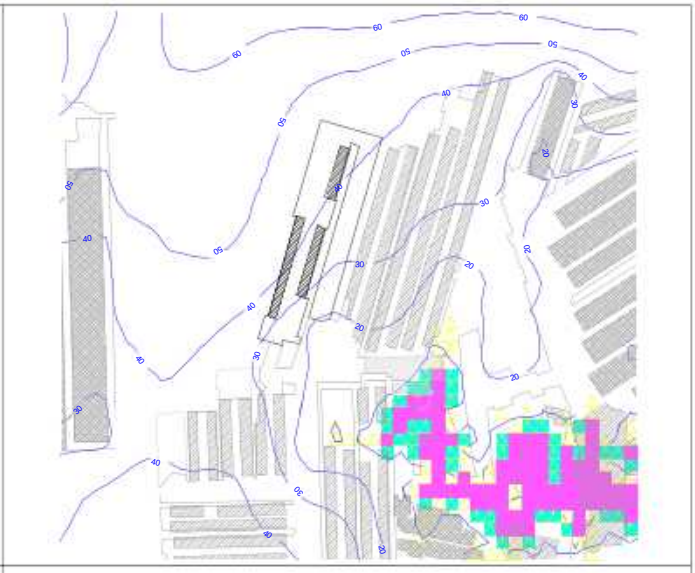


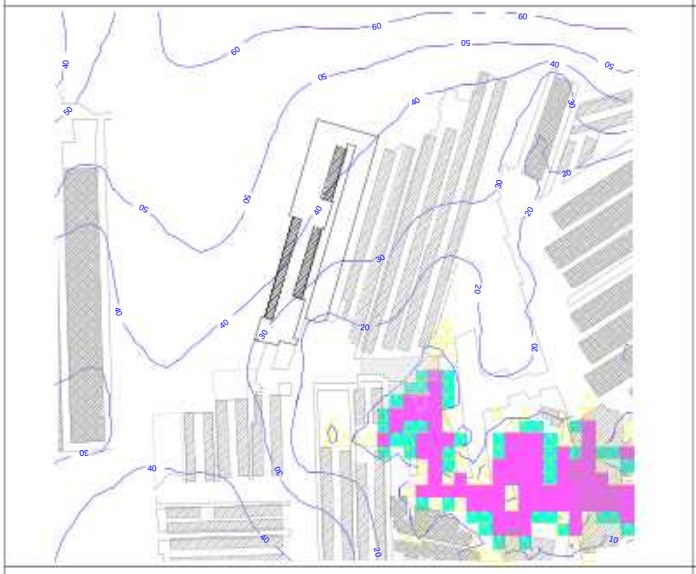
Figure 4.70b: Groundwater Elevation (mAHD) Time-Series (Prediction Period - Proposed Case) - Cross-Section B-B'



December 2025 (SP145) - Approved Case

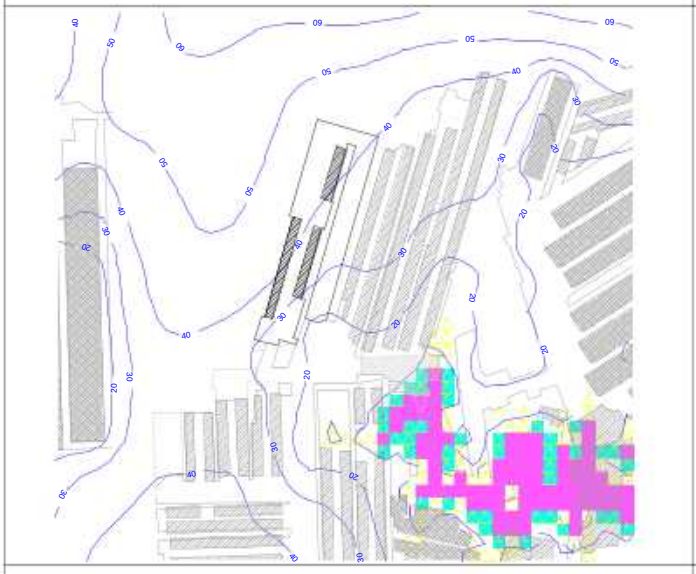


December 2025 (SP145) - Proposed Case



December 2027 (SP153) - Approved Case

December 2027 (SP153) - Proposed Case



December 2049 (SP241) - Approved Case

Scale 1:58,080 @A4: 0 250 500m

December 2049 (SP241) - Proposed Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mH$_2$O

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Pressure (mH$_2$O)
- Modelled Pressure ≤ 1mH$_2$O

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA | Date: 31/10/2025

Drawn By: DAW | Checked By: JRWB

Pressure Head (mH$_2$O) - Prediction Period

Mount York Claystone (Layer 15) (10th Percentile)

Figure 4.71a-1

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File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D018_PH_10TH\68229_R01RevA_D018a_PH_10TH_L15\68229_R01RevA_D018a_PH_10TH_L15.grf

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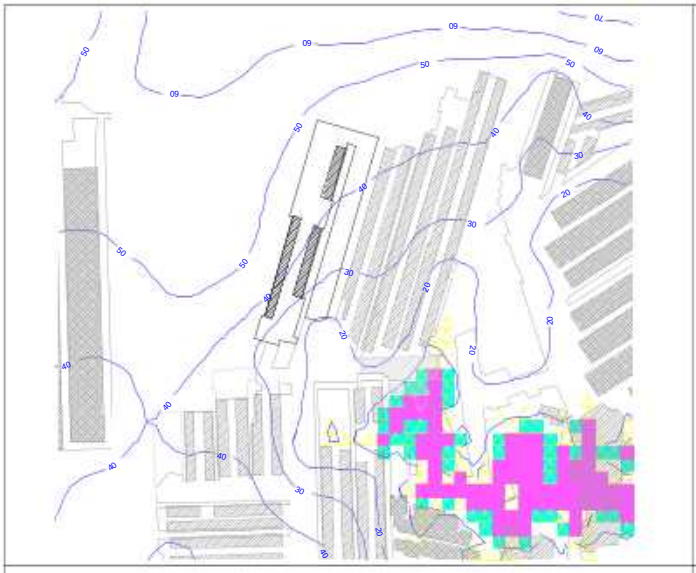
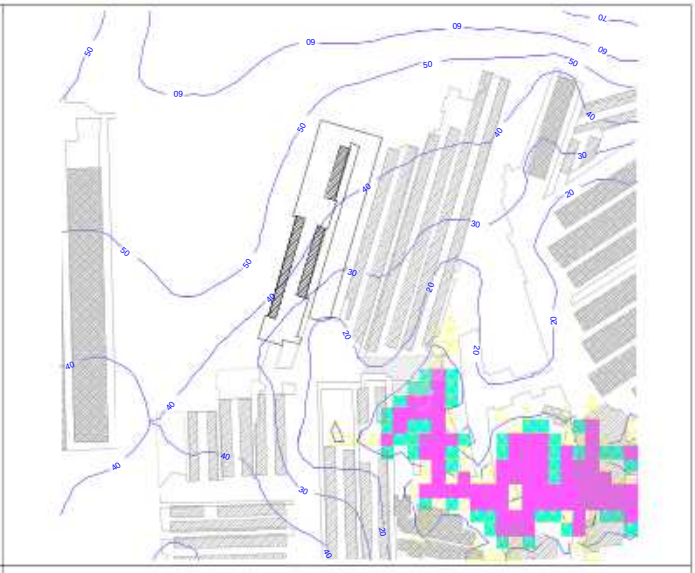
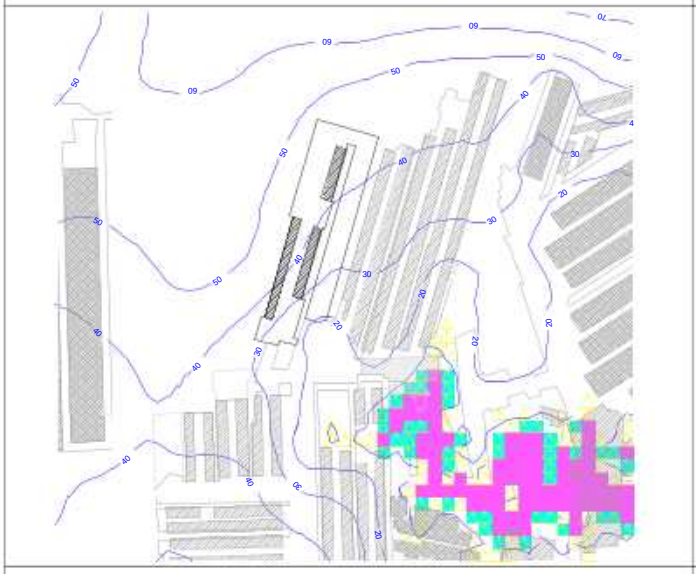


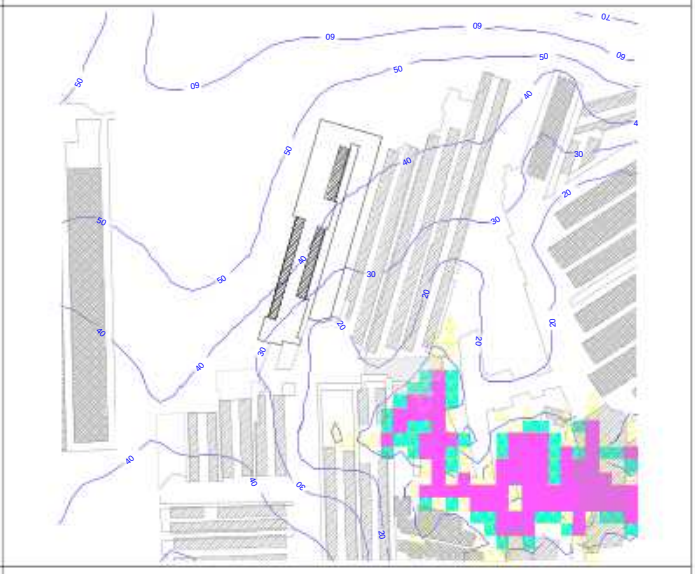
December 2025 (SP145) - Approved Case



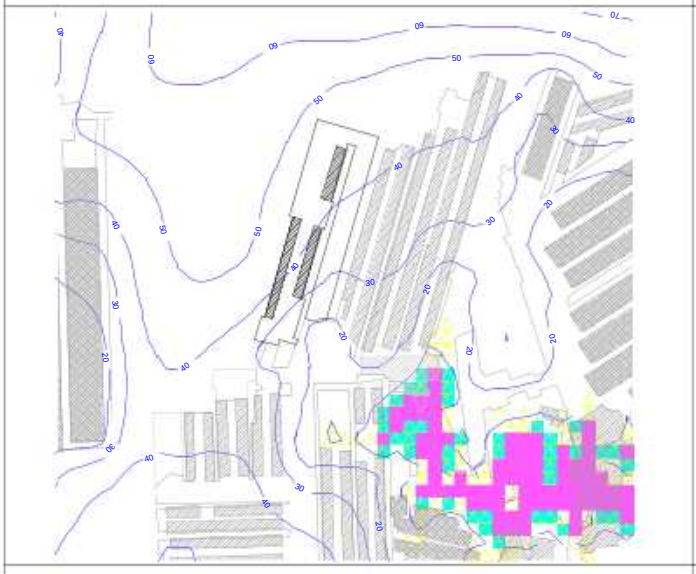
December 2025 (SP145) - Proposed Case



December 2027 (SP153) - Approved Case

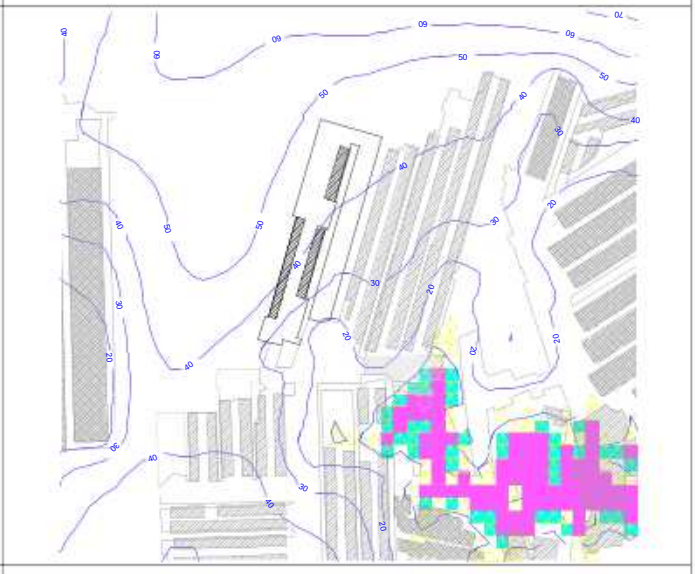


December 2027 (SP153) - Proposed Case



December 2049 (SP241) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241) - Proposed Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mH$_2$O

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Pressure (mH$_2$O)
- Modelled Pressure ≤ 1mH$_2$O

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA | Date: 31/10/2025

Drawn By: DAW | Checked By: JRWB

Pressure Head (mH$_2$O) - Prediction Period

Mount York Claystone (Layer 15) (90th Percentile)

Figure 4.71a-2

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File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D019_PH_90TH\68229_R01RevA_D019a_PH_90TH_L15\68229_R01RevA_D019a_PH_90TH_L15.grf

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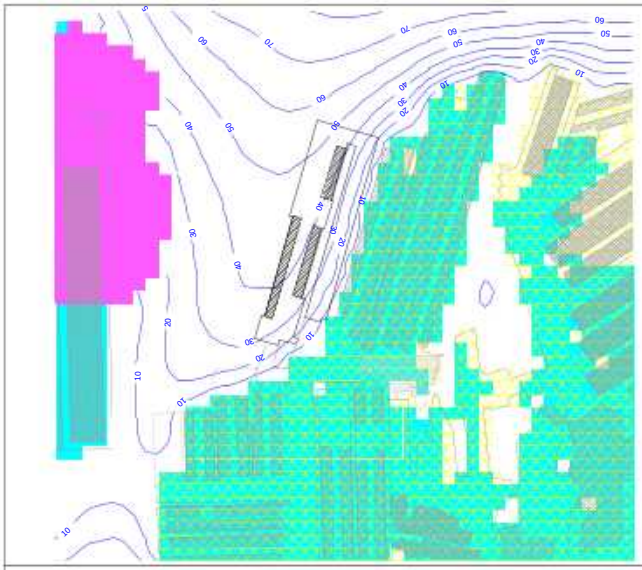
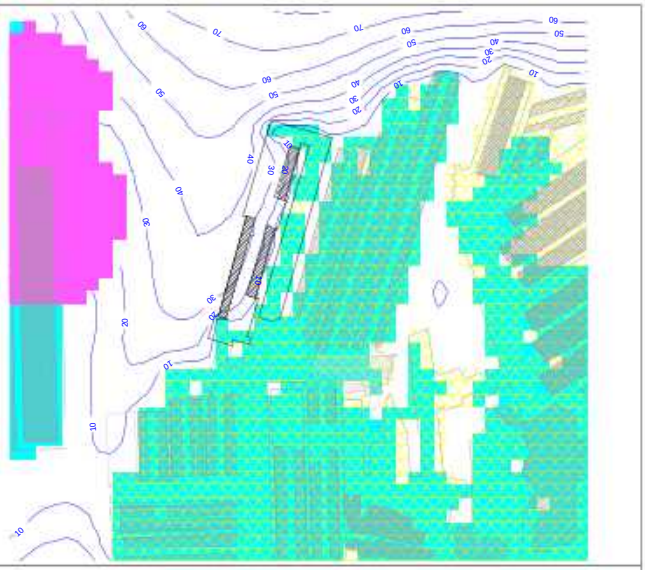
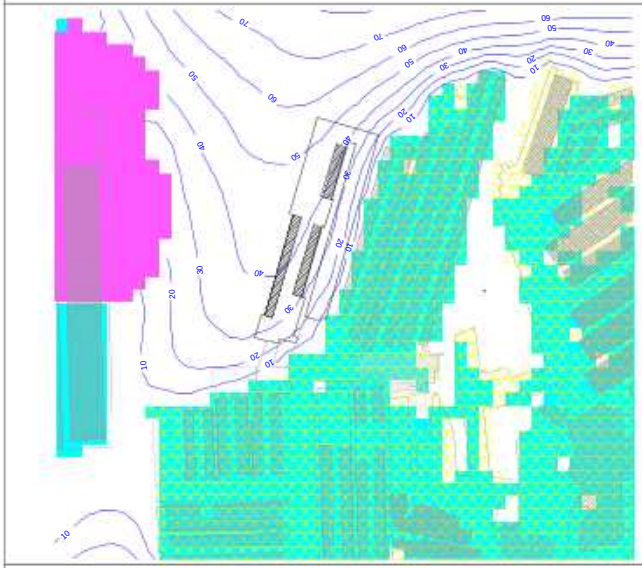


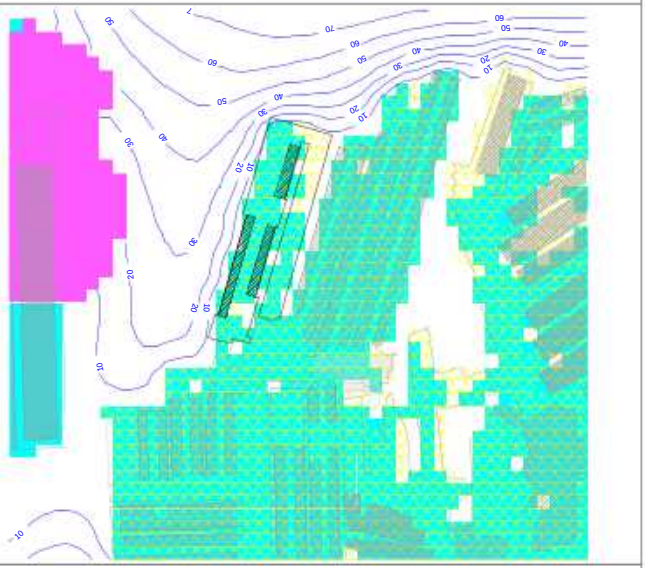
December 2025 (SP145) - Approved Case



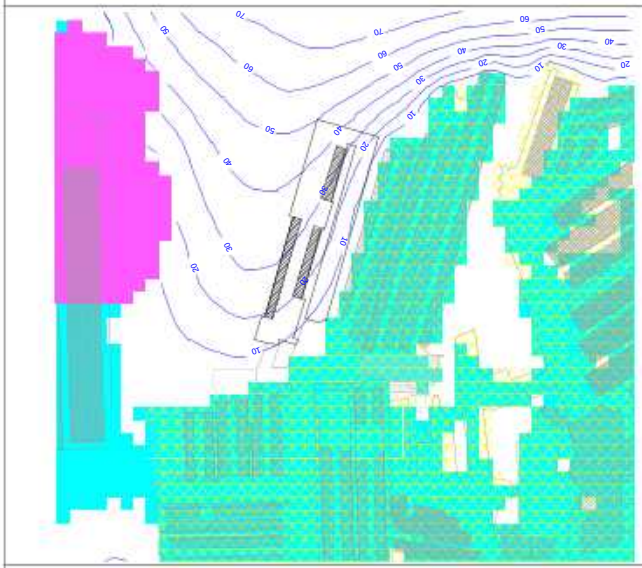
December 2025 (SP145) - Proposed Case



December 2027 (SP153) - Approved Case

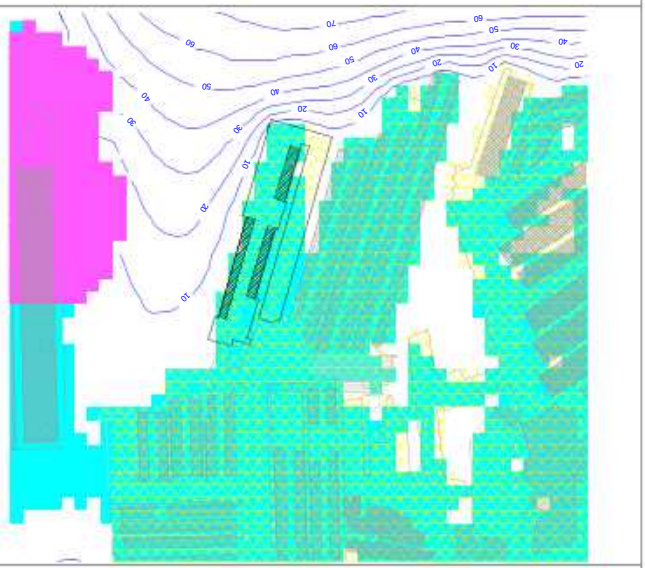


December 2027 (SP153) - Proposed Case



December 2049 (SP241) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241) - Proposed Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mH$_2$O

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Pressure (mH$_2$O)
- Modelled Pressure ≤ 1mH$_2$O

Job No.: 68229		**Pressure Head (mH$_2$O) - Prediction Period**
Client: Clarence Colliery Pty Ltd		Katoomba Seam (Layer 18) (10th Percentile)
Version: R01RevA	Date: 31/10/2025	
Drawn By: DAW	Checked By: JRWB	**Figure 4.71b-1**

JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D018_PH_10TH\68229_R01RevA_D018b_PH_10TH_L18\68229_R01RevA_D018b_PH_10TH_L18.grf

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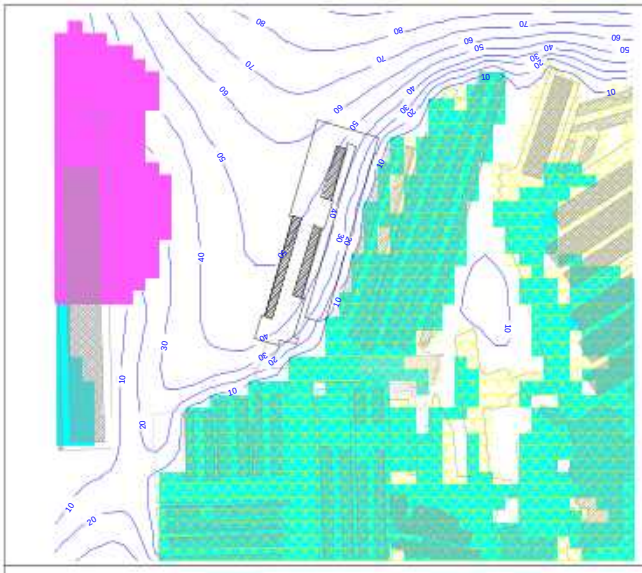
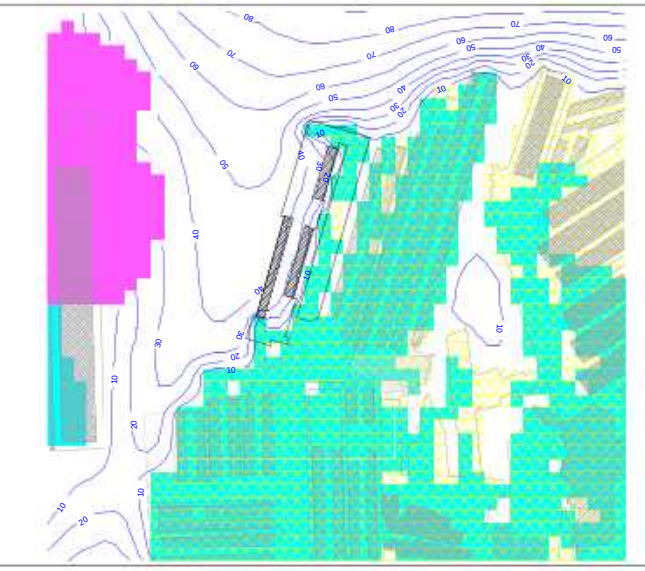


December 2025 (SP145) - Approved Case



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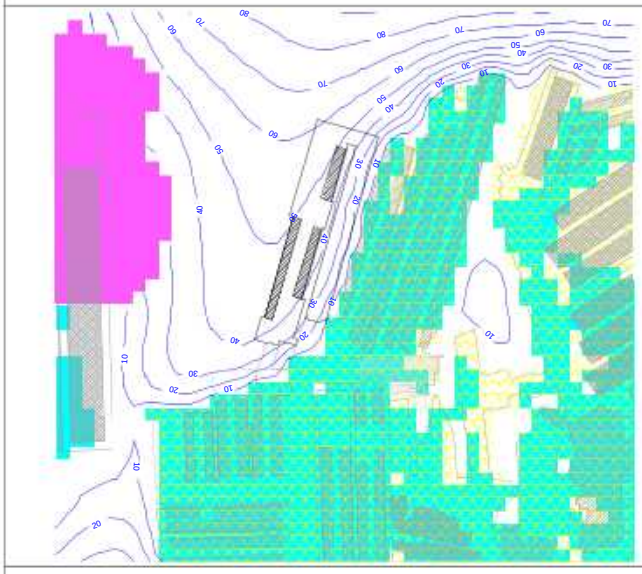
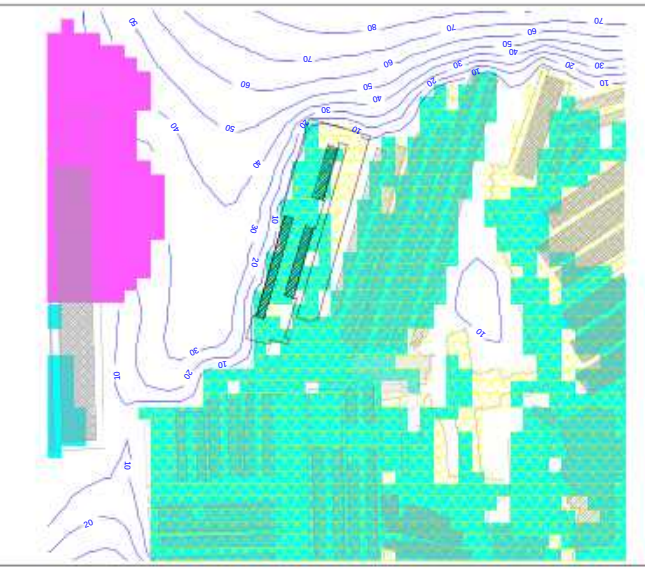
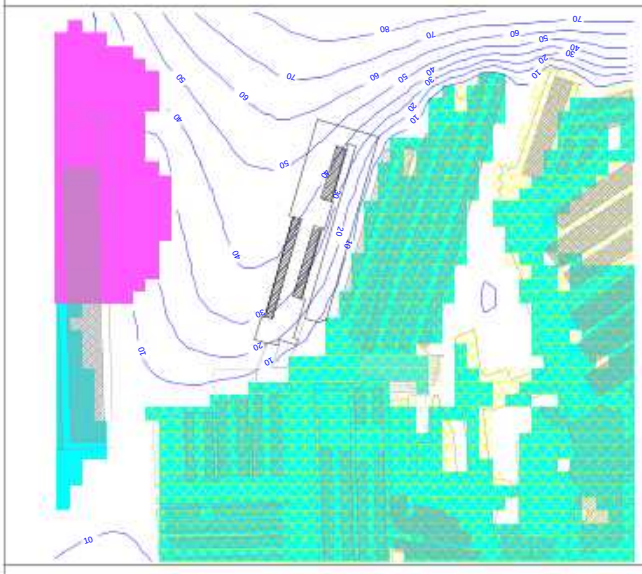


December 2027 (SP153) - Approved Case

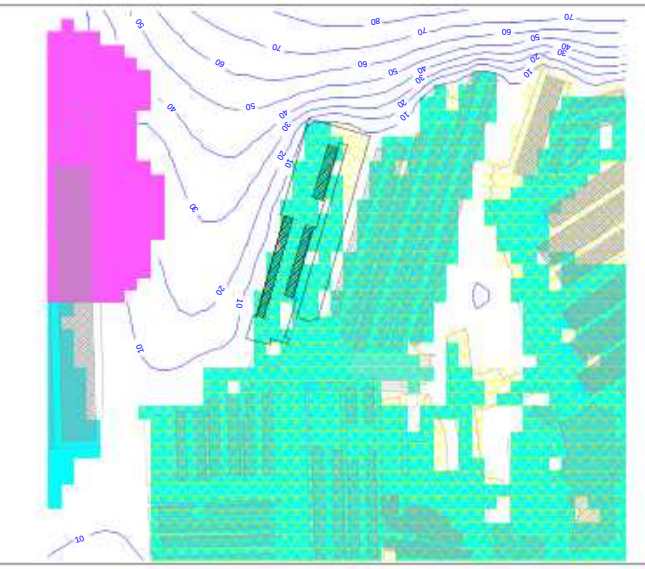


December 2027 (SP153) - Proposed Case



December 2049 (SP241) - Approved Case

Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241) - Proposed Case

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Interval: 10mH$_2$O

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Pressure (mH$_2$O)
- Modelled Pressure ≤ 1mH$_2$O

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA | Date: 31/10/2025

Drawn By: DAW | Checked By: JRWB

Pressure Head (mH$_2$O) - Prediction Period

Katoomba Seam
(Layer 18) (90th Percentile)

Figure 4.71b-2

JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D019_PH_90TH\68229_R01RevA_D019b_PH_90TH_L18\68229_R01RevA_D019b_PH_90TH_L18.grf

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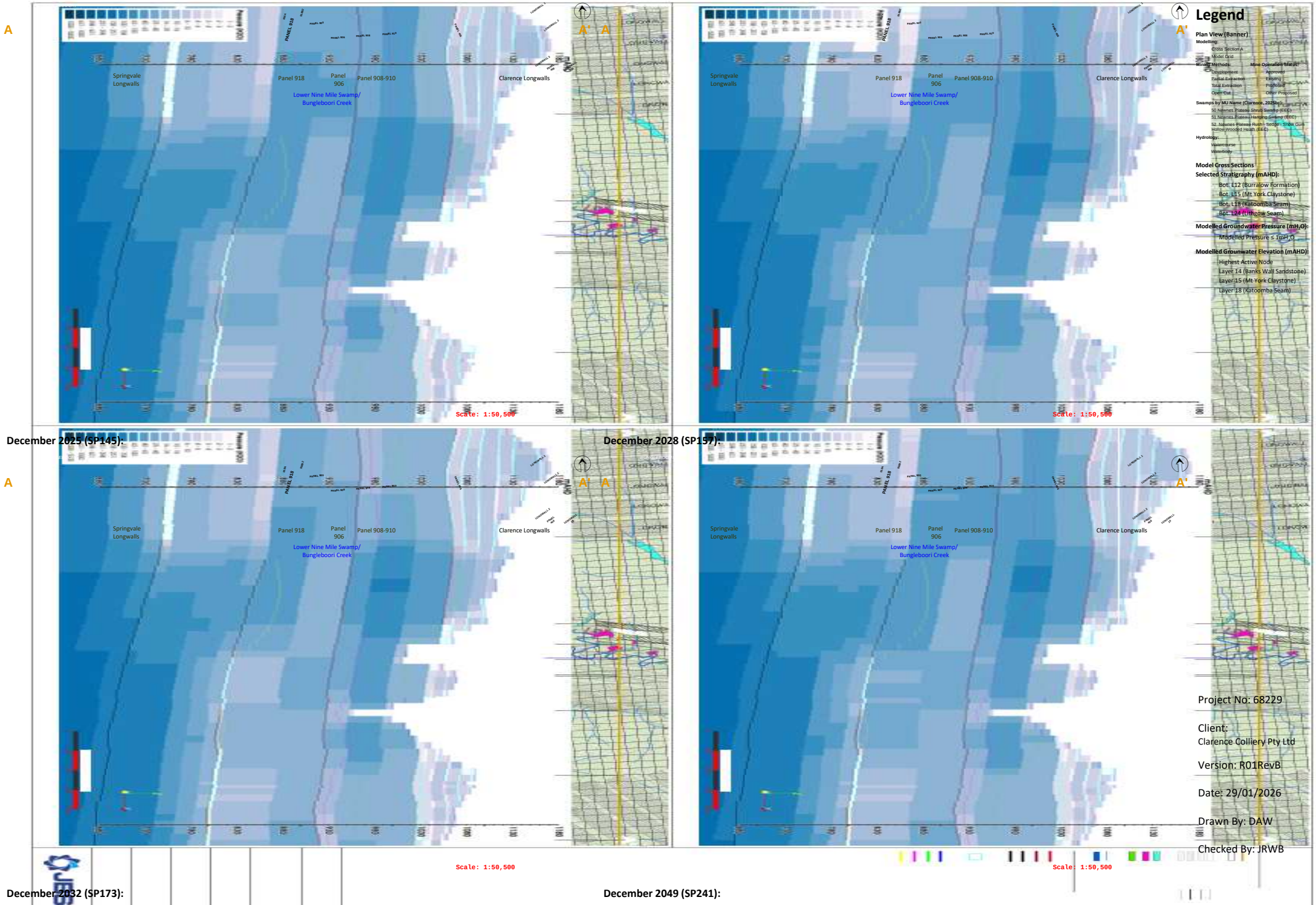


Figure 4.72a: Groundwater Pressure (mH_2O) Time-Series (Prediction Period - Approved Case) - Cross-Section A-A'

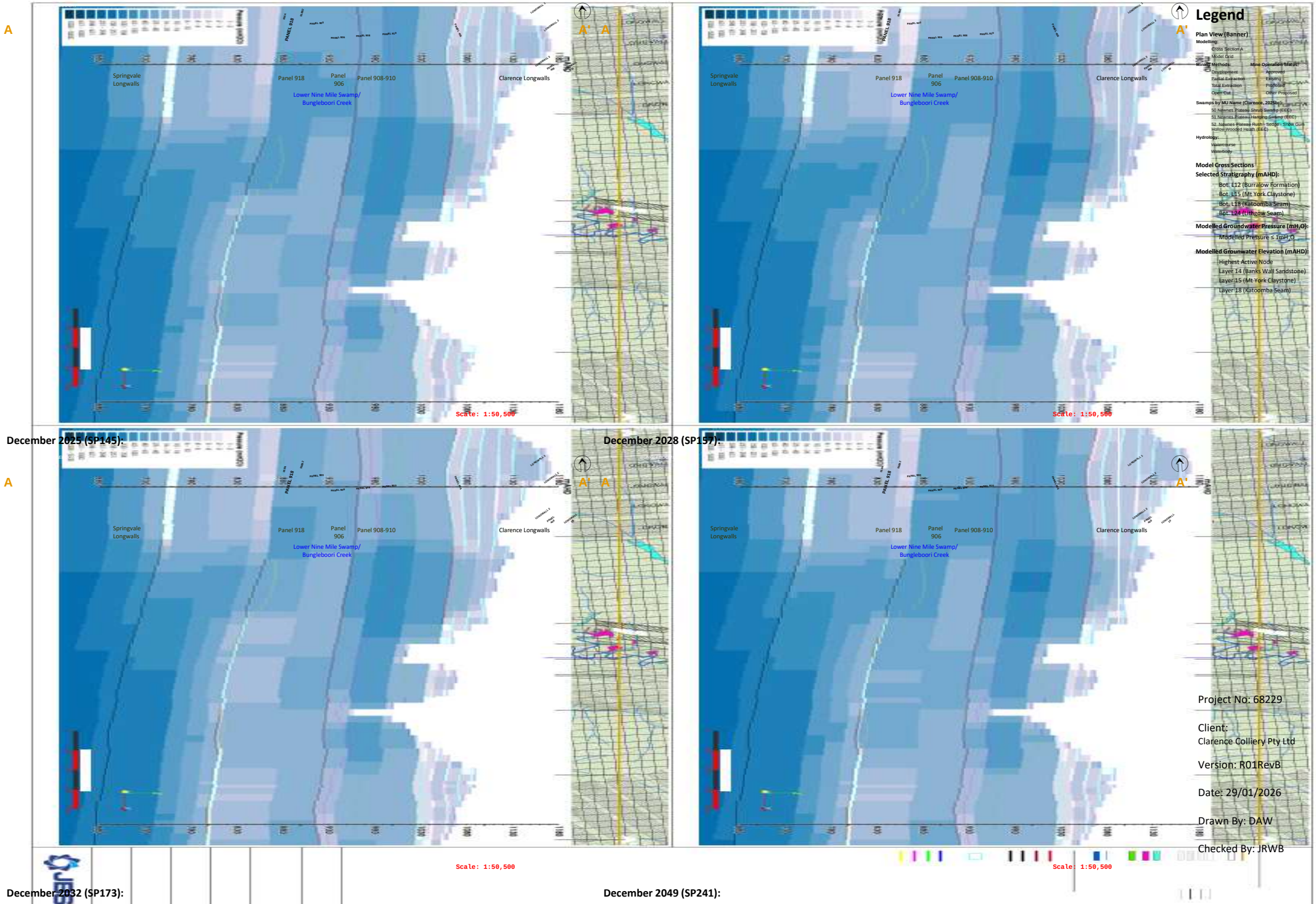


Figure 4.72b: Groundwater Pressure (mH_2O) Time-Series (Prediction Period - Proposed Case) - Cross-Section A-A'

Figure 4-73a presents groundwater pressure along Cross-Section B-B' (refer **Figure 4-1**) for the Approved Case. **Figure 4-73b** presents model output along that cross-section for the Proposed Case.

Comparing **Figure 4-73b** to **Figure 4-73a**, modelled groundwater pressure shows depressurisation in the Katoomba Seam (Layer 18) due to 918 Panel, especially Sub Panel 918B1 and Sub Panel 918B2. Comparing **Figure 4-73b** to **Figure 4-73a**, in the Approved Case there is a relatively higher pressure in the unmined area to the north of 918 Panel, that reduces in the Proposed Case, as is expected. The changes to groundwater pressure to propagate northerly horizontally and vertically upwards, diminishing towards the Burralow Formation (Layer 1 through 12).

4.15.5.7 Change in Groundwater Elevation

Figure 4-74a presents the modelled change in groundwater elevation in the highest active node in the Prediction Period.

From **Figure 4-74a**, the decline in elevation of the highest active node due to the influence of mining is small (being between 0.5 to 2m), directly above 918 Panel. The change to groundwater elevation diminishes with distance from 918 Panel and does not extend beyond 250m from 918 Panel. Comparison of the 10th and 90th percentile output shows a range in uncertainty, with potential for negligible decline (being less than 0.5m) in the 90th percentile modelled output.

Figure 4-74b presents the modelled change to groundwater elevation in the Mount York Claystone (Layer 15).

From **Figure 4-74b**, there is a negligible decline to groundwater elevation (being less than 2m) of up to 2m, with the extent of change occurring in the vicinity of Sub Panel 918A and north of Panel 918. An interpretation of change to the north of Panel 918 is presented below when discussing model results from the Katoomba Seam (Layer 18).

Figure 4-74c presents the modelled change to groundwater elevation in the Katoomba Seam (Layer 18).

From **Figure 4-74c**, as is expected, there is a large (change is greater than 25m) decline in groundwater elevation of up to 50m in the near vicinity of 918 Panel. The extent of the decline in groundwater elevation propagates west to between Springvale Mine and Clarence Colliery, and northwest beneath Bungleboori Creek. As described in **Section 4.15.5.5**, the saddle point in this area declines. This is the explanation of the decline in groundwater elevation in this area. i.e. lateral replenishment is dissipated.

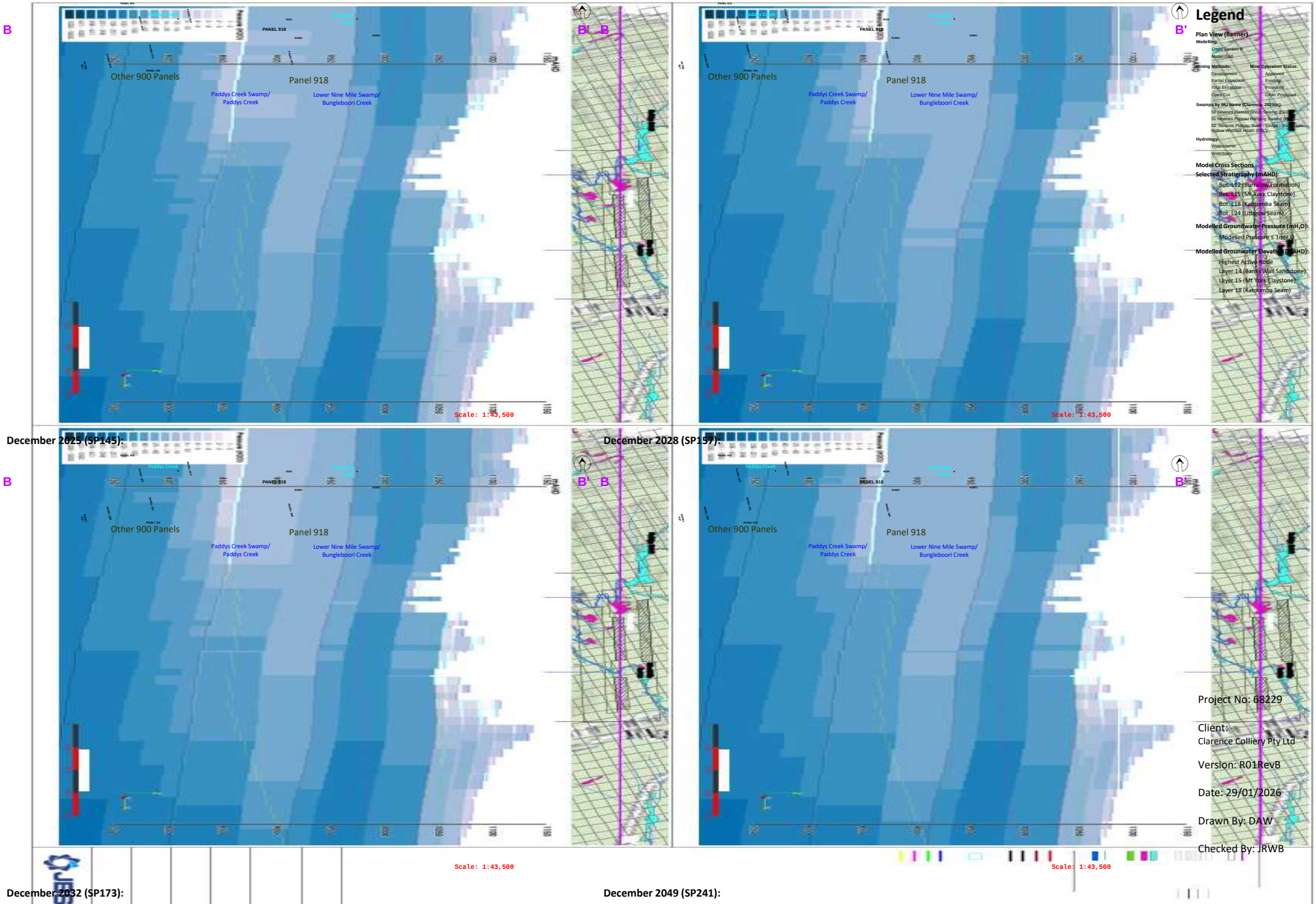


Figure 4.73a: Groundwater Pressure (mH_2O) Time-Series (Prediction Period - Approved Case) - Cross-Section B-B'

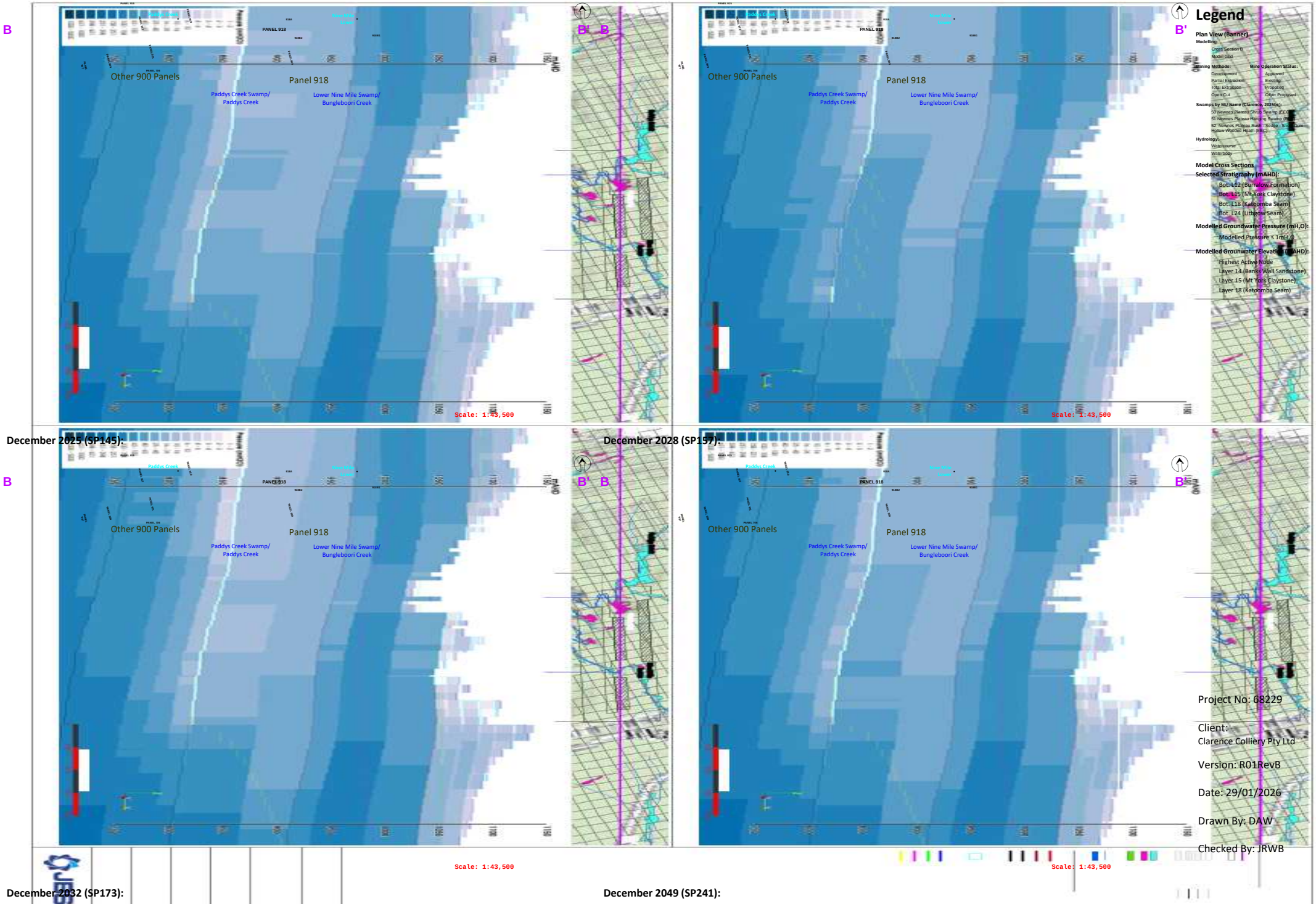
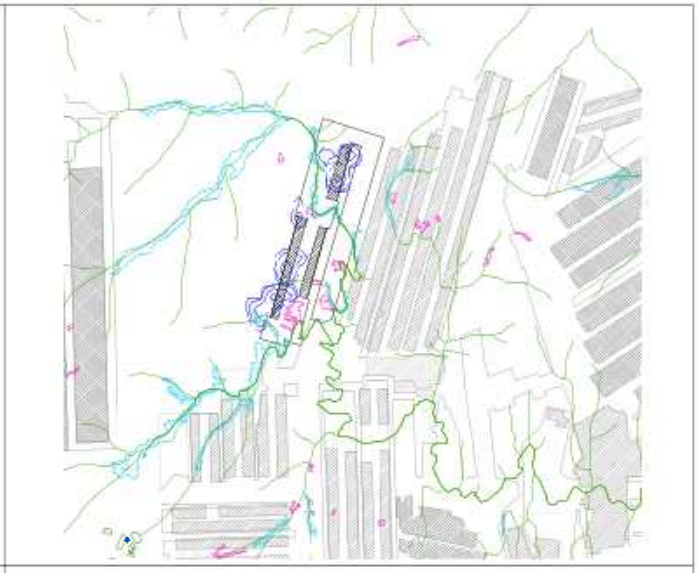
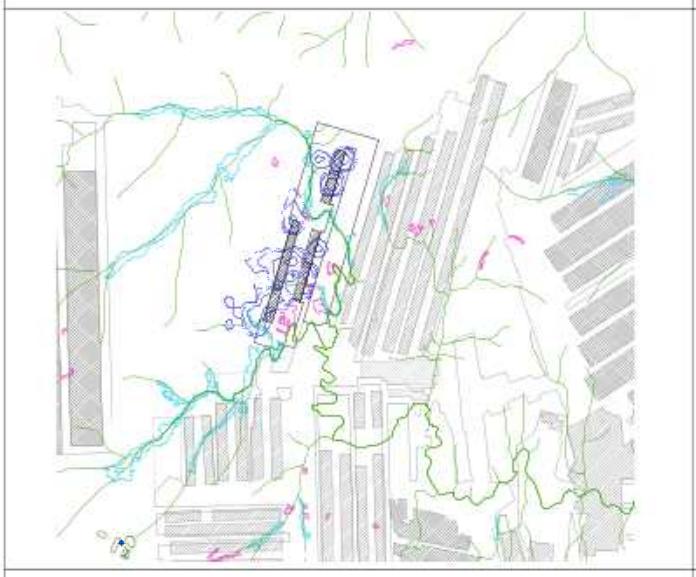


Figure 4.73b: Groundwater Pressure (mH_2O) Time-Series (Prediction Period - Proposed Case) - Cross-Section B-B'

December 2025 (SP145)



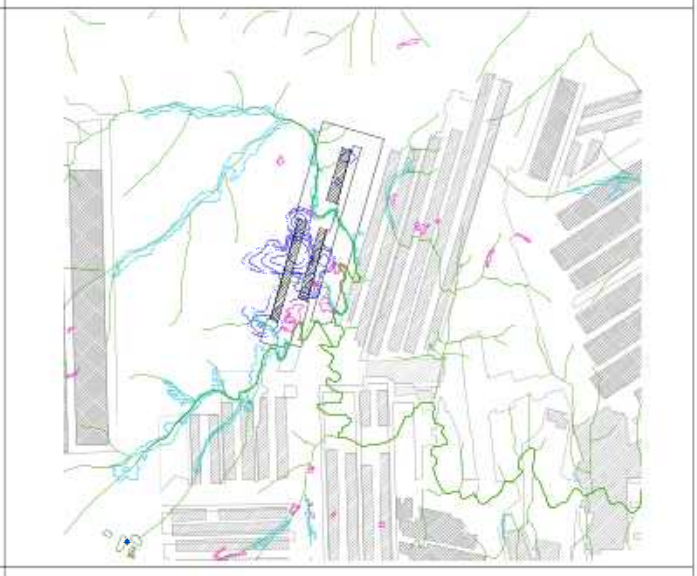
December 2027 (SP153)



December 2028 (SP157)

December 2029 (SP160)

December 2032 (SP173) Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241) Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Hydrology:
- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- Watercourse
- Waterbody

Groundwater Works:
- Groundwater Work (industrial, irrigation and stock and domestic)
- Water Access Licence

Model Results:
- Modelled Change in Groundwater Elevation (m)

Contour Intervals: -0.1m, -0.2m, -0.5m, -1m, -2m, -5m, -10m, -20m, -50m, -100m (as relevant)

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevD | Date: 12/02/2026

Drawn By: DAW | Checked By: JRWB

Change in Groundwater Elevation (m) - Prediction Period

Proposed Case minus Approved Case

Highest Active Node (10th Percentile)

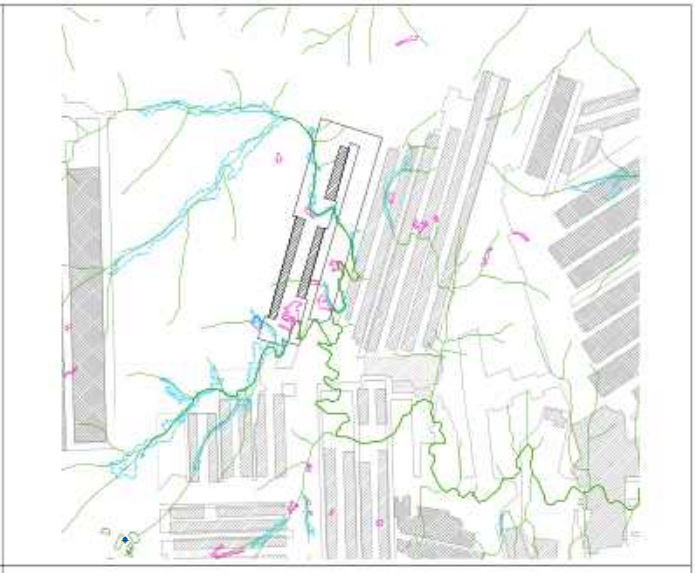
Figure 4.74a-1

JBS&G

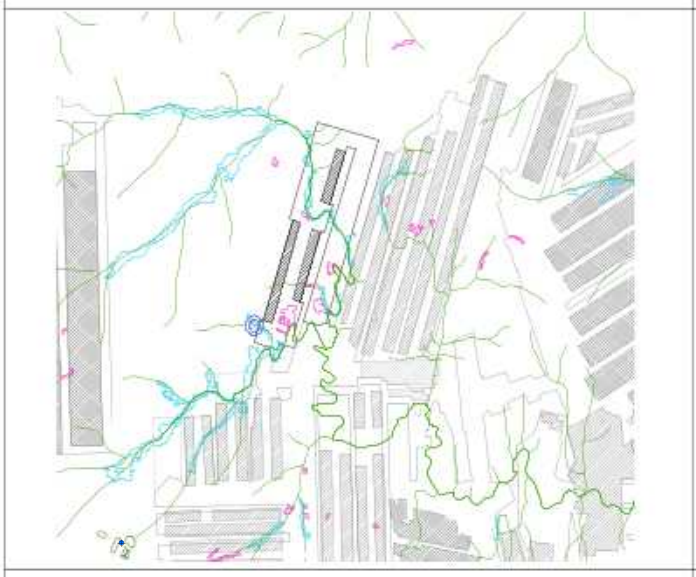
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevD_D015_DDN_10TH\68229_R01RevD_D015a_DDN_10TH_UWT\68229_R01RevD_D015a_DDN_10TH_UWT.grf

Reference: 68229_R01RevA_APR_03c_23UnReCalNSMC, 68229_R01RevA_PRO_02a_23UnReCalNSMC.

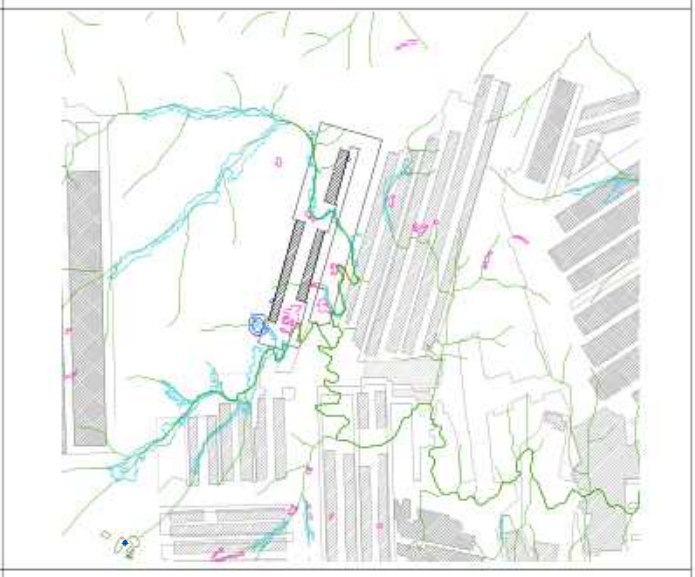
December 2025 (SP145)



December 2027 (SP153)

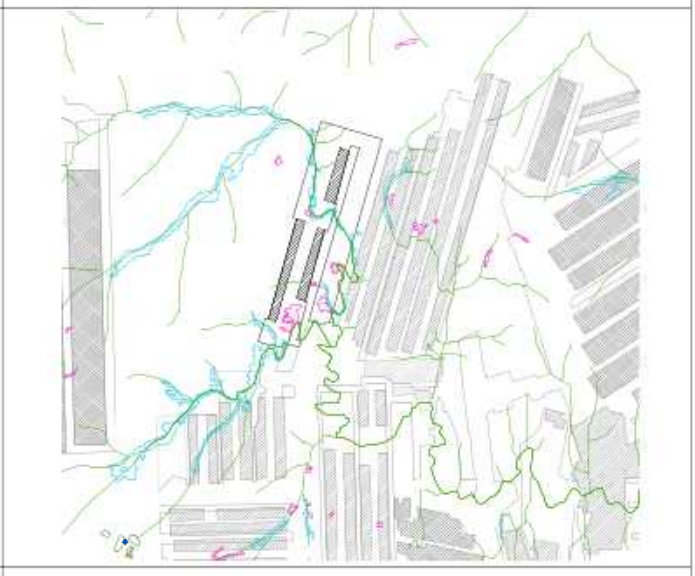


December 2028 (SP157)



December 2029 (SP160)

December 2032 (SP173) Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241) Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Hydrology:
- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- Watercourse
- Waterbody

Groundwater Works:
- Groundwater Work (industrial, irrigation and stock and domestic)
- Water Access Licence

Model Results:
- Modelled Change in Groundwater Elevation (m)

Contour Intervals: -0.1m, -0.2m, -0.5m, -1m, -2m, -5m, -10m, -20m, -50m, -100m (as relevant)

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevD | Date: 12/02/2026

Drawn By: DAW | Checked By: JRWB

Change in Groundwater Elevation (m) - Prediction Period

Proposed Case minus Approved Case

Highest Active Node (90th Percentile)

Figure 4.74a-2

JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevD_D016_DDN_90TH\68229_R01RevD_D016a_DDN_90TH_UWT\68229_R01RevD_D016a_DDN_90TH_UWT.grf

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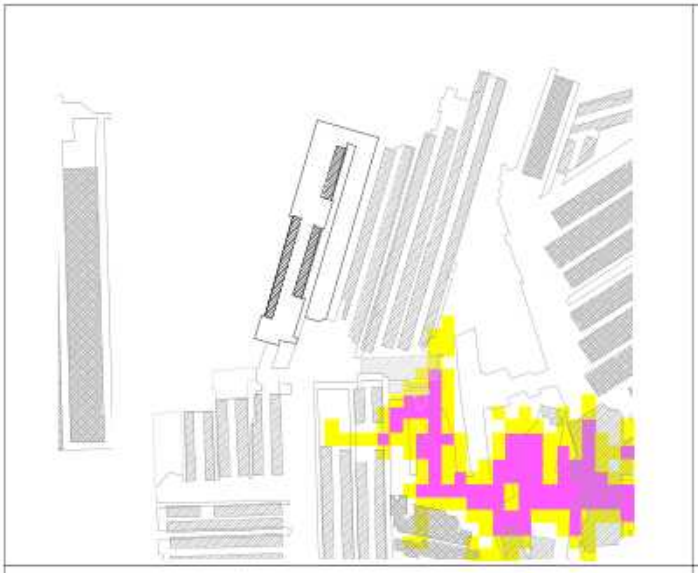

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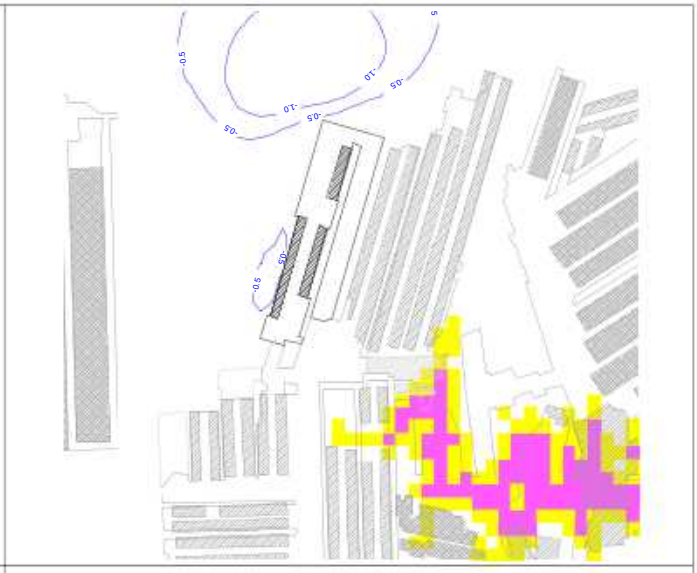

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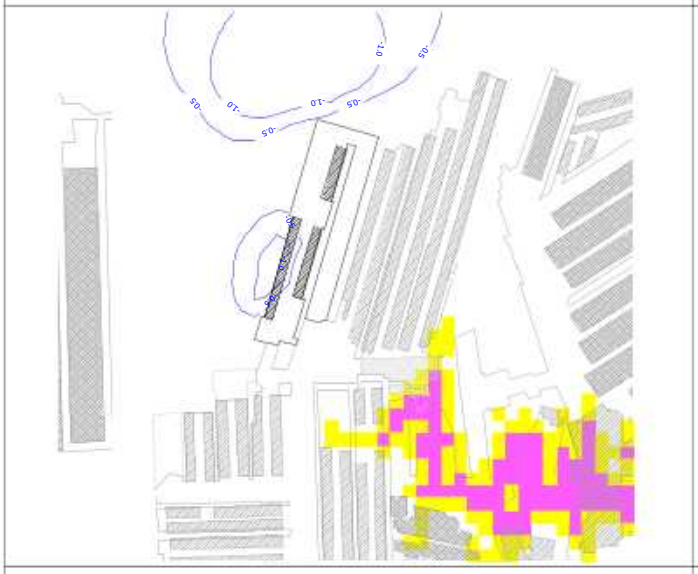

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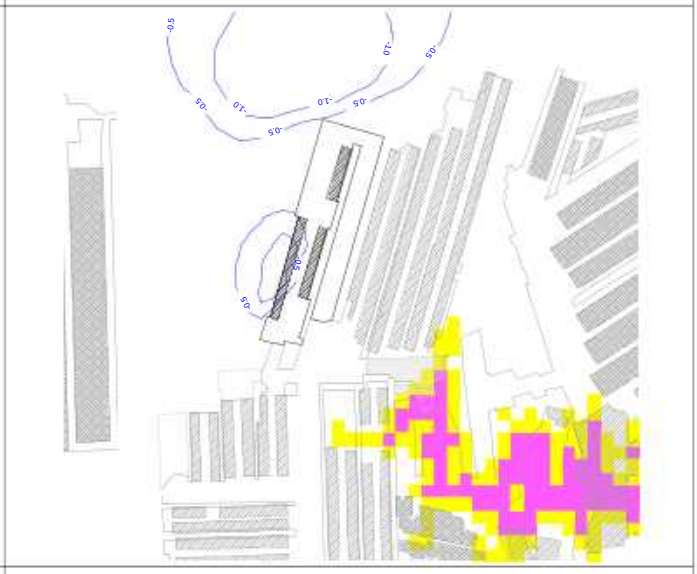

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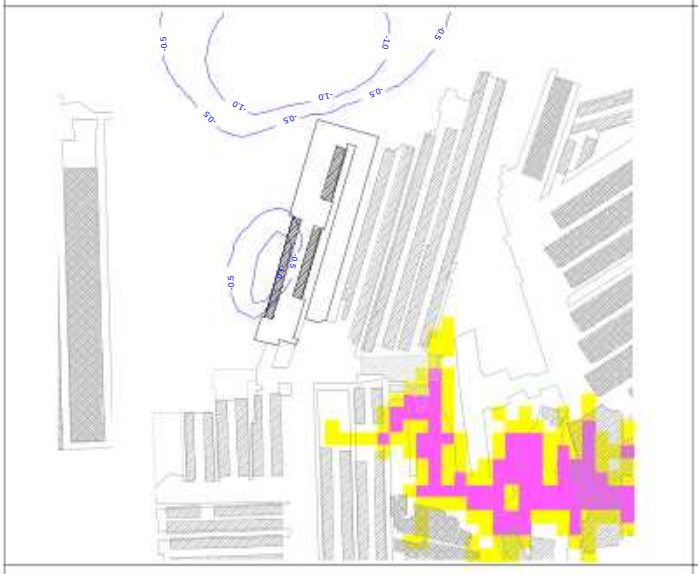
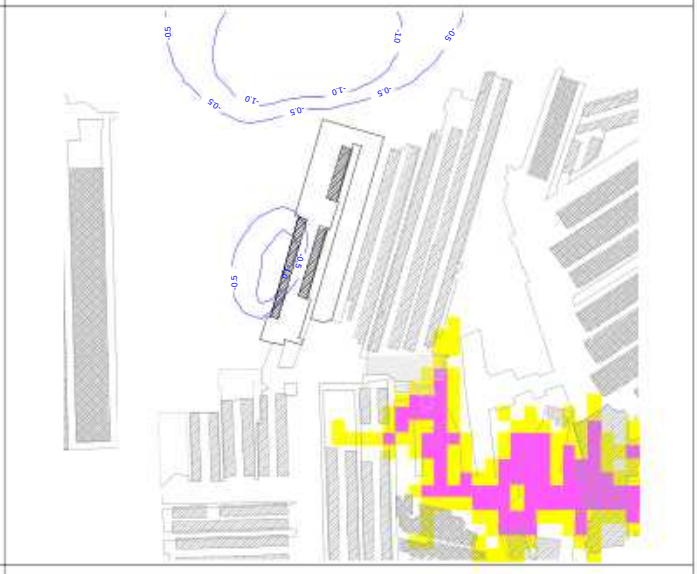


December 2032 (SP173) Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241) Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Intervals: -0.5m, -1m, -2m, -5m, -10m, -20m, -50m, -100m (as relevant)

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Change in Groundwater Elevation (m)

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA | Date: 31/10/2025

Drawn By: DAW | Checked By: JRWB

Change in Groundwater Elevation (m) - Prediction Period
Proposed Case minus Approved Case

Mount York Claystone
(Layer 15) (10th Percentile)

Figure 4.74b-1

JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D015_DDN_10TH\68229_R01RevA_D015b_DDN_10TH_L15\68229_R01RevA_D015b_DDN_10TH_L15.grf

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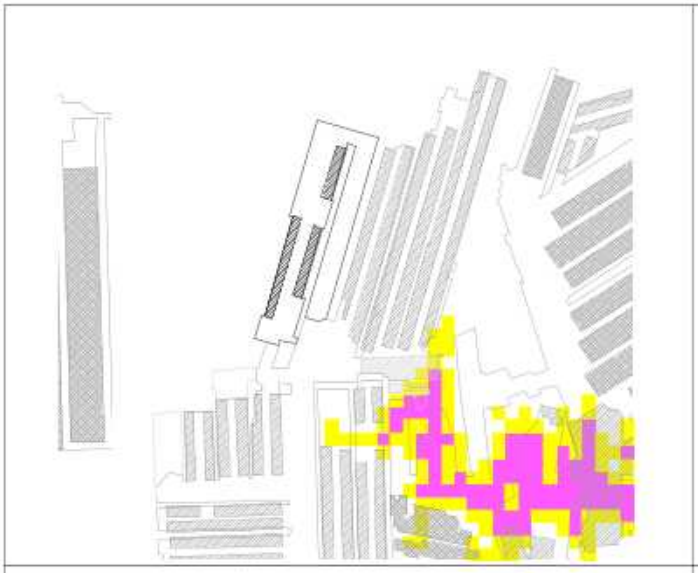
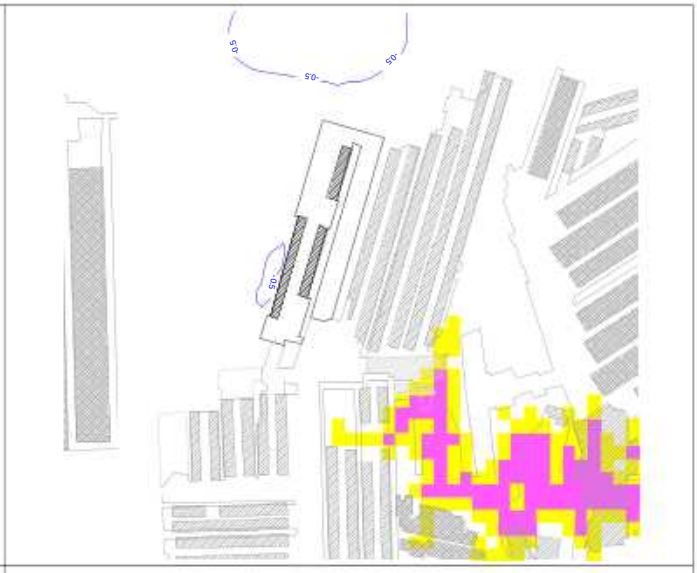


December 2025 (SP145)



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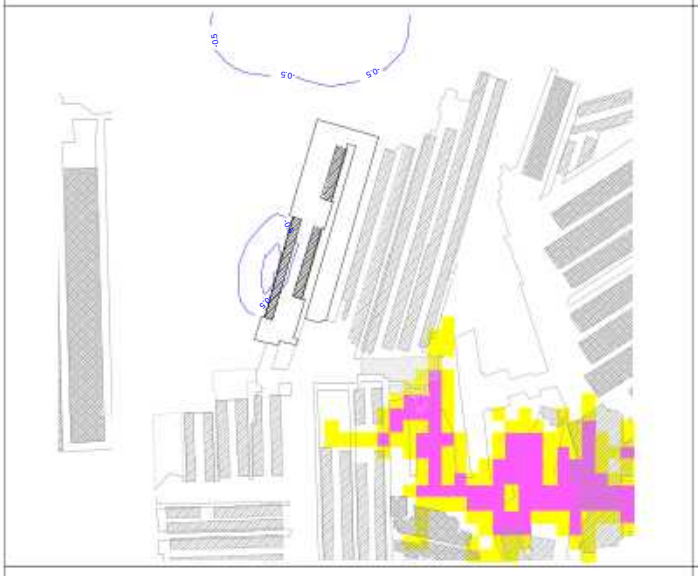

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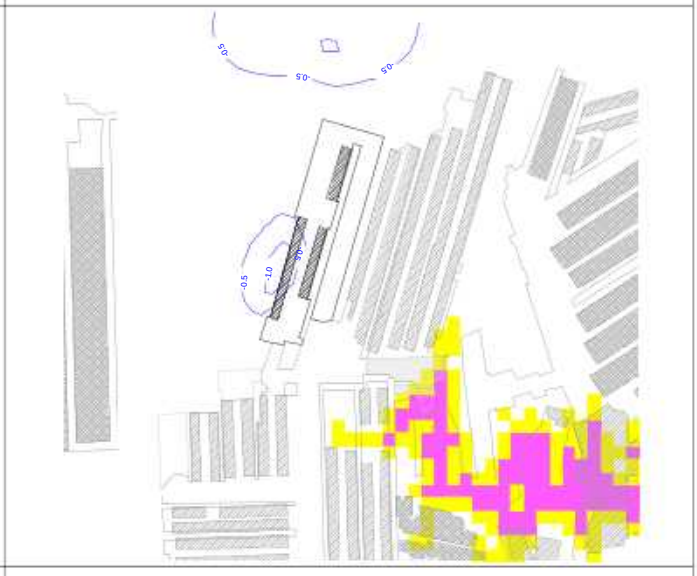
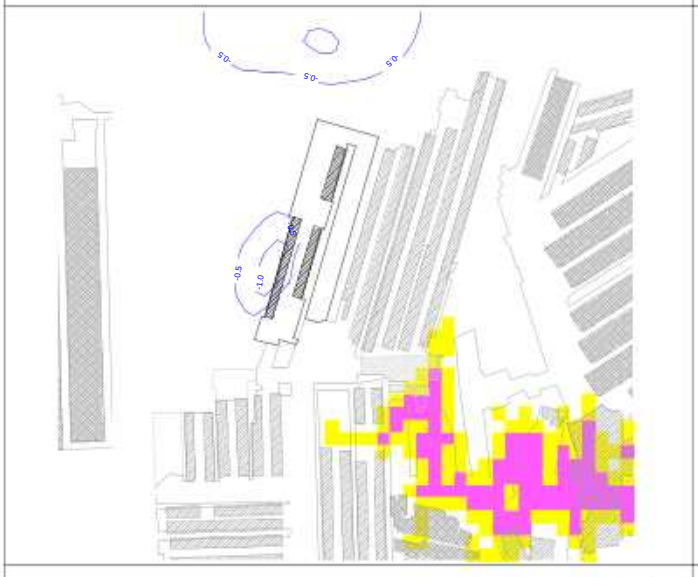
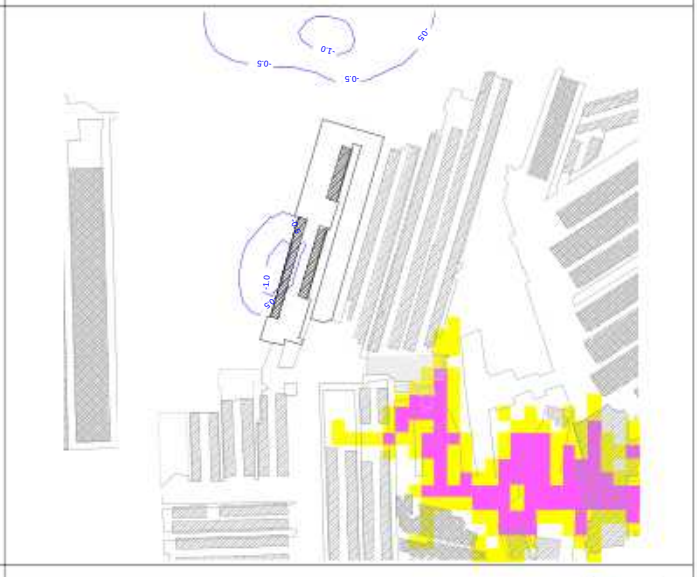


December 2029 (SP160)



December 2032 (SP173)

Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241)

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Intervals: -0.5m, -1m, -2m, -5m, -10m, -20m, -50m, -100m (as relevant)

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Change in Groundwater Elevation (m)

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA | Date: 31/10/2025

Drawn By: DAW | Checked By: JRWB

Change in Groundwater Elevation (m) - Prediction Period
Proposed Case minus Approved Case

Mount York Claystone
(Layer 15) (90th Percentile)

Figure 4.74b-2

JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D016_DDN_90TH\68229_R01RevA_D016b_DDN_90TH_L16\68229_R01RevA_D016b_DDN_90TH_L15.grf

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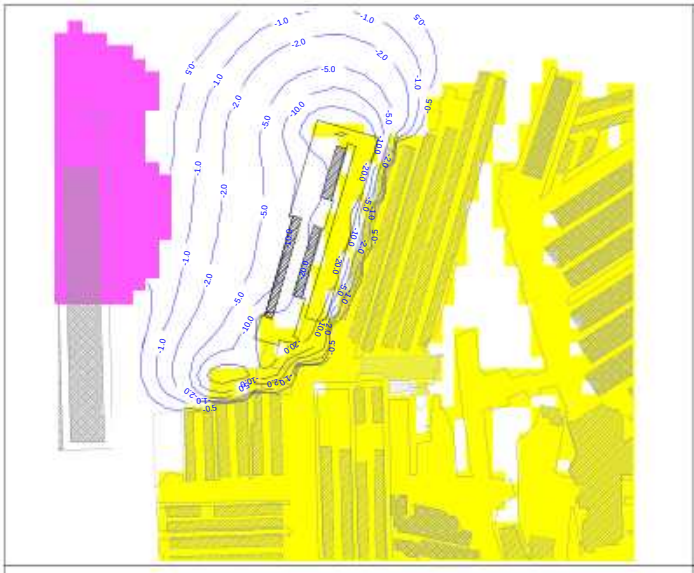
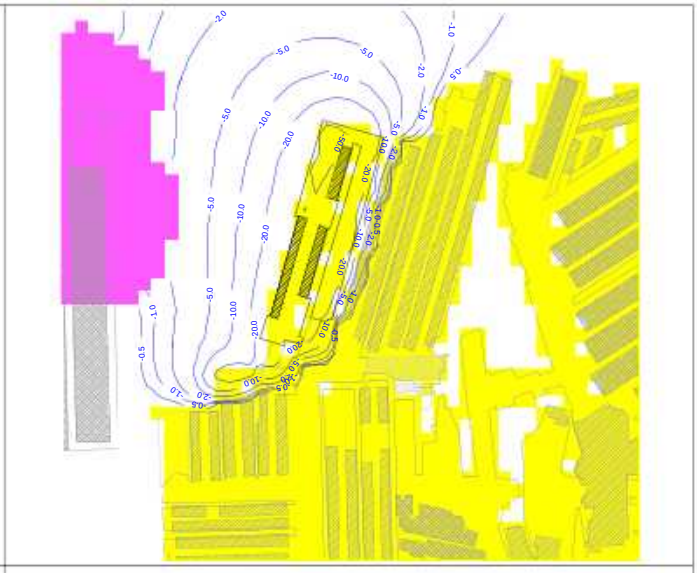


December 2025 (SP145)



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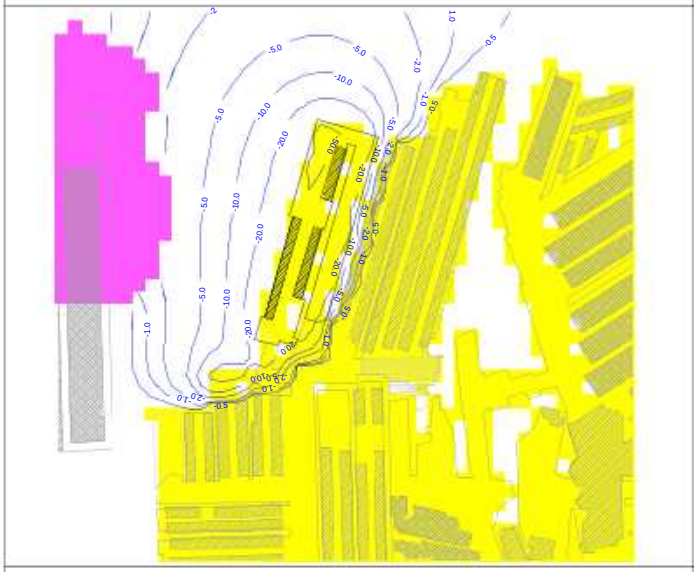

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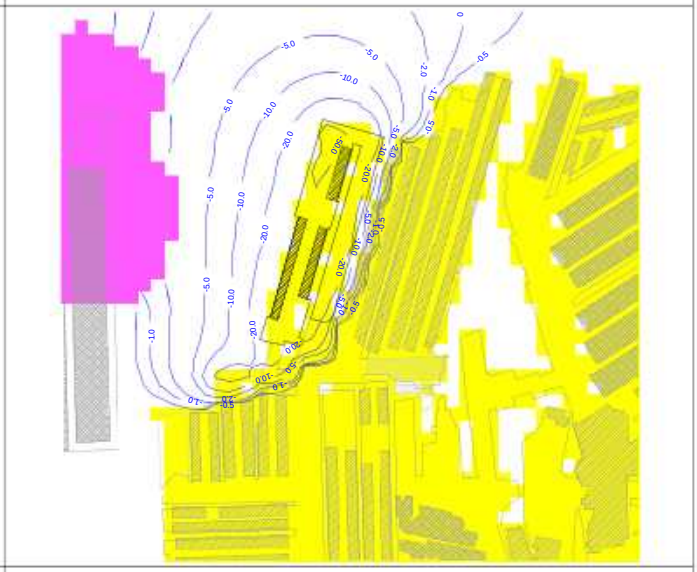
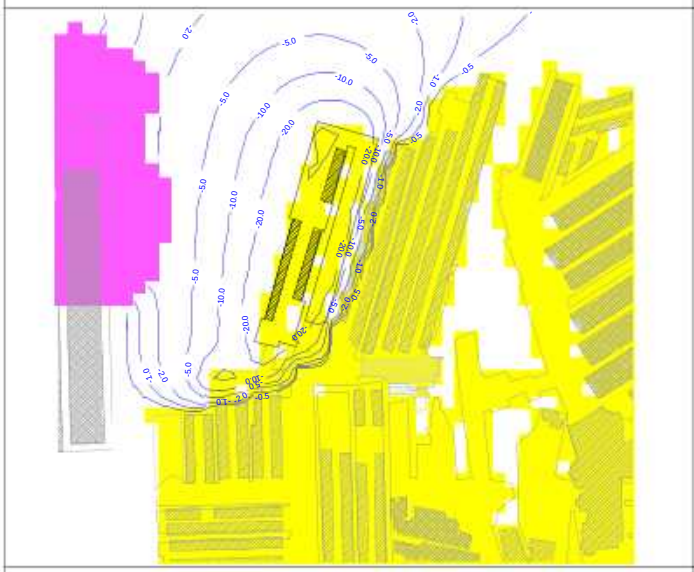
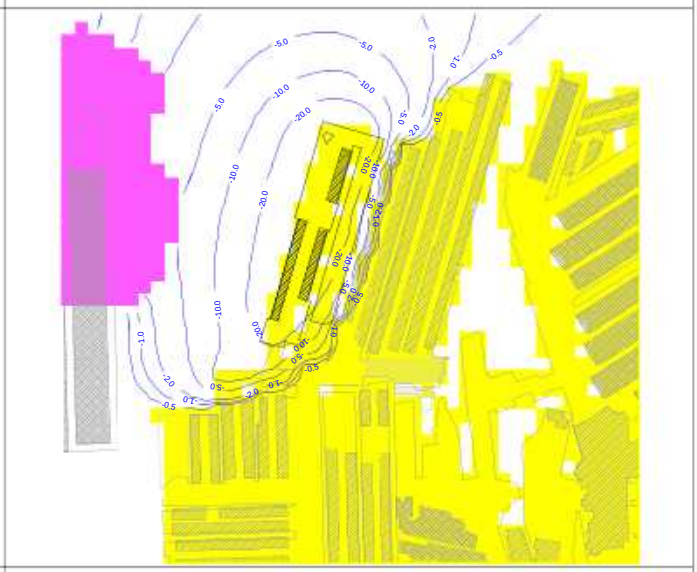


December 2029 (SP160)



December 2032 (SP173)

Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241)

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Intervals: -0.5m, -1m, -2m, -5m, -10m, -20m, -50m, -100m (as relevant)

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Change in Groundwater Elevation (m)

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA | Date: 31/10/2025

Drawn By: DAW | Checked By: JRWB

Change in Groundwater Elevation (m) - Prediction Period

Proposed Case minus Approved Case

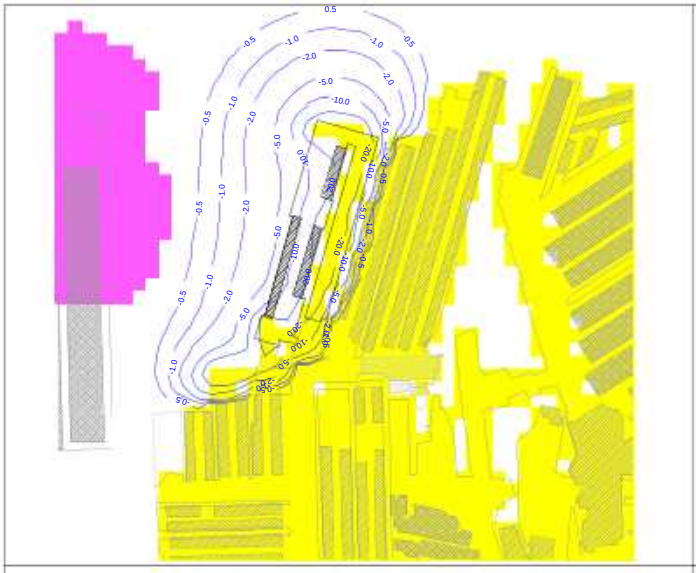
Katoomba Seam
(Layer 18) (10th Percentile)

Figure 4.74c-1

JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D015_DDN_10TH\68229_R01RevA_D015c_DDN_10TH_L18\68229_R01RevA_D015c_DDN_10TH_L18.grf

Reference: 68229_R01RevA_APR_03c_23UnReCalNSMC, 68229_R01RevA_PRO_02a_23UnReCalNSMC.



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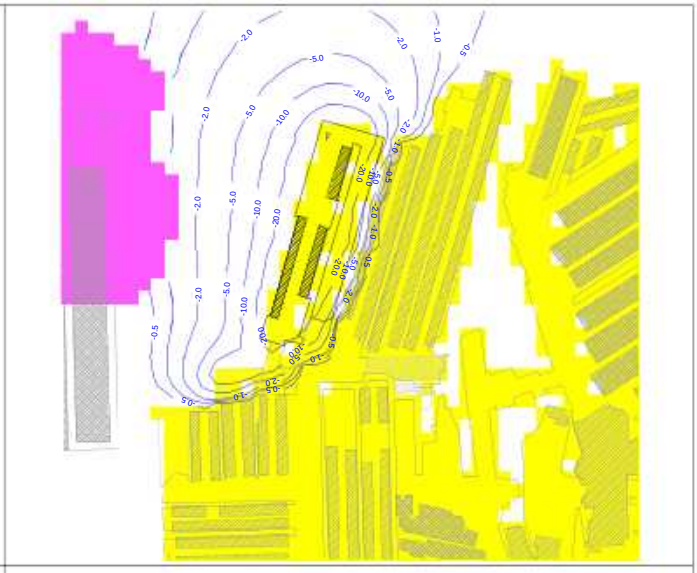

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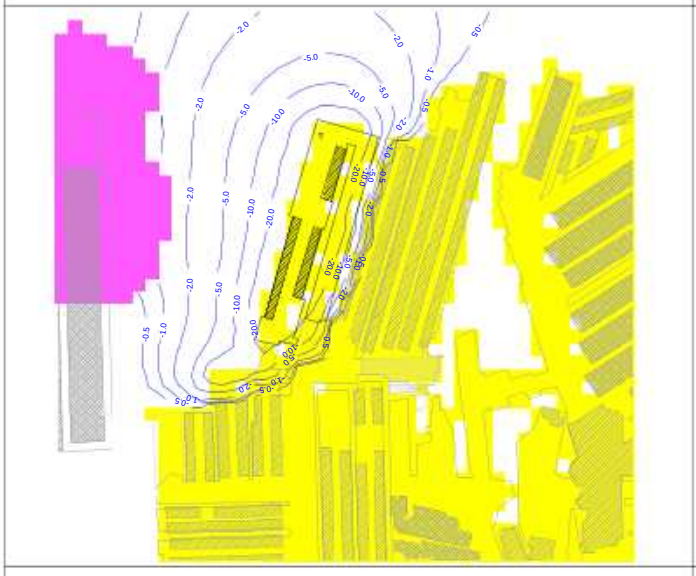
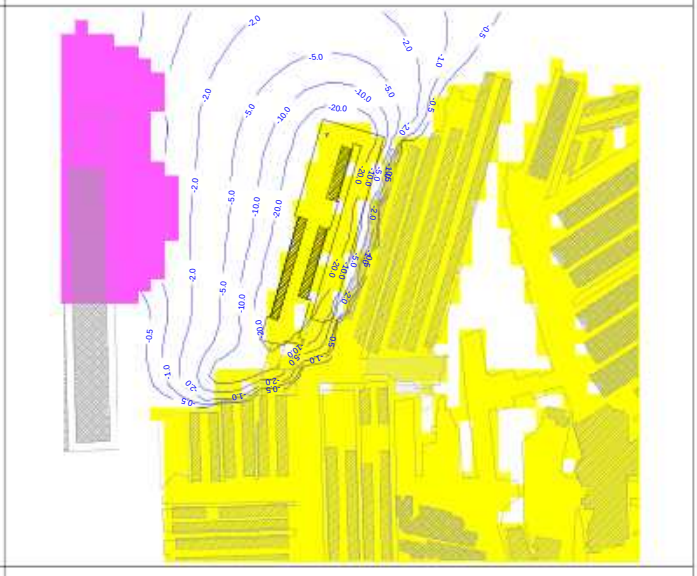
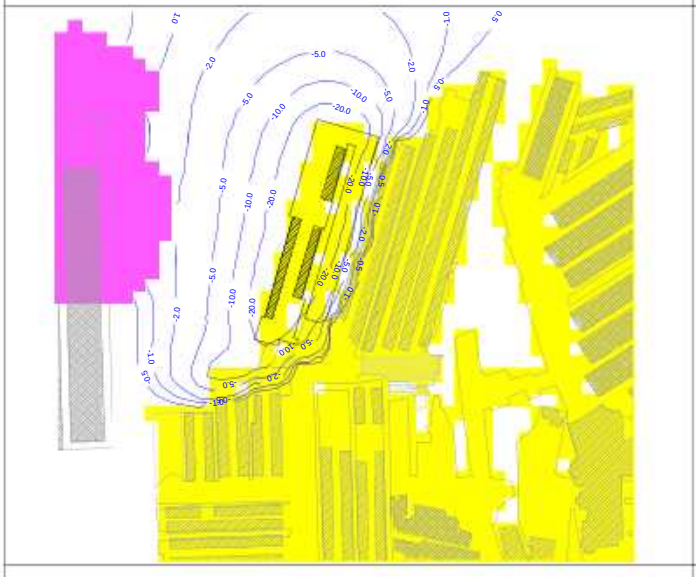


December 2028 (SP157)

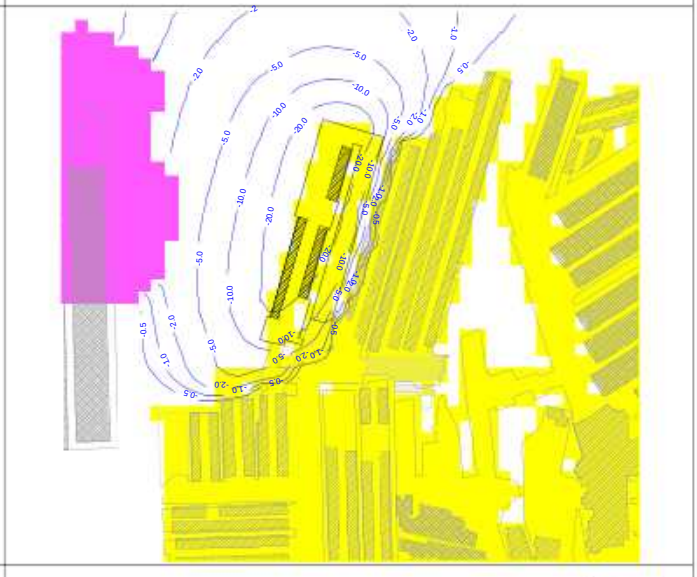


December 2029 (SP160)



December 2032 (SP173)

Scale 1:58,080 @A4: 0 250 500m



December 2049 (SP241)

Scale 1:58,080 @A4: 0 250 500m

Legend

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Contour Intervals: -0.5m, -1m, -2m, -5m, -10m, -20m, -50m, -100m (as relevant)

Model Cell Type:
- Pinched-Out Cells

Model Boundary Conditions:
- Drain (DRN) Cells

Model Results:
- Modelled Change in Groundwater Elevation (m)

Job No.: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA | Date: 31/10/2025

Drawn By: DAW | Checked By: JRWB

Change in Groundwater Elevation (m) - Prediction Period
Proposed Case minus Approved Case

Katoomba Seam
(Layer 18) (90th Percentile)

Figure 4.74c-2

JBS&G

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D016_DDN_90TH\68229_R01RevA_D016c_DDN_90TH_L18\68229_R01RevA_D016c_DDN_90TH_L18.grf

Reference: 68229_R01RevA_APR_03c_23UnReCalNSMC, 68229_R01RevA_PRO_02a_23UnReCalNSMC.

4.15.5.8 Groundwater Hydrographs and Depth Versus Pressure

Groundwater (interpolated and multilevel) hydrographs and depth-versus-groundwater pressure diagrams were extracted in the vicinity of 918 Panel. Depth-versus-groundwater pressure diagrams are presented for the deterministic (Simulation0) model output.

Groundwater hydrographs for deterministic (Simulation0) is presented in **Appendix J** for the purpose of completeness.

Output is presented at the following locations:

- CLRP40, CLRP27_V, CLRP42R and CLRP41A (**Figure 4-75**)
- CLRP29_V, CLRP28, CLRP18_V and CLRP22_V (**Figure 4-76**)
- GW099052, GW09905, GW099054, CSP9, CLRP31 and CSP8 (**Figure 4-77**)
- CSP1, PG1, CSP2 and PG2 (**Figure 4-78**)
- CSP6, CSP34, PSE1 and PSE2 (**Figure 4-79**)
- CSP36, L01Node 16613, CSP4 and CSP35 (**Figure 4-80**).

As per the approach for groundwater hydrographs presenting calibrations results and sensitivity analysis results, three-dimensional interpolation of model output was undertaken, as relevant.

As described in **Section 4.15.5.1**, the 10th percentile ranked (R10) groundwater elevation and 90th percentile ranked (R90) groundwater elevation are shown in through to **Figure 4-75**, with the 10th percentile ranked (R10) ranked difference to groundwater elevation and 90th percentile ranked (R90) ranked difference to groundwater elevation also presented. Modelled output is presented for the Approved Case and Proposed Case.

As outlined in **Section 4.12.4.4**, displayed above the groundwater elevation (interpolated and multilevel) hydrographs is the cumulative rainfall departure from mean (CRD), in millimetres (mm), for each model output location. The modelled recharge, in millimetres per day (mm/day) for each stress period, was ranked into the 10th percentile (R10) and 90th percentile (R90) for each model output location for both the Approved and Proposed Case.

CLRP40, CLRP27_V, CLRP42R and CLRP41A

From **Figure 4-75a**, modelled output along the standpipe piezometers, CLRP40 and CLRP42R, shows there will be a negligible (change is less than 2m) decline in groundwater elevation in the Banks Wall Sandstone (Layer 13). From **Figure 4-75a**, modelled output along the standpipe piezometer, CLRP41A, shows there will be a negligible decline in groundwater elevation in the Burralow Formation (Layer 10). Comparison of modelled output for CLRP41A compared to CLRP40 and CLRP42R, indicates there is a wider range of uncertainty in CLRP41A. This will be due to uncertainty in hydraulic properties and subsidence-induced change to hydraulic properties due to extraction beneath CLRP41A. A particular factor that has greater uncertainty at CLRP41A compared to CLRP40 and CLRP42R, is the enhanced recharge, displayed above the groundwater elevation hydrographs.

From **Figure 4-75a**, modelled output along the vibrating wire piezometer, CLRP27_V, shows there will be a negligible (change is less than 2m) increase in groundwater elevation in the Banks Wall Sandstone (Layer 13 and 14) and the Burra-Moko Head Sandstone (Layer 16). In the Caley Formation (Layer 17), modelled output shows a medium (change is 10 to 25m) decline in groundwater elevation. From **Figure 4-75a**, at CLRP27_V, as expected, there is a wider range in uncertainty in the change to groundwater elevation at depth that decreases with increasing elevation towards ground surface.

From **Figure 4-75b**, at CLRP40, there are medium (change is 10 to 25m) declines to groundwater elevation that occur in the Katoomba Seam (Layer 18) and above in the Caley Formation (Layer 17), due to nearby extraction in the 918 Panel. Above the Caley Formation (Layer 17), through the vertical profile, declines in groundwater

elevation are negligible (change is less than 2m). From **Figure 4-75b**, at CLRP42R, there are medium (change is 10 to 25m) declines to groundwater elevation that occur in the Katoomba Seam (Layer 18) and small (change is 2 to 10m) declines to groundwater elevation in the Caley Formation (Layer 17), due to nearby extraction in the 918 Panel. Above the Caley Formation (Layer 17), through the vertical profile, declines in groundwater elevation are negligible (change is less than 2m). From **Figure 4-75b**, at CLRP27_V and CLRP41A, there are large (change is greater than 25m) declines in groundwater elevation in the Katoomba Seam (Layer 18), due to the location within 918 Panel. The changes to groundwater elevation diminish with increasing elevation through the vertical profile, to be negligible (change is less than 2m) changes near ground surface.

From **Figure 4-75c** and **Figure 4-75d**, at CLRP40, CLRP 27_V, CLRP42R and CLRP41A, depressurisation occurs in the Katoomba Seam (Layer 18) in the Proposed Case compared to the Approved Case. For CLRP27_V and CLRP41A, the Katoomba Seam (Layer 18) becomes completely depressurised by December 2027 (SP153), due to extraction in 918 Panel. For CLRP41A, the decrease in groundwater pressure propagates vertically upwards throughout the entire profile due to mining (subsidence), although is an insignificant change within the Burralow Formation (Layer 1 to Layer 12).

CLRP29_V, CLRP28, CLRP18_V and CLRP22_V

From **Figure 4-76a** and **Figure 4-76b**, modelled output at the vibrating wire piezometer CLRP29_V and CLRP22_V, and standpipe piezometer, CLRP28, shows there will be a negligible (change is less than 2m) decline in groundwater elevation throughout the entire vertical profile.

From **Figure 4-76a**, modelled output at the vibrating wire piezometer, CLRP18_V, shows there will be a negligible (change is less than 2m) decline in groundwater elevation in the Burralow Formation (Layer 11). From **Figure 4-76b**, modelled output at CLRP18_V, indicates there will be negligible decline in groundwater elevation from ground surface to the Caley Formation (Layer 17) and a medium (change is 2 to 5m) decline in groundwater elevation in the Katoomba Seam (Layer 18).

From **Figure 4-76c** and **Figure 4-76d**, at CLRP29_V, CLRP28 and CLRP18_V, there is a minor decrease in groundwater pressure within Katoomba Seam (Layer 18) that propagates vertically upwards to the Burra-Moko Head Sandstone (Layer 16). From **Figure 4-76c** and **Figure 4-76d**, at CLRP22_V, there is no discernible change to groundwater pressure throughout the vertical profile. This is interpreted as being due to the location of CLRP22_V, within an area of existing extraction (910 Panel).

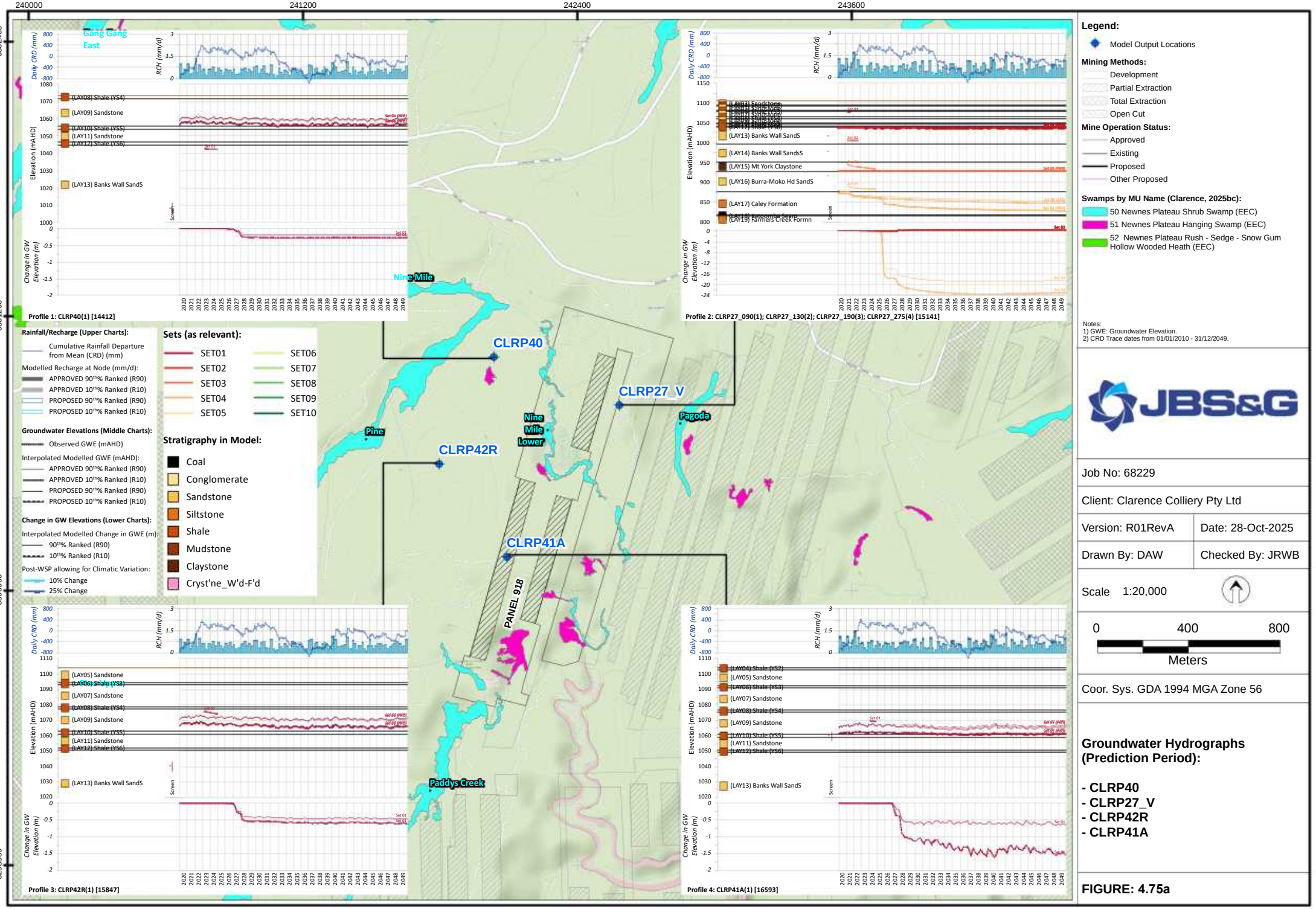
GW099052, GW09905, GW099054, CSP9, CLRP31 and CSP8

From **Figure 4-77a**, modelled output at the new NSW DCCEEW monitoring cluster, GW099052, GW09905 and GW099054, indicates there will be there will be a negligible (change is less than 2m) decline in groundwater elevation in the Banks Wall Sandstone (Layer 14), Mount York Claystone (Layer 15) and the Burra-Moko Head Sandstone (Layer 16). From **Figure 4-77b**, modelled output at the new NSW DCCEEW monitoring cluster, shows there will be a negligible (change is less than 2m) decline in groundwater elevation throughout the entire vertical profile.

From **Figure 4-77a** and **Figure 4-77b**, modelled output along the standpipe piezometer, CLRP31, shows there will be a negligible (change is less than 2m) decline in groundwater elevation throughout the entire vertical profile.

In **Figure 4-77a**, for swamp monitoring piezometers (CSP8 and CSP9), as per **Section 4.15.5.5**, the 10% change threshold is also presented as well as a 25% change threshold for the purpose of reference. From **Figure 4-77a**, modelled output at CSP8 and CSP9, indicates there is a negligible (change is less than 5%, with respect to groundwater dependent ecosystems) decline in elevation of the highest active node. From **Figure 4-77b**, modelled output at CSP8 and CSP9, indicates there is a negligible (change is less than 2m) decline in groundwater elevation throughout the entire vertical profile.

From **Figure 4-77c** and **Figure 4-77d**, at the new NSW DCCEEW monitoring cluster and CLRP31, there is a minor decrease in groundwater pressure within Katoomba Seam (Layer 18) that propagates vertically upwards to the



Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 28-Oct-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:20,000

Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Prediction Period):

- **CLRP40**
- **CLRP27_V**
- **CLRP42R**
- **CLRP41A**

FIGURE: 4.75a

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D009a_UA_Hydrographs_CLRP40_CLRP27_CLRP42R_CLRP41A.mxd

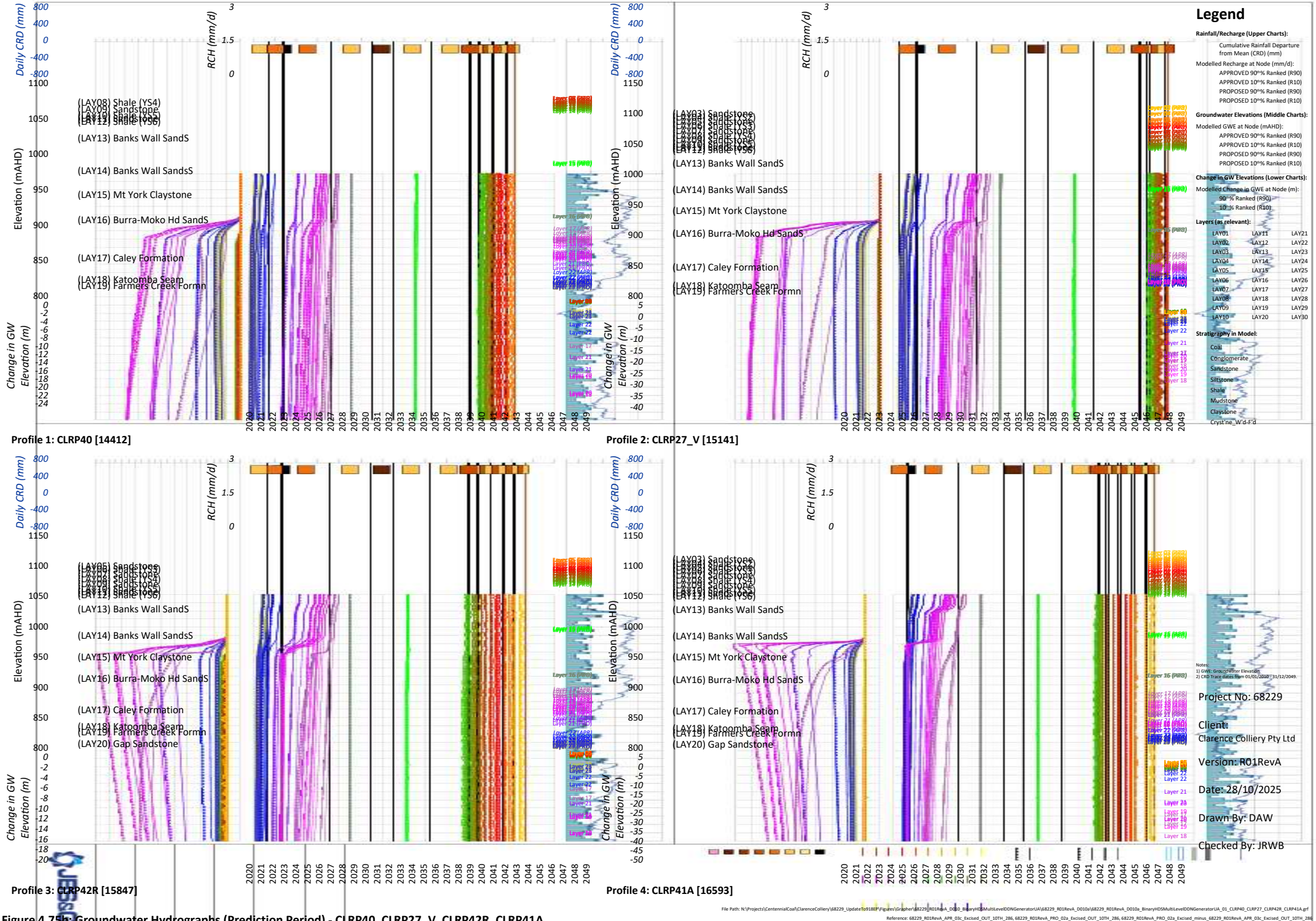
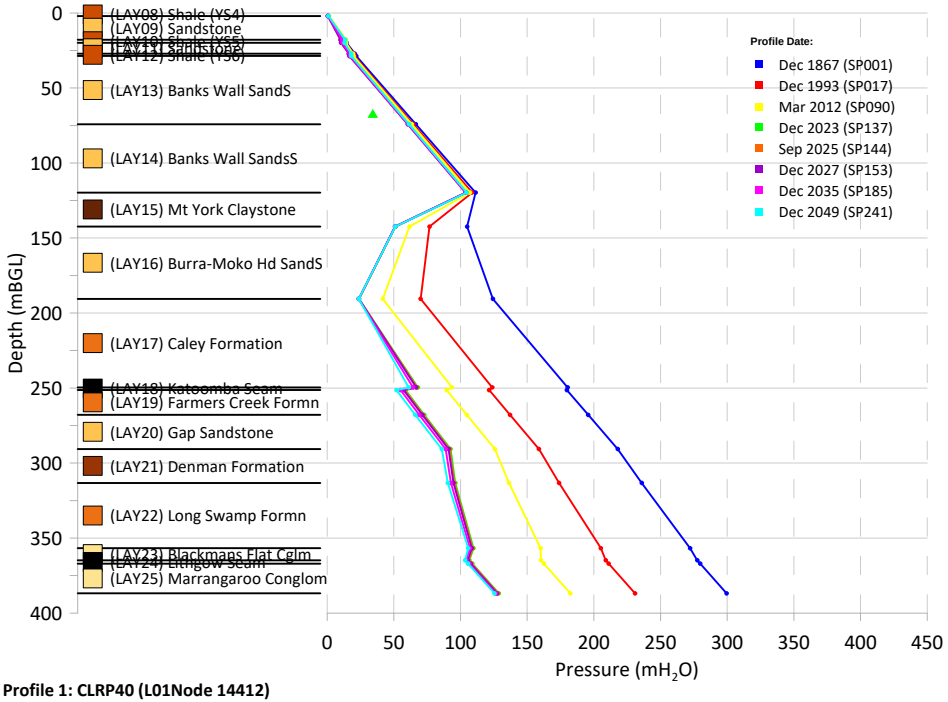
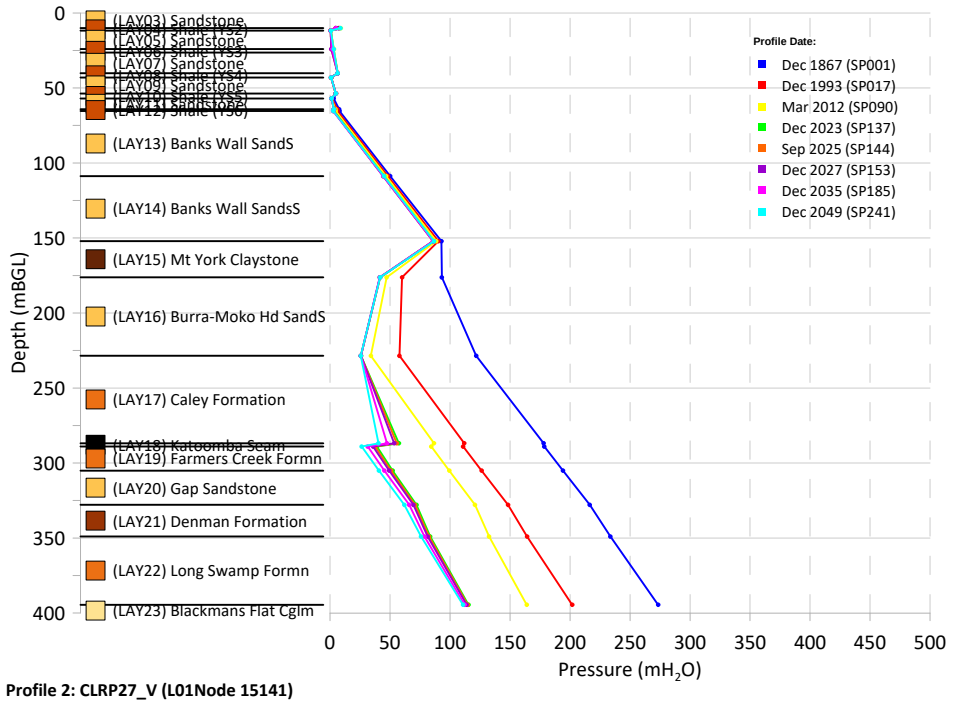


Figure 4.75b: Groundwater Hydrographs (Prediction Period) - CLRP40, CLRP27_V, CLRP42R, CLRP41A



Profile 1: CLRP40 (L01Node 14412)

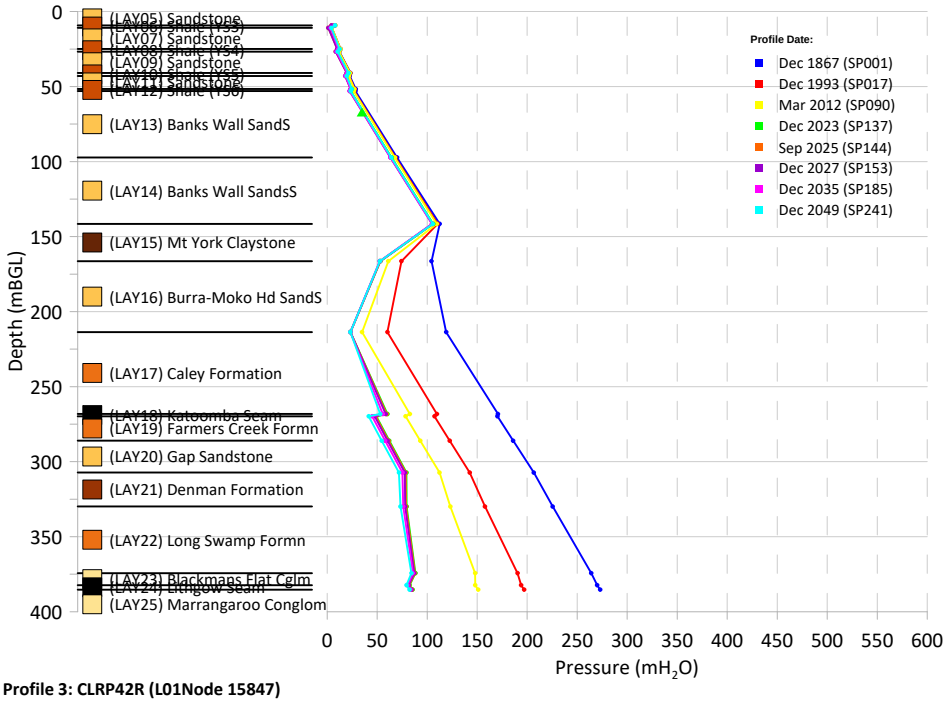


Profile 2: CLRP27_V (L01Node 15141)

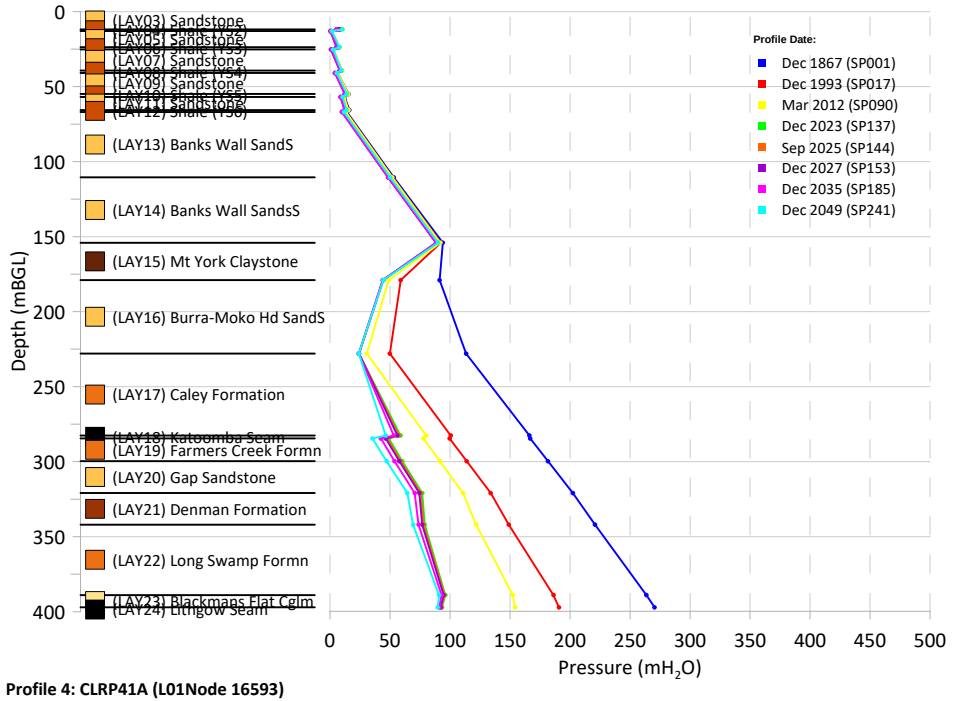
Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd



Profile 3: CLRP42R (L01Node 15847)



Profile 4: CLRP41A (L01Node 16593)

Notes:

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 23/10/2025	
Drawn By: DAW	
Checked By: JRWB	

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Figure 4.75c: Depth versus Groundwater Pressure Diagrams (Prediction Period - Approved Case) - CLRP40, CLRP27_V, CLRP42R, CLRP41A

Reference: 68229_R01RevA_APR_03c.

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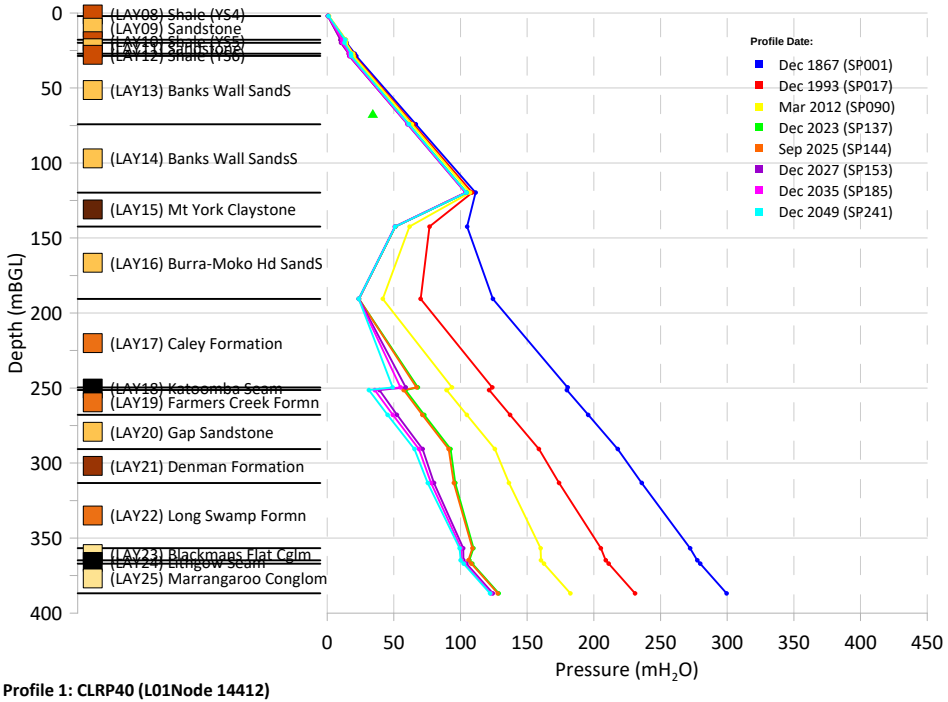
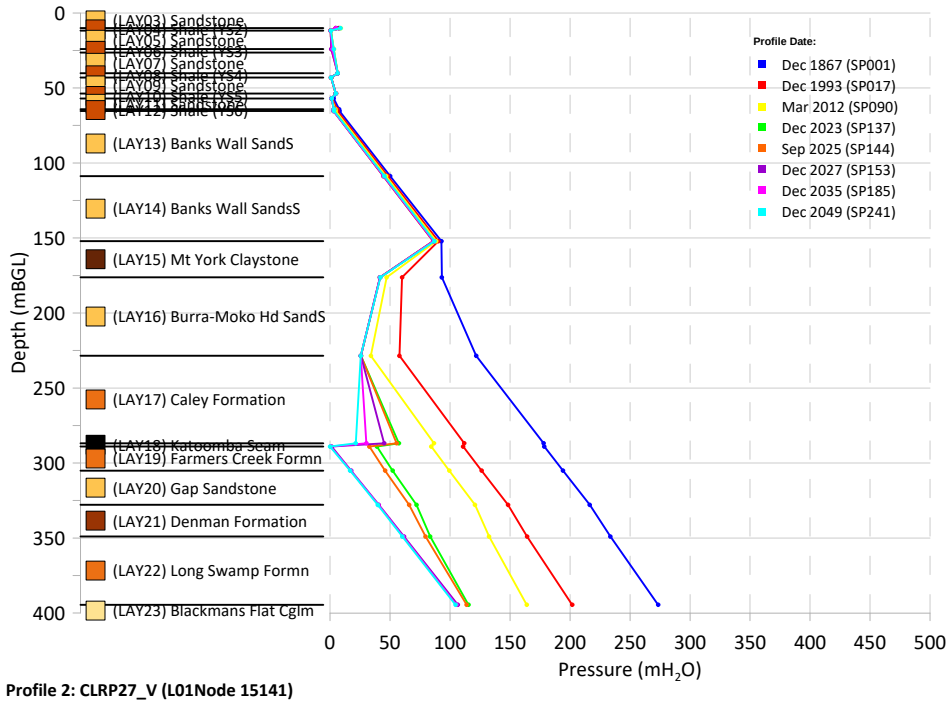
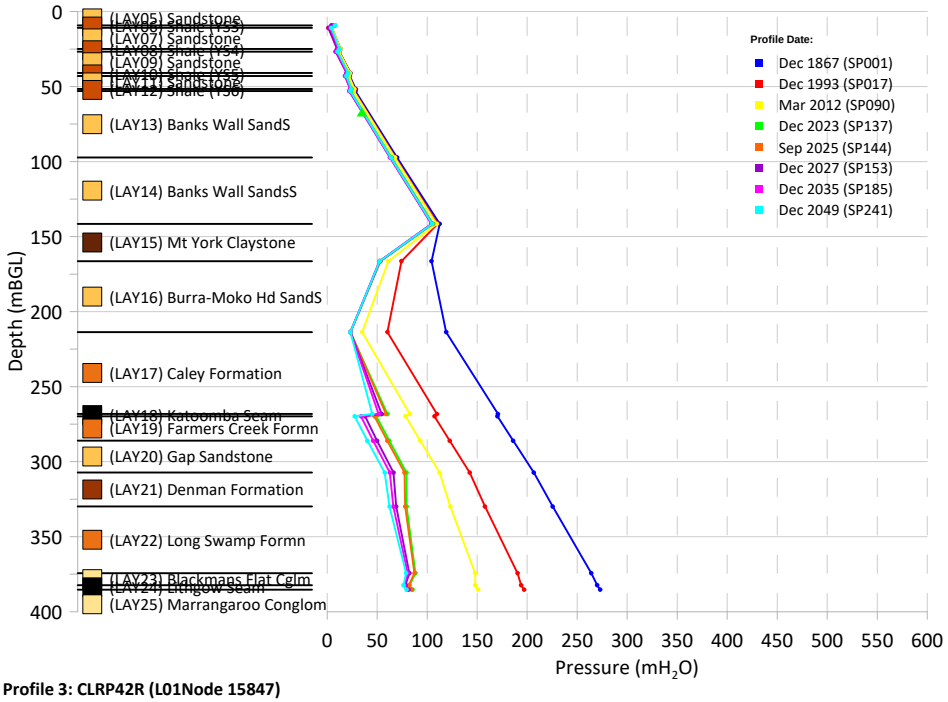


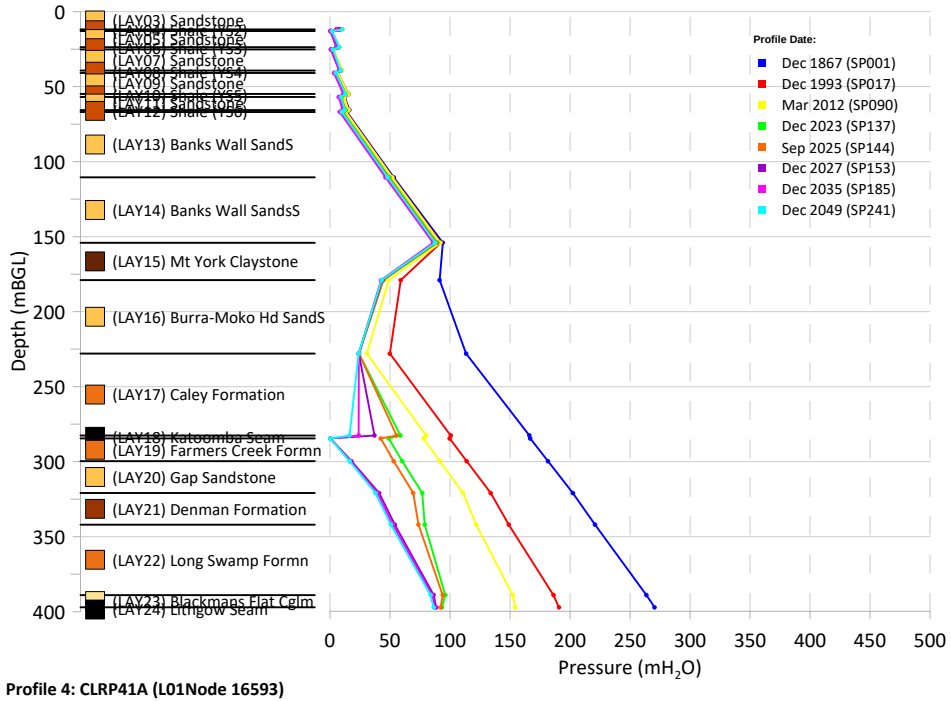
Profile 1: CLRP40 (L01Node 14412)



Profile 2: CLRP27_V (L01Node 15141)



Profile 3: CLRP42R (L01Node 15847)



Profile 4: CLRP41A (L01Node 16593)

Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:

Project No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA

Date: 23/10/2025

Drawn By: DAW

Checked By: JRWB

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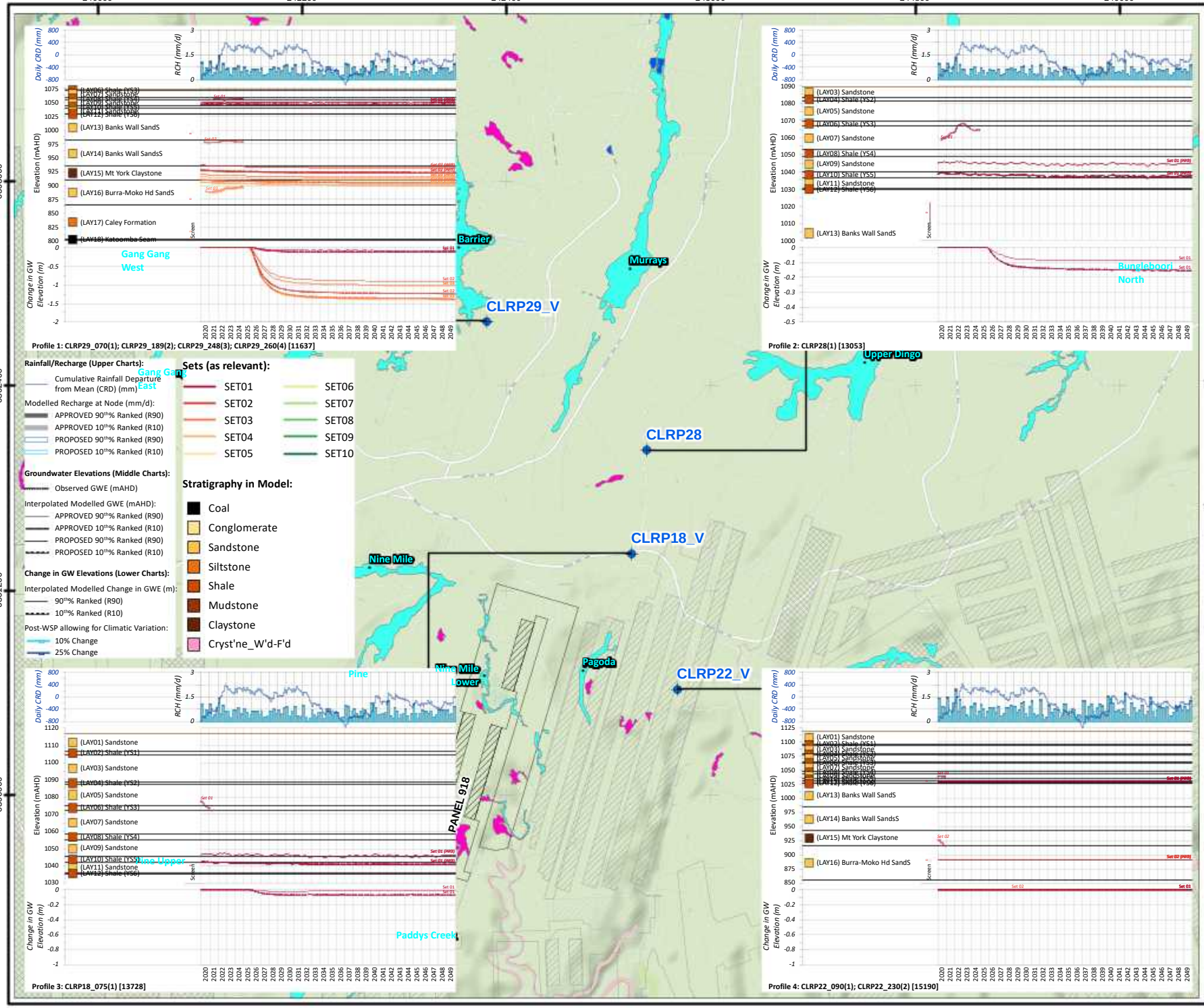
Figure 4.75d: Depth versus Groundwater Pressure Diagrams (Prediction Period - Proposed Case) - CLRP40, CLRP27_V, CLRP42R, CLRP41A

Reference: 68229_R01RevA_PRO_02a.

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Graphs\68229_R01RevA_D008_PressureVerticalProfile_PRO\68229_R01RevA_D008a\68229_R01RevA_D008a_VerticalProfileExtraction_Pressure_01_CLRP40_CLRP27_CLRP42R_CLRP41A.gpf



Legend:

- Model Output Locations

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):

- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Notes:
1) GWE: Groundwater Elevation.
2) CRD Trace dates from 01/01/2010 - 31/12/2049.

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Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 28-Oct-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:30,000

0 500 1,000
Meters

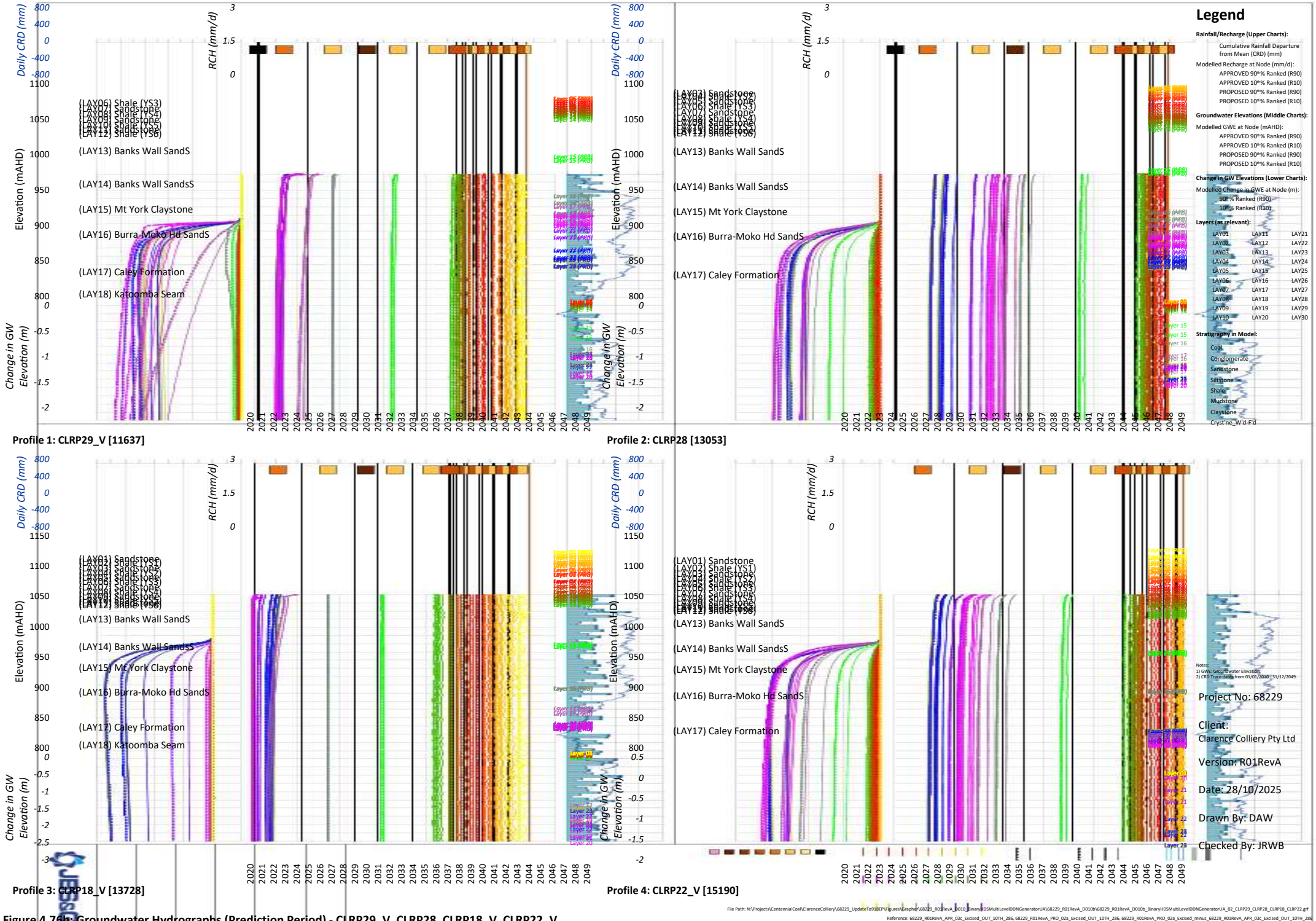
Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Prediction Period):

- CLRP29_V
- CLRP28
- CLRP18_V
- CLRP22_V

FIGURE: 4.76a

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D009b_UA_Hydrographs_CLRP29_CLRP28_CLRP18_CLRP22.mxd



Profile 1: CLRP29_V [11637]

Profile 2: CLRP28 [13053]

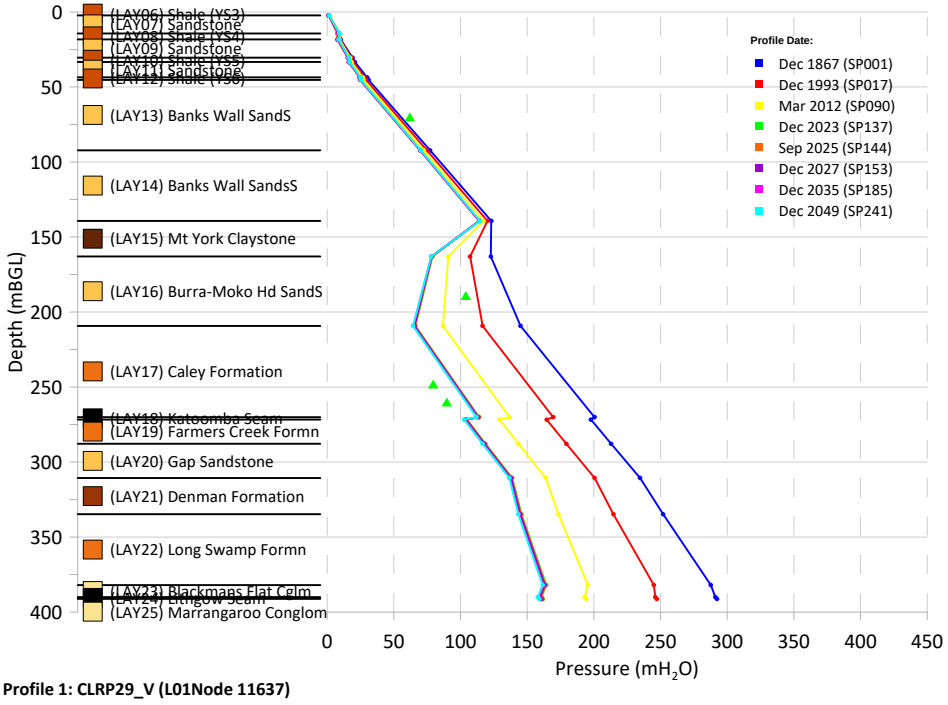
Profile 3: CLRP18_V [13728]

Profile 4: CLRP22_V [15190]

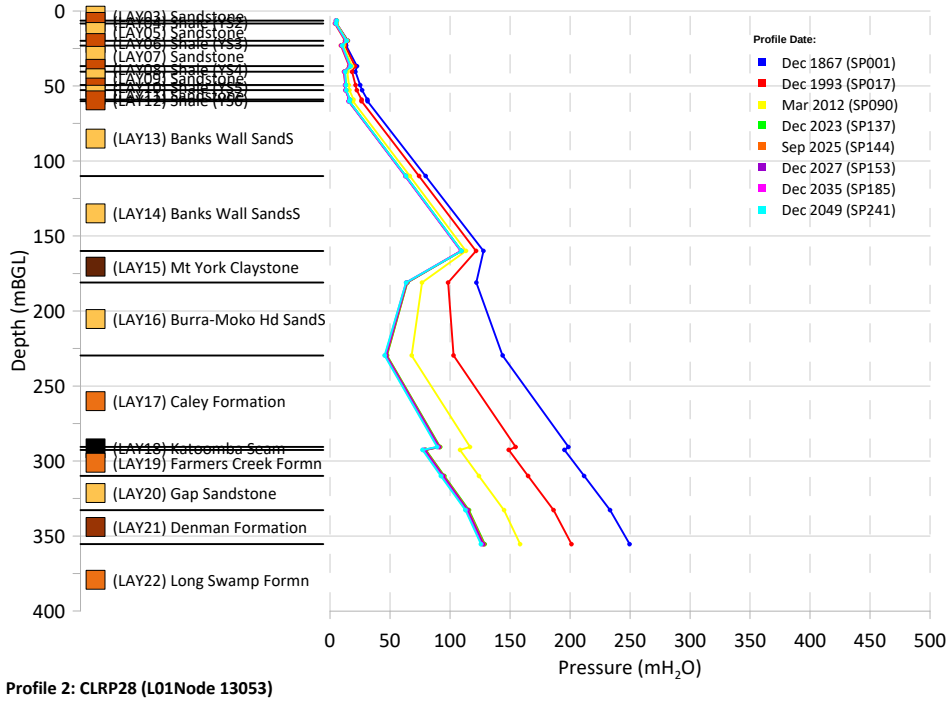
Figure 4.76b: Groundwater Hydrographs (Prediction Period) - CLRP29_V, CLRP28, CLRP18_V, CLRP22_V

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D010.binaryHDSMultiLevelIDDNGeneratorUA\68229_R01RevA_D010b\68229_R01RevA_D010b_BinaryHDSMultiLevelIDDNGeneratorUA_02_CLRP29_CLRP28_CLRP18_CLRP22.grf

Reference: 68229_R01RevA_APR_03c_Excised_OUT_10TH_286, 68229_R01RevA_PRO_02a_Excised_OUT_10TH_286, 68229_R01RevA_PRO_02a_Excised_minus_68229_R01RevA_APR_03c_Excised_OUT_10TH_286



Profile 1: CLRP29_V (L01Node 11637)

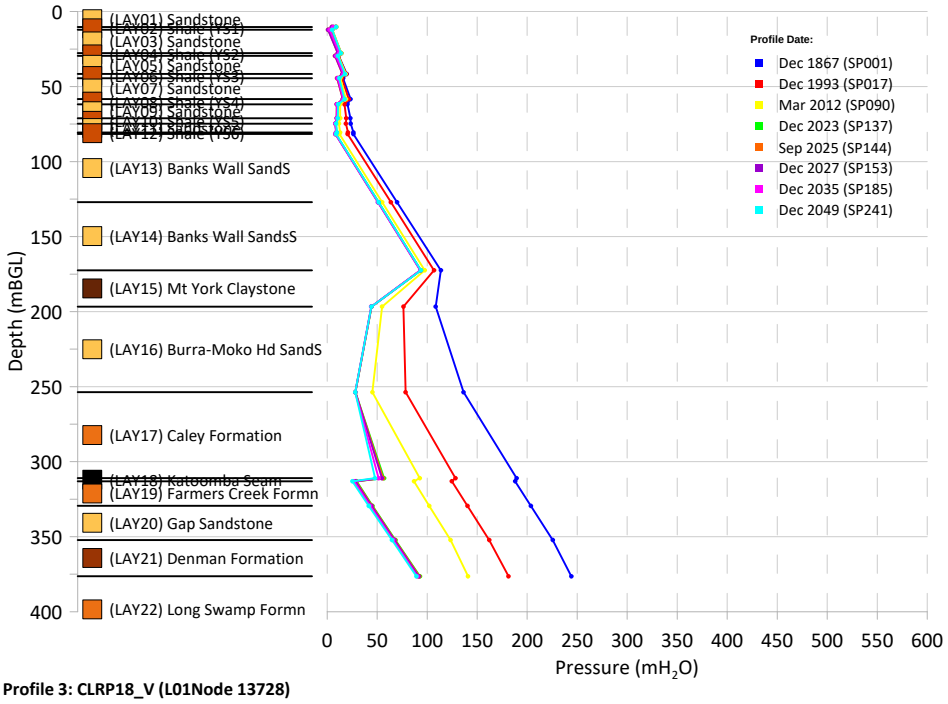


Profile 2: CLRP28 (L01Node 13053)

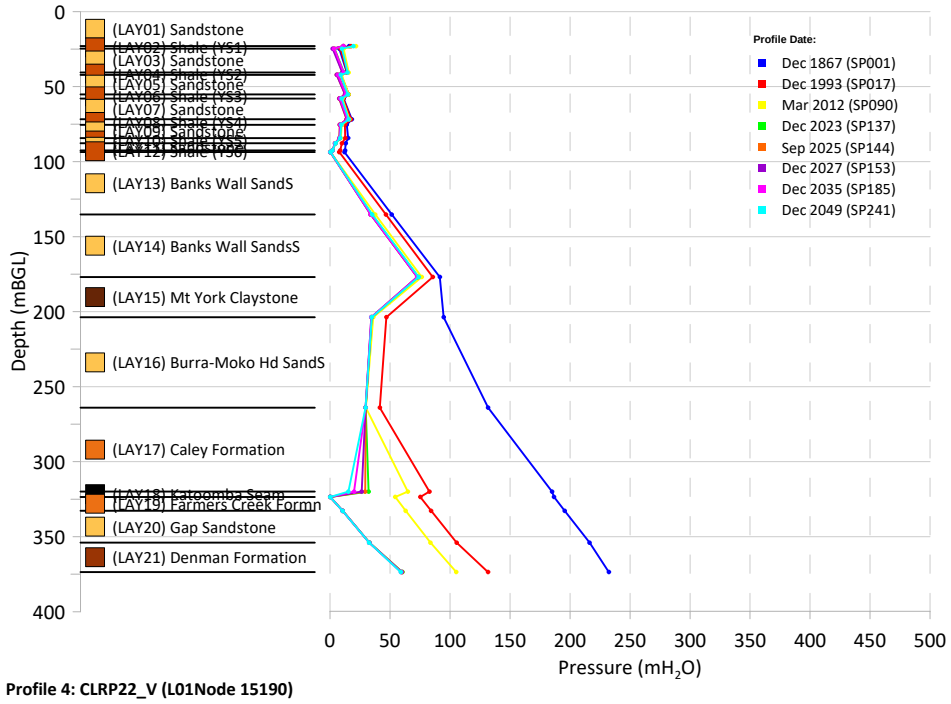
Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd



Profile 3: CLRP18_V (L01Node 13728)



Profile 4: CLRP22_V (L01Node 15190)

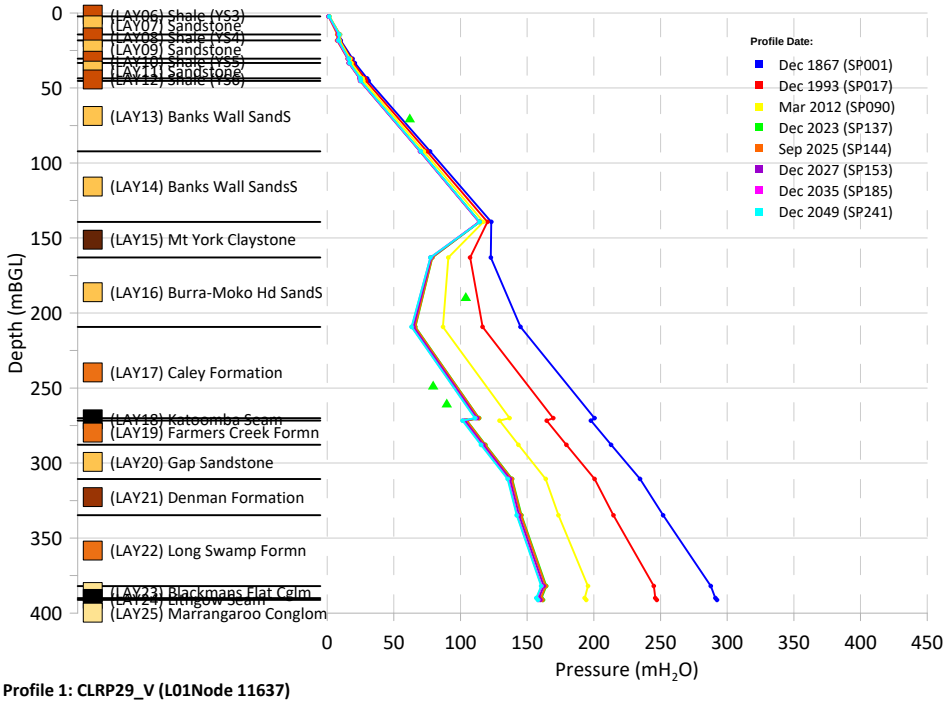
Notes:

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 23/10/2025	
Drawn By: DAW	
Checked By: JRWB	

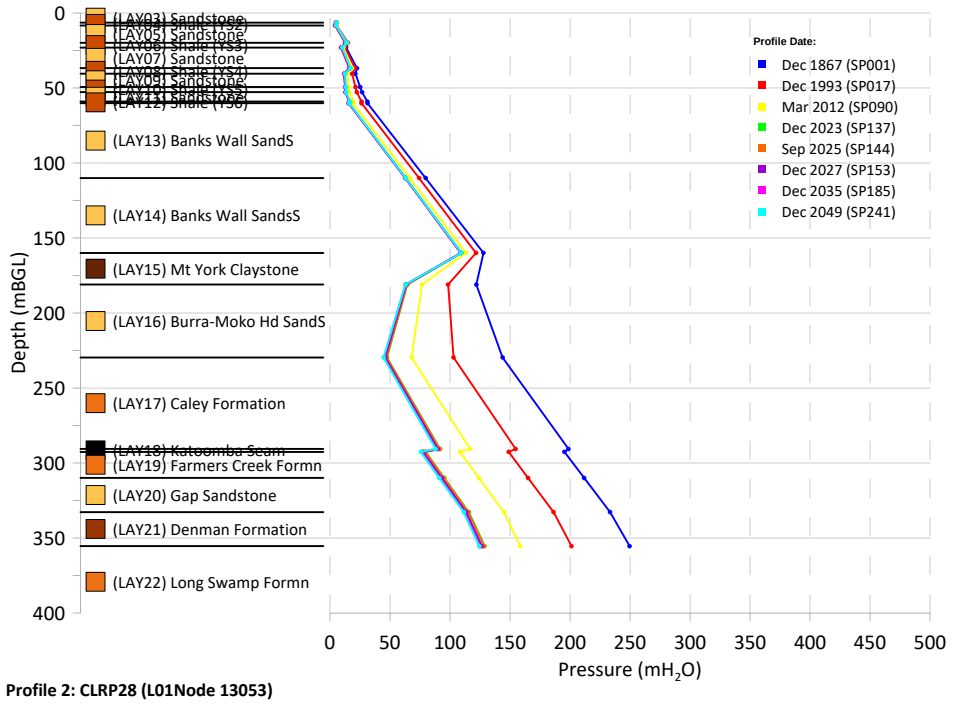
Figure 4.76c: Depth versus Groundwater Pressure Diagrams (Prediction Period - Approved Case) - CLRP29_V, CLRP28, CLRP18_V, CLRP22_V

Reference: 68229_R01RevA_APR_03c.

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D007_PressureVerticalProfile_APR\68229_R01RevA_D007b\68229_R01RevA_D007b_VerticalProfileExtraction_Pressure_02_CLRP29_CLRP28_CLRP18_CLRP22.gpf



Profile 1: CLRP29_V (L01Node 11637)

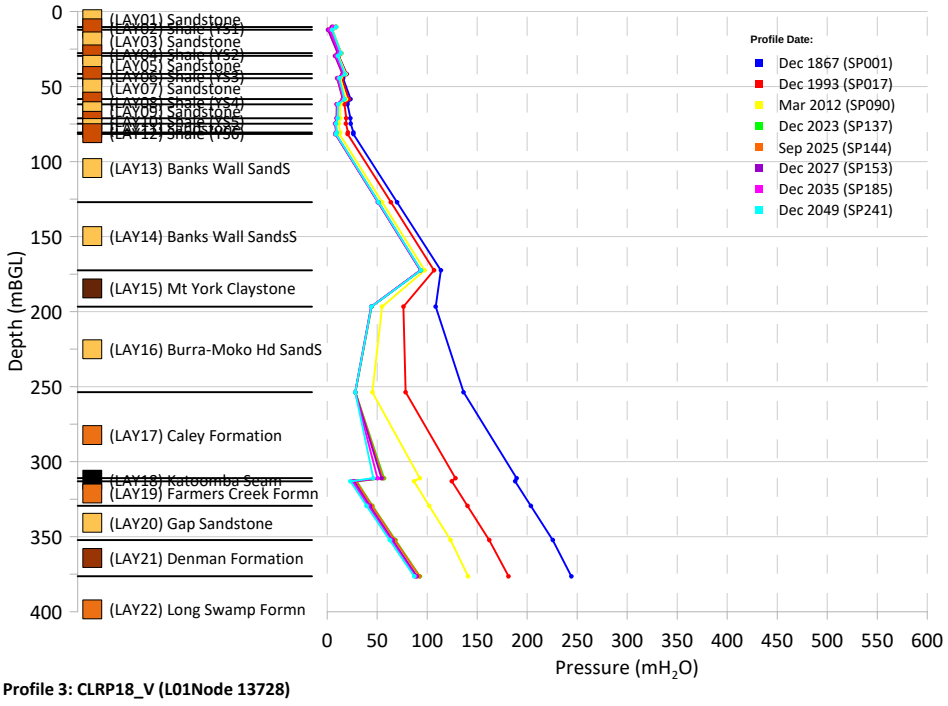


Profile 2: CLRP28 (L01Node 13053)

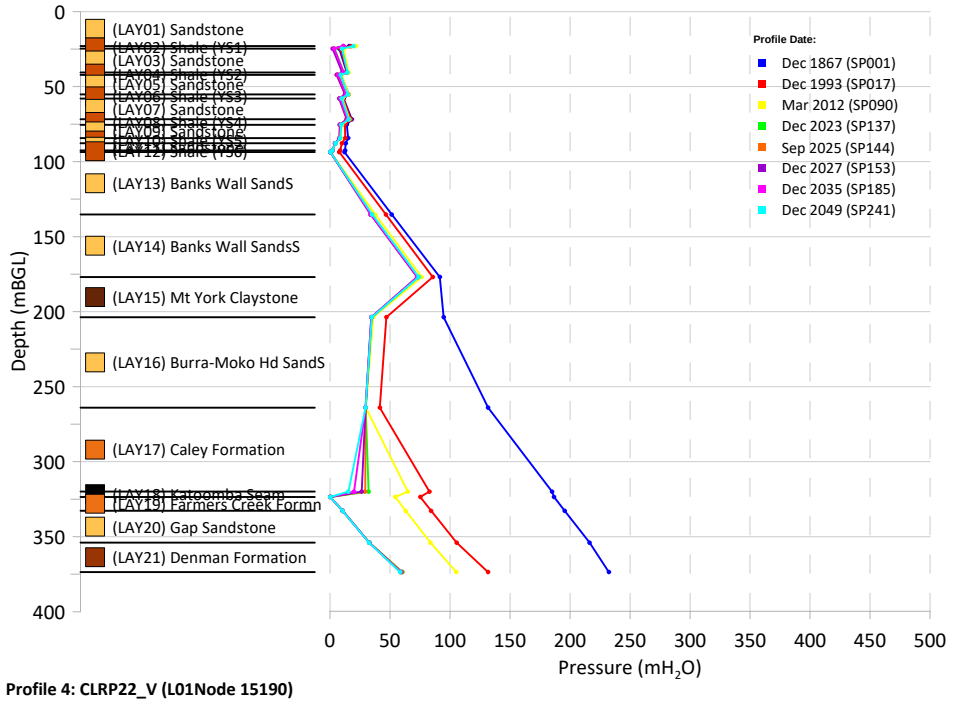
Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd



Profile 3: CLRP18_V (L01Node 13728)



Profile 4: CLRP22_V (L01Node 15190)

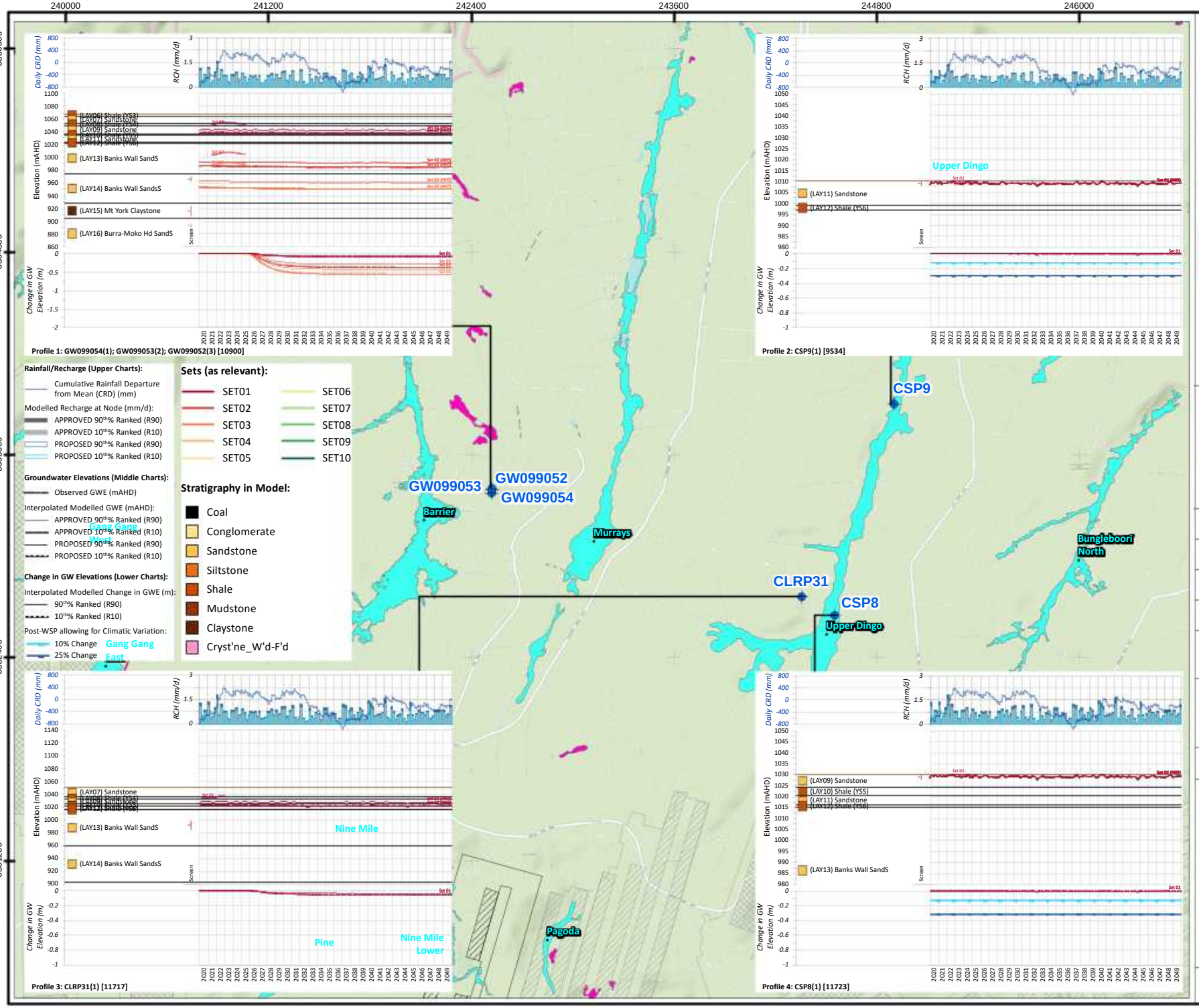
Notes:

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 23/10/2025	
Drawn By: DAW	
Checked By: JRWB	

Figure 4.76d: Depth versus Groundwater Pressure Diagrams (Prediction Period - Proposed Case) - CLRP29_V, CLRP28, CLRP18_V, CLRP22_V

Reference: 68229_R01RevA_PRO_02a.

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D008_PressureVerticalProfile_PRO\68229_R01RevA_D008b\68229_R01RevA_D008b_VerticalProfileExtraction_Pressure_02_CLRP29_CLRP28_CLRP18_CLRP22.grf



Legend:

- Model Output Locations

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):

- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Notes:
1) GWE: Groundwater Elevation.
2) 10% and 25% threshold calculated based on model output between 01/01/2011 and 31/12/2021.
3) CRD Trace dates from 01/01/2010 - 31/12/2049.

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Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 28-Oct-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:30,000

0 500 1,000
Meters

Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Prediction Period):

- **GW09905X**
- **CSP9**
- **CLRP31**
- **CSP8**

FIGURE: 4.77a

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D009c_UA_Hydrographs_GW_CSP9_CLRP31_CSP8.mxd

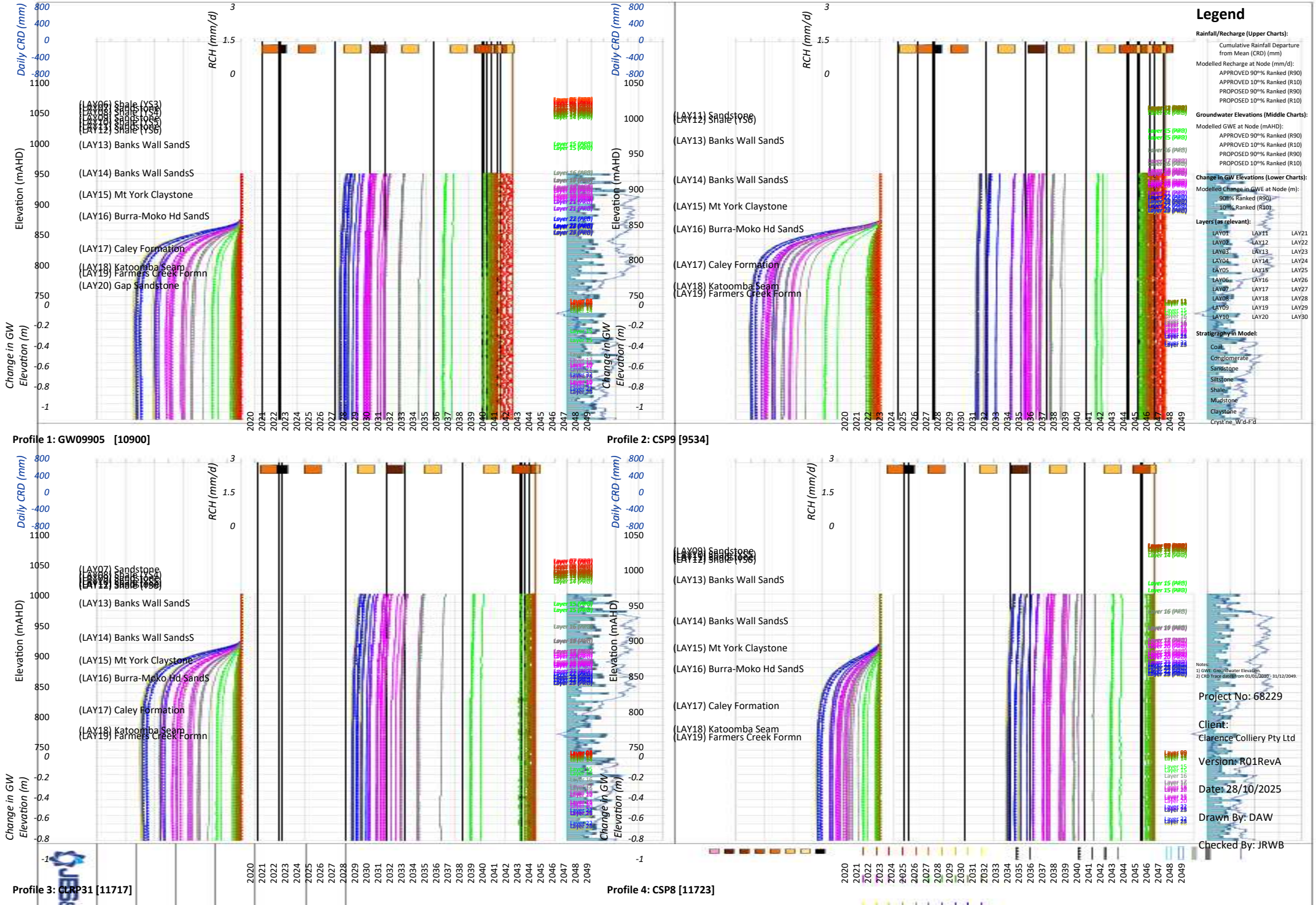
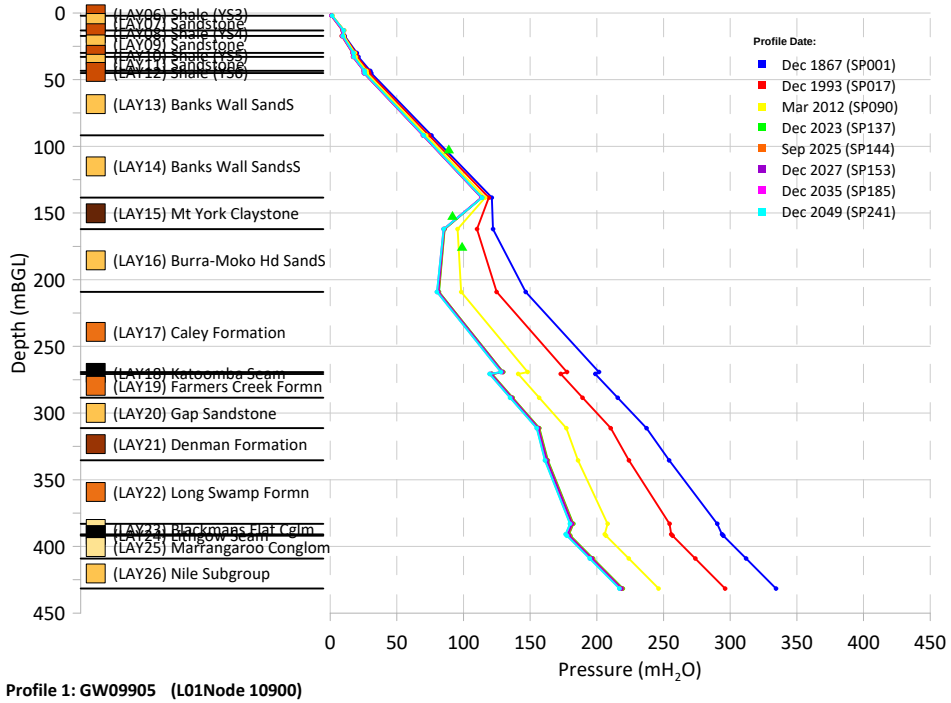
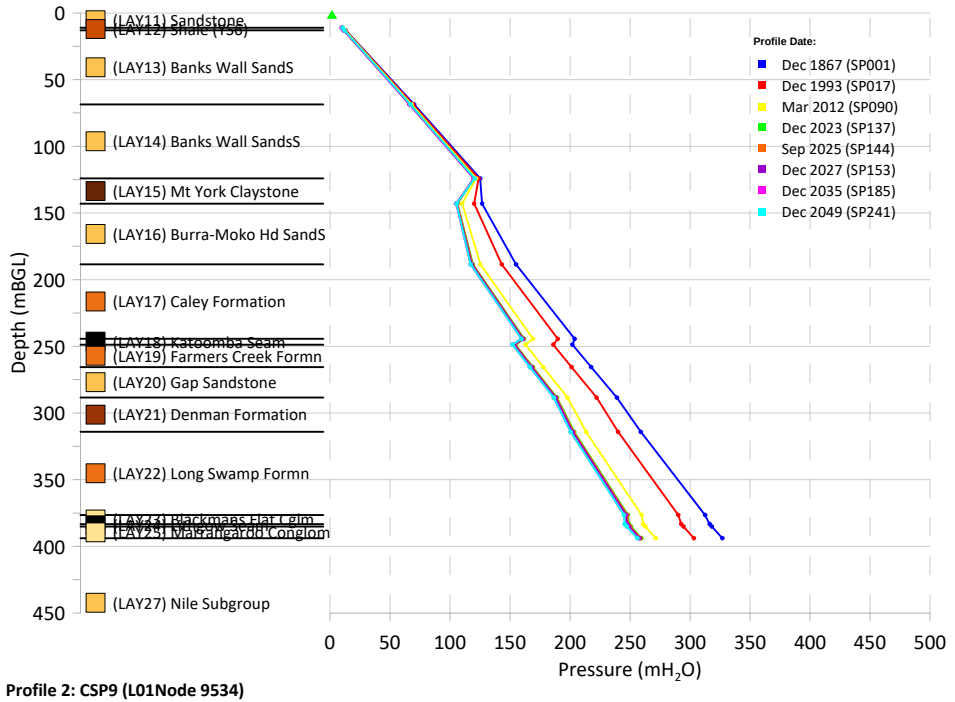


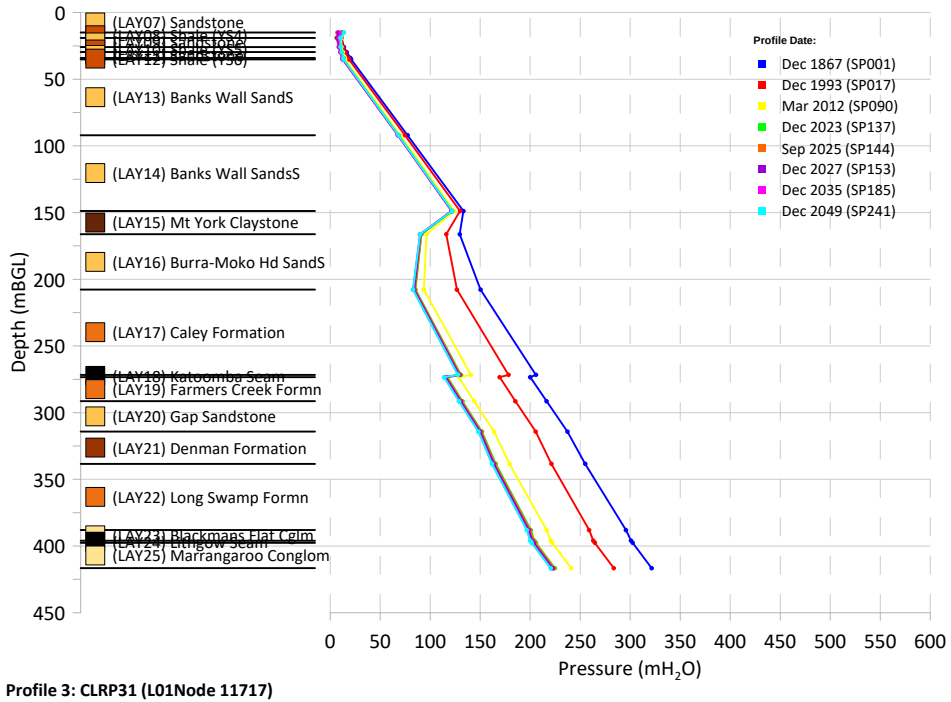
Figure 4.77b: Groundwater Hydrographs (Prediction Period) - GW09905 , CSP9, CLRP31, CSP8



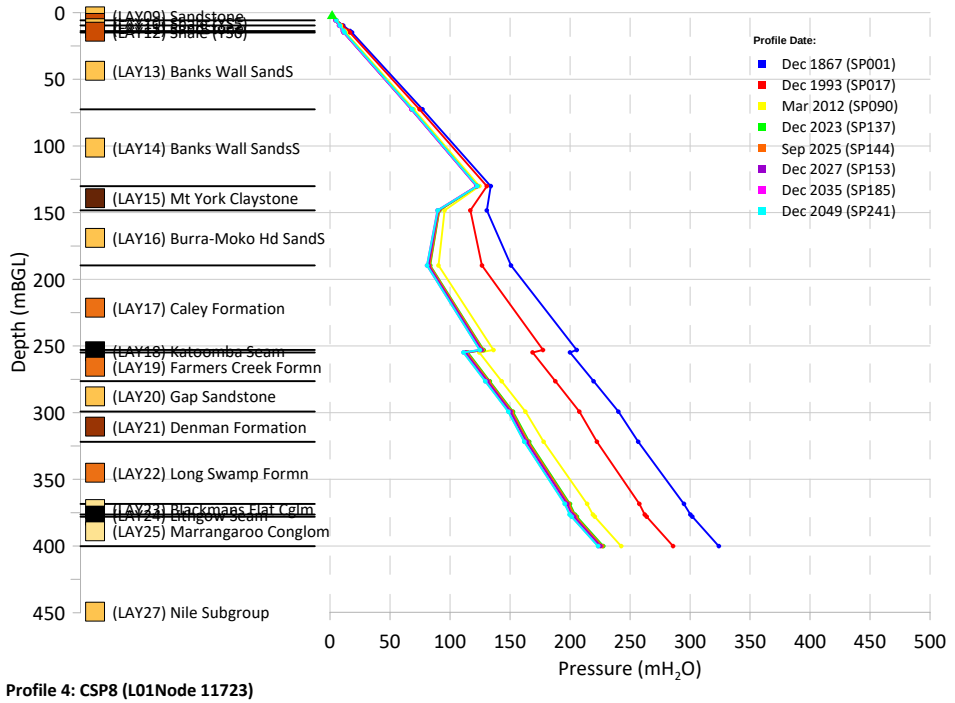
Profile 1: GW09905 (L01Node 10900)



Profile 2: CSP9 (L01Node 9534)



Profile 3: CLRP31 (L01Node 11717)



Profile 4: CSP8 (L01Node 11723)

Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:

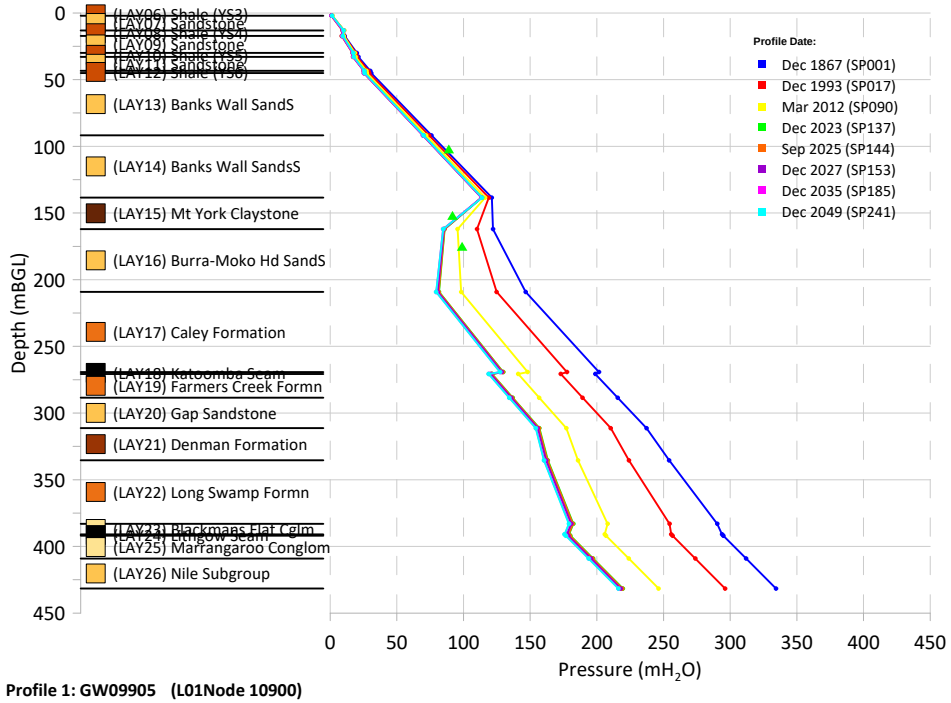
Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 23/10/2025	
Drawn By: DAW	
Checked By: JRWB	

JBS&G

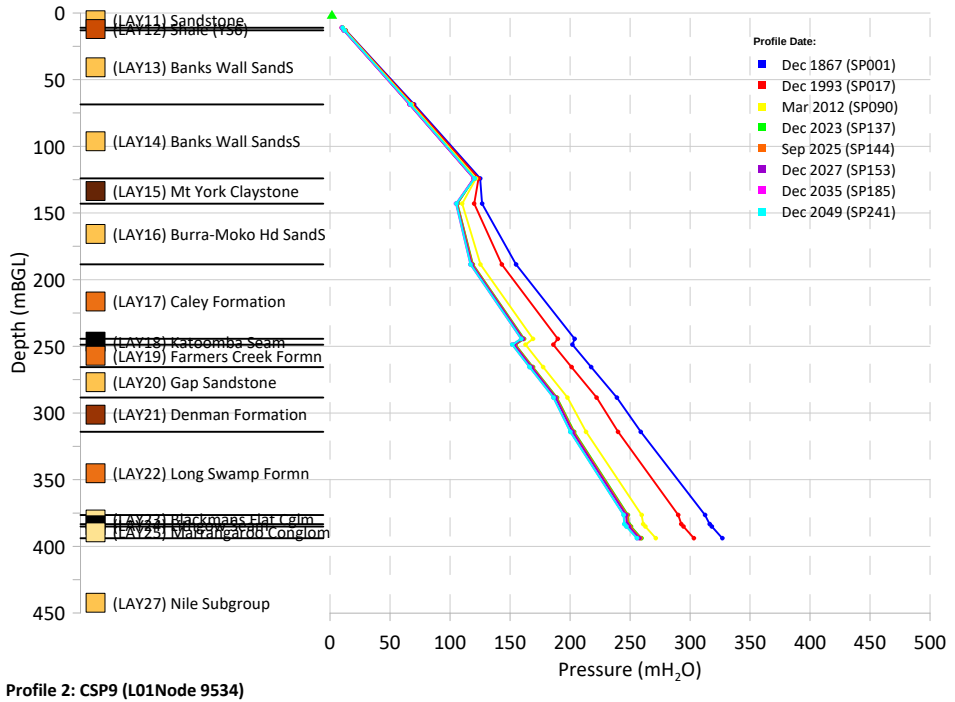
Figure 4.77c: Depth versus Groundwater Pressure Diagrams (Prediction Period - Approved Case) - GW09905X, CSP9, CLRP31, CSP8

Reference: 68229_R01RevA_APR_03c.

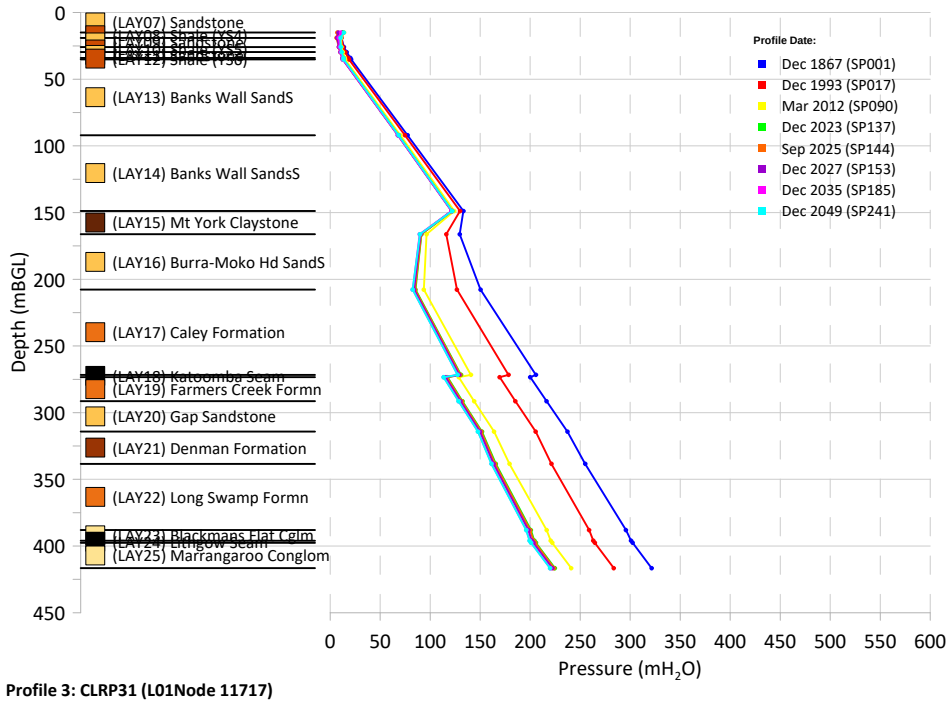
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP#\Figures\Graphen\68229_R01RevA_D007_PressureVerticalProfile_APR\68229_R01RevA_D007c\68229_R01RevA_D007c_VerticalProfileExtraction_Pressure_06_GW_CSP9_CLRP31_CSP8.gpf



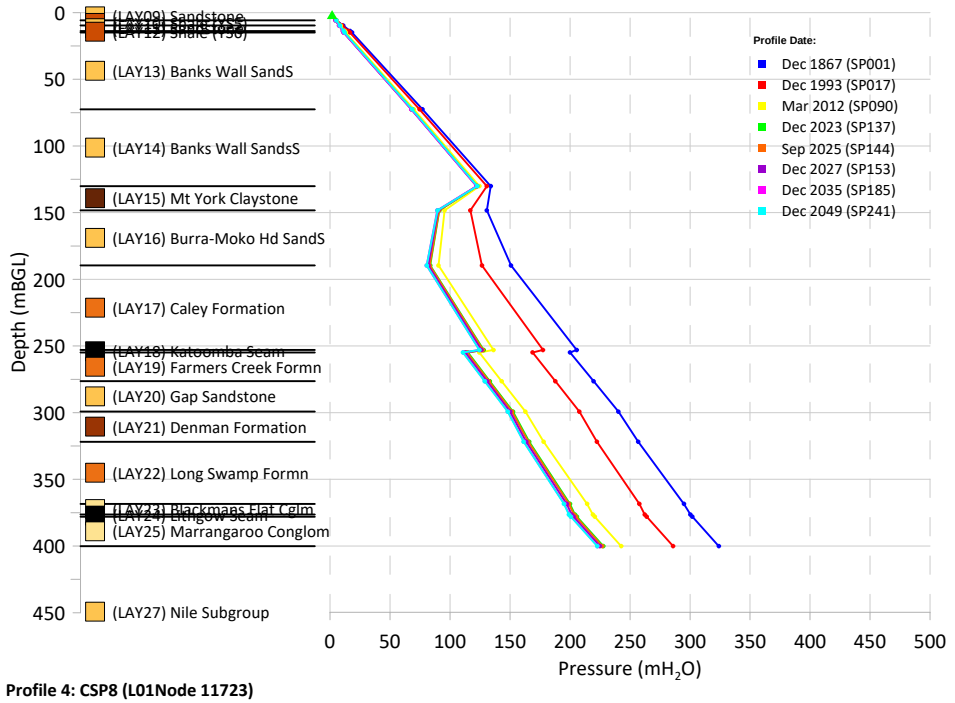
Profile 1: GW09905 (L01Node 10900)



Profile 2: CSP9 (L01Node 9534)



Profile 3: CLRP31 (L01Node 11717)



Profile 4: CSP8 (L01Node 11723)

Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 23/10/2025	
Drawn By: DAW	
Checked By: JRWB	

JBS&G

Figure 4.77d: Depth versus Groundwater Pressure Diagrams (Prediction Period - Proposed Case) - GW09905X, CSP9, CLRP31, CSP8

Reference: 68229_R01RevA_PRO_02a.

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EPI\Figures\Grapher\68229_R01RevA_D008_PressureVerticalProfile_PRO\68229_R01RevA_D008c\68229_R01RevA_D008c_VerticalProfileExtraction_Pressure_06_GW_CSP9_CLRP31_CSP8.grf

Burra-Moko Head Sandstone (Layer 16). From **Figure 4-77c** and **Figure 4-77d**, at CSP8 and CSP9, there is no discernible change to groundwater pressure throughout the vertical profile.

CSP1, PG1, CSP2 and PG2

From **Figure 4-78a**, there is a negligible (change is less than 5%, with respect to groundwater dependent ecosystems) decline in elevation of the highest active node for swamp monitoring piezometer, CSP1, and a negligible increase in elevation of the highest active node for swamp monitoring piezometers, PG1 and PG2.

From **Figure 4-78a**, there is a small (change is 5 to 10%, with respect to groundwater dependent ecosystems) decline, with medium (change is 10 to 25%) transitory declines, in elevation of the highest active node for swamp monitoring piezometer, CSP2. These medium transitory declines are considered to be insignificant as they are transitory and do not lead to long-term change. Furthermore, a range of model output is presented in **Figure 4-78a**, being the 10th% and 90th% ranked change (stochastic). As already noted, stochastic results are not probabilistic, and the 90$^{th\%}$ ranked change does not indicate these transitory changes will occur.

From **Figure 4-78b**, at CSP2, there are large (change is greater than 25m) declines in groundwater elevation at depth, due to mining of 918 Panel. That decline diminishes with increasing elevation up the vertical profile.

From **Figure 4-78c** and **Figure 4-78d**, at PG1 and PG2, by December 2024 (SP137), depressurisation in the Katoomba Seam (Layer 18) has occurred in both the Approved Case and Proposed Case, due to extraction of 906 Panel. By December 2049 (SP241), there are minor changes in groundwater pressure beneath the Katoomba Seam (Layer 18) and within the Caley Formation (Layer 17). At PG1 and PG2, there are no discernible changes to groundwater pressure near ground surface. From **Figure 4-78c** and **Figure 4-78d**, at CSP1 and CSP2, by December 2027 (SP153), the Katoomba Seam (Layer 18) becomes completely depressurised, due to mining of 918 Panel. These declines to groundwater pressure propagate vertically upwards through Caley Formation (Layer 17), but do not extend above the Mount York Claystone (Layer 15). At CSP1 and CSP2, there are no discernible changes to groundwater pressure near ground surface.

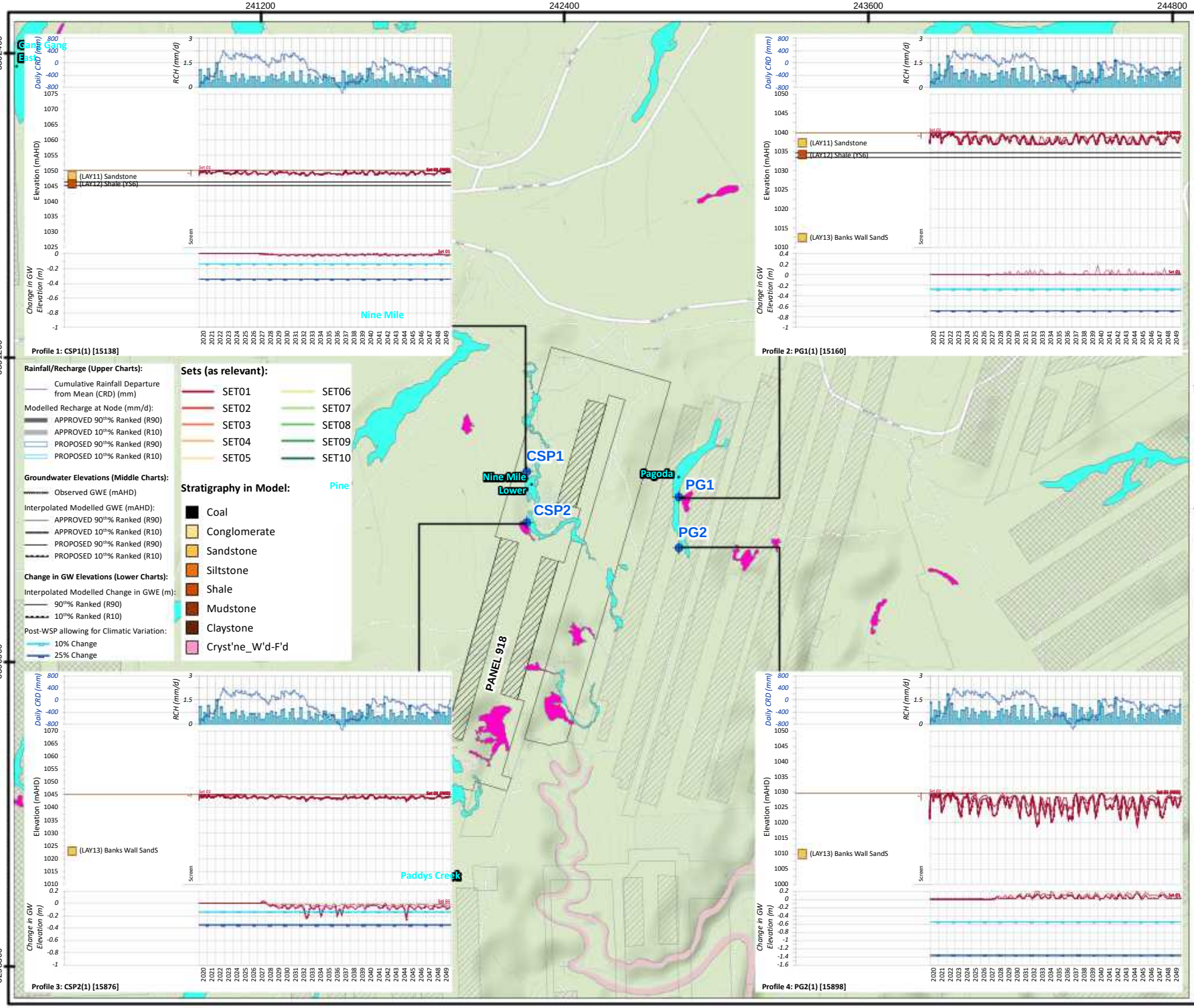
CSP6, CSP34, PSE1 and PSE2

From **Figure 4-79a**, modelled output at swamp monitoring piezometers, CSP6, PSE1 and PSE2, shows there will be a negligible (change is less than 5%, with respect to groundwater dependent ecosystems) decline in elevation of the highest active node.

From **Figure 4-79a**, modelled output at swamp monitoring piezometer, CSP34, shows there will be a small (change is 5 to 10%) increase in elevation of the highest active node.

From **Figure 4-79b**, modelled output shows that at depth, swamp monitoring piezometers located at distance (CSP6 and PSE2) from 918 Panel compared to those located in the vicinity (CSP34 and PSE1) of 918 Panel, will have significantly less change to groundwater elevation, as well as a tighter range in uncertainty.

From **Figure 4-79c** and **Figure 4-79d**, at CSP6, which is located north of 918 Panel, there is a minor decrease in groundwater pressure within Katoomba Seam (Layer 18) that propagates vertically upwards to the Burra-Moko Head Sandstone (Layer 16). In and above the Mount York Claystone (Layer 15) to ground surface, there is no discernible change to groundwater pressure. From **Figure 4-79c** and **Figure 4-79d**, at CSP34 and PSE1, by December 2027 (SP153), complete depressurisation in the Katoomba Seam (Layer 18) has occurred in the Proposed Case, due to extraction. These declines to groundwater pressure propagate vertically downwards, with no discernible change to groundwater pressure occurring vertically above the Mount York Claystone (Layer 15). From **Figure 4-79c** and **Figure 4-79d**, at PSE2, there is no discernible change to groundwater pressure throughout the entire vertical profile. This is interpreted as being due to the location of PSE2, within an area of existing extraction (915 Panel).



Legend:

- Model Output Locations

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):

- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Notes:
1) GWE: Groundwater Elevation.
2) 10% and 25% threshold calculated based on model output between 01/01/2011 and 31/12/2021.
3) CRD Trace dates from 01/01/2010 - 31/12/2049.

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 04-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:20,000

0 250 500
Meters

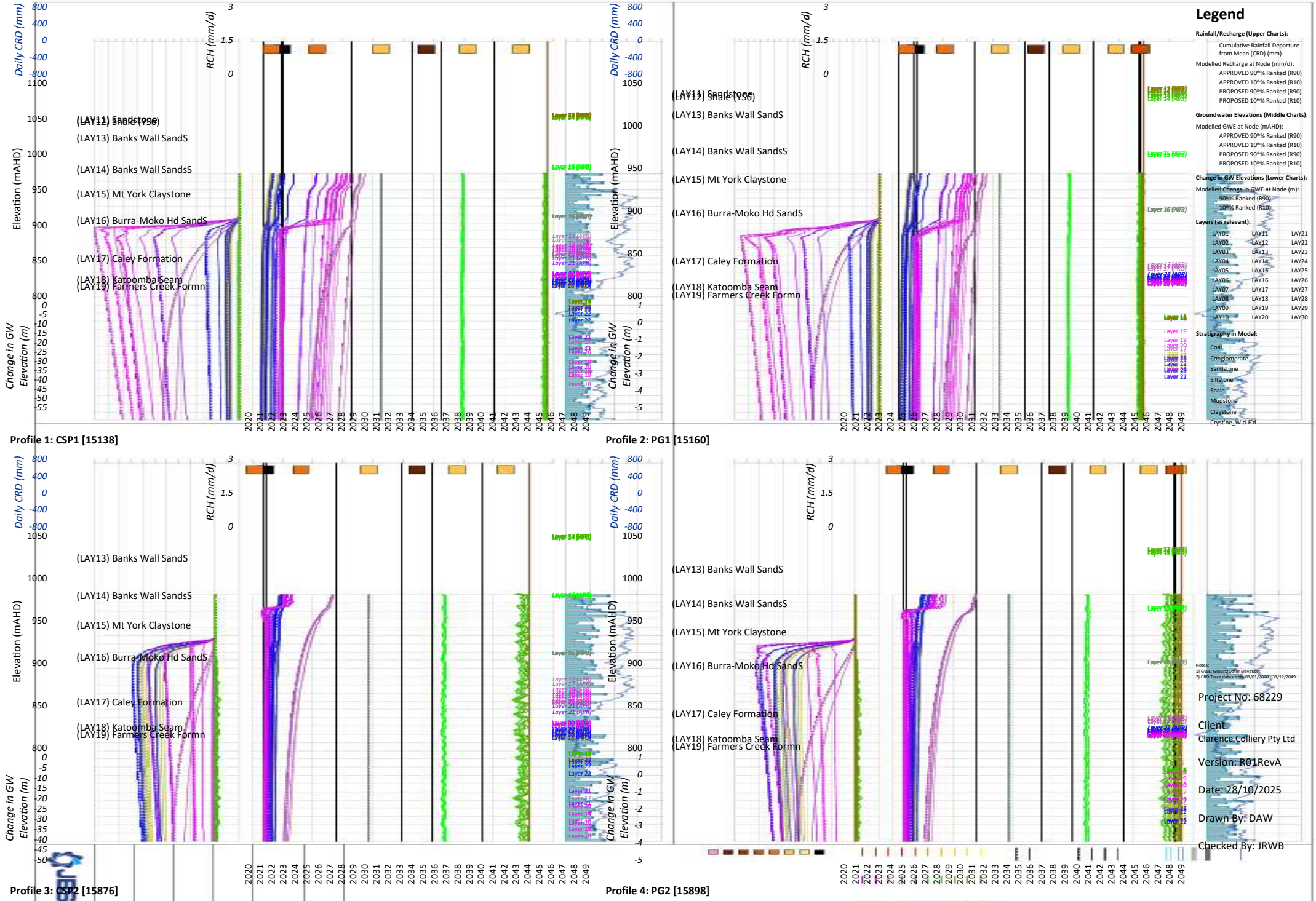
Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Prediction Period):

- CSP1
- PG1
- CSP2
- PG2

FIGURE: 4.78a

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D009d_UA_Hydrographs_CSP1_PG1_CSP2_PG2.mxd



Profile 1: CSP1 [15138]

Profile 2: PG1 [15160]

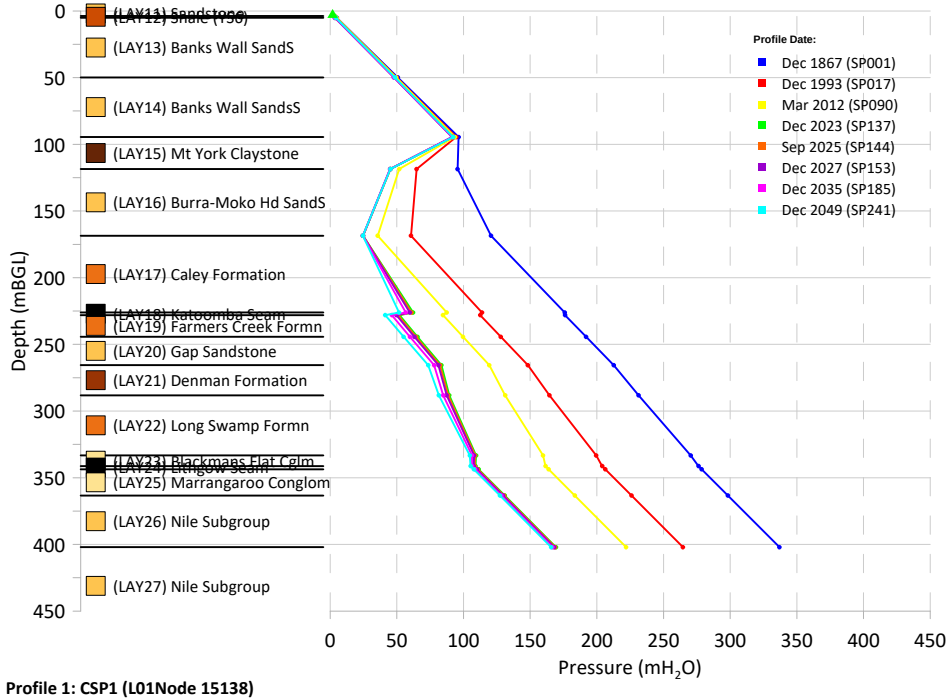
Profile 3: CSP2 [15876]

Profile 4: PG2 [15898]

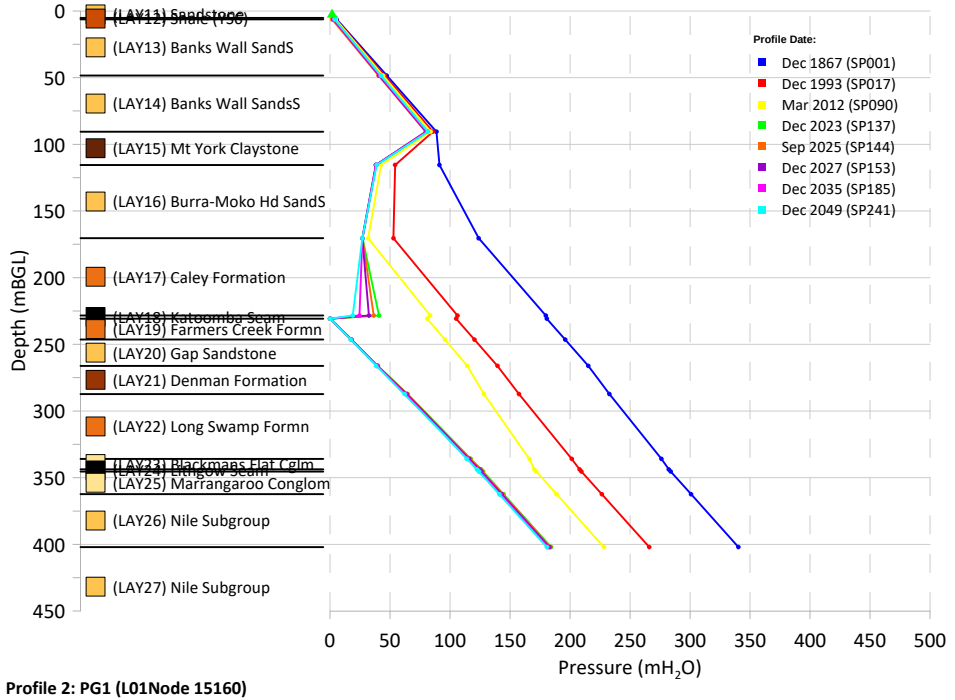
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Graphers\68229_R01RevA_D010_BinaryHDSMultiLevelDDNGeneratorUA\68229_R01RevA_D010d\68229_R01RevA_D010d_BinaryHDSMultiLevelDDNGeneratorUA_07_CSP1_PG1_CSP2_PG2.grf

Reference: 68229_R01RevA_APR_03c_Excised_OUT_10TH_286, 68229_R01RevA_PRO_02a_Excised_OUT_10TH_286, 68229_R01RevA_PRO_02a_Excised_minus_68229_R01RevA_APR_03c_Excised_OUT_10TH_286

Figure 4.78b: Groundwater Hydrographs (Prediction Period) - CSP1, PG1, CSP2, PG2



Profile 1: CSP1 (L01Node 15138)

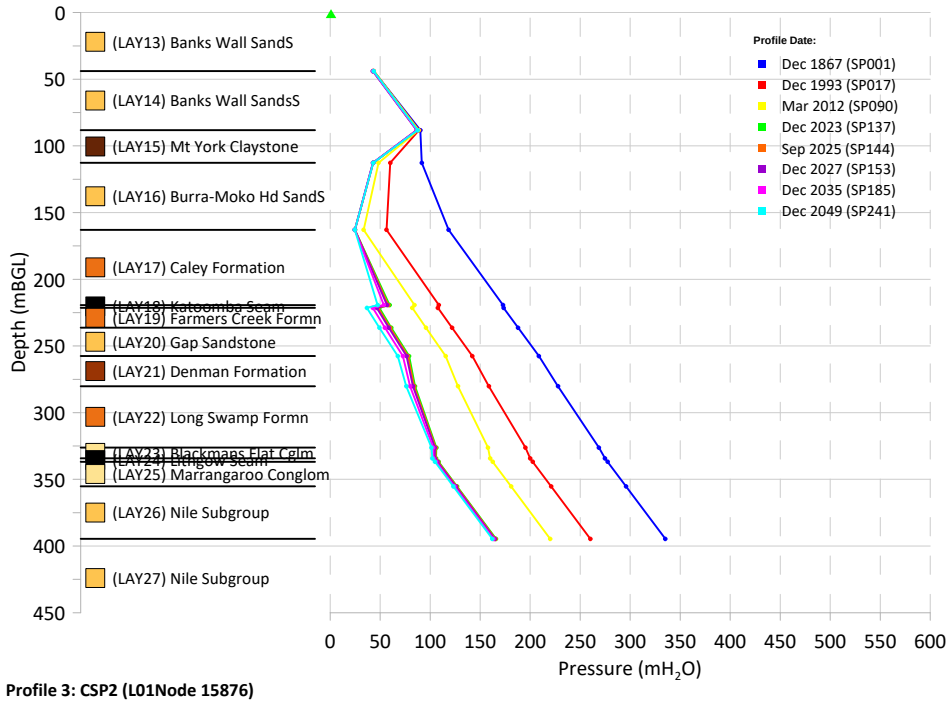


Profile 2: PG1 (L01Node 15160)

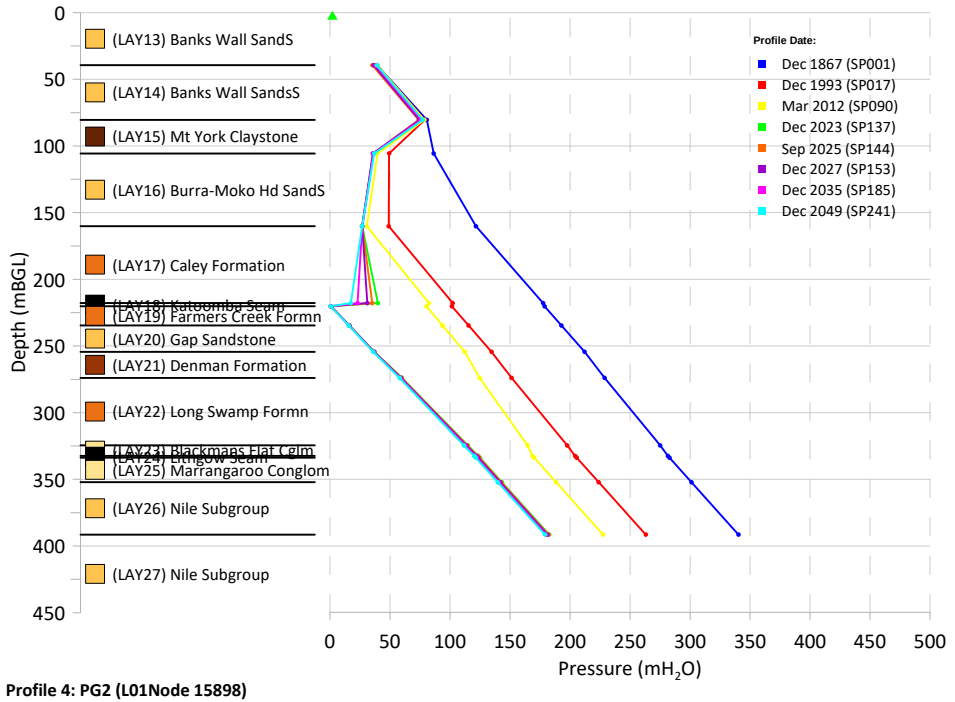
Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd



Profile 3: CSP2 (L01Node 15876)



Profile 4: PG2 (L01Node 15898)

Notes:

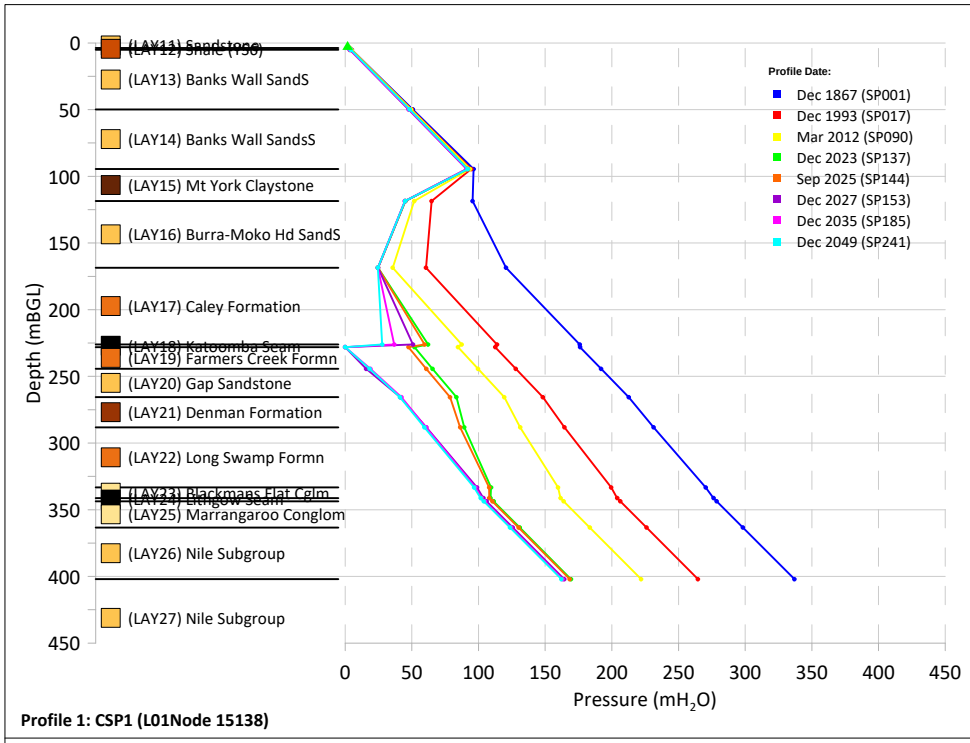
Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 23/10/2025	
Drawn By: DAW	
Checked By: JRWB	

JBS&G

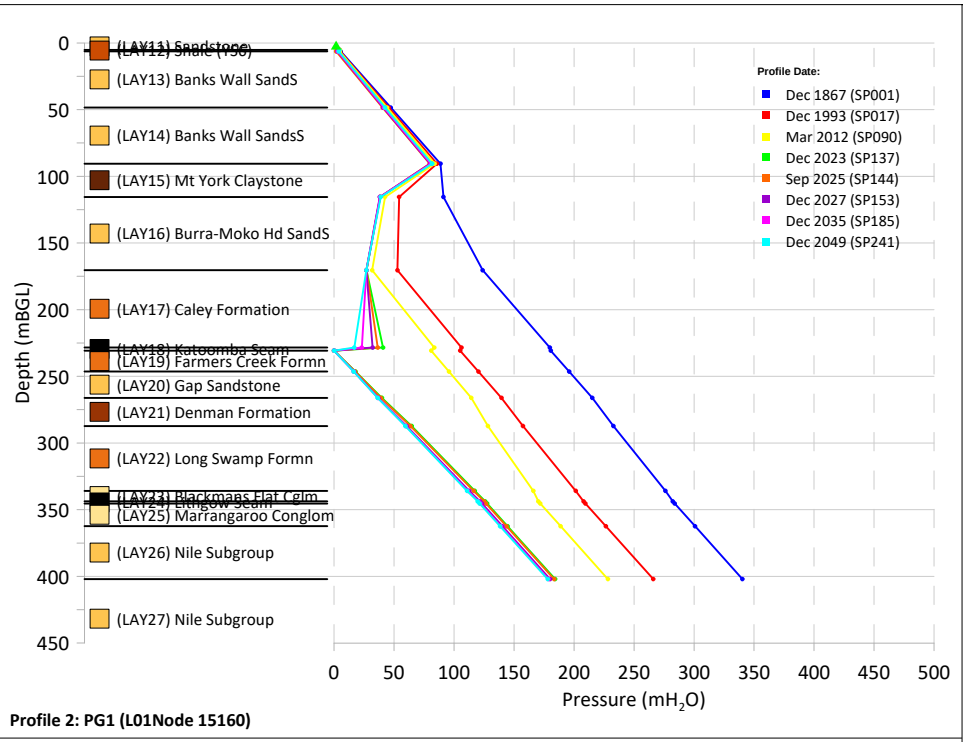
Figure 4.78c: Depth versus Groundwater Pressure Diagrams (Prediction Period - Approved Case) - CSP1, PG1, CSP2, PG2

Reference: 68229_R01RevA_APR_03c.

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EPI\Figures\Graphan\68229_R01RevA_0007_PressureVerticalProfile_APR\68229_R01RevA_D007d\68229_R01RevA_D007d_VerticalProfileExtraction_Pressure_07_CSP1_PG1_CSP2_PG2.gpf



Profile 1: CSP1 (L01Node 15138)

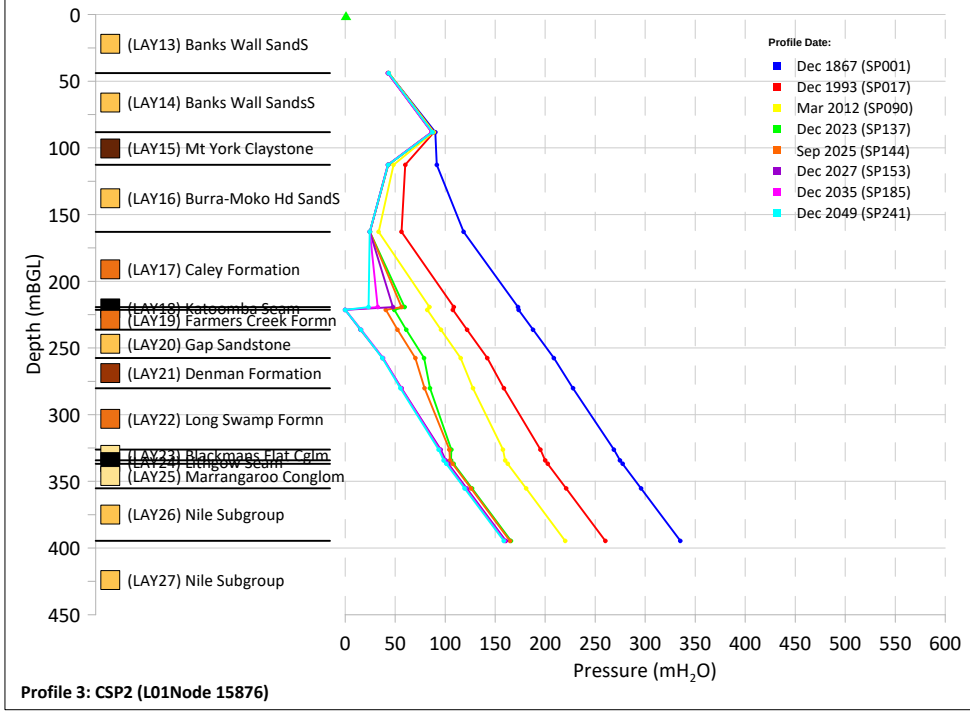


Profile 2: PG1 (L01Node 15160)

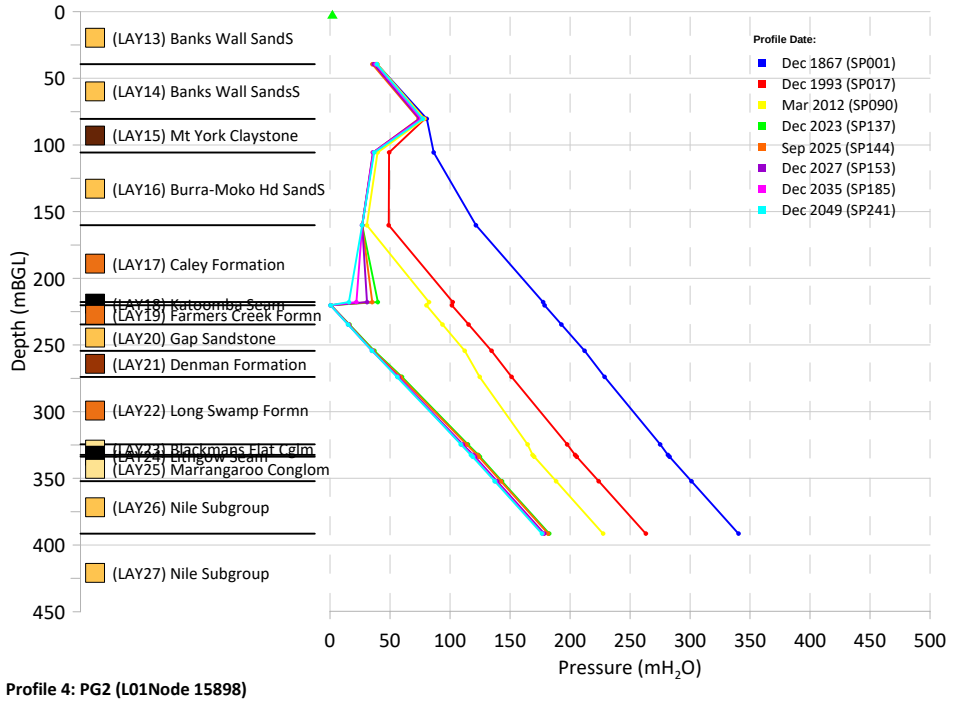
Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd



Profile 3: CSP2 (L01Node 15876)



Profile 4: PG2 (L01Node 15898)

Notes:

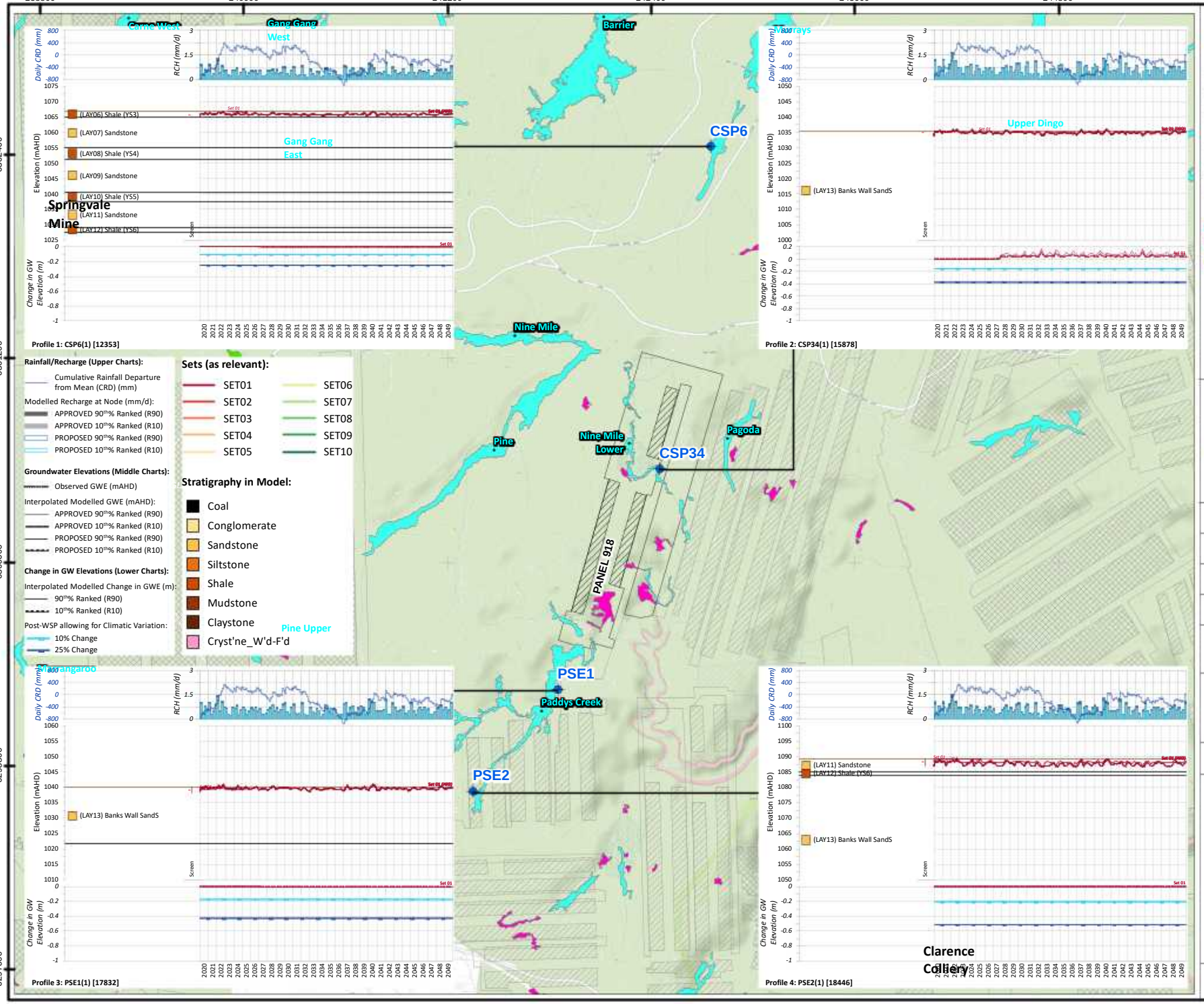
Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 23/10/2025	
Drawn By: DAW	
Checked By: JRWB	

JBS&G

Figure 4.78d: Depth versus Groundwater Pressure Diagrams (Prediction Period - Proposed Case) - CSP1, PG1, CSP2, PG2

Reference: 68229_R01RevA_PRO_02a.

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EPI\Figures\Graphan\68229_R01RevA_D008_PressureVerticalProfile_PRO\68229_R01RevA_D008d\68229_R01RevA_D008d_VerticalProfileExtraction_Pressure_07_CSP1_PG1_CSP2_PG2.gpf



Legend:

- Model Output Locations

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):

- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Notes:
1) GWE: Groundwater Elevation.
2) 10% and 25% threshold calculated based on model output between 01/01/2011 and 31/12/2021.
3) CRD Trace dates from 01/01/2010 - 31/12/2049.

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 04-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:30,000

0 500 1,000
Meters

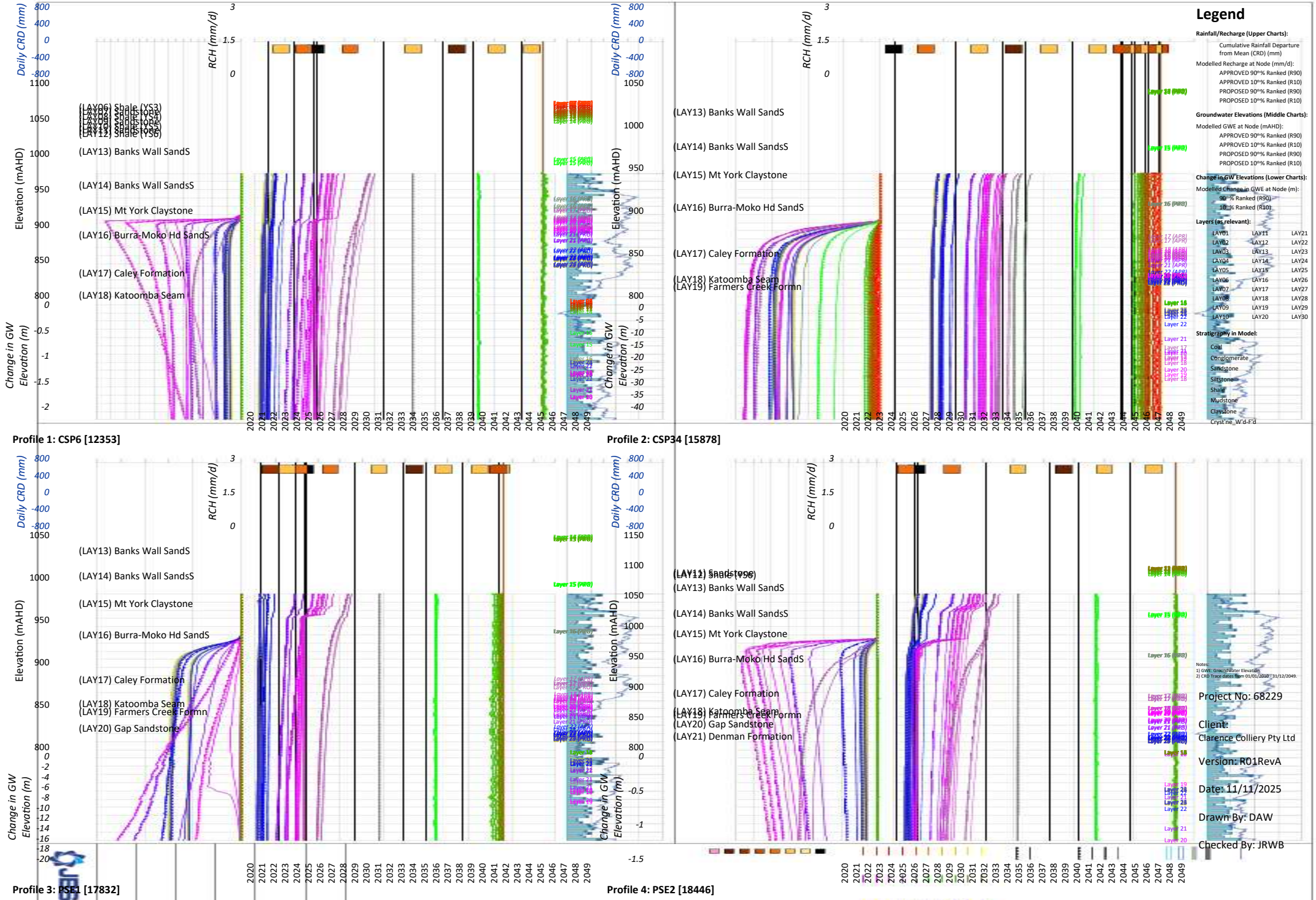
Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Prediction Period):

- CSP6
- CSP34
- PSE1
- PSE2

FIGURE: 4.79a

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D009e_UA_Hydrographs_CSP6_CSP34_PSE1_PSE2.mxd



Profile 1: CSP6 [12353]

Profile 2: CSP34 [15878]

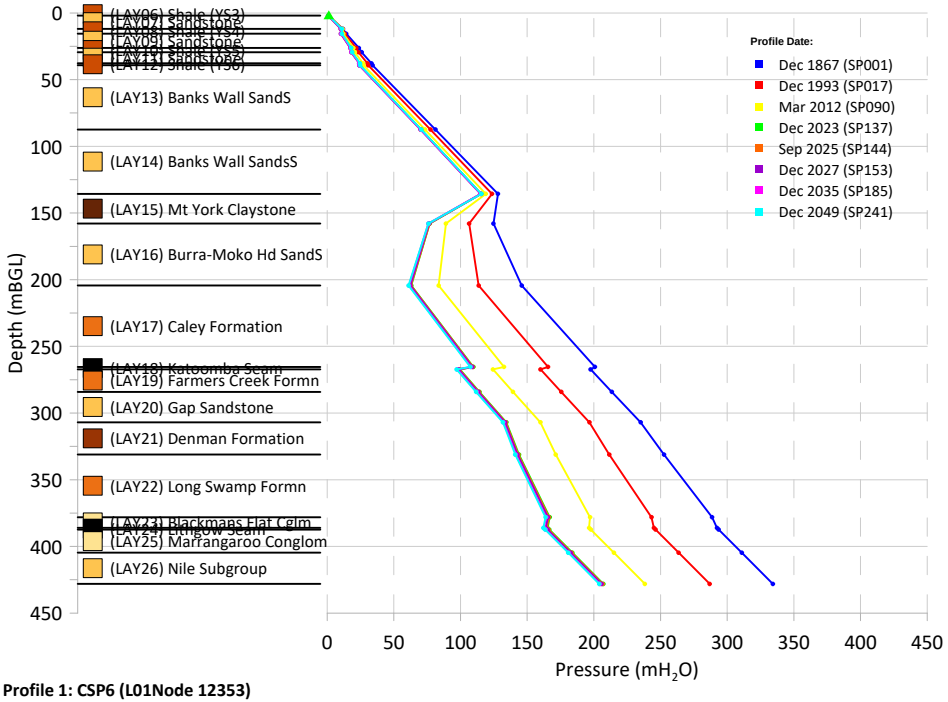
Profile 3: PSE1 [17832]

Profile 4: PSE2 [18446]

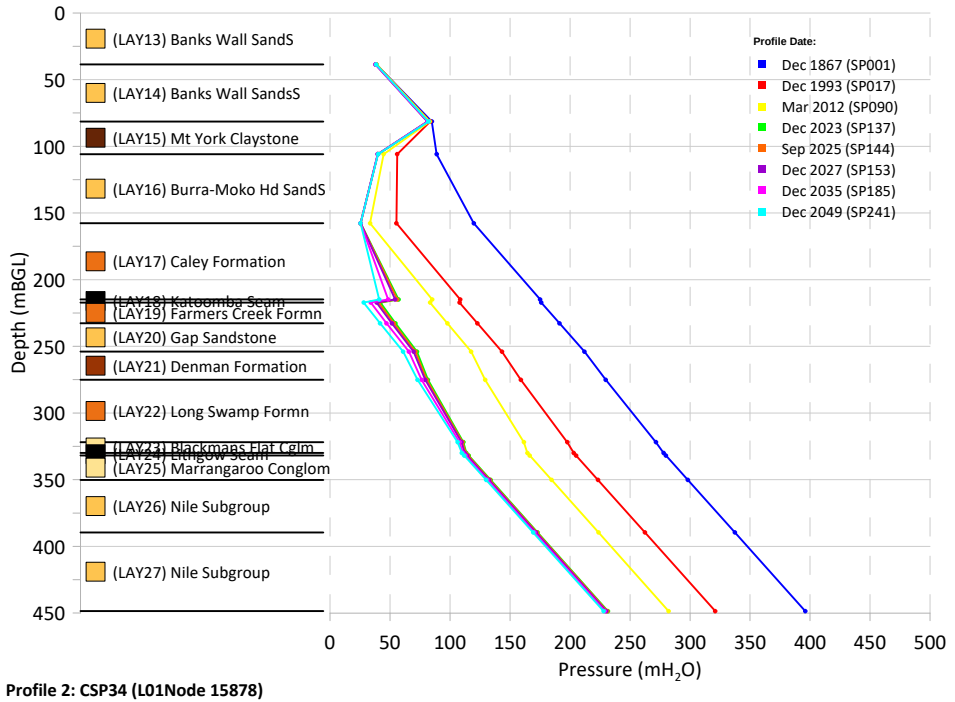
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D010_BinaryHDSMultiLevelDDNGeneratorUA\68229_R01RevA_D010e\68229_R01RevA_D010e_BinaryHDSMultiLevelDDNGeneratorUA_08_CSP6_CSP34_PSE1_PSE2.grf

Reference: 68229_R01RevA_APR_03c_Excised_OUT_10TH_286, 68229_R01RevA_PRO_02a_Excised_OUT_10TH_286, 68229_R01RevA_PRO_02a_Excised_minus_68229_R01RevA_APR_03c_Excised_OUT_10TH_286

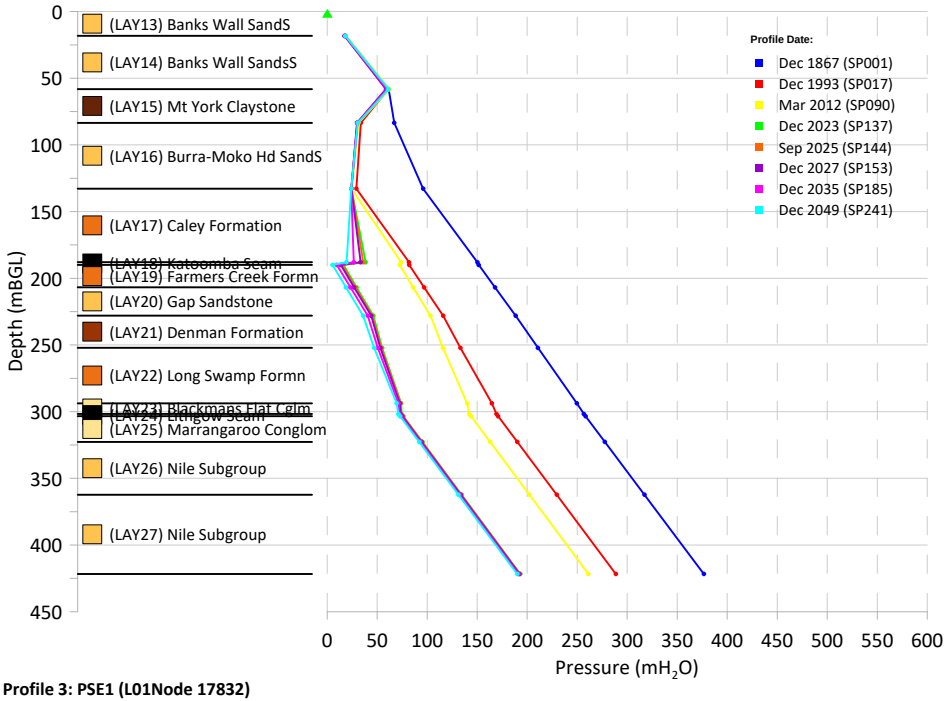
Figure 4.79b: Groundwater Hydrographs (Prediction Period) - CSP6, CSP34, PSE1, PSE2



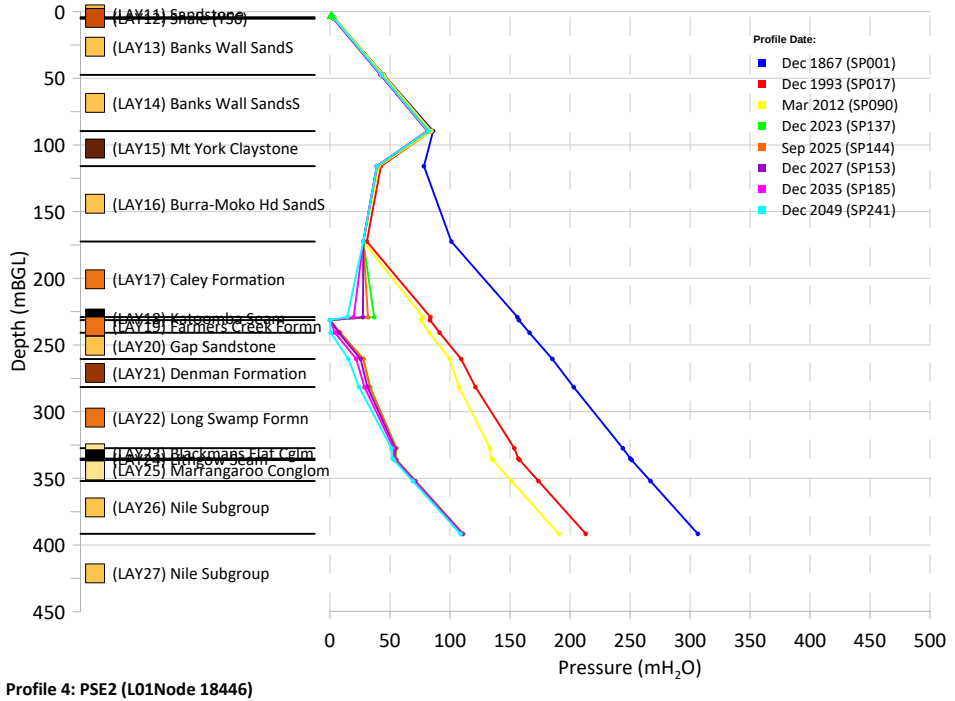
Profile 1: CSP6 (L01Node 12353)



Profile 2: CSP34 (L01Node 15878)



Profile 3: PSE1 (L01Node 17832)



Profile 4: PSE2 (L01Node 18446)

Legend

Profile Type:

Modelled — Observed

Stratigraphy in Model:

- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:

Project No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA

Date: 23/10/2025

Drawn By: DAW

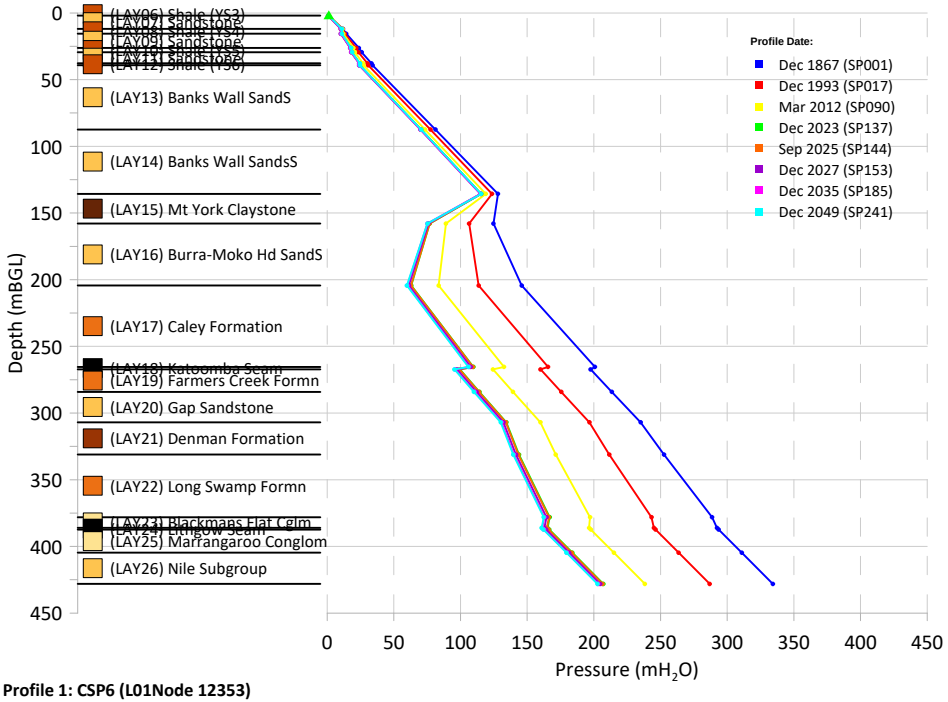
Checked By: JRWB

JBS&G

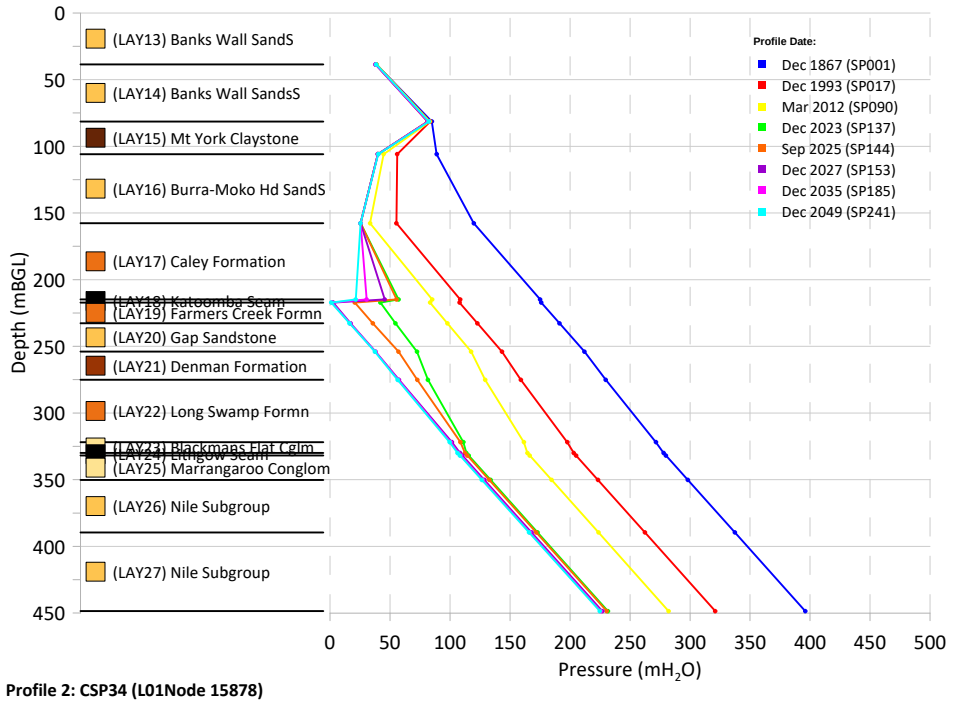
Figure 4.79c: Depth versus Groundwater Pressure Diagrams (Prediction Period - Approved Case) - CSP6, CSP34, PSE1, PSE2

Reference: 68229_R01RevA_APR_03c.

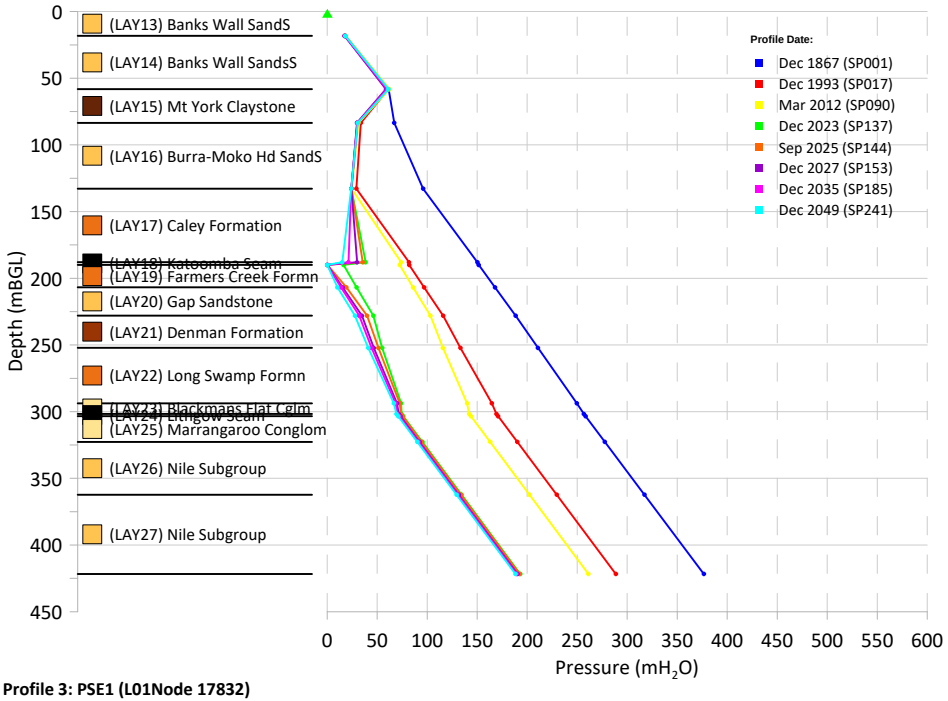
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EPi\Figures\Grapher\68229_R01RevA_D007_PressureVerticalProfile_APR\68229_R01RevA_D007e\68229_R01RevA_D007e_VerticalProfileExtraction_Pressure_08_CSP6_CSP34_PSE1_PSE2.gpf



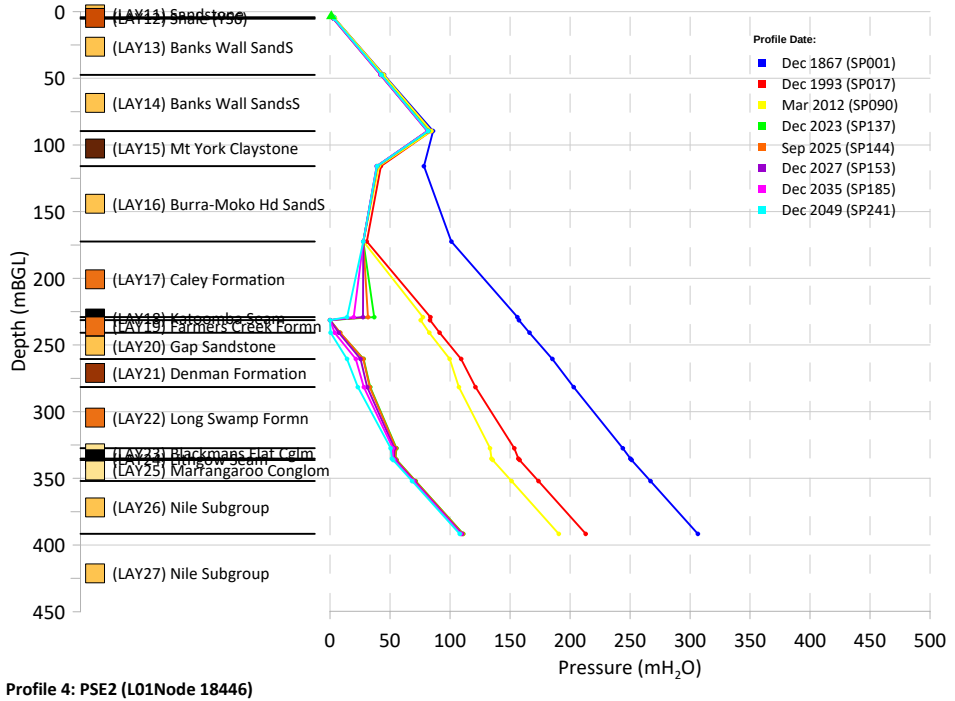
Profile 1: CSP6 (L01Node 12353)



Profile 2: CSP34 (L01Node 15878)



Profile 3: PSE1 (L01Node 17832)



Profile 4: PSE2 (L01Node 18446)

Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 23/10/2025	
Drawn By: DAW	
Checked By: JRWB	

Figure 4.79d: Depth versus Groundwater Pressure Diagrams (Prediction Period - Proposed Case) - CSP6, CSP34, PSE1, PSE2

Reference: 68229_R01RevA_PRO_02a.

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo018EPI\Figures\Grapher\68229_R01RevA_D008_PressureVerticalProfile_PRO\68229_R01RevA_D008e\68229_R01RevA_D008e_VerticalProfileExtraction_Pressure_08_CSP6_CSP34_PSE1_PSE2.grf

CSP36, L01Node 16613, CSP4 and CSP35

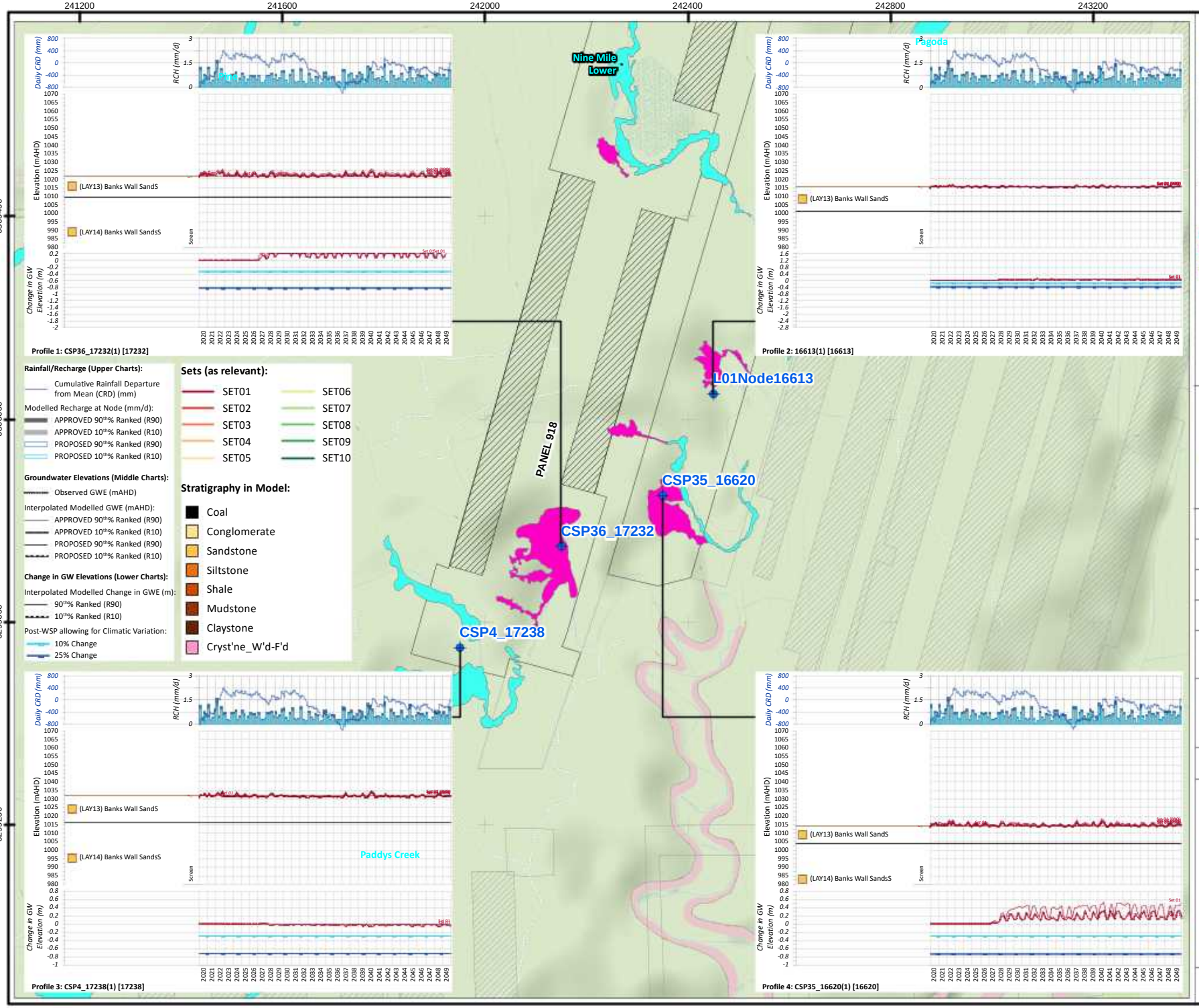
From **Figure 4-80a**, modelled output at swamp monitoring piezometers, including CSP36 and CSP35, shows there will be a small (change is 5 to 10%) to medium (change is 10 to 25%) increase in elevation of the highest active node.

From **Figure 4-80a**, modelled output along the swamp location, L01Node 16613, shows there will be a small (change is 5 to 10%) increase in elevation of the highest active node.

From **Figure 4-80a**, modelled output along swamp monitoring piezometer, CSP4, shows there will be a negligible (change is less than 5%) decline in elevation of the highest active node.

From **Figure 4-80b**, modelled output shows that beneath the swamp locations, there are large (change is greater than 25m) declines to groundwater elevation that occur in the Katoomba Seam (Layer 18). In the Caley Formation (Layer 17), there are medium (change is 10 to 25m) declines to groundwater elevation. From the Burra-Moko Head Sandstone (Layer 16) to ground surface the changes to groundwater elevation are negligible (change is less than 2m). Similarly, the range in uncertainty is wider in the Katoomba Seam (Layer 18) and diminishes with increasing elevation to ground surface.

From **Figure 4-80c** and **Figure 4-80d**, groundwater pressure in all four swamp locations, experience completely depressurisation in the Katoomba Seam (Layer 18), that propagates vertically downwards. There are no discernible changes to groundwater pressure vertically above the Mount York Claystone (Layer 15) through to ground surface.



Legend:

- Model Output Locations

Mining Methods:

- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:

- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):

- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Notes:
1) GWE: Groundwater Elevation.
2) 10% and 25% threshold calculated based on model output between 01/01/2011 and 31/12/2021.
3) CRD Trace dates from 01/01/2010 - 31/12/2049.
4) Observations are translated, to be representative, of the centre of each cell for purpose of comparison.

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 28-Oct-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:10,000

0 200 400
Meters

Coor. Sys. GDA 1994 MGA Zone 56

Groundwater Hydrographs (Prediction Period):

- **CSP36**
- **L01Node16613**
- **CSP4**
- **CSP35**

FIGURE: 4.80a

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D009i_UA_Hydrographs_CSP36_16613_CSP4_CSP35.mxd

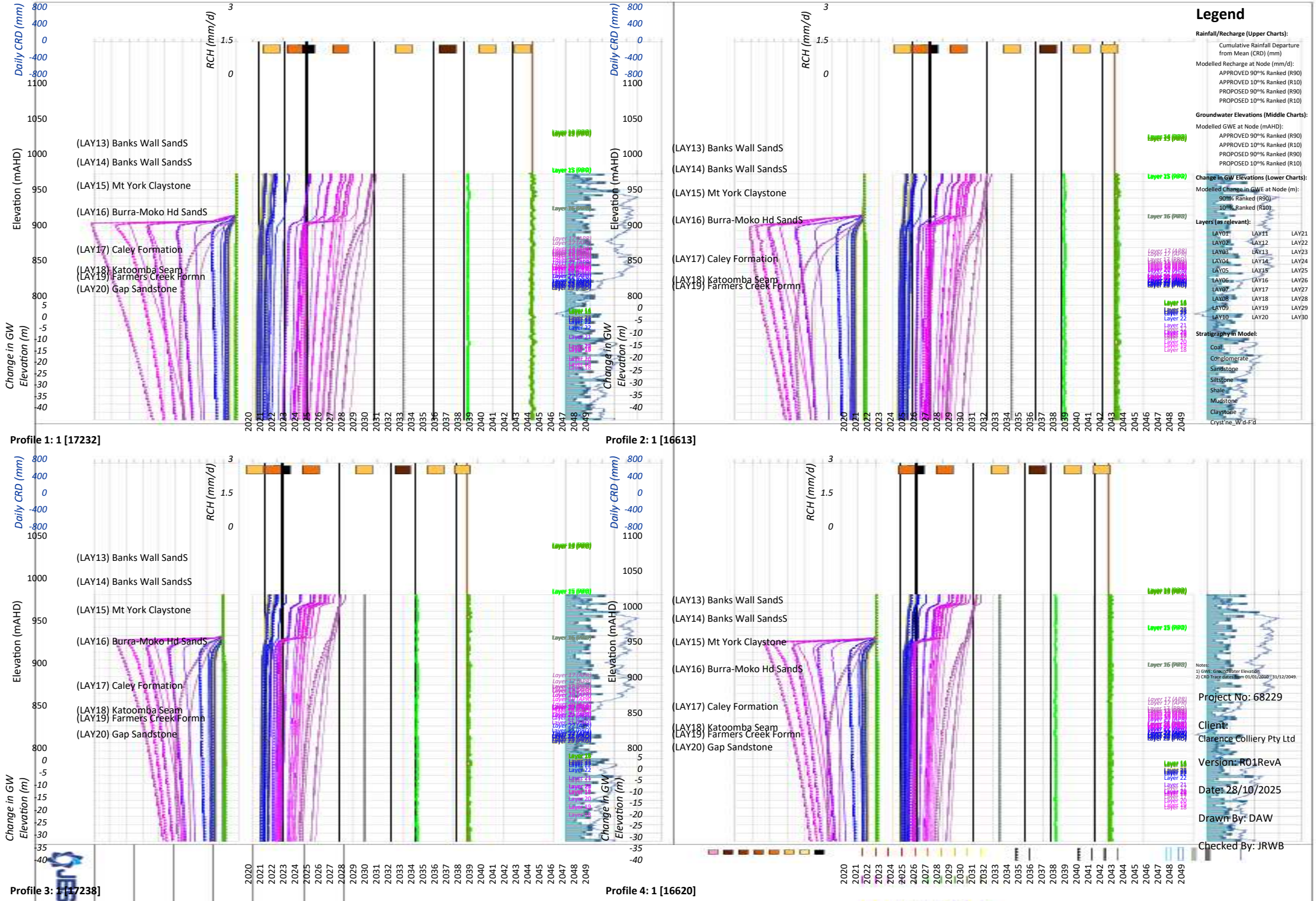
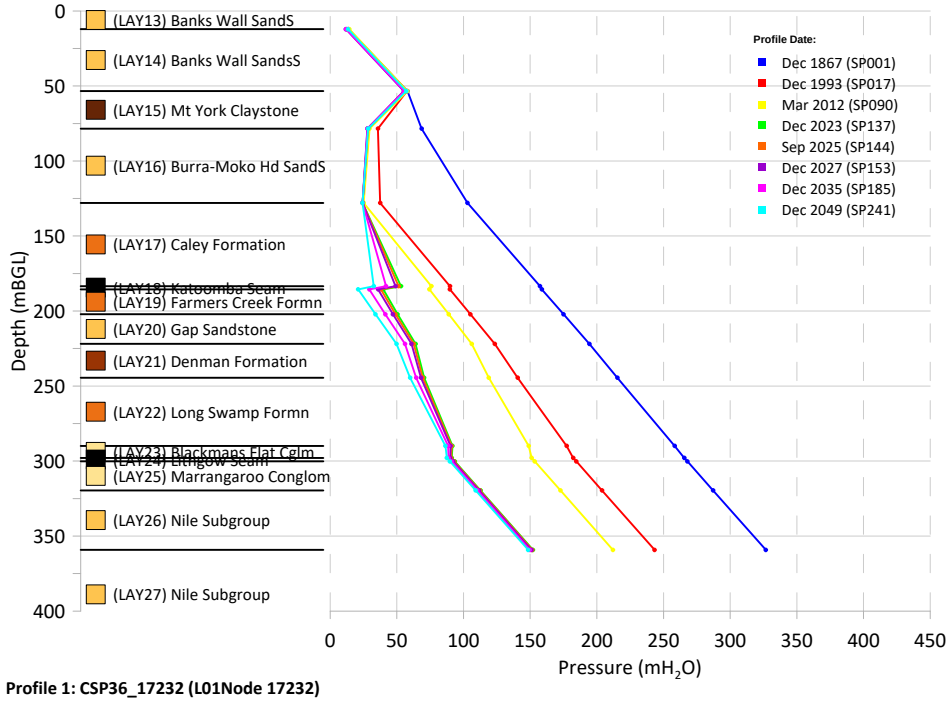
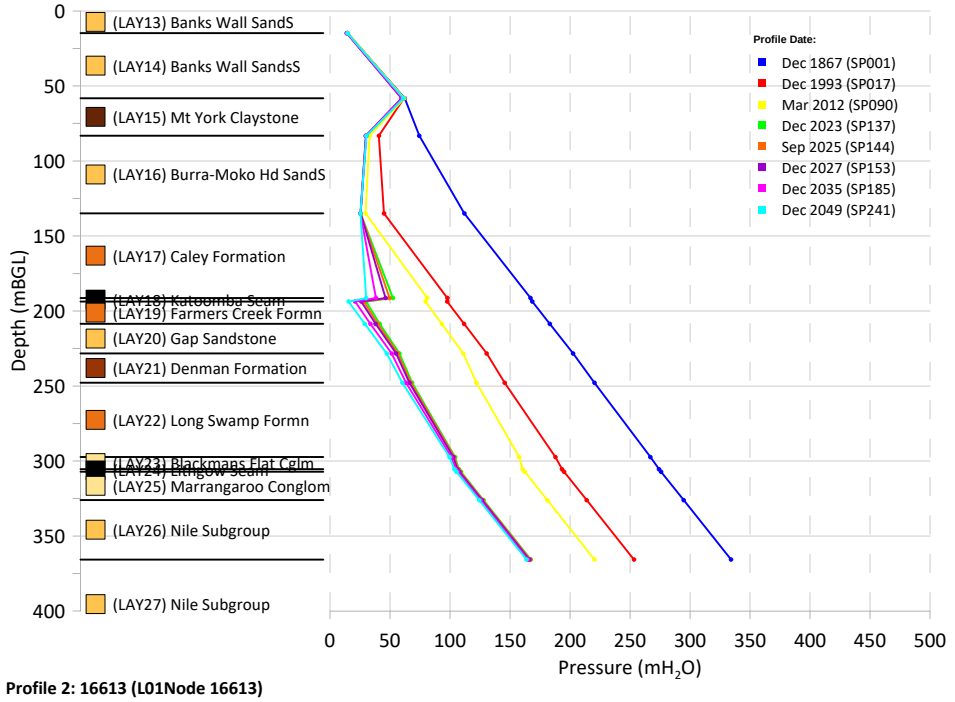


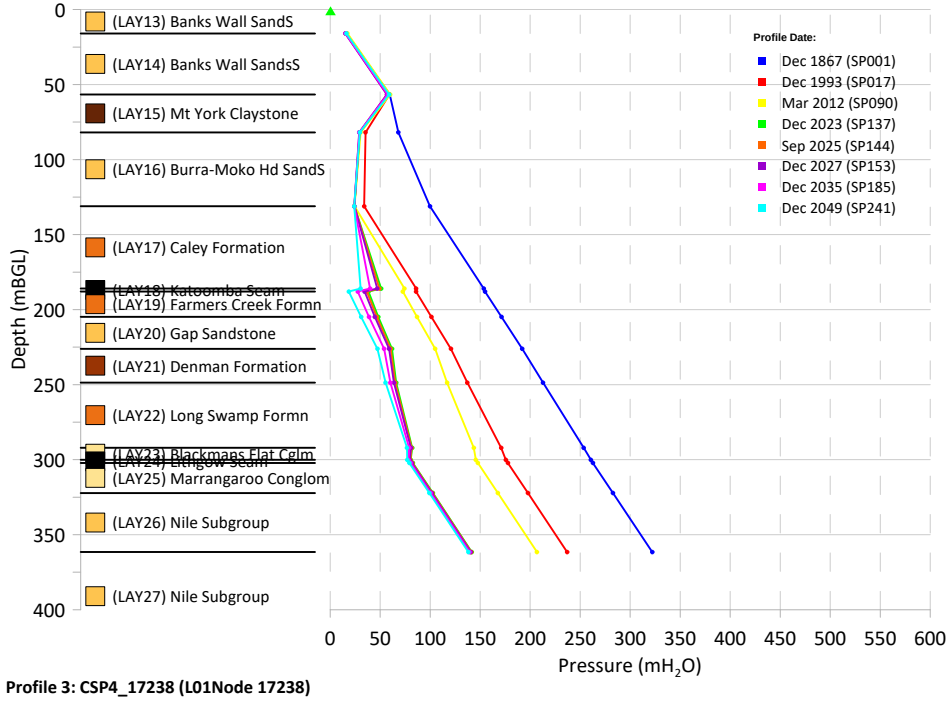
Figure 4.80b: Groundwater Hydrographs (Prediction Period) - CSP36, L01Node16613, CSP4, CSP35



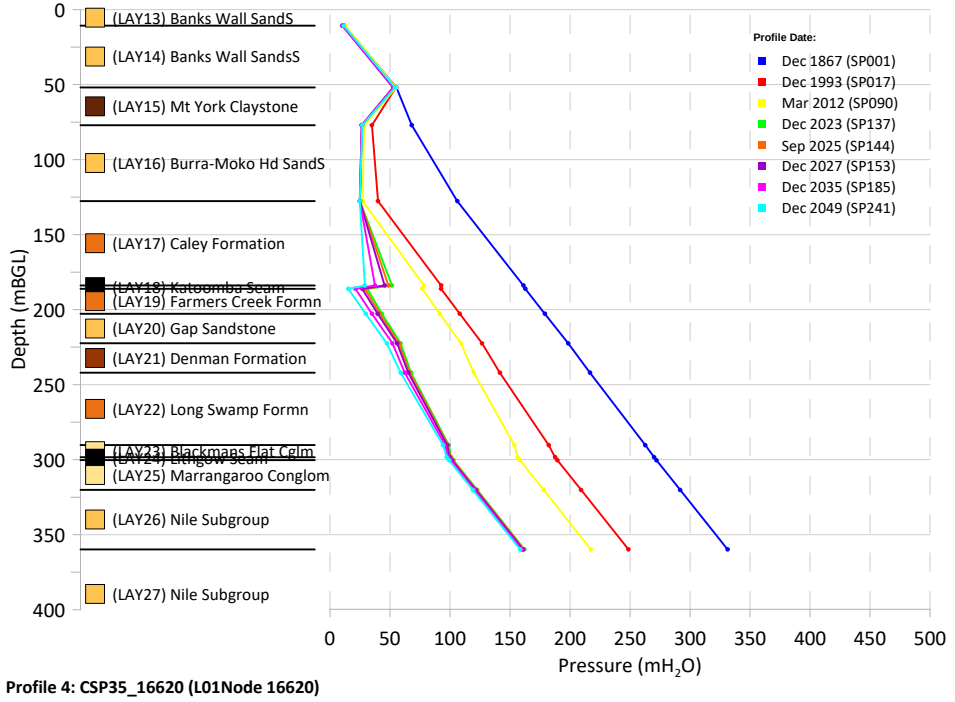
Profile 1: CSP36_17232 (L01Node 17232)



Profile 2: 16613 (L01Node 16613)



Profile 3: CSP4_17238 (L01Node 17238)



Profile 4: CSP35_16620 (L01Node 16620)

Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:

Project No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA

Date: 27/10/2025

Drawn By: DAW

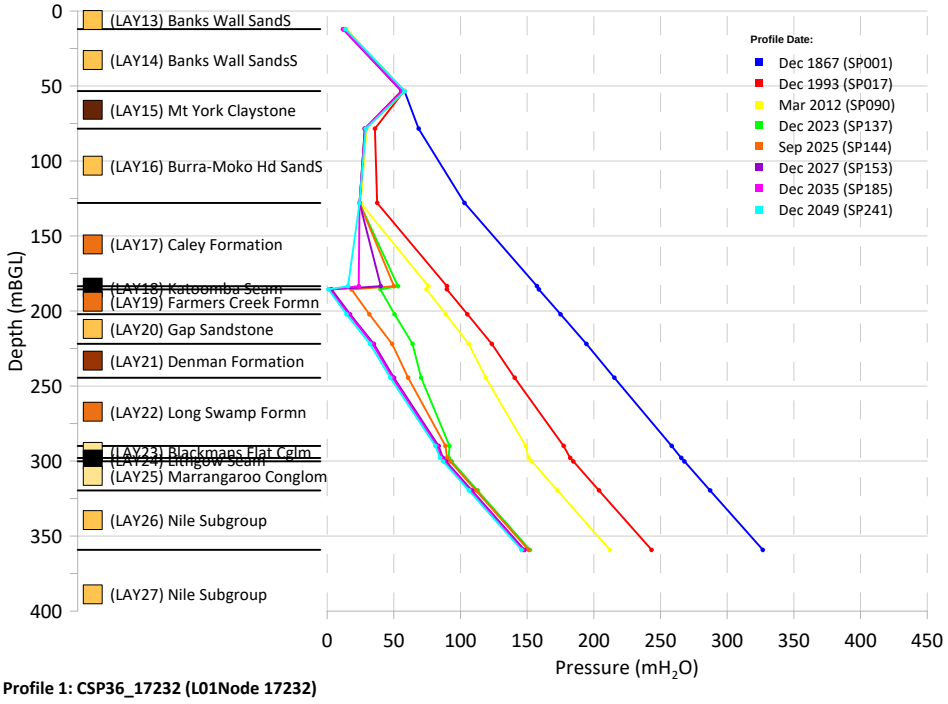
Checked By: JRWB

JBS&G

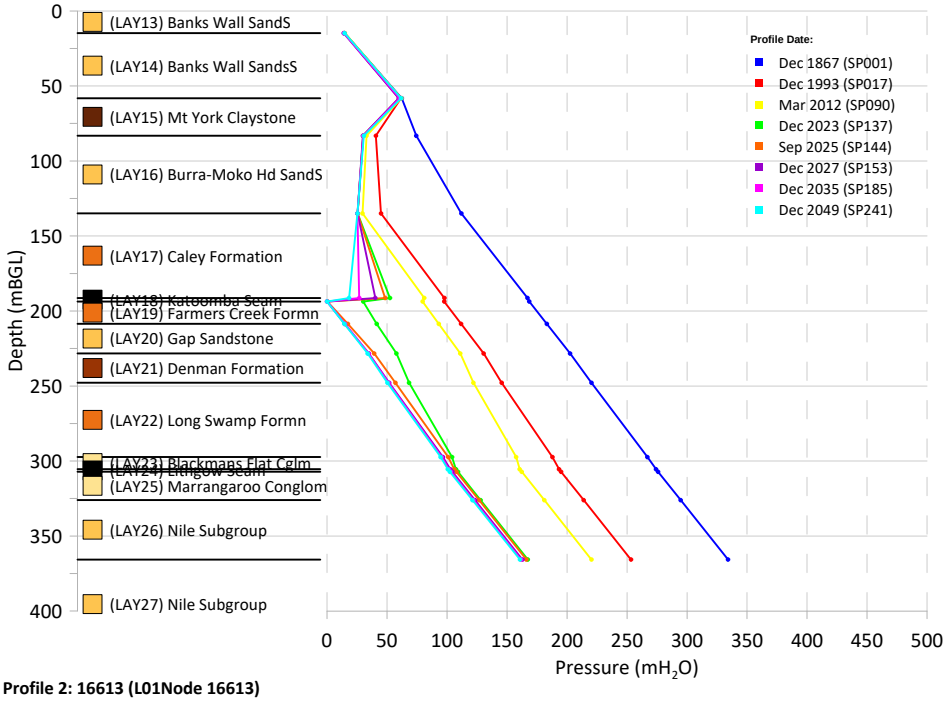
Figure 4.80c: Depth versus Groundwater Pressure Diagrams (Prediction Period - Approved Case) - CSP36, L01Node16613, CSP4, CSP35

Reference: 68229_R01RevA_APR_03c.

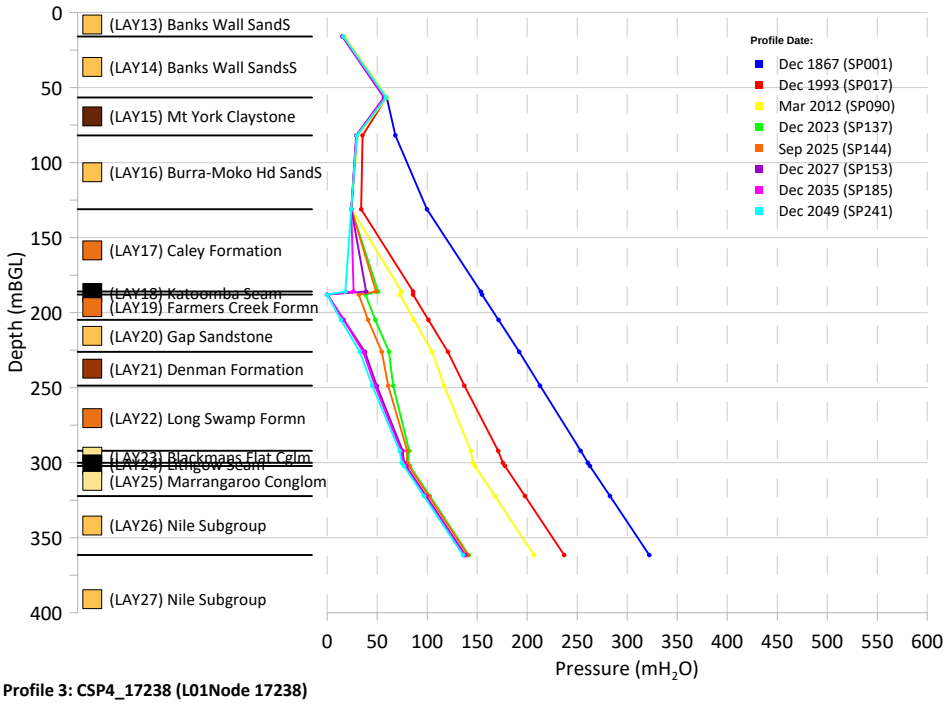
File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Grapher\68229_R01RevA_D007_PressureVerticalProfile_APR\68229_R01RevA_D007\68229_R01RevA_D007_VerticalProfileExtraction_Pressure_201_CSP36_16613_CSP4_CSP35.grf



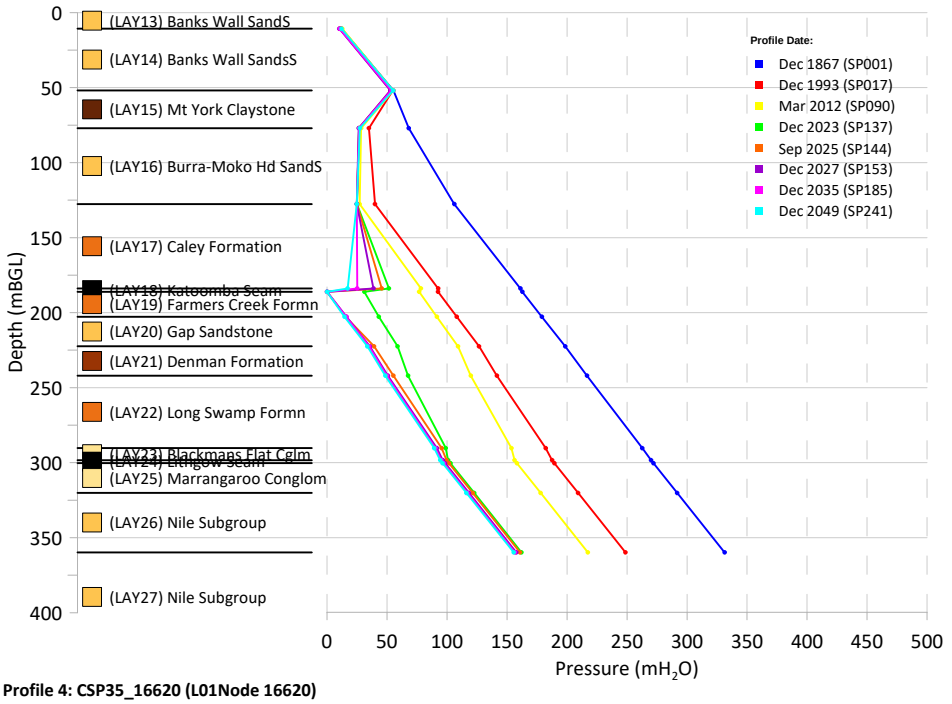
Profile 1: CSP36_17232 (L01Node 17232)



Profile 2: 16613 (L01Node 16613)



Profile 3: CSP4_17238 (L01Node 17238)



Profile 4: CSP35_16620 (L01Node 16620)

Legend

Profile Type:
Modelled — Observed

Stratigraphy in Model:
- Coal
- Conglomerate
- Sandstone
- Siltstone
- Shale
- Mudstone
- Claystone
- Cryst'ne_W'd-F'd

Notes:

Project No: 68229	
Client: Clarence Colliery Pty Ltd	
Version: R01RevA	
Date: 27/10/2025	
Drawn By: DAW	
Checked By: JRWB	

JBS&G

Figure 4.80d: Depth versus Groundwater Pressure Diagrams (Prediction Period - Proposed Case) - CSP36, L01Node16613, CSP4, CSP35

Reference: 68229_R01RevA_PRO_02a.

File Path: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\Graphs\68229_R01RevA_D008_PressureVerticalProfile_PRO\68229_R01RevA_D008\68229_R01RevA_D008_VerticalProfileExtraction_Pressure_201_CSP36_16613_CSP4_CSP35.grf

4.15.5.9 Modelled Change to Groundwater Contribution to Surface Water

The categorisation of change to groundwater contribution to surface water is presented in the Nomenclature. A negligible change is considered to be a change of less than 10%.

The modelled change to groundwater contribution to surface water was calculated using the USGS MODFLOW utility ZonBudUSG. The .ZONE file was created by mapping each DRN (Drain) boundary condition associated with watercourse and water body, seepage face and surface overland flow to the catchments of the Swamp Water Balance Model developed for Springvale Mine / Angus Place Colliery. A similar exercise was undertaken for RIV (River) boundary conditions. The Swamp Water Balance Model includes catchments that overlie Clarence Colliery. ZonBudUSG was then run to extract changes to DRN (Drain) and RIV (River) associated with the respective .ZONE files.

Output for zones within the .ZBLST file were then collated by a JBS&G custom-developed script into ranked output at catchment outlets. This was undertaken for all 286 pairs of simulations. Output presented below is with respect to the 10th percentile ranked value (R10) and 90th percentile ranked value (R90).

It is noted that for outflow from each boundary condition, being watercourse and water body, seepage faces, surface overland flow or river, (collated on a subcatchment basis) an adjustment was made to account for loss between point of exit from the groundwater system into a surface water system.

The adjustment factors were as follows:

- 0.2 (loss of 80%) for Seepage Faces
- 0.8 (loss of 20%) for Watercourse/Waterbody
- 0.6 (loss of 40%) for Surface Overland Flow
- 1.0 (loss of 0%) for River.

These adjustment factors were determined during the original development of the Swamp Water Balance Model via calibration.

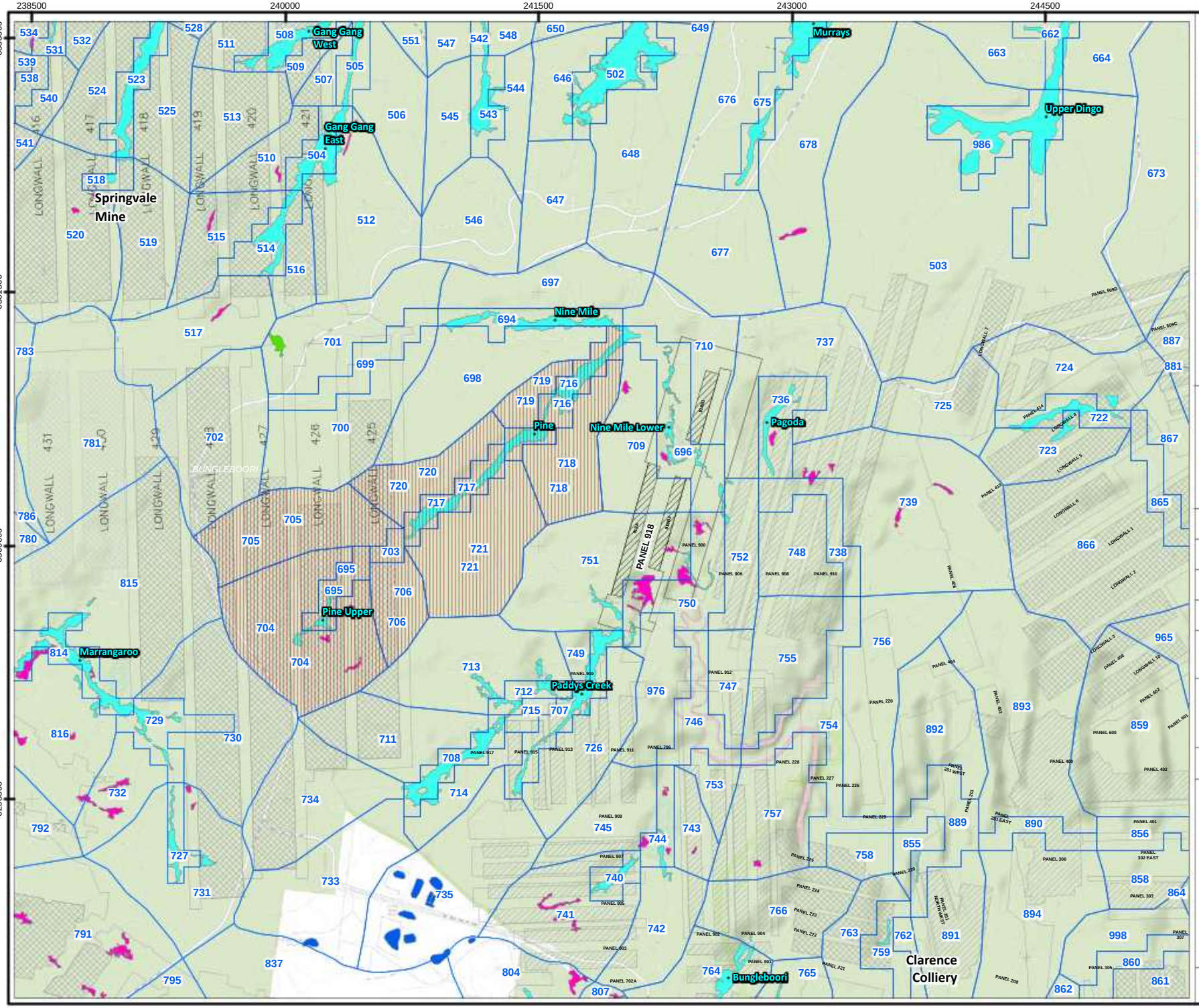
Figure 4-81 presents the surface water catchments that were used to calculate modelled groundwater contribution to surface water.

Pine Swamp (Node 716)

Figure 4-81a presents the surface water catchments from the Swamp Water Balance Model that contribute to Node 716.

Figure 4-82 presents the collated modelled groundwater contribution to surface water for the Proposed Case and the Approved Case. Collated output is presented from 31 December 2009 (SP081) to 31 December 2049 (SP241).

From **Figure 4-82**, modelling indicates that there is a negligible (change is less than 5%) decrease in groundwater contribution to surface water between the Proposed Case and Approved Case.



Legend:

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):
- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Modelling:
- Surface Water Catchments
- Selected Catchment

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 05-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:30,000

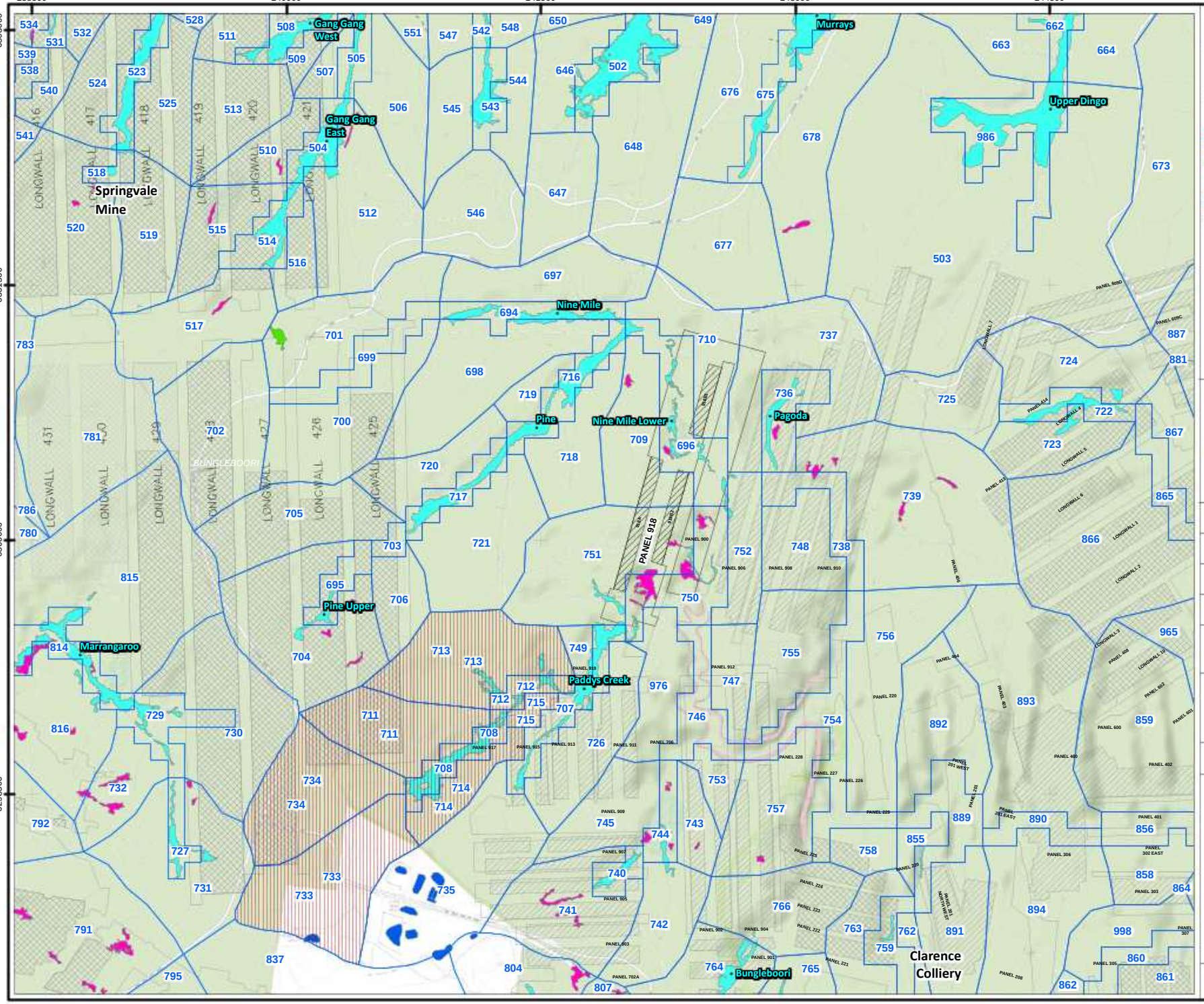
0 0.5 1
km

Coor. Sys. GDA 1994 MGA Zone 56

Surface Catchments - Pine Swamp (Node 716)

FIGURE: 4.81a

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D052a_Catchments_Node716.mxd



Legend:

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):
- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Modelling:
- Surface Water Catchments
- Selected Catchment

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 05-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:30,000

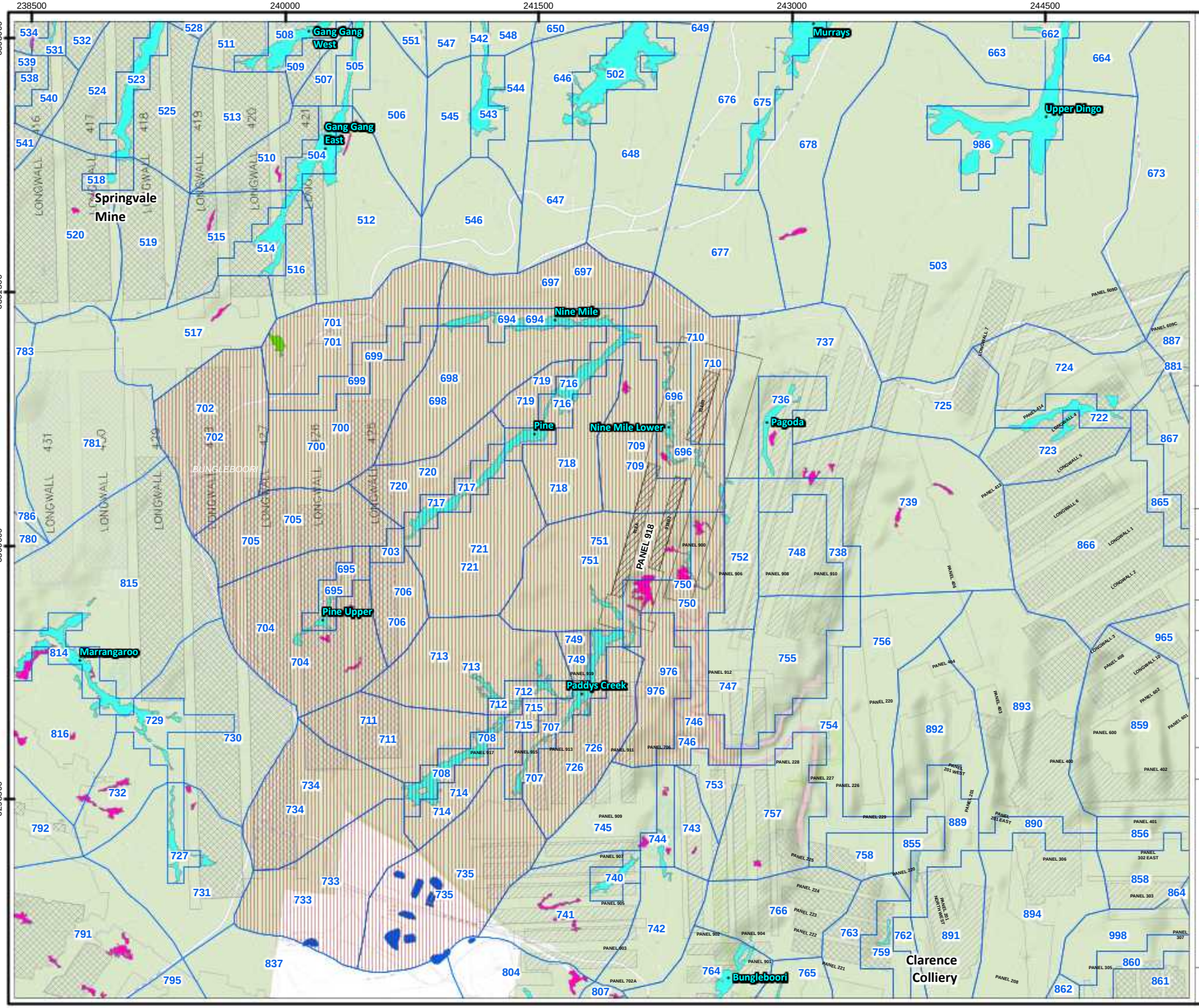
0 0.5 1
km

Coor. Sys. GDA 1994 MGA Zone 56

Surface Catchments
- Paddys Creek Swamp (Node 712)

FIGURE: 4.81b

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D052b_Catchments_Node712.mxd



Legend:

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):
- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Modelling:
- Surface Water Catchments
- Selected Catchment

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 05-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:30,000

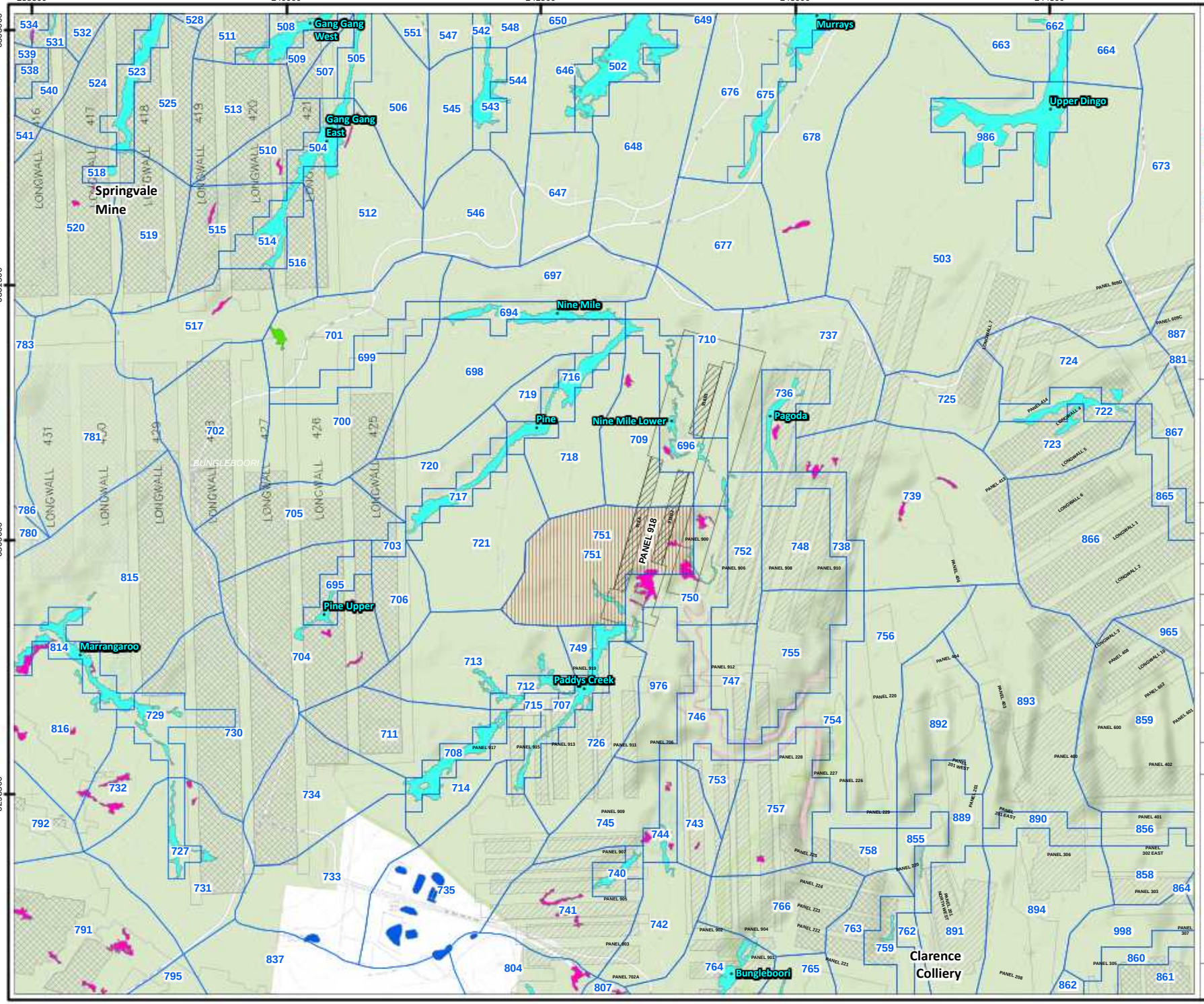
0 0.5 1
km

Coor. Sys. GDA 1994 MGA Zone 56

Surface Catchments
- Bungleboori Creek (Node 746)

FIGURE: 4.81c

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D052c_Catchments_Node746.mxd



Legend:

Mining Methods:
- Development
- Partial Extraction
- Total Extraction
- Open Cut

Mine Operation Status:
- Approved
- Existing
- Proposed
- Other Proposed

Swamps by MU Name (Clarence, 2025bc):
- 50 Newnes Plateau Shrub Swamp (EEC)
- 51 Newnes Plateau Hanging Swamp (EEC)
- 52 Newnes Plateau Rush - Sedge - Snow Gum Hollow Wooded Heath (EEC)

Modelling:
- Surface Water Catchments
- Selected Catchment

JBS&G

Job No: 68229

Client: Clarence Colliery Pty Ltd

Version: R01RevA	Date: 05-Nov-2025
Drawn By: DAW	Checked By: JRWB

Scale 1:30,000

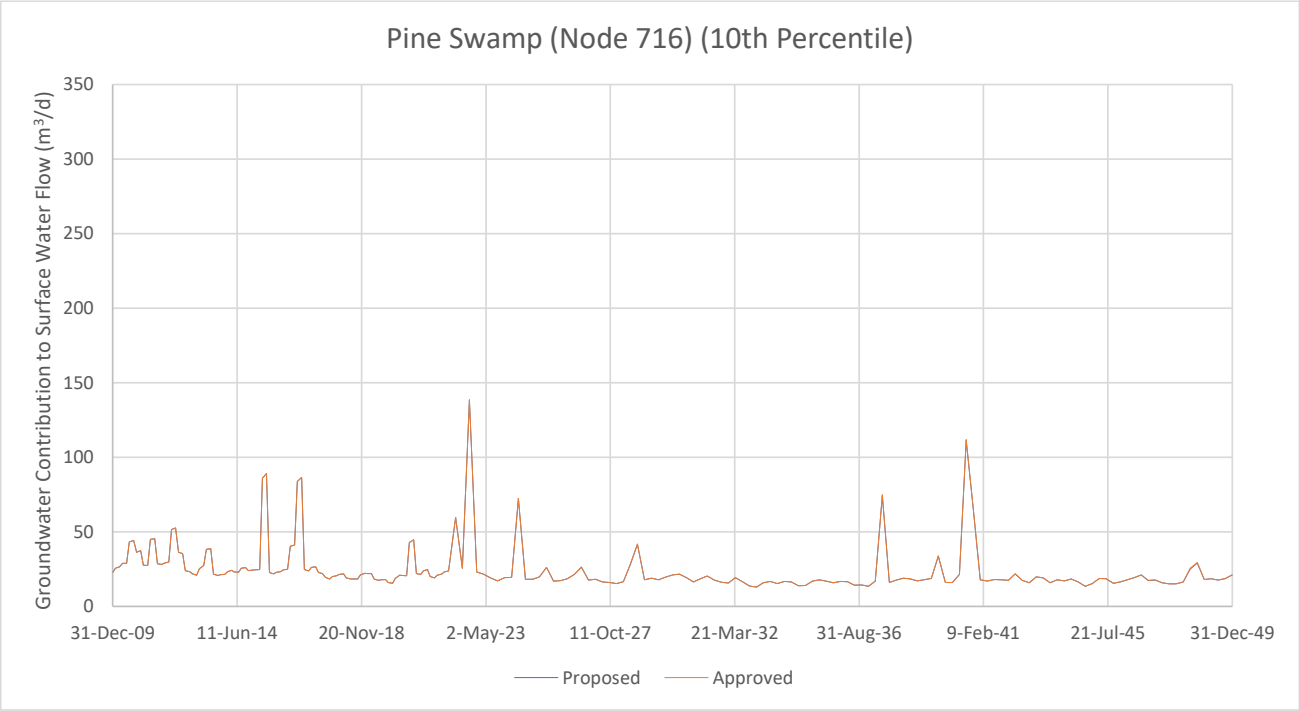
0 0.5 1
km

Coor. Sys. GDA 1994 MGA Zone 56

Surface Catchments
- Paddys Creek Upper (Node 751)

FIGURE: 4.81d

File Name: N:\Projects\CentennialCoal\ClarenceColliery\68229_UpdateTo918EP\Figures\GIS\Maps\68229_R01RevA_D052d_Catchments_Node751.mxd



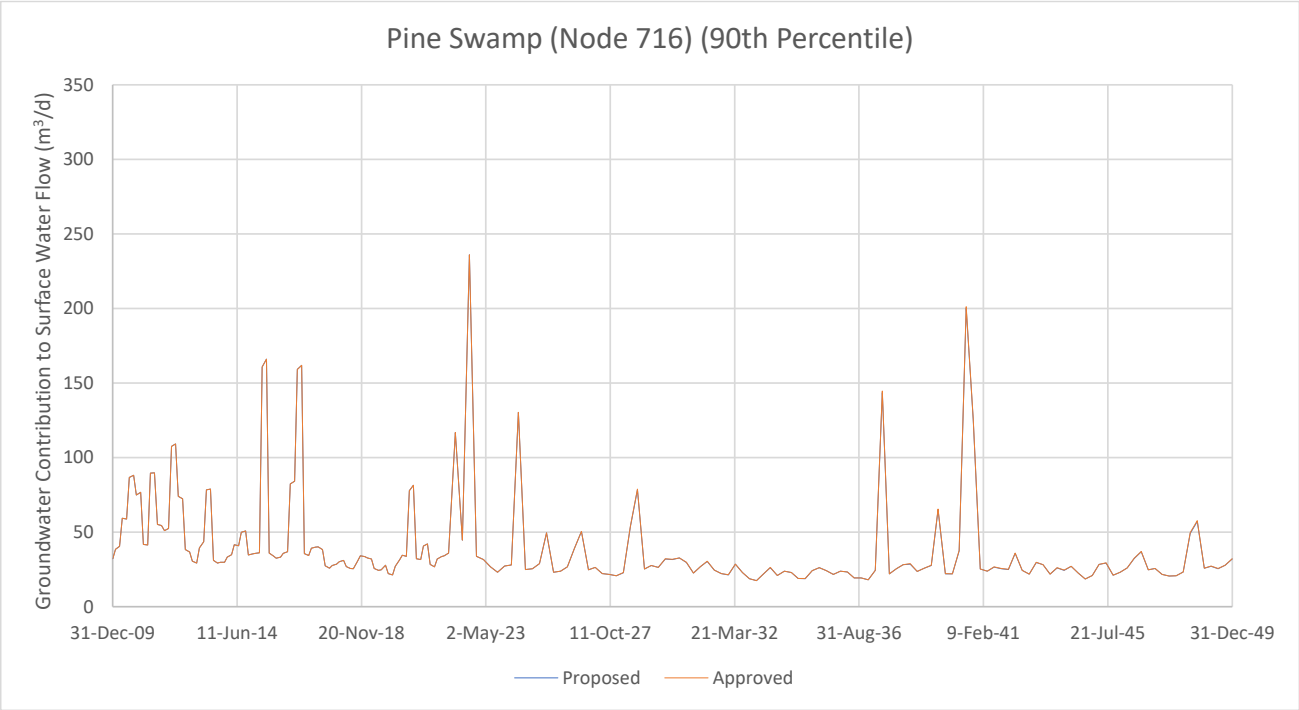


Figure 4-82: Modelled Groundwater Contribution to Surface Water – Prediction Simulation (Stochastic): Pine Swamp (Node 716)

Paddys Creek Swamp (Node 712)

Figure 4-81b presents the catchments contributing to Paddys Creek Swamp (Node 712).

Figure 4-83 presents the collated modelled groundwater contribution to surface water flow to Paddys Creek Swamp (Node 712) for the Proposed Case and Approved Case.

From **Figure 4-83**, modelling indicates that there is a negligible (change is less than 5%) decrease in groundwater contribution to surface water between the Proposed Case and Approved Case.

Bungleboori Creek, below junction of Swamps (Node 746)

Figure 4-81c presents the catchments contributing to Bungleboori Creek (Node 746).

Figure 4-84 presents the collated groundwater contribution to surface water flow to Bungleboori Creek (Node 746) for the Proposed Case and Approved Case.

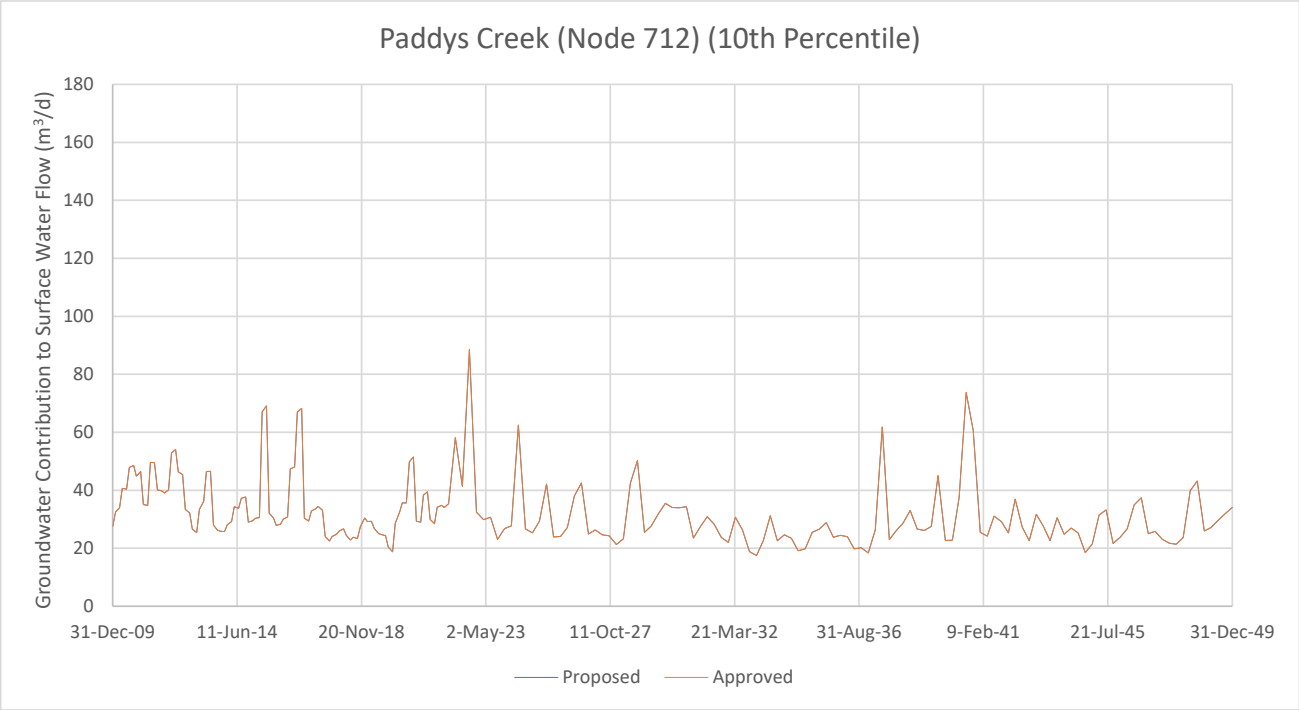
From **Figure 4-84**, modelling indicates that there is a negligible (change is less than 5%) increase in groundwater contribution to surface water between the Proposed Case and Approved Case.

Paddys Creek Tributary (Node 751)

Figure 4-81d presents the catchment contributing to the unnamed tributary that leads into Paddys Creek (Node 751).

Figure 4-85 presents the collated groundwater contribution to surface water flow to Paddys Creek Tributary (Node 751) for the Proposed Case and Approved Case.

From **Figure 4-85**, modelling indicates that there is a negligible (change is less than 5%) increase in groundwater contribution to surface water between the Proposed Case and Approved Case. There is an approximately 2.8% increase in both the 10^{th} and 90^{th} percentile groundwater contribution to surface water flow.



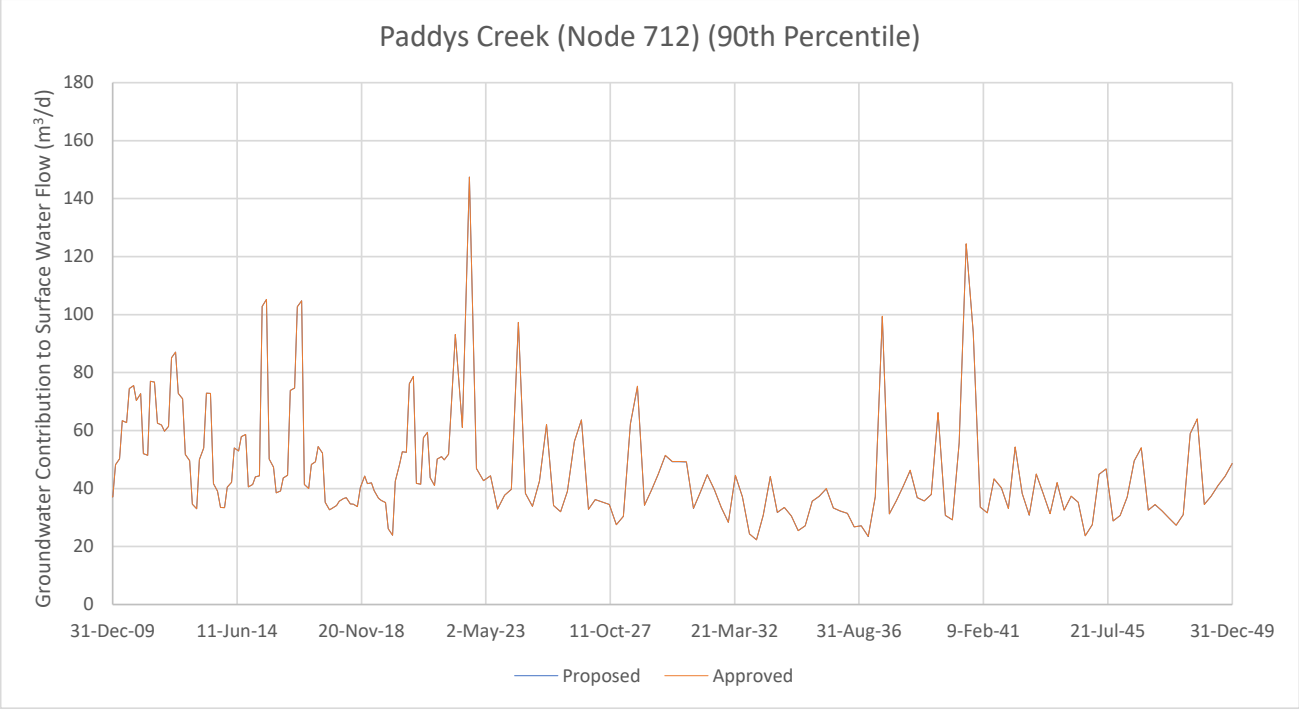
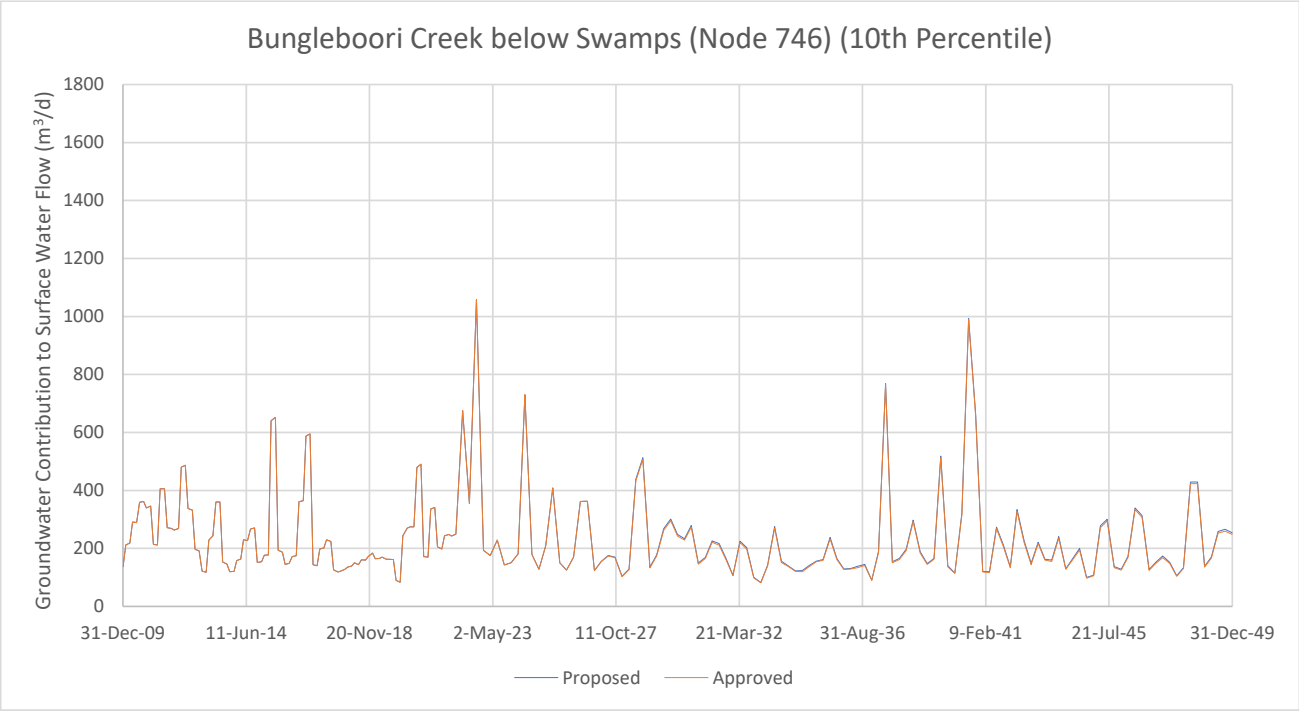


Figure 4-83: Modelled Groundwater Contribution to Surface Water – Prediction Simulation (Stochastic): Paddys Creek (Node 712)



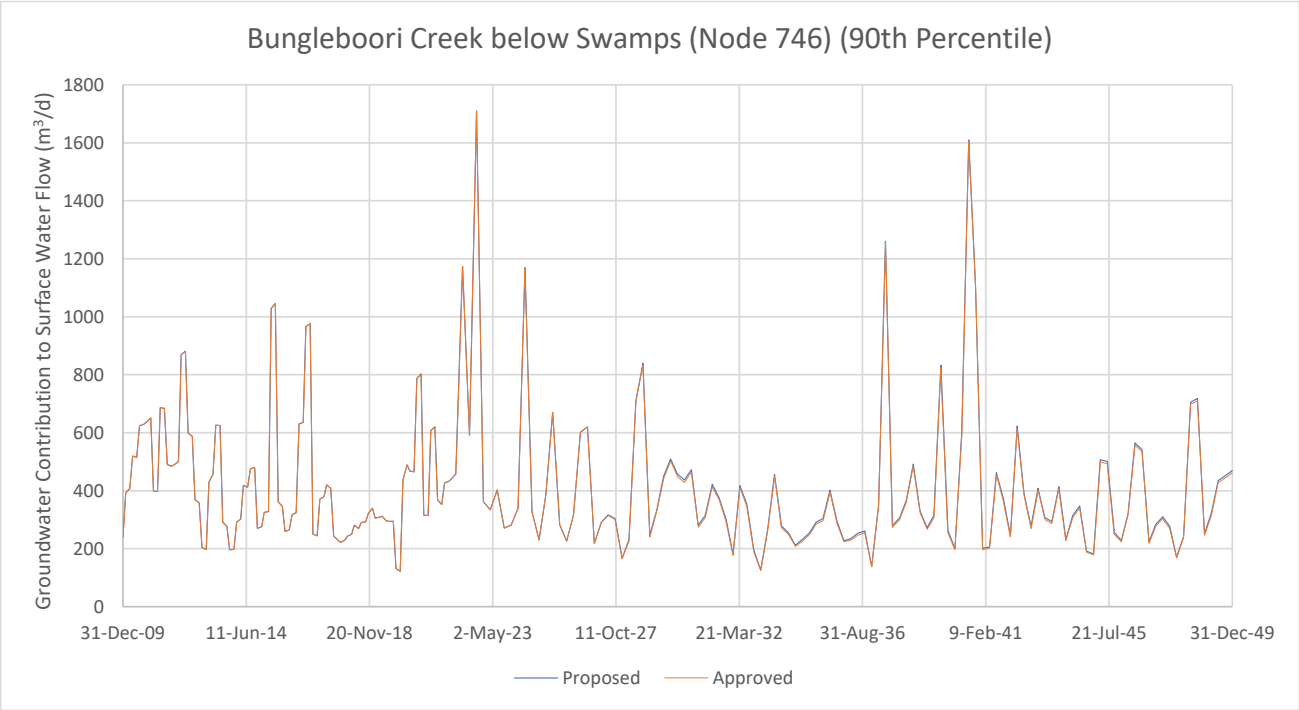
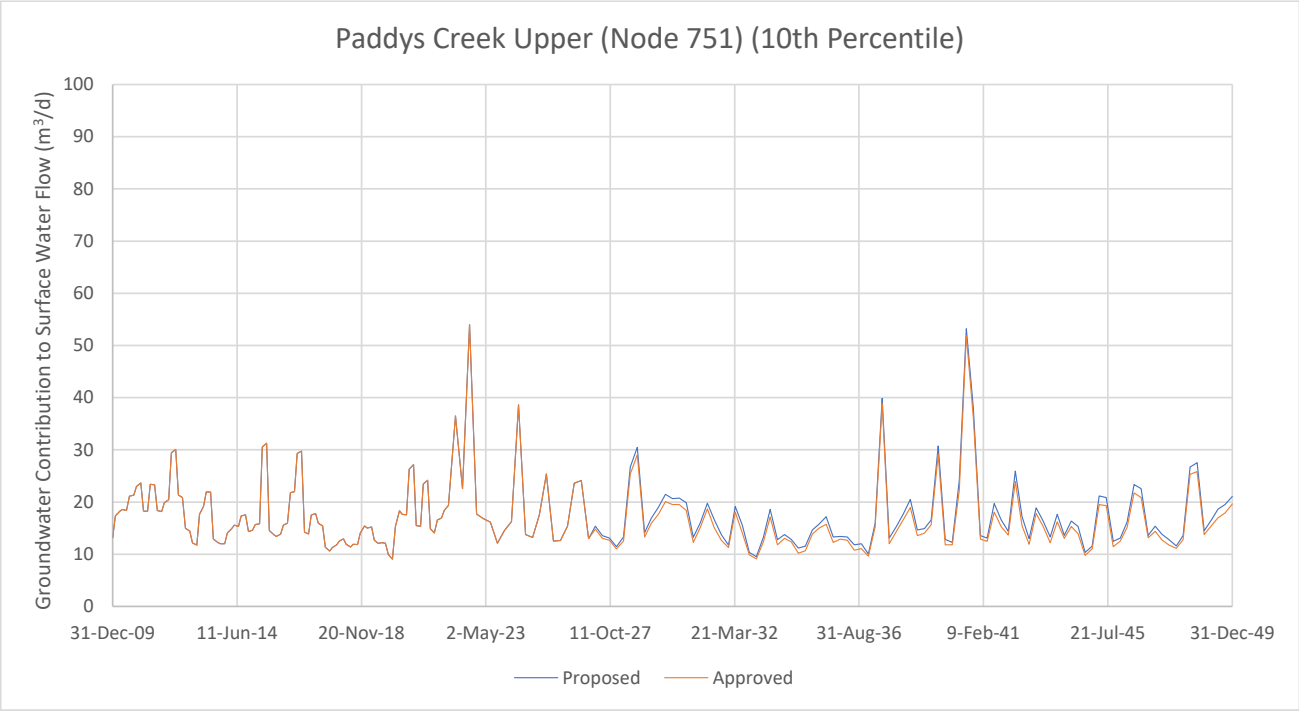


Figure 4-84: Modelled Groundwater Contribution to Surface Water – Prediction Simulation (Stochastic): Bungleboori Creek (Node 746)



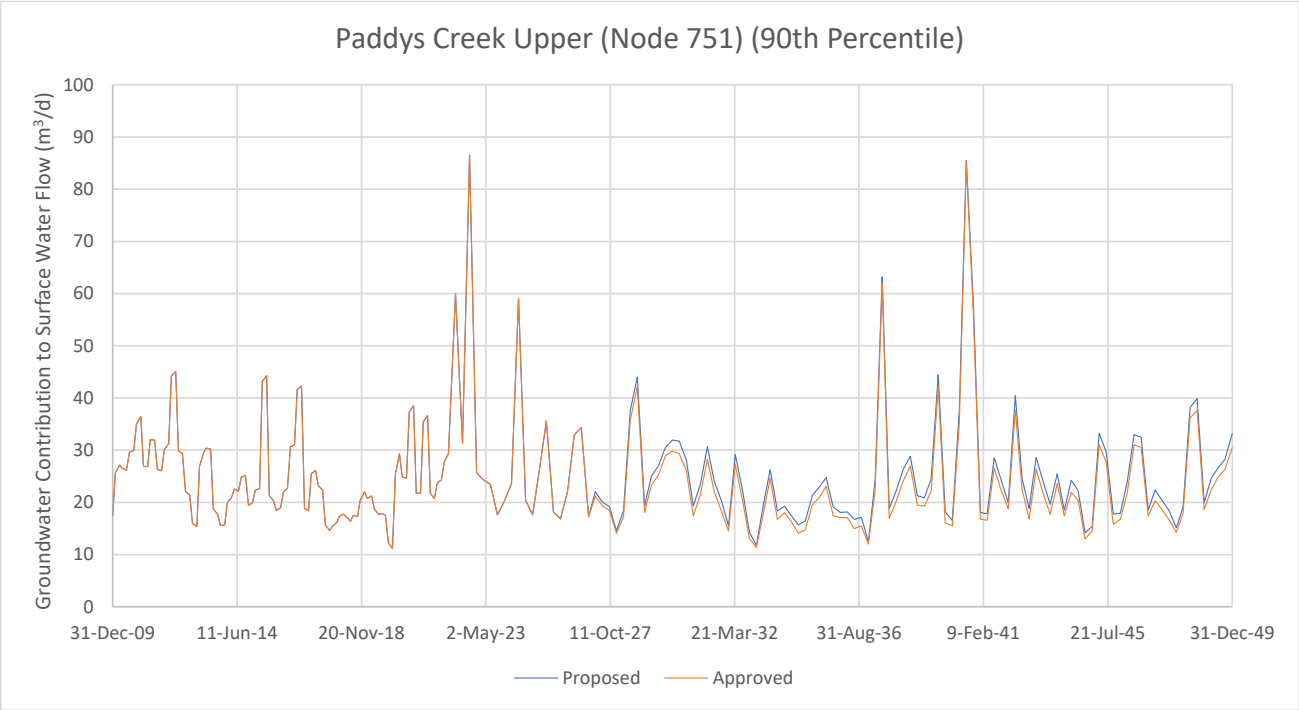


Figure 4-85: Modelled Groundwater Contribution to Surface Water – Prediction Simulation (Stochastic): Paddys Creek Upper (Node 751)

4.16 Scenario Analysis – Mine Design Parameters

To identify the dependence of model predictions on mine design parameters, another set of 300 sets of randomised parameters were generated via the Latin Hypercube Sampling technique (refer **Section 4.14.1**).

The 300 sets consisted the same parameters as presented in **Section 4.14.1**, except that all non mine design related parameters were fixed. That required modification of the large, composite Jacobian, before use of the Latin Hypercube Sampling methodology.

Following completion of stochastic simulations, the same issue identified in **Section 4.14.1**, was identified and the same solution implemented, namely excising the particular SP and TS associated with localised issues with the head (.HDS) files.

Following review, 285 of the 300 sets of simulations were utilised in this report. Sets of simulations (after excising the abovementioned model output times) were excluded if any particular model did not converge, and the residual was more than 0.5m, at a particular stress period.

Appendix H presents the ranked change in groundwater elevation between the Approved Case and Proposed Case using the same approach and output times as presented in **Section 4.15.5.7**.

From **Appendix H**, for the 10th percentile change in groundwater elevation contours for "Proposed Case – Mine Design Parameters" are all slightly within the "Proposed Case". This makes sense, because the 'maximum drawdown' is due to the influence of 'mine design parameters'.

From **Appendix H**, for the 90th percentile change in groundwater elevation contours, there is a significant difference between the "Proposed Case – Mine Design Parameters" and the "Proposed Case". This is because 'other-than-mine design parameters' are important in the 'minimum drawdown' output.

Scenario analysis indicates that for 10th percentile ranked change ('maximum drawdown'), mine design parameters are important, but are far less important for 90th percentile ranked chang ('minimum drawdown').

4.17 Scenario Analysis – Climate Change

Due to the short duration of Extraction Plan for 918 Panel, and that this is part of an Extraction Plan, rather than a Modification to Consent, climate change scenario analysis was not considered to be required.

4.18 Summary of Model Predictions

Mine Dewatering Rate

Analysis indicates that there is a negligible increase (change is less than 10%) in mine dewatering rate of approximately 0.9ML/d by July 2027 (SP152) for the Proposed Case compared to the Approved Case. In the long-term, there is a negligible increase in mine dewatering rate of approximately 0.2ML/d for the Proposed Case compared to the Approved Case. This negligible increase to modelled mine dewatering rate will be accommodated through existing water management infrastructure. It is also considered that the increase has an insignificant effect on licensable take.

The observed increase in mine dewatering rate for 908-910 Panel Area (double-sided lifting; Model Mining Method = 3) was an initial increase of 0.7ML/d, which then decline to near zero. This observation is consistent with that predicted for 918 Panel.

Groundwater Elevation and Pressure

For the Proposed Case, modelling indicates that the change in groundwater elevation of the highest active node is small (change is between 0.5 to 2m, with respect to the highest active node), directly above 918 Panel. The change to elevation of the highest active node diminishes with distance from 918 Panel to become negligible (change is less than 0.5m). At depth, in the immediate vicinity of 918 Panel, there is a negligible (change is less than 2m) decline in groundwater elevation in the Mount York Claystone (Layer 15), and a large

(change is greater than 25m) decrease in groundwater elevation in the Katoomba Seam (Layer 18), as expected.

For the Proposed Case, modelling indicates that the relatively higher groundwater elevation, and corresponding higher groundwater pressure, that exists between Springvale Mine and 918 Panel at Clarence Colliery. The reduction in lateral replenishment of groundwater is the explanation of the decline in groundwater elevation to the north of 918 Panel. That decline is not significant, since both Springvale Mine and Clarence Colliery are active mining operations.

Groundwater hydrographs along Lower Nine Mile Shrub and Hanging Swamps (CSP1, CSP2, CSP34, L01Node 16613, CSP35) and Paddys Creek Shrub and Hanging Swamps (PSE1, PSE2, CSP4 and CSP36) are negligible (change is less than 5%) to small (change is 5 to 10%) with respect to decline of elevation of the highest active node for groundwater dependent ecosystems. At the monitoring location CSP2 located in Lower Nine Mile Shrub Swamp above 918 Panel, there are medium (change is 10 to 25%) transitory declines, in elevation of the highest active node. That change is considered insignificant as it is transitory and do not lead to long-term change. For that location, 90th% modelled change in groundwater elevation is negligible.

Accordingly, groundwater hydrographs indicate that, for groundwater dependent ecosystems in the vicinity of 918 Panel, Level 1 Minimal Impact Considerations of the NSW Aquifer Interference Policy (NSW DCCEEW, 2012) are considered to be met.

Groundwater Contribution to Surface Water

Analysis indicates that there is a negligible (change is less than 5%) change in groundwater contribution to surface water when comparing the Proposed Case to the Approved Case. There is a negligible decrease in groundwater contribution to surface water for catchments including Pine Swamp and Paddys Creek Swamp. There is a negligible increase in groundwater contribution to surface water for catchments including Bungleboori Creek and tributaries to Paddys Creek.

Of particular note is the modelled increase to Paddys Creek Swamp (Node 751; refer **Figure 4-85**), where model output (both 10th% and 90th% stochastic output) confirms the interpretation presented with respect to modelled change to uppermost water table at that location (see **Figure ES.4** and **Figure 4-36** (replicated as **Figure ES.6**)). That interpretation was, due to the locally steep topography in that area, which is at the scale of model grid, the modelled elevation of the water table is below ground surface and reflects the uppermost water table beneath the topographic ridgeline, rather the swamp. With subsidence-induced change to hydraulic properties beneath local topographic ridgelines in that area, additional groundwater is released to surface water through seepage faces, and underpins the conclusion that the impact to Paddys Creek Swamp will be insignificant.

5. Impact Assessment

This chapter presents the expected impacts of the Extraction Plan of the 918 Panel, including cumulative impacts, on groundwater dependent ecosystems, groundwater-surface water interaction as well as water management infrastructure at Clarence Colliery.

5.1 Impact Assessment

5.1.1 Approach to Cumulative Impact Assessment

The approach undertaken to assess cumulative change is presented in **Section 4.15.1** and comprised representation of all former and current mining operations in the Western Coalfields.

All surrounding existing and historical mining operations in the Western Coalfields are included in the numerical groundwater model. Mining operations in the vicinity of Clarence Colliery are presented in **Figure 1-1**.

5.1.2 Groundwater Dependent Ecosystems

In accordance with the NSW Aquifer Interference Policy (NSW DCCEEW, 2012), there are several high priority GDEs identified in the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources* 2023 (NSW) in the vicinity of Clarence Colliery. The location of these GDEs are presented in the *High Priority Groundwater-Dependent Ecosystem Map (GDE037_Version 1)*. Additionally, the Temperate Highland Peat Swamps on Sandstone are identified as high priority groundwater dependent ecosystems, with the Lower Nine Mile Shrub and Hanging Swamps and Paddys Creek Shrub and Hanging Swamps located in the vicinity of the 918 Panel.

The "Level 1 Minimal Impact Considerations" threshold of 10% (NSW DCCEEW, 2012), which is the cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any listed high priority groundwater dependent ecosystem, was used as the basis of categorisation of the magnitude of change.

Modelling indicates that the Proposed Case, in the Lower Nine Mile Shrub and Hanging Swamps and Paddys Creek Shrub and Hanging Swamps, will lead to a negligible (change is less than 5%; refer Table NM-B2f) to small (change is 5 to 10%, refer Table NM-B2f) decline in groundwater elevation. In the Lower Nine Mile Shrub Swamp mapped directly above the 918 Panel (refer CSP2 in **Figure 4-78**), there are medium (change is 10 to 25%) transitory declines, in elevation of the highest active node. From **Figure 4-78**, the 90th% modelled change at that location is, however, negligible throughout. The modelled changes at this location is therefore considered to be insignificant.

Modelling indicates that the impact of implementation of the Extraction Plan for 918 Panel will be insignificant.

5.1.3 Groundwater/Surface Water Interaction

Three aspects are considered with respect to groundwater/surface water interaction:

- Change to elevation of the highest active node with respect to groundwater dependent ecosystems, described above
- Change to groundwater contribution to surface water flow
- Change to groundwater quality and surface water quality.

As described in **Section 5.1.2**, modelling indicates that implementation of Extraction Plan for 918 Panel will have a negligible to small change to elevation of the highest active node in the Lower Nine Mile Shrub and Hanging Swamps and Paddys Creek Shrub and Hanging Swamps.

Modelling indicates that the Pine Swamp and Paddys Creek Swamp catchments will receive a negligible (change is less than 5%, refer Table NM-B2b) decline in groundwater contribution to surface water between the Proposed Case and the Approved Case. Modelling indicates that the Paddys Creek Tributary and Bungleboori Creek catchments, which includes all the Lower Nine Mile Shrub and Hanging Swamps and Paddys Creek Shrub and Hanging Swamps, will receive a negligible (change is less than 5%, refer Table NM-B2b) increase in groundwater contribution to surface water between the Proposed Case and the Approved Case.

Implementation of the Extraction Plan for 918 Panel will lead to a negligible change in groundwater quality or surface water quality, and will not change the beneficial use class of either groundwater or surface water.

Accordingly, implementation of the Extraction Plan for 918 Panel is considered to be insignificant with respect to groundwater/surface water interaction.

5.1.4 Groundwater Users

As identified in **Section 3.8**, there do not exist any groundwater works within a 2km vicinity of 918 Panel, other than observation and dewatering works owned and operated by Clarence Colliery or Springvale Mine.

Accordingly, changes to the groundwater system due to changes to the Extraction Plan for 918 Panel will have an insignificant impact on other groundwater users.

5.1.5 Surrounding Land-Uses

As outlined in **Section 3.9**, surrounding land-use includes the Greater Blue Mountains World Heritage Area.

Modelling indicates that the change to groundwater elevation in **Section 4.15.5.7**, does not extend into the Greater Blue Mountains World Heritage Area, hence the impact of implementation of the Extraction Plan for 918 Panel on the Greater Blue Mountains World Heritage Area is insignificant.

The Garden of Stone Reserves overlie Clarence Colliery. Modelling indicates the change in groundwater elevation is negligible to small within the reserve. The impact of the implementation of the Extraction Plan for 918 Panel on the Garden of Stone Reserves is considered to be insignificant.

As outlined in **Section 3.9**, surrounding land-use at Clarence Colliery also consists of current and former mining operations. Modelling indicates that the change in groundwater elevation in **Section 4.15.5.7**, does not extend to mines in the vicinity of Clarence Colliery, hence the impact of the implementation of the Extraction Plan for 918 Panel to these operations is insignificant.

5.1.6 Mine Water Management

Modelling demonstrates that the Proposed Case, when compared to the Approved Case, will lead to a negligible increase (change is less than 10%, refer Table NM-B2a) in dewatering rate, with an additional 0.9ML/d during the peak and 0.2ML/d in the longer term.

Additional mine dewatering associated with implementation of Extraction Plan for 918 Panel will be managed within existing mine water management infrastructure.

Accordingly, implementation of Extraction Plan for 918 Panel will have an insignificant effect on mine water management infrastructure.

5.2 Compliance Assessment

5.2.1 Commonwealth Legislation

5.2.1.1 Environment Protection and Biodiversity Conservation Act 1999 (Cth)

The following matters were listed as endangered ecological communities (EECs) under the *Environment Protection and Biodiversity Conservation Act* 1999 (Cth) and are understood to be present and/or in the vicinity of Clarence Colliery:

- Temperate Highland Peat Swamps on Sandstone (may occur)
- Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion (may occur)
- Natural Temperate Grassland of the South Eastern Highlands (may occur)
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (may occur)

It is noted in **Section 2.1.1** that none of the EECs are listed as being 'likely to occur' and the only EEC that is a high priority GDE is the Temperate Highland Peat Swamps on Sandstone (THPSS). For the purpose of this assessment, it is assumed that these other EECs are not present in the vicinity of 918 Panel. Those other EECs, being the Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion, Natural Temperate Grass land of the South Eastern Highlands or White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

In the vicinity of 918 Panel, the Lower Nine Mile Shrub and Hanging Swamps and Paddys Creek Shrub and Hanging Swamps, which are Newnes Plateau Shrub and Hanging swamps, will receive a negligible to small change to groundwater elevation (with respect to GDEs). In the Lower Nine Mile Shrub Swamp mapped directly above the 918 Panel (refer CSP2 in **Figure 4-78**), there are medium transitory declines in groundwater elevation (with respect to GDEs) in the 10th% modelled change but are not presented in the 90th% modelled change. Accordingly, these transitory changes are not considered to be significant, since they do not lead to long-term decline.

The change to groundwater contribution to surface water in each of these catchments containing the THPSS, is a negligible change due to the Proposed Case.

Given the above, the impact of the implementation of the Extraction Plan for 918 Panel is considered to be insignificant.

5.2.2 Commonwealth Guidelines and Policy

5.2.2.1 Significant Impact Guidelines

Water Quantity

Table 5-1 presents an assessment of the implementation of the Extraction Plan for 918 Panel against CTH DCCEEW (2022) with respect to water quantity.

Table 5-1: Impact Assessment against Significant Impact Guidelines 2022 – Water Quantity

Requirement	Compliant	Response
A significant impact on the hydrological characteristics of a water resource may occur where there are, as a result of the action: • changes in the water quantity, including the timing of variations in water quantity	Yes (**Section 4.15.5.7** and **Section 4.15.5.8**)	Modelling indicates there will be negligible to small decline in elevation of the water table in Lower Nine Mile Shrub and Hanging Swamps and Paddys Creek Shrub and Hanging Swamps. Modelling indicates in Lower Nine Mile Shrub Swamp mapped directly above the 918 Panel (refer CSP2 in **Figure 4-78**), there are medium transitory declines in groundwater elevation (with respect to GDEs), which quickly recovers. Those transitory declines are not considered to be significant and do not lead to long-term change. Modelling indicates the change to groundwater contribution to surface water along watercourses containing THPSS is negligible and therefore insignificant.

Requirement	Compliant	Response
• changes in the integrity of hydrological or hydrogeological connections, including structural damage (for example, large scale subsidence)	Yes (**Section 4.10.2.7** and **Section 4.11**)	THPSS (shrub) exist along watercourses. As presented in **Figure 3-9**, most of those watercourses are in an orientation that is consistent with mapped geological lineaments. As presented in **Section 3.5.6** and **Section 4.10.2.7**, geological lineaments were incorporated into the numerical groundwater model, with reactivation by extraction using high-subsidence mining methods (Model Mining Method = 4 and 5). Details of subsidence magnitudes are presented in the Subsidence Assessments (SCT, 2025 and MSEC, 2025). The PPPE method (Model Mining Method = 3) is a low-subsidence mining method. SCT(2025) indicates the predicted magnitude of subsidence is 76 +/- 20mm. As presented in **Section 3.7.1** and **Section 4.11**, subsidence-induced change to hydraulic properties is informed by the Tammetta (2013) equation (with respect to the top of Zone A), as well as changes to strata through Zone B to Zone D.
• changes in the area or extent of a water resource. where these changes are of sufficient scale or intensity as to significantly reduce the current or future utility of the water resource for third party users, including environmental and other public benefit outcomes.	Yes (**Section 4.15.5.7**)	THPSS (shrub) are not static water bodies, rather are low topographic gradient (bed slope), locally wide ecosystems along watercourses. Modelling does not indicate an increase or decrease in the extent of these swamps due to implementation of Extraction Plan for 918 Panel.
The following aspects may need to be considered when assessing changes in hydrological characteristics: • flow regimes (volume, timing, duration and frequency of surface water flows)	Yes (**Section 4.15.5.9**)	Modelled change to groundwater contribution to surface water is presented in **Section 4.15.5.9** and is negligible. The modelled change to duration of dry periods is presented in the Surface Water Assessment (JBS&G, 2025c) and was found to be insignificant.
• recharge rates to groundwater	Yes (**Section 4.10.1.1**)	High subsidence mining methods also incorporate an increase in recharge factor associated with ground disturbance. There is no decrease in recharge rate due to implementation of the Extraction Plan for 918 Panel.
• aquifer pressure or pressure relationships between aquifers	Yes (**Section 3.5.3** and **Section 4.7**)	The conceptual and numerical groundwater model incorporate three groundwater systems, being the perched (Burralow Formation), shallow (Banks Wall Sandstone above the Mount York Claystone) and deep (Illawarra Coal Measures). Variably saturated flow conditions were also applied to selected layers in the numerical groundwater model, so as to be consistent with the conceptual model.
• groundwater table and potentiometric surface levels	Yes (**Section 4.15.5**)	Groundwater elevation contours are presented with respect to the highest active node (uppermost water table exists within the Burralow Formation and Banks Wall Sandstone), Mount York Claystone and Katoomba Seam. Groundwater hydrographs and depth versus

Requirement	Compliant	Response
		pressure plots are presented through the groundwater model.
• groundwater-surface water interactions	Yes (**Section 4.10.2**)	The design of the groundwater model facilitated consideration of groundwater/surface water interaction. As presented in **Section 4.10.2**, the model includes seepage faces, ephemeral watercourses, perennial watercourses and surface overland flow. The Surface Water Assessment (JBS&G, 2025c) presents evaluation of the context of modelled change to groundwater contribution to surface water.
• river-floodplain connectivity	Yes (**Section 4.10.2**)	The Western Coalfields does not include floodplains, however, does include THPSS along most watercourses on the Newnes Plateau and along the Upper Coxs River.
• inter-aquifer connectivity	Yes (**Section 3.5.3** and **Section 4.7**)	The conceptual and numerical groundwater model incorporate three groundwater systems, being the perched, shallow and deep. Enhanced potential connection between these groundwater system is accommodated in the numerical groundwater model via subsidence-induced change to hydraulic properties.
• coastal processes including changes to sediment movement or accretion, water circulation patterns, permanent alterations in tidal patterns, or substantial changes to water flows or water quality in estuaries.	N/A	Not applicable.
Unless the proponent can establish otherwise, the department will assume that there is a connection between surface water and groundwater. The proponent should also consider the potential impact of drilling, excavating or hydraulic stimulation on connectivity between surface water and groundwater, and whether this is likely to impact on the hydrology of the system beyond the life of the proposed action.	Yes (**Section 3.5.3** and **Section 4.7**)	The potential impact on groundwater/surface water interaction from development and extraction of 918 Panel is accommodated in the approach to the numerical groundwater model.

Section 4.3.1 of CTH DCCEEW (2022) notes that *"…proponent can demonstrate that all of the water used by a proposed action is authorised through such entitlements, the action is less likely to require a referral due to significant impacts on the hydrological characteristics of a water resource."*.

Groundwater extraction for the purpose of depressurisation during development and ahead of extraction will be undertaken within currently held WALs in the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources* 2023 (NSW). This includes the approach to licensing of any reduction in groundwater contribution to surface water in a gaining watercourse (which occurs at Clarence Colliery, in THPSS shrub swamps, as are groundwater dependent ecosystems), in accordance with Figure 7 of NSW DCCEEW (2022b).

Water Quality

Table 5-2 presents an assessment of the implementation of the Extraction Plan for 918 Panel against CTH DCCEEW (2022) with respect to water quality.

Table 5-2: Impact Assessment against Significant Impact Guidelines 2022 – Water Quality

Requirement	Compliant	Response
A significant impact on a water resource may occur where, as a result of the action: • there is a risk that the ability to achieve relevant local or regional water quality objectives would be materially compromised, and as a result the action: ○ creates risks to human or animal health or to the condition of the natural environment as a result of the change in water quality	Yes (**Section 5.1.3**)	• There is negligible change to groundwater and surface water quality due to implementation of the Extraction Plan for 918 Panel, since minor disruption of ground surface and change in groundwater flow path will not lead to a change to beneficial use class of groundwater or surface water. • Modelling indicates there will be a negligible change to groundwater contribution to surface water due to implementation of the Extraction Plan for 918 Panel.
○ substantially reduces the amount of water available for human consumptive uses or for other uses, including environmental uses, which are dependent on water of the appropriate quality	Yes (**Section 4.15.5.9**)	
○ causes persistent organic chemicals, heavy metals, salt or other potentially harmful substances to accumulate in the environment	Yes (**Section 5.1.3**)	• There are no significant quantities of potential contaminants of concern, including salts, associated with mining at Clarence Colliery.
○ seriously affects the habitat or lifecycle of a native species dependent on a water resource, or	Yes (**Section 5.1.2**)	• The change in groundwater contribution to surface water and change in elevation of the uppermost water table due to extraction of 918 Panel is considered to be insignificant, and, accordingly, the impact to groundwater dependent ecosystems is also considered to be insignificant.
○ causes the establishment of an invasive species (or the spread of an existing invasive species) that is harmful to the ecosystem function of the water resource, or	Yes (**Section 5.1.2**)	• Change to groundwater level in THPSS (shrub) can create a circumstance that can lead to encroachment of juvenile eucalypts.
• there is a significant worsening of local water quality (where current local water quality is superior to local or regional water quality objectives), or	Yes (**Section 5.1.3**)	Implementation of the Extraction Plan for 918 Panel will not lead to a change in the beneficial use class of groundwater or surface water.

Requirement	Compliant	Response
• high quality water is released into an ecosystem which is adapted to a lower quality of water.	Yes (**Section 5.1.6**)	Mine water discharge occurs to the Wollangambee River from Clarence Colliery via its EPL LD002. There will be no change in water quality of discharge due to implementation of the Extraction Plan for 918 Panel as it is a continuation of existing activities.
For water-dependent ecosystems, a significant impact is likely if the predicted change in water quality is greater than that required for 'moderately to slightly disturbed' systems as described in the relevant local or regional water quality objectives (typically the 80% to 95% ecosystem protection guideline values listed in the Australian Water Quality Guidelines). Note that other thresholds may apply where changes in water quality may impact on other matters of national environmental significance, such as threatened species or ecological communities.	Yes (**Section 5.1.3**)	Implementation of the Extraction Plan for 918 Panel will not lead to a change in the beneficial use class of groundwater or surface water.

5.2.2.2 Information Guideline Explanatory Notes

Assessing groundwater-dependent ecosystems 2019

This Explanatory Note outlines scientific methodological framework, informed based on risk, to identify groundwater dependent ecosystems that may be impacted by an activity.

For the Extraction Plan for 918 Panel, all THPSS have been confirmed by field studies (refer **Section 3.5.9**), including on-going updates to mapped extents. That work is consistent with the designation of THPSS in both the *Biodiversity Conservation Act* 2016 (NSW), *Water Management Act* 2000 (NSW) (via the Water Sharing Plan, as listed high priority groundwater dependent ecosystems) and *Environment Protection and Biodiversity Conservation Act* 1999 (Cth).

The Groundwater Assessment is consistent with this Explanatory Note, and helped inform the focus of monitoring, conceptual hydrogeological model, ecohydrological impact pathway diagram and design of the numerical groundwater model.

Deriving site-specific guideline values for physico-chemical parameters and toxicants 2019

Trigger levels for groundwater or surface water quality at Clarence Colliery are specified in Clarence (2026).

As JBS&G understands it, these trigger values were developed in accordance with CTH WQA (2025), insofar comparison to a reference to a control site. Further detail on the development of site-specific guideline values and an evaluation of consistency with CTH IESC (2019b) is presented in Clarence (2026).

There will be no change to groundwater and surface water quality due to implementation of the Extraction Plan for 918 Panel.

Mine water discharge to the Wollangambee River, after treatment, via EPL LDP002 is governed under the *Protection of the Environment Operations Act* 1997 (NSW).

Characterisation and modelling of geological fault zones 2021

As presented in **Section 3.5.6**, geological lineaments in the Western Coalfields were extracted from regional geological maps and supplemented with structural geological studies (Palaris, 2013abc) and interpretation by engineering geologists at Clarence Colliery.

Figure 3-8 presents an example of the Deanes Creek Lineament encountered in the Lithgow Seam at Springvale Mine. **Figure 3-9** presents the location of lineaments included in the Groundwater Assessment and in the numerical groundwater model.

As discussed in **Section 3.5.6**, lineaments are infilled with detritus (fine grained mudstone, which has lithified) and are considered to be an 'open' type, hydrogeologically, where 'open' indicates that the lineament is not a barrier to, typically, horizontal flow. The hydrogeological interpretation, assisted by review of groundwater elevations, as demonstrated in calibration hydrographs, does not indicate a barrier to flow.

Uncertainty analysis for groundwater modelling 2023

The approach to uncertainty analysis in the numerical groundwater model is consistent with the 'ensemble' methods outlined in CTH IESC (2023a), which are the most sophisticated method.

Details of assumed standard deviation and variance is presented in **Section 4.14.1** and **Section 4.15.2**.

Subsidence associated with underground coal mining 2023

Subsidence-induced change to hydraulic properties in strata overlying the mined seam is a significant aspect of the Groundwater Assessment and the numerical groundwater model.

As presented in **Section 3.7.1** and **Section 4.11**, whilst the PPPE (Model Mining Method = 3) mining method is a partial extraction method, there is also limited goafing with this method.

Ramp functions were constructed that were informed by the Tammetta (2013) regression equation (height of the top of Zone A above the top of the mined seam), including Tammetta's 'Special H' cases. Those ramp functions, which were calibrated, were then applied to model geometry and where high-subsidence mining methods (Model Mining Method = 4 and 5; being total extraction and longwall method) were used, the resultant modelled hydraulic conductivities were amended.

The approach to consideration of the effect of subsidence on groundwater modelling is comprehensive.

Using impact pathway diagrams based on ecohydrological conceptualisation in environmental impact assessment 2024

Section 3.5.4 presents the application of the impact pathway diagram methodology outlined in CTH IESC (2024) to the Extraction Plan for 918 Panel. For Clarence Colliery, the impact pathway to THPSS (groundwater dependent ecosystems) pertains to:

- changes to swamp water level
- changes to groundwater contribution to surface water.

The approach to the Groundwater Assessment and the numerical groundwater model (this report) and the Surface Water Assessment (JBS&G, 2025c) were tailored to calculate the expected change with respect to these aspects.

5.2.2.3 Australian Drinking Water Guidelines 6 – 2011

Modelling indicates that there are no changes to groundwater elevation at groundwater works in the vicinity of 918 Panel. Furthermore, there will be no change to groundwater quality at those works due to implementation of the Extraction Plan for 918 Panel.

Accordingly, implementation of the Extraction Plan will have an insignificant impact on water quality (for drinking water supply).

5.2.3 NSW Legislation

5.2.3.1 Environmental Planning and Assessment Act 1979

Table 5-3 presents an assessment of the Extraction Plan for 918 Panel against the Water Resources Impact Assessment Criteria of DA 504-00-Mod-10 (NSW DPH&I, 2024).

Table 5-3: Impact Assessment against Environmental Planning and Assessment Act 1979

Performance Measure	Compliant	Response
significant inflows to mine workings	Yes (**Section 5.1.6**)	The modelled increase in mine dewatering rate is 0.9ML/d and decreases to 0.2ML/d over the longer term. This is an insignificant change.
reduction in pumping yield in privately-owned groundwater bores	Yes (**Section 5.1.4**)	There are no groundwater users within 2km of 918 Panel. Accordingly, there will be no significant change to yield from groundwater works due to implementation of the Extraction Plan for 918 Panel.
reduction in surface flows and groundwater baseflow to upland swamps (Newnes Plateau Shrub Swamps) and wetlands	Yes (**Section 5.1.3**)	Modelling indicates there is a negligible change to groundwater contribution to surface flows and groundwater baseflow to upland swamps and wetlands (not relevant, but confirmed).
reduction in surface flows and groundwater baseflow to waterbodies including Marrangaroo Creek, Farmers Creek, Dargans Creek, Wolgan River, Dumbano Creek, Bungleboori Creek, and Wollangambee River (excluding reduction in flows associated with the proposed water transfer scheme)	Yes (**Section 5.1.3**)	Modelling indicates there is a negligible change to surface flows and groundwater baseflow in all watercourses in the vicinity of 918 Panel.

5.2.3.2 Water Management Act 2000

Direct extraction from groundwater occurs at Clarence Colliery due to dewatering/depressurisation ahead of mining activity. Direct extraction will continue with implementation of the Extraction Plan for 918 Panel.

The rules listed in the Water Sharing Plan, with respect to siting of a water supply work, are not relevant to Clarence underground workings, with 918 Panel being located within the existing Mining Lease.

As the numerical groundwater model is complex, it is consistent with the NSW Aquifer Interference Policy (NSW DCCEEW, 2012).

As described in **Section 2.3.3**, Clarence Colliery has two WALs to extract groundwater from the Sydney Basin West Groundwater Source.

Indirect extraction from surface water can also occur due to dewatering/depressurisation at Clarence. This is associated with changes to the groundwater system that then lead to changes to the surface water system.

A discussion of licensable take is presented in **Section 6.1**.

5.2.3.3 Biodiversity Conservation Act 2016

ECCs listed in the *Biodiversity Conservation Act* 2016 (NSW) are the same as those listed in the *Environment Protection and Biodiversity Conservation Act* 1999 (Cth). Impact assessment of the implementation of the Extraction Plan for 918 Panel with respect to these EECs is presented in **Section 5.2.1.1**, with an insignificant impact expected on ECCs.

5.2.4 NSW Guidelines and Policy

5.2.4.1 NSW Water Quality and River Flow Objectives 2006

Table 5-4 presents an assessment of the implementation of the Extraction Plan for 918 Panel against NSW Water Quality Objectives (NSW DCCEEW, 2006b). It is noted that only applicable objectives are discussed in **Table 5-4**.

Table 5-4: Impact Assessment against NSW Water Quality Objectives 2006

Water Quality Objective	Compliant	Response
Aquatic Ecosystems "Maintaining or improving the ecological condition of water bodies and their riparian zones over the long term."	Yes	Implementation of the Extraction Plan for 918 Panel will not lead to a change in water quality being discharged through LDP002 (upstream of Main Dam). The modelled change to groundwater elevation along watercourses containing THPSS (Lower Nine Mile Hanging and Shrub Swamps and Paddys Creek Hanging and Shrub Swamps) will not lead to a change to surface water quality.
Visual Aesthetics "Aesthetic qualities of water"	Yes	Implementation of the Extraction Plan for 918 Panel will continue to comply with turbidity requirements of discharge through LDP002 (upstream of Main Dam). The negligible decrease to groundwater contribution to surface water in watercourses containing THPSS that will not lead to an increase in turbidity. The change in surface water velocity will be determined in the Surface Water Assessment, however, will be negligible and are insignificant.
Drinking Water "Refers to quality of drinking water drawn from the raw surface or groundwater sources before any treatment."	Yes	The catchment containing Bungleboori Creek lies outside of the Sydney Drinking Water Catchment and the contributing catchment to Farmers Creek Dam, which is operated by Lithgow City Council as a Local Water Utility. Accordingly, water quality aspects pertaining to Neutral or Beneficial Effect on Water Quality do not apply. Notwithstanding, implementation of the Extraction Plan for 918 Panel will not lead to a change in surface water quality. The negligible change to groundwater contribution to surface water in watercourses containing THPSS will not lead to a change in surface water quality.
Industrial Water Supplies "The high economic value of water taken from river and lakes for use by industry needs recognition in water quality planning and management. It has been identified as an important environmental value through community consultation."	Yes	Groundwater is treated at the Water Treatment Plant and then discharged to Main Dam via LDP002.

Table 5-5 presents an assessment of the implementation of the Extraction Plan for 918 Panel against NSW River Flow Objectives (NSW DCCEEW, 2006b). It is noted that only applicable objectives are discussed in **Table 5-5**.

Table 5-5: Impact Assessment against NSW River Flow Objectives 2006

Water Quality Objective	Compliant	Response
Protect natural pools in dry times "Protect natural water levels in pools of creeks and rivers and wetlands during period of no flow"	Yes	There is no direct extraction from surface watercourses at Clarence Colliery. Modelling indicates that implementation of the Extraction Plan for 918 Panel will not lead to a decrease in groundwater contribution to surface water.
Protect natural low flows	Yes	As above, there is not direct extraction from surface watercourse at Clarence Colliery Modelling indicates that implementation of the Extraction Plan for 918 Panel will not lead to a decrease in groundwater contribution to surface water. Accordingly, there is no impact with respect to this objective.
Maintain wetland and floodplain inundation "Maintain or restore natural inundation patterns and distribution or floodwaters supporting natural wetland and floodplain ecosystems"	Yes	The implementation of the Extraction Plan for 918 Panel will not lead to a change in pattern, distribution or distribution of inundation. The magnitude of groundwater contribution to surface water is small compared to surface water flow. This is assessed separately in the Surface Water Assessment, but is negligible and are insignificant.
Maintain natural flow variability "Maintain or mimic natural flow variability in all streams"	Yes	As above.
Minimise effects of weirs and other structures	Yes	Not applicable. There are no hydraulic structures in the vicinity of 918 Panel. Existing water management infrastructure (erosion and sediment control and LDP002) will continue to be used.
Maintain groundwater for ecosystems "Maintain groundwater within natural levels and variability, critical to surface flows and ecosystems"	Yes	Groundwater dependent ecosystems, including Lower Nine Mile Hanging and Shrub Swamps and Paddys Creek Hanging and Shrub Swamps, will be maintained. Interpretation of modelling results indicate that the change in elevation of the highest active node at Lower Nine Mile Hanging and Shrub Swamps and Paddys Creek Hanging and Shrubs Swamps will have an insignificant impact.

5.2.4.2 NSW Groundwater Quality Protection Policy 1998

Implementation of Extraction Plan for 918 Panel will not lead to a change in groundwater quality within groundwater system. As such, there will be no change in beneficial use category of groundwater water.

Accordingly, it is considered that implementation of the Extraction Plan for 918 Panel is consistent with the NSW Groundwater Quality Protection Policy.

5.2.4.3 NSW Aquifer Interference Policy 2012

Table 5-6 presents an assessment of implementation of the Extraction Plan for 918 Panel with respect to Level 1 Minimal Impact Considerations – Highly Productive Porous Rock of the NSW Aquifer Interference Policy (NSW DCCEEW, 2012).

Table 5-6: Impact Assessment against NSW Aquifer Interference Policy 2012

Minimal Impact Consideration	Compliant	Response
Water table "less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, 40m from any: • high priority groundwater dependent ecosystems • high priority culturally significant site listed in the Schedule of the relevant water sharing plan. OR a maximum of a 2m water table decline cumulatively at any water supply work.".	Yes	For THPSS, modelling indicates that implementation of the Extraction Plan for 918 Panel will not exceed the Level 1 Impact Consideration in the Lower Nine Mile Hanging and Shrub Swamps and Paddys Creek Hanging and Shrub Swamps. Whilst modelling indicated there would be transitory exceedances of the Level 1 Impact Consideration in the Lower Nine Mile Shrub Swamp mapped directly above 918 Panel in the 10th% stochastic output, those changes are not present in the 90th% output. As the changes in the 10th% model output are transitory and do not lead to long-term change to groundwater elevation, the impact of implementation of the Extraction Plan for 918 Panel on Lower Nine Mile Hanging and Shrub Swamps and Paddys Creek Hanging and Shrub Swamps, is considered to be insignificant. As explained in **Section 4.12.4.4**, detailed time-series output was extracted at multiple locations and then representative locations selected. This is due to practical limitations in the model grid and is reasonable. There do not exist any groundwater supply works within 2km of 918 Panel, other than dewatering works owned and operated by Clarence Colliery or Springvale Mine. Groundwater supply works are installed into the Banks Wall Sandstone. Implementation of the Extraction Plan for 918 Panel will not lead to a decline in elevation of the water table at those non-Centennial groundwater supply works.
Water pressure "a cumulative pressure head decline of not more than a 2m decline, at any water supply work."	Yes	There do not exist any groundwater supply works within 2km of 918 Panel, other than dewatering works owned and operated by Clarence Colliery or Springvale Mine. Implementation of the Extraction Plan for 918 Panel will not lead to a decline in groundwater elevation at groundwater supply works.
Water quality "any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity."	Yes	Implementation of the Extraction Plan for 918 Panel will not lead to a change to the beneficial use category of groundwater, therefore is compliant.

Appendix B presents the Aquifer Interference Assessment Framework for the Extraction Plan for 918 Panel, with respect to Porous Rock – Highly Productive.

Table 4-1 presents an assessment of model confidence level of the Australian Groundwater Modelling Guidelines (Barnett et. al., 2012) and **Section 4.4** outlines the external peer review process for the model.

From **Appendix B**, the Extraction Plan for 918 Panel is considered to be consistent with that framework.

5.2.4.4 NSW Groundwater Assessment Toolbox

Groundwater assessment toolbox for major projects in NSW – Overview Document

Mining at Clarence commenced in 1979 and currently operates under Consolidated Consent DA 504-00-Mod-10 (NSW DPH&I, 2024).

The conceptual hydrogeological model for the Western Coalfields has been developed over multiple decades, from ongoing monitoring at both Clarence and surrounding operations in the Western Coalfield.

As part of that evolution, within the last decade, inclusion of the potential role of geological lineaments (including reactivation) and refinement of the approach to representing subsidence-induced change to hydraulic properties has been advanced. Furthermore, at Clarence, there has been a significant expansion to the groundwater monitoring network, comprising both swamp piezometers, regional standpipe piezometers and vibrating wire piezometers.

The numerical groundwater model developed for Clarence Colliery includes all surrounding operations, both current and historical, and therefore accounts for cumulative impact considerations. The numerical groundwater model also uses the latest methodologies identified by CTH IESC (2023a), namely 'ensemble methods', such that model results are presented incorporating predictive uncertainty.

Given the above, the Extraction Plan for 918 Panel is considered consistent with the objectives outlined in NSW DCCEEW (2022a), namely the level of assessment is cognisant of the potential risk to the environment.

Other aspects of water management at Clarence Colliery is presented in the WMP (Clarence, 2026), which is being updated as part of this Extraction Plan.

Guidelines for Groundwater Documentation for SSD/SSI Projects

Table 5-7 and **Table 5-9** presents an assessment of the Extraction Plan for 918 Panel against NSW DCCEEW (2022b), namely "Appendix A – Underground coal mines and large coal mines" of NSW DCCEEW (2022b).

Table 5-7 presents an assessment with respect to groundwater investigations (baseline data) and **Table 5-9** presents an assessment with respect to groundwater impact assessment.

Table 5-7: Impact Assessment against Guidelines for Groundwater Documentation for SSD/SSI Projects 2022 – Groundwater investigations (baseline data)

Requirement	Compliant	Response

Detailed groundwater investigations, including (but not limited to):
• Groundwater monitoring network installed to target all identified groundwater sources that have the potential to be affected by the development, at a spatial density and coverage that is based on an initial desktop review and conceptual understanding of groundwater system, a risk assessment and gap analysis (vertical and spatial coverage).
• Estimates of hydraulic properties (hydraulic conductivity and storage properties) for lithology to be encountered by and overlying the development, measured at a number of test locations (spatially and vertically) across the development area, using a range of appropriate testing methods (such as rising and falling head (slug) tests, packer tests, pumping tests, core tests). Presentation of this data, including test locations on a map, is also required.
• Collation of data collected and recorded by others, including:
  ○ Data collected by other mining or exploration companies at exploration drill holes and/or monitoring bores.
  ○ Government monitoring network.
  ○ Bore census surveys to collect additional information from existing third-party users, including confirming details of construction, depth, pumping rate, reliance, groundwater quality.
	Yes (**Section 3.5.8**)	• There is an extensive groundwater monitoring network installed at Clarence Colliery. Data used in this assessment also included data from adjacent operations at Springvale Mine and Angus Place Colliery. The spatial and vertical coverage was extensive.
		• Packer tests were undertaken at various locations in the Western Coalfields (refer **Section 3.5.8**). Outcomes from those packer tests were also included as targets in the numerical groundwater model.
		• The geological model, provided by Clarence, was supplemented with regional information from NSW Regional NSW (2016). Those geological models formed the basis of the numerical groundwater model (refer **Section 4.7.1**). Surrounding operations are owned by other Centennial business entities, therefore was able to be obtained. In addition, at the historical, and now flooded, State Mine, located to the south of Springvale Mine, periodic dipping of groundwater elevation in the Lithgow Seam is undertaken (see **Figure 3-12**). The PINNEENA database was used to obtain information of groundwater users at distance from Clarence Colliery (see **Figure 3-13**); however, these are not monitored for groundwater elevation. A bore census was not undertaken.

• Mapping and consideration of geological structures, including assessment of influence on groundwater flow.	Yes (**Section 3.5.6**)	Geological lineaments have been mapped throughout the Western Coalfields, at a regional scale (regional geological maps) and at site scale (Springvale Mine, Angus Place Colliery and Clarence Colliery). **Figure 3-9** presents the location of lineaments considered in the Groundwater Assessment, which then informed implementation within the model, including reactivation. As noted in **Section 3.5.6**, lineaments are considered an 'open' type, insofar as infilled with detritus, but not to the extent of acting as a hydrogeological barrier, which, when encountered underground, 'lose' their contents.

Requirement	Compliant	Response
• Ground-truthing and ecological assessment of high priority groundwater dependent ecosystems (including springs) mapped in the Water Sharing Plan(s) and BoM GDE Atlas, including assessment of water reliance and resilience, as well as assessment of the source of the water that ecosystem relies on.	Yes (**Section 3.5.9**)	THPSS are a primary focus of environmental management at Clarence Colliery, and elsewhere in the Western Coalfields. THPSS are nominated in the relevant Water Sharing Plan as high priority groundwater dependent ecosystems and were subject to early identification (NSW DCCEEW, 2006), with subsequent study and detailed mapping over the past two decades (Clarence, 2025bc).
• Discussion with local Aboriginal community to identify culturally significant sites that rely on water, as well as an assessment of the source of the water.	Yes	Clarence maintains a community engagement program. JBS&G presumes this includes consultation with relevant Aboriginal communities.
• Baseline groundwater level/pressure monitoring in hydrostratigraphic units where the water affecting activities will occur and in units that have the potential to be affected (for example, overlying units), with monitoring over at least a two-year period. The monitoring frequency should be suitable to detect groundwater level response to climate (rainfall, evapotranspiration) and existing water affecting activities. The monitoring data should be sufficient to allow assessment of vertical gradients and connection between hydrostratigraphic units.	Yes (**Section 3.5.8** and **Section 4.12.4**)	Observed and modelled groundwater elevation and pressure is presented in multiple output formats. As presented in **Section 4.12.4**, the observation dataset is available over a decade at some locations, well in excess of the minimum of two years.
• Baseline groundwater quality sampling from monitoring bores, analysed preferably by National Association of Testing Authorities (NATA) certified laboratory for a comprehensive suite including major ions, dissolved metals, salinity (as electrical conductivity), trace metals, dissolved gases, nutrients and hydrocarbons with sufficient frequency to establish potential seasonal variation (for example, quarterly). Presentation of QA/QC is also required.	Yes (**Section 3.5.8**)	Groundwater sampling of regional standpipe piezometers is presented in **Section 3.5.8**. The analytical suite is presented in WMP (Clarence, 2026). Samples are analysed using a NATA accredited laboratory.
• Assessment of potential surface water-groundwater interaction, including streamflow monitoring to estimate baseflow (where applicable) and use of Guidelines for Groundwater Documentation for standpipe(s) to monitor shallow groundwater levels and assess whether watercourse is a losing or gaining system.	Yes (**Section 3.5.8**)	THPSS are groundwater dependent ecosystems, therefore are gaining watercourses. As presented **Section 3.5.8**, there are a series of swamp monitoring piezometers and regional piezometers.

Table 5-8: Impact Assessment against Guidelines for Groundwater Documentation for SSD/SSI Projects 2022 – Groundwater impact assessments

Requirement	Compliant	Response
The Independent Expert Scientific Committee (IESC) on Coal Seam Gas and Large Coal Mining Development is a statutory committee of leading scientists that independently advises government regulators on the impacts that coal seam gas and large coal mining development may have on Australia's water resources. The IESC have developed a number of information guidelines and explanatory notes on: • The preparation of development proposals • Uncertainty analysis – Guidance for numerical modelling within a risk management framework • Assessing groundwater dependent ecosystems • Deriving site-specific guideline values for physico-chemical parameters and toxicants.	Yes (**Section 5.2.2.1**) Yes (**Section 5.2.2.2**) Yes (**Section 5.2.2.2**) Yes	• Responses to significant impact guidelines requirements are presented in **Section 5.2.2.1**. • As the requirements of the Explanatory Note, a stochastic approach to model results incorporating predictive uncertainty was undertaken. • THPSS are listed as endangered ecological communities under *Biodiversity Conservation Act* 2016 (NSW) and *Environment Protection and Biodiversity Conservation Act* 1999 (Cth). THPSS are also listed in the relevant schedule of the Water Sharing Plan that covers groundwater sources pertinent to Clarence Colliery. • The Extraction Plan for 918 Panel (nor previous or future mining activity at Clarence Colliery) will not lead to a change in groundwater or surface water quality. Site-specific guideline values are presented in the WMP (Clarence, 2026) and were derived in accordance with CTH WQA (2025). Mine water discharge at Clarence Colliery is treated prior to disposal to the Wollangambee River, in accordance with its EPL at LDP002.

In addition to the IESC requirements:
• Detailed conceptual hydrogeological model(s) including description and conceptual illustration of:
  ○ Hydrostratigraphy
  ○ Geological structures and influence on groundwater flow
  ○ The water table elevation and groundwater flow directions prior to and during operations and post-development
	Yes (**Section 3.5.3**)
	Yes (**Section 3.5.6**)
	Yes (**Section 4.15.5.5**)
		• The hydrogeological units considered in this study are presented in **Section 3.5.1**, and comprise the Narrabeen Group and the Illawarra Coal Measures. As presented in **Section 3.5.3**, the hydrogeological units are grouped into three groundwater system (perched, shallow and deep).
		• Regional and local mapping of geological lineaments was collated and used in this study.
		• Model layer output from highest active nodes was collated in to present elevations of uppermost water table. The uppermost water table exists in the Burralow Formation and Banks Wall Sandstone, depending on spatial

Requirement	Compliant	Response
		location. As noted in **Section 3.5.3**, there are multiple water tables in the Western Coalfields.
○ Potentiometric surface and groundwater flow directions in confined aquifers prior to and during operations and post-development	Yes (**Section 4.15.5.5** and **Section 4.15.5.6**)	• Model layer output (groundwater elevation and pressure head (difference between hydraulic head and bottom elevation of relevant cell) presented for pertinent hydrogeologic units (Katoomba Seam and Mount York Claystone). Cross-sectional hydraulic head (groundwater elevation) and pressure head also presented.
○ Vertical gradients	Yes (**Section 4.15.5.5 and Section 4.15.5.8**)	• Vertical flow direction indicated in cross-sectional hydraulic head (groundwater elevation). Supplemented with groundwater hydrographs at observation locations (e.g. vibrating wire piezometers) as well as depth versus pressure profiles.
○ Identified groundwater dependent ecosystems and/or culturally significant sites, including dependence on groundwater	Yes (**Section 3.5.9**)	• THPSS are mapped as high priority groundwater dependent ecosystems in the relevant schedule of the Water Sharing Plan of the groundwater source covering Clarence Colliery.
○ Other groundwater users	Yes (**Section 3.8**)	• Other groundwater users comprise water supply works far to the south of 918 Panel at Clarence Colliery.
○ Surface water-groundwater interaction	Yes (**Section 3.6**)	• Groundwater/surface water interaction is occurring along watercourses that flow over the Burralow Formation, transitioning to flowing over the Banks Wall Sandstone. As noted, groundwater dependent ecosystems (THPSS Shrub Swamps) also frequently occur along these watercourses.
○ Multiple conceptual diagrams to illustrate the understanding	Yes (**Section 3.5.3**)	• The conceptual model is illustrated in cross-section, since there are three groundwater systems to display.
○ Groundwater recharge and discharge zones and	Yes (**Section 3.5.3**)	• Recharge occurs directly to ground surface at topographic highs and is dissipated laterally due to the presence of low permeability aquitard plies of the Burralow Formation. This results in the uppermost water table being a subdued reflection of surface topography. Recharge to the deep groundwater system occurs through vertical percolation from shallow groundwater system (through the Mount York Claystone) into the deep groundwater system (Illawarra Coal Measures). Recharge to the deep groundwater system also occurs laterally at outcrop of the Illawarra Coal Measures along the Upper Coxs River, flowing to the northeast.
	Yes	• The site water balance is presented in the WMP (Clarence, 2026) that has been submitted together with this Extraction Plan.

Requirement	Compliant	Response
○ Water balance, including a description of site water demands, water disposal methods (e.g. volume and frequency of any water discharges), water supply infrastructure and water storage structures.		
Demonstration that water for the construction and operation stages of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan.	Yes (**Section 3.7.3**)	At Clarence (and at surrounding operations in the Western Coalfields), depressurisation of target coal seam during development is required before extraction can occur. Clarence operates with a significant water supply surplus.
Fit for purpose modelling (in most cases numerical modelling) consistent with the expectations of the NSW Aquifer Interference Policy, the IESC and industry best practice (Australian Groundwater Modelling Guidelines (Barnett et. al. 2012) and IESC guidance notes on uncertainty analysis).	Yes (**Section 4.2**)	The numerical groundwater model meets the expectations of the NSW Aquifer Interference Policy, CTH IESC Explanatory Notes and the AGMG (Class 2). The approach to uncertainty analysis incorporates the most sophisticated method, being 'ensemble methods'
Independent peer review of numerical groundwater modelling	Yes (**Section 4.4**)	The model has been subject to 3rd party review.
Details of water proposed to be taken (direct and indirect) from each groundwater source as defined by the relevant Water Sharing Plan and demonstration that the predicted water takes will be appropriately licensed.	Yes (**Section 6.1**)	Implementation of the Extraction Plan for 918 Panel will lead to a small, transitory, increase in modelled dewatering rate, which reduces to a negligible increase. Accordingly, as presented in **Section 6.1**, this change will be consistent with currently held WALs (listed in **Table 2-6**). In this next modification to consent, a review of licensable take will be presented.
Consideration of all stages of the development (construction, operation and closure).	Yes (**Section 1.2** and **Section 4.15.3**)	Prediction simulations include other approved mining activities at Clarence and in surrounding operations. This Groundwater Assessment pertains to an Extraction Plan and not a modification to consent. Accordingly, post-closure simulations are not presented.
Final landform assessment, including final void management, predicted postmining water takes and impacts and rehabilitation measures.	N/A	This is no final void for Clarence Colliery, as it is an underground coal mine (with surface works; therefore being a colliery).
Assessment of cumulative impacts considering other surrounding approved and proposed mining developments.	Yes (**Section 4.12.1** and **Section 4.15.1**)	All surrounding historical and proposed future mining has been included in the numerical groundwater model. Accordingly, assessment of significance of change has been undertaken in context of changes that have already occurred.
Assessment of potential water quality effects/risk of leachates from emplacement/tailing storage areas as a result of the development.	N/A	The waste emplacement area for Clarence is Western Coal Services, located adjacent to Mount Piper Power Station. There will be no change to existing

Requirement	Compliant	Response
		operation at Western Coal Services due to implementation of the Extraction Plan for 918 Panel.
Assessment of potential acid rock drainage issues related to presence of potential acid forming (PAF) material and/or acid sulfate soils.	N/A	Acid Mine Drainage issues are not present at Clarence in the Illawarra Coal Measures. Implementation of the Extraction Plan for 918 Panel is a continuation of current operations, therefore implementation of the Extraction Plan will not lead to new issues with respect Acid Mine Drainage. With respect to acid sulfate soils, these are not present in surface geology at Clarence Colliery.
Assessment of subsidence effects, particularly above longwalls and pillars (for underground mines).	Yes (**Section 4.11**)	This is a significant issue at Clarence and in surrounding operations in the Western Coalfields Subsidence-induced change to hydraulic properties have been thoroughly addressed in this Groundwater Assessment.
Assessment of potential changes to hydraulic properties of adjacent lithology, potential creating enhanced connection between the development and surface water and other receptors. Including a risk assessment of induced fracturing redirecting saline waters to streams, river and other shallow water sources and receptors.	Yes (**Section 4.11**)	The potential for connection between Burralow Formation, Banks Wall Sandstone and the Illawarra Coal Measures (through the Mount York Claystone; which separates the shallow groundwater system from the deep groundwater system) has been the subject of thorough analysis. There are no saline groundwater quality issues in the Western Coalfields.
Presentation of a range of potential effects on groundwater quantity and associated effects on receptors, using uncertainty analysis.	Yes (**Section 4.14.1**)	The CTH IESC Explanatory Note on Uncertainty Analysis (CTH DCCEEW, 2023a) lists multiple methods and the most sophisticated method, 'ensemble methods' has been used in this study.
Clear documentation of assumptions used to conduct the assessment (for example the numerical modelling) such that any change to the assumptions would change the predicted impacts.	Yes (**Section 4**)	In accordance with AGMG (Barnett et. al., 2012), the approach to documentation of the numerical groundwater model and the conceptual hydrogeological model has been comprehensive and transparent.
Proposed surface and groundwater monitoring activities and methodologies.	Yes (**Section 3.5.8** and **Section 6.4**)	The current monitoring program and recommendations for consideration of analytical suite for swamp monitoring piezometers (to be consistent with NSW DCCEEW (2022b)) are presented in the Groundwater Assessment. The WMP (Clarence, 2026) outlines additional detail on the monitoring program.
Proposed management of surplus water	Yes (**Section 3.7.3**)	Implementation of the Extraction Plan for 918 Panel at Clarence is a continuation of an existing activity. Mine water discharge occurs to the Wollangambee River, after treatment, via EPL LDP002.
Documentation of avoidance and mitigation measures.	Yes (**Section 6.2**)	Adaptive management has led to refinement of an earlier mine plan for the 918-920 Panel Area, to be 918 Panel only. Other changes included no

Requirement	Compliant	Response
		extraction beneath THPSS Shrub Swamps, although they exist within a 26.5o Angle of Draw.
Assessment of impacts against the Aquifer Interference Policy minimal impact considerations and identification of make good provisions, if required.	Yes (**Section 5.2.4.3**)	Analysis indicates that modelled change to the elevation of the water table in the highest active node is consistent with the NSW Aquifer Interference Policy. Make good provisions are not relevant as other groundwater users, non-mine dewatering groundwater works, are more than 2km from 918 Panel, and there is no modelled change to water table at these works, or pressure head where those works are confined.

Minimum Groundwater Modelling Requirements for SSD/SSI Projects

As noted in **Section 4.3**, 918 Panel at Clarence Colliery will be developed and extracted within a Mining Lease, rather than an Exploration Lease. The current version of the GMMP is from 2019 and, as JBS&G understands it, will be updated after completion of the current model development phase (this report and JBS&G (2025c)).

As stated in NSW DCCEEW (2022c), the intent of the "Minimum Groundwater Modelling Requirements" is to supplement the AGMG (Barnett et. al., 2012). The numerical groundwater model developed for Clarence Colliery (and the wider Western Coalfields) is a Class 2 model (refer **Table 4-1**).

An assessment of the Extraction Plan for 918 Panel against NSW DCCEEW (2022c) is presented in **Table 5-9**.

Table 5-9: Impact Assessment against Minimum Groundwater Modelling Requirements for SSD/SSI Projects 2022

Requirement	Compliant	Response
GMMP	Yes (**Section 4.3** (GMMP), **Section 4.2** (Model Objectives) and **Section 4.15.1**)	Current version of GMMP is 2019 (GHD, 2019). Model objectives (Class 2 model under AGMG) were: • Continue to quantify the regional spatial and temporal change to groundwater elevation • Resolve the influence of refilling of the historical State Mine, and all others, on regional groundwater level and flow • Account for large observed inflows into Clarence Colliery, ~13-17ML/d, relative to its small extraction (longwall, historical) footprint • Incorporate influence of geological lineaments (basement to surface, seam to surface and basement to seam) as well as reactivation by 'high' subsidence mining methods (Model Mining Method 4 and 5) • quantify the spatially and temporally varying change to the groundwater system due to the development and extraction of 918 Panel, with particular focus on changes to surface watercourses and potentially impacted swamps. The model objectives were achieved. Cumulative impact addressed via inclusive of all surrounding mining operations (from late 1800s through to end of simulation).
Conceptual Model	Yes (**Section 3.5.3**)	Comprehensive site and regional geological model is available (**Section 3.4**), including identification and inclusive of geological limits. Conceptual Model development supported by an extensive groundwater and surface water monitoring network installed in multiple aquifers and aquitards, vertically, which has been in operation for many years. Supplemented by quantitative estimates of mine dewatering rates.
Mathematical Model	Yes (**Section 4.6** and **Section 4.7**)	MODFLOW-USG with Quadtree Refinement. 30 model layers to incorporate all relevant hydrogeological units.
Calibration	Yes (**Section 4.12**)	Comprehensive calibration process using inverse techniques via PEST (Watermark Numerical Computing (2024, 2025)). Detailed output included scatter plots (including distribution of residuals; and spatial distribution of residuals), statement of sRMS and RMS, hydrographs, vertical groundwater elevation and pressure profiles (which demonstrate fit to vertical gradients). Due to the complexity of the Western Coalfields (multiple aquitards/aquitards) manually interpreted potentiometric

Requirement	Compliant	Response
		surfaces were not plausible, but consistency demonstrated via review of spatial distribution of residuals.
Sensitivity Analysis	Yes (**Section 4.14**)	Relative parameter uncertainty variance reduction presented as an improvement to parameter identifiability. Stochastic approach including subspace methods (CTH IESC, 2023a) and then used to present range of model output. This is a superior approach to subjective probability (changing a single parameter value up and down, individually). Prior and posterior histograms presented of selected parameters to demonstrate the benefit of calibration on stochastic parameter fields (generated by the Latin Hypercube Sampling method).
Model Results (Deterministic)	N/A	Due to the requirements of CTH IESC (2023a), stochastic output was presented in this report. An exception was modelled mine dewatering rate, which is discussed below.
Particle Tracking	N/A (not undertaken)	The use of particle tracking will be considered in future use of the numerical groundwater model.
Model Results incorporating Predictive Uncertainty	Yes (**Section 4.15**) Yes (**Section 4.15.5.3** and **Section 6.1**)	Stochastic simulations were used in order to present a range of model output (change in groundwater elevation and change to groundwater contribution to surface water). For water take, as this is an Extraction Plan, not a modification to consent, an update to licensable take is not presented in this report. This is considered reasonable, since the modelled change to modelled dewatering rate is small. As JBS&G understands it, this will be undertaken in a subsequent project. **Table 2-6** presents current WALs at Clarence Colliery.
Climate Change	N/A (**Section 3.2** and **Section 4.17**)	**Section 3.2** notes that output from NARCLiM V1.0 (NSW DCCEEW, 2025) was used in the derivation of future climate, namely 'Average' of General Circulation Models and regional down-scaling sub-models. **Section 4.17** notes that this report pertains to an Extraction Plan, therefore the duration of mining is too short for alternative climate change scenarios (Wet and Dry) to be considered.
Reporting	Yes (this report)	Detailed discussion of model conceptualisation, construction, calibration, sensitivity analysis and simulations incorporating predictive uncertainty is presented in this report.
Model Archive	Yes	Model (MODFLOW) input and output files will be provided to Clarence at the completion of the Groundwater Assessment.
Independent Review	Yes (**Section 4.4**)	Third party review is in the process of being completed and will be provided as separate correspondence to NSW DCCEEW.

Cumulative Groundwater Impact Assessment Approaches

Surrounding land-uses at Clarence Colliery include adjacent mining operations, the Greater Blue Mountains World Heritage Area and the village of Clarence.

With respect to adjacent mining operations, these are operated by other Centennial business entities and also seek to depressurise the target coal seam (Lithgow Seam for Springvale Mine and Angus Place Colliery) to allow development and extraction of coal.

With respect to the Greater Blue Mountains World Heritage Area, changes to groundwater contribution to surface water, decline in the elevation of the uppermost water table and subsidence-related change to ground surface are important potential impacts. These potential impacts have been minimised through mine design,

namely single-sided lifting, which is a 'low subsidence' mining method, in the proximity to the World Heritage Area. 918 Panel is located at a significant distance from the World Heritage Area and there will be no additional change to water resources or ground surface with respect to implementation of the Extraction Plan.

With respect to the village of Clarence, it is located at a substantial distance from Clarence Colliery. In particular with respect to implementation of the Extraction Plan for 918 Panel, there will be no additional change to groundwater elevation in aquifers targeted by those water supply works.

As presented in **Section 4.12.1**, all surrounding historical and future mining operations have been included in the numerical groundwater model. Accordingly, impact assessment was undertaken in context of cumulative changes that have already occurred, rather than in isolation/separately.

NSW Aquifer Interference Policy

An assessment of the Extraction Plan for 918 Panel with respect to the NSW Aquifer Interference Policy (NSW DCCEEW, 2012) is presented in **Section 5.2.4.3**.

6. Licensing, Management, Mitigation and Monitoring

This chapter presents the response to licensing, management, monitoring and mitigation aspects associated with implementation of the Extraction Plan for 918 Panel at Clarence Colliery.

6.1 Licensing

6.1.1 Background

The NSW Aquifer Interference Policy (NSW DCCEEW, 2012) requires that the estimated take from surface water and groundwater sources is based on a complex modelling platform, due to Clarence Colliery being a mine (as well as surface works, hence is a colliery).

The current WAL's at Clarence Colliery are outlined in **Section 2.3.3**, with the total entitlement from the Sydney Basin West Groundwater Source being 7,718ML/wy.

Estimated licensable take from surface water and groundwater sources was determined based on simulations of the numerical groundwater model developed for Clarence Colliery (this report).

The estimated take from surface water and groundwater sources was based on the numerical groundwater model, therefore meets the requirement of the NSW Aquifer Interference Policy (NSW DCCEEW, 2012) that the estimate is based on a complex modelling platform.

Furthermore, reference is made to the recent guideline published by NSW DCCEEW (2022b) on the approach to the treatment of indirect take from surface water sources.

There are multiple surface water sources in the vicinity of Clarence Colliery (refer **Figure 3-3**):

- Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2023
    - Colo River Water Source
    - Wywandy Water Source
    - Dharabuladh Water Source.

There are multiple groundwater sources in the vicinity of Clarence Colliery (refer **Figure 2-1**):

- Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023
    - Sydney Basin West Groundwater Source
        - underlain by the Lachlan Fold Belt Greater Metropolitan Groundwater Source.
            - outcrops in the southwest corner of the groundwater model (as designated by the groundwater source boundaries specified in the Water Sharing Plan).
    - Sydney Basin North Groundwater Source
        - underlain by the Lachlan Fold Belt Greater Metropolitan Groundwater Source
        - not relevant as far to the northwest of Clarence Colliery.
    - Lachlan Fold Belt Greater Metropolitan Groundwater Source.

As will be discussed in further detail below, a groundwater source method has been adopted with respect to groundwater take. This method takes into account the minor increase in recharge due to ground disturbance (subsidence) and the reduction in evapotranspirative loss due to a decline in groundwater elevation in some parts of the model. The method also considers the change in the exchange between other groundwater sources, namely the Lachlan Fold Belt Greater Metropolitan Groundwater Source, which underlies the Sydney Basin West Groundwater Source.

6.1.2 Model Setup

There were two groundwater model simulations considered in the calculation of direct (groundwater) and indirect (surface water) licensable take:

Proposed Case

The groundwater model is described in **Section 4** and a simulation was prepared that takes into account historical mine workings in the vicinity of Clarence Colliery, as well as Clarence Colliery itself, including extraction of 918 Panel.

With respect to surrounding mine workings:

- Angus Place Colliery was assumed to continue as approved, but is currently in Care and Maintenance and has been for many years
- Springvale Mine was assumed to continue as approved (excluding LW501-503).

It is noted that licensable take is based on a single simulation (deterministic) using the currently calibrated values of all model parameters. Further detail on the calibration of the groundwater model is presented in **Section 4.12**.

For the purpose of reference, the model control file associated with the Proposed Case is:

- 71577_L01RevA_APR_01a

Licensing Null Case

The consented activity under the *Environmental Planning and Assessment Act* 1979 (NSW) at Clarence Colliery is mining, with dewatering being an ancillary activity in support of the consented activity.

In accordance with the NSW Aquifer Interference Policy (NSW DCCEEW, 2012), a simulation was prepared that assumed Clarence Colliery switched to Care and Maintenance on the date of commencement of the first Water Sharing Plan relevant to Clarence Colliery. This was 1 July 2011.

Mining (including dewatering) in all surrounding operations proceeded as per the Proposed Case.

For the purpose of reference, the model control file associated with the Licensing Null Case is:

- 71577_L01RevA_LNU-CLR_01a

6.1.3 Estimated Take

The estimated take from each of the water sources was determined via post-processing of results from the numerical groundwater model at Clarence Colliery.

Surface Water

The estimated licensable surface water take is an indirect take. An indirect take is where there is reduced groundwater contribution to surface water flow. For Clarence Colliery, this is due to a reduction in groundwater contribution to surface water catchments and represents change in groundwater contribution to surface water with respect to watercourses, seepage faces and surface overland flow.

It is noted that a loss factor of 80% (20% retention) for seepage faces and a loss factor of 20% (80% retention) for groundwater/surface water interaction with respect to ephemeral watercourses was applied when preparing the impact assessment (refer **Section 4.15**). A loss factor was not applied to groundwater/surface water interaction with respect to perennial watercourses.

When estimating licensable surface water take, the abovementioned loss factors were not applied. This was required in order to partition groundwater take and surface water take from the output of the numerical groundwater model (MODFLOW).

NSW DCCEEW (2022), Figure 7, declares that a reduction in groundwater contribution to surface water should be assigned to groundwater take, rather than surface water take. Accordingly, the estimated take from surface water sources (indirect take), presented in **Table 6-1** will be added the estimated groundwater take from groundwater sources in determining the overall licensable take at Clarence Colliery.

It is noted that the modelled reduction in groundwater contribution to surface water in the Turon Crudine River Water Source and Fish River Water Source was zero, therefore is not presented in **Table 6-1**.

Table 6-1: Surface Water Licensable Take (ML/wy) (to be assigned to Sydney Basin West Groundwater Source in accordance with NSW DCCEEW (2022))

Water Year (wy)	Colo River Water Source	Wywandy Water Source	Dharabuladh Water Source
2014/15	9	1	3
2015/16	2	0	3
2016/17	11	2	4
2017/18	0	0	3
2018/19	3	0	5
2019/20	34	1	8
2020/21	46	3	10
2021/22	83	4	12
2022/23	83	7	12
2023/24	65	2	11
2024/25	44	2	11
2025/26	21	1	11
2026/27	14	3	10
2027/28	49	3	11
2028/29	57	6	14
2029/30	50	4	15
2030/31	18	1	11
2031/32	21	1	11
2032/33	33	1	10
2033/34	7	1	9
2034/35	26	3	11
2035/36	9	2	9
2036/37	114	3	14
2037/38	46	6	12
2038/39	106	4	14
2039/40	152	4	16
2040/41	68	8	15
2041/42	55	7	14
2042/43	7	3	10
2043/44	23	1	10
2044/45	49	2	12
2045/46	42	3	11
2046/47	28	4	11

2047/48	69	5	13
2048/49	68	6	14

From **Table 6-1**, the modelled take from the:

- Colo River Water Source ranges between 0 and 152ML/wy
- Wywandy Water Source ranges between 0 and 8ML/wy
- Dharabuladh Water Source ranges between 3 and 16ML/wy.

Groundwater

The estimated licensable groundwater take from groundwater sources is presented in **Table 6-2**.

The approach to preparing **Table 6-2** was to use the change to the groundwater model water balance with respect to each water source.

The licensable groundwater take was based on the difference between Proposed Case and the Licensable Null Case, where Clarence Colliery was assumed to switch to Care and Maintenance on the date of commencement of the first Water Sharing Plan relevant to Clarence Colliery.

Table 6-2: Groundwater Licensable Take (ML/wy)

Water Year (wy)	Sydney Basin West Groundwater Source	Lachlan Fold Belt Greater Metropolitan Groundwater Source
2014/15	1703	0
2015/16	1574	0
2016/17	1335	0
2017/18	1355	0
2018/19	680	0
2019/20	1324	0
2020/21	1186	0
2021/22	1872	0
2022/23	0	0
2023/24	1266	0
2024/25	2047	0
2025/26	1439	0
2026/27	1776	0
2027/28	1656	0
2028/29	1312	0
2029/30	1097	0
2030/31	1034	0
2031/32	963	0
2032/33	950	0
2033/34	847	0
2034/35	682	0
2035/36	751	0
2036/37	543	0
2037/38	553	0

2038/39	459	0
2039/40	399	0
2040/41	464	0
2041/42	369	0
2042/43	463	0
2043/44	412	0
2044/45	382	0
2045/46	358	0
2046/47	338	0
2047/48	298	0
2048/49	236	0

From **Table 6-2**, the modelled take from the:

- Sydney Basin West Groundwater Source ranges between 0 and 2047ML/wy
- Lachlan Fold Belt Greater Metropolitan Groundwater Source is 0ML/wy.

Table 6-3 presents the combined groundwater take with respect to the Sydney Basin West Groundwater Source and the Lachlan Fold Belt Greater Metropolitan Groundwater Source, in accordance with Figure 7 of NSW DCCEEW (2022). It is noted that the Lachlan Fold Belt Greater Metropolitan Groundwater Source underlies the Sydney Basin West Groundwater Source in the vicinity of Clarence Colliery, hence all estimated licensable surface water take (**Table 6-1**) was assigned to the Sydney Basin West Groundwater Source and none was assigned to the Lachlan Fold Belt Greater Metropolitan Groundwater Source.

Table 6-3: Combined Groundwater Licensable Take (ML/wy) (including Surface Water Take in accordance with NSW DCCEEW (2022) with respect to Sydney Basin West Groundwater Source)

Water Year (wy)	Groundwater Source	
Combined Take from Sydney Basin Coxs River Groundwater Source and Sydney Basin Richmond Groundwater Source		*Lachlan Fold Belt*[1]
2014/15	1716	0
2015/16	1579	0
2016/17	1352	0
2017/18	1358	0
2018/19	688	0
2019/20	1367	0
2020/21	1245	0
2021/22	1971	0
2022/23	0	0
Sydney Basin West Groundwater Source		*Lachlan Fold Belt Greater Metropolitan Groundwater Source*
2023/24	1344	0
2024/25	2104	0
2025/26	1472	0
2026/27	1803	0
2027/28	1719	0
2028/29	1389	0

2029/30	1166	0
2030/31	1064	0
2031/32	996	0
2032/33	994	0
2033/34	866	0
2034/35	721	0
2035/36	772	0
2036/37	677	0
2037/38	615	0
2038/39	583	0
2039/40	575	0
2040/41	554	0
2041/42	441	0
2042/43	481	0
2043/44	447	0
2044/45	446	0
2045/46	414	0
2046/47	381	0
2047/48	385	0
2048/49	324	0

Notes: 1) adopted name, for the purpose of this letter.

From **Table 6-3**, the combined modelled take from the:

- Sydney Basin West Groundwater Source ranges between 0 and 2104ML/wy
- Lachlan Fold Belt Greater Metropolitan Groundwater Source is 0ML/wy.

6.1.4 Discussion

Comparison of **Table 6-3** against **Table 2-6** indicates there is sufficient WALs available to Clarence Colliery with respect to the Sydney Basin West Groundwater Source. From **Table 6-3**, there is no take from the Lachlan Fold Belt Greater Metropolitan Groundwater Source.

6.2 Management

Clarence Colliery is subject to a WMP (Clarence, 2026). Discharge of groundwater inflow to underground workings will continue to be treated via the Water Treatment Plant and discharged at LDP002, in accordance with the conditions specified in EPL 726.

There is no intended change to water management infrastructure at Clarence Colliery Pit Top due to implementation of the Extraction Plan for 918 Panel.

6.2.1 Trigger Level Analysis

JBS&G have undertaken a review of groundwater level observations and groundwater model outputs at identified locations to devise groundwater level trigger values that will be appropriate to use in the next revision of the WMP (Clarence, 2026).

Table 6-4 presents the groundwater level trigger values to adopt in the WMP for the implementation of the Extraction Plan for 918 Panel.

Groundwater level trigger values are not required for vibrating wire piezometers, since they do not monitor environmental receptors, and therefore do not need to be presented in the WMP. Accordingly, only swamp piezometers are presented in **Table 6-4**.

The basis of groundwater level trigger values presented in **Table 6-4** was review of observed data (**Figure 3-11**) and range of change in Sensitivity Analysis (presented in **Section 4.14.3**).

Table 6-4: Groundwater Level Trigger Values (Swamp Piezometers)

Location	Standing Water Level Trigger Value (mBGL)
PG1	0.40
PG2	0.45
PSE1	1.00
PSE2	0.70
PS	0.40
PSS	1.00
CSP1	0.40
CSP2	0.35
CSP4	0.70
CSP5	0.45
CSP34	0.55
CSP35	0.45
CSP36	0.50

The WMP (Clarence, 2026) outlines the currently adopted site-specific guideline values. As JBS&G understands it, these have been set in accordance with CTH WQA (2025).

There is not suggested change to water quality related triggers at Clarence Colliery with implementation of the Extraction Plan for 918 Panel, as development and extraction of 918 Panel will not lead to change to groundwater or surface water quality.

6.2.2 Adaptive Management

Experience in impacts to perched, shallow and deep groundwater system due to depressurisation of target coal seams and subsidence-induced change to hydraulic properties to strata overlying the target coal seam has evolved over the last decade, leading to amendment to mining methods. In the case of the Extraction Plan for 918 Panel, this comprises a low-subsidence method via the PPPE method.

For the Extraction Plan for 918 Panel, this represents a revision to that presented in an earlier version of the Extraction Plan (being 918-920 Panel Area). In the current Extraction Plan, extraction in the 918 Panel does not occur beneath THPSS shrub and hanging swamps (with the exception of Paddy's Creek Hanging Swamp which is located partly above the proposed 918B2 sub-panel); however, these exist within the 26.5° Angle of Draw.

Further detail of the management methodology is presented in **Appendix B**.

6.3 Mitigation

Given the limited scale of the proposed mining activities associated with the implementation of the Extraction Plan for 918 Panel, the potential for significant impacts to groundwater is considered low.

Future use of the PPPE method (outside of 918 Panel) depends on confirmation of the subsidence assessment (SCT, 2025), namely that "*Numerical modelling estimates a maximum surface subsidence of 76mm +/- 20mm tolerance due to natural variability and survey tolerance. The number model used for this assessment of two*

shortwall panels has been validated with Clarence 910-906 Panels. Numerical modelling has been successful in understanding the subsidence mechanisms and informing mine design at Airly Mine.". Subsidence contours and output from valley closure assessment are presented in MSEC (2025) and will also need to confirmed.

If it is not confirmed that PPPE is a low-subsidence method, as per its design, then alternative, lower potential subsidence mining methods will have to be considered and, potentially, adopted.

Further detail of the mitigation methodology is presented in **Appendix B**.

6.4 Monitoring

A comprehensive groundwater monitoring network exists at Clarence Colliery. This includes the recent installation of standpipe swamp piezometers (CSP34, CSP35 and CSP36) in the vicinity of 918 Panel.

It is recommended that these standpipe swamp piezometers along Lower Nine Mile Swamp and Paddys Creek Swamp, receive regular monitoring, inclusive of electronic logging, with groundwater quality analysis occurring on, at least, a quarterly basis.

Section 4.2.3 of the WMP (Clarence, 2026) presents the current analytical suite for swamp piezometers at Clarence. This comprises field parameters, including turbidity.

NSW DCCEEW (2022b) states (and in preparation for the next modification to consent):

"*Baseline groundwater quality sampling from monitoring bores, analysed preferably by National Association of Testing Authorities (NATA) certified laboratory for a comprehensive suite including major ions, dissolved metals, salinity (as electrical conductivity), trace metals, dissolved gases, nutrients and hydrocarbons with sufficient frequency to establish potential seasonal variation (for example, quarterly). Presentation of QA/QC is also required.*"

JBS&G suggests that the following groundwater quality analysis suite be considered for swamp piezometers and other standpipe piezometers:

- Field parameters: pH, EC, Temp (°C), DO (mg/L), Eh (mV)
- Physiochemical Parameters (Laboratory): pH, TDS (mg/L)
- Major Ions (Dissolved): Na, K, Ca, Mg, Cl, SO_4, Alkalinity
- Trace Ions (Dissolved): Fe, Mn, Zn
- Metals (Dissolved): Al, As, Ba, B, Cd, Cr, Cu, F, Hg, Ni, Pb, Se
- Nutrients: N and P.

Continuous monitoring of subsidence performance is part of current Annual Environmental Management Review and will be required to be continued, to confirm the outcome of the Subsidence Assessment (SCT, 2025) for 918 Panel, namely 76mm +/- 20mm, as well as subsidence predictions in the wider area around 918 Panel, including valley closure, as presented in MSEC (2025). This is because the magnitude of subsidence-induced change to hydraulic properties adopted in the numerical groundwater model (and conceptual model) depends on minimal disruption to the regionally significant Mount York Claystone aquitard.

7. Conclusions

The objective of this report was to assess the change to groundwater elevation, change to groundwater contribution to surface water and change to mine dewatering rate due to the implementation of the Extraction Plan for 918 Panel. The assessment was supported by the numerical groundwater model.

The objectives of the numerical groundwater model were to assess the change to groundwater elevation, change to groundwater contribution to surface water and change to mine dewatering rate.

The objectives of the report and the numerical groundwater model were met.

Modelling, including stochastic simulations, indicated the implementation of the Extraction Plan for 918 Panel is considered to have insignificant change to groundwater elevation, an insignificant change to groundwater contribution to surface water and an insignificant change to mine dewatering rate.

The determination of insignificant impact pertains to groundwater dependent ecosystems, groundwater/surface water interaction, groundwater users, surrounding land-uses (including the Greater Blue Mountains World Heritage Area and Garden of Stone Reserves) and mine water management.

8. Model Limitations

All models, whether they use an analytical or a numerical solution methodology, suffer constraints in their representation of environmental processes.

The following is a list of limitations of the numerical groundwater model.

It is emphasised that these limitations do not invalidate the use of the numerical groundwater model to assess the change to groundwater elevation, change to groundwater contribution to surface water systems and change to mine dewatering rate due to the Extraction Plan for 918 Panel at Clarence Colliery.

This is, generally, because the limitations are applied to both the Proposed Case and the Approved Case, and the impact assessment is based on the difference between the Proposed Cases and the Approved Case.

Where there is a limitation that is relevant to an Area of Interest, namely, a water user or environmental receptor, a conservative approach was adopted in the numerical groundwater model. In application this meant making choices during model development that will overestimate the potential change to that Area of Interest.

Limitations that are of practical in nature, in terms of computation time, are noted as such.

Limitations of the current version of the model are as follows:

- The size of the model is 34.4km west-east and 29.2km south-north, with model grid size ranging from 400m x 400m to 100m x 100m
    - This, together with the need to solve the variably saturated flow equation (Richard's Equation), poses a significant computational constraint, with run times exceeding 14 hours per simulation during model calibration (4 instances per PC) and up to 22 hours per simulation (4 instances per PC) during model prediction.
- The number of parameters is 11,354 and the number of observations is 26,712
    - This poses a significant computational constraint when calculating the Jacobian matrix during model calibration
    - During this study, new parameters were introduced, mostly related to representation of uncertainty in Tammetta's equation estimate of HA2, the height of top of Zone A above the top of the mined seam (both for partial extraction and for total extraction (longwall)). These new parameters were added to the previously available Jacobian.
- The minimum model grid size is 100m x 100m
    - This is a computational constraint and can not be practically reduced further.
        - To compensate for this level of precision, laterally, the bottom of all watercourses throughout the model domain was identified at a resolution of 20m and those values used to define the top of the relevant 100m model cell.
- Representation of geological lineaments
    - The model grid size is 100m x 100m. This can not be practically reduced further
    - The approach to representation of lineaments was composite hydraulic properties, in accordance with the method presented in Freeze and Cherry (1979)
    - The approach to consideration of lineament reactivation was via the time-varying material (TVM) module, where lineaments were intersected by extraction (Model Mining Method 4 and 5 only, due to the relative magnitude of subsidence/ground movements).
- 'Return flow' with mine dewatering (and 'Stacked Drains')

- On the timescale (stress period duration) used in MODFLOW, application of pressure = 0 to represent mine dewatering, means that where groundwater is removed from the model domain (within a particular mine) is not relevant
  - Practically speaking, groundwater intercepted by underground workings drains to a down-gradient sump and is extracted through a ventilation shaft, or is pumped via pipeline, to surface for treatment and discharge (at Clarence this occurs to the Wollangambee River). In the groundwater model, groundwater is instead removed at the location of the boundary condition and does not travel down-gradient to a sump.
    - As noted, due to the timescale used in MODFLOW removal at the location of the boundary condition is not relevant though, as long as that water is removed.
- When mine water management is applied (being where groundwater is allowed to recover/accumulate in down-gradient portions of the mine, typically after extraction has occurred), the typical approach in MODFLOW is to change the stage in the drain (DRN) boundary condition, where the stage is such that if groundwater elevation in that model cell is below the stage, then the DRN does not extract water.
  - The option to 'return flow' is available in MODFLOW-USG version of the drains (DRT) boundary condition, namely drains with return flow.
    - Use of this mechanism was developed in the current version of the model, but was disabled as 'return flow' led to minor, localised 'groundwater mounding' at point of recharge of that 'return flow'
    - In a future version of use of 'return flow', it is expected that the proportion returned will be significantly reduced.

- General Head Boundary (GHB) cells were used to represent the filling (water) of the State Mine Complex
  - at present General Head Boundary (GHB) is applied in SP17 and onward, with recovery from depressurisation (via Drains (DRN)) from SP12/13 (with Drains (DRN) turned off from SP12/13)
  - Model convergence (localised) issues were present in SP12/13 and SP17, but did not exist in other Stress Periods
    - Simulations where volumetric water budget, percent discrepancy, was too high were excluded, with all others retained since issues pertained to a single or a few model cells in that State Mine Complex area.
  - SP12TS10, SP13TS10 and SP17TS10 were excised from the Heads (.HDS) files output, prior to post-processing
  - This issue did not pertain to cell-by-cell budget (.CBB) files output, since simulations with poor volumetric water budget at those SPs were excluded from post-processing
  - A numerically 'smoother' transition in the model with introduction of GHB cells could be implemented by using a low value of conductance for these cells initially and then increasing that value in subsequent stress periods, until the target value is being applied.
- The use of variably saturated flow in the numerical model is consistent with the conceptual model. In applying variably saturated flow in MODFLOW-USG, capillary head, and hence application of relative hydraulic conductivity, Krw, is calculated by comparing the modelled groundwater elevation in a particular cell with the mid-elevation of that cell. In thick layers, this can lead to the modelled groundwater elevation being constrained to near the mid elevation of a model cell.
- Climate change simulations in the numerical groundwater model.

- For this Extraction Plan, given the short duration of the mine schedule, consideration of climate change was not considered to be relevant (namely, separate complete simulations of a WET and a DRY future climate, when the length of mine schedule in the Extraction Plan is only two years).
  - As presented in the report, future climate (AVE, average) was guided by the NARCliM dataset (V1.0)
  - AVE, WET and DRY pertain to assessment of the four General Circulation Models (GCMs) and three regional down-sampling models pertaining to each GCM from NARCliM (V1.0).

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