6.4 Incidental Water Impacts

6.4.1 Influence on Alluvium

As discussed previously, there would be no direct interception of the alluvium, including that associated with the Isaac River, by the proposed open cut pit for the Project (refer Section 6.2). Any predicted interference of alluvial groundwater therefore largely relates to the potential for increased leakage from the alluvium to the underlying Permian coal measures that are depressurised as a result of the Project. Over the extent of Quaternary alluvium, model predictions show that there is zero predicted loss of water from the alluvium as a result of exercising the underground water rights for the Project (see Section 3.6.1 of Appendix B). That is, there is no predicted direct or indirect interference with alluvial groundwater as a result of the Project.

6.4.2 Influence on Baseflow

The predicted change in water levels induced by mining could increase the hydraulic gradient between the Isaac River itself and the underlying alluvium. As outlined within the conceptual model (Section 5.7), the Isaac River is largely a losing system in the Study Area, with seepage of surface water into the underlying alluvium. The model predicts that over the life of mine, the change in the average rate of seepage from the River to the alluvium is insignificant and considered within the error threshold of model predictions (less than 3.65 ML/year).

The Isaac River is ephemeral in nature, with flows following rainfall events that generate runoff. On average, when the Isaac River flows, 161,863 ML/year of surface water is discharged downstream. An estimate of less than 0.01% increased seepage from the Isaac River to the alluvium as a result of mining at the Project, therefore, represents an insignificant potential for flow rate reduction. The number of days that the Isaac River runs dry is not predicted to increase with the addition of the Project.

Harrow Creek and Cherwell Creek located within the vicinity of the Project Area are both set up in the model with a stage height of 0.0 m which means they are simulated as potentially gaining systems (i.e., negative net flow). Comparing the river flow budgets for Harrow Creek and Cherwell Creek in the Cumulative against the Approved Case indicates no change in the net flow in these two creeks due to the Project.

6.5 Cumulative Impacts

Cumulative impacts associated with approved and foreseeable open cut and underground coal mines surrounding the Project were modelled in accordance with IESC requirements (refer Table 2-1). The simulated cumulative drawdown predictions presented in this section show the impacts on different aquifers due to the existing approved works and entitlements within the model domain. The simulated cumulative drawdown predictions also shows whether the zone of impact from the approved neighbouring operations is predicted to interact with the zone of impact from the Project in the different aquifers.

Together with all approved and proposed CVM mining, the surrounding mines included within the model are the Olive Downs Project (Olive Downs South and Willunga), Moorvale South Project, Poitrel Mine, Daunia Mine, Peak Downs Mine, Grosvenor Mine, Lake Vermont Mine, Eagle Downs Mine, Saraji Mine, Saraji East Project and the Winchester South Project. The vast majority of the predicted cumulative drawdown impacts are not related to the Project but result from these other existing and approved mining activities represented in the model.
Maximum Cumulative drawdown impact predictions are shown in Figure 6-7 through Figure 6-14. These drawdowns represent the total impact of mining to model groundwater levels by comparing the maximum difference in aquifer groundwater levels for the Cumulative model scenario with those in a theoretical "No Mining" or Null Run scenario, for all times during the predictive model period.

There are no cumulative drawdown impacts predicted for the Quaternary alluvium within or around the CVM area (Figure 6-7). Maximum predicted cumulative drawdown impacts are predicted within the extents of the Isaac River alluvium in the south of the model domain near the Olive Downs South operations, more than 32 km south east from the Project.

Cumulative impacts within the regolith can be seen connecting the Project-related drawdown to drawdown impacts at Peak Downs, south of the Project (Figure 6-8). For the Leichhardt and Vermont coal seams, there is no drawdown interaction between the Project and the neighbouring mines that target the Rangal Coal Measures which are not present at the CVM area (Figure 6-9 and Figure 6-10).

Figure 6-11 to Figure 6-14 show the maximum predicted cumulative drawdown in the Q, P, H and D seams of the Moranbah Coal Measures. As shown in the figures Project cumulative drawdown is predicted to interact with the zone of impact from the Peak Downs open pits, Saraji open cut, Eagle Downs and Grosvenor underground operations. The extents of maximum predicted cumulative drawdown in the Moranbah Coal Measures coal seams are approximately 13 km to the east and 10 km to the north of the Project.

Assessment of cumulative impacts associated with the approved Bowen Gas Project was undertaken as a sensitivity analysis for the Olive Downs Project numerical groundwater model (HydroSimulations, 2018) (Figure 6-15). The Bowen Gas Project targets coal seams within the Rangal Coal Measures and Moranbah Coal Measures. As the Project shares much the same Study Area as the Olive Downs Project, results from the Olive Downs Project sensitivity analysis are equally applicable to the Project. Results of the assessment were presented in HydroSimulations (2018) and indicate that the assessment of cumulative impacts in the model is sensitive to the inclusion of the Bowen Gas Project, with cumulative drawdown extents in the Rangal Coal Measures extending significantly to the east across the model domain with the inclusion CSG extraction. Cumulative drawdown extents from the Bowen Gas Project are considered conservative and were predicted to be greater than the impacts produced by the Olive Downs Project alone (HydroSimulations, 2018).
Maximum Cumulative Drawdown
in Quaternary Alluvium (Layer 1)

FIGURE 6-7
Maximum Cumulative Drawdown in Regolith (Layer 2)

FIGURE 6-8
Maximum Cumulative Drawdown in Leichhardt Seam (Layer 5)
FIGURE 6-10

Maximum Cumulative Drawdown in Vermont Seam (Layer 7)

**Legend**
- **Drawdown Contours (m)**
- **Model Boundary**
- **Model Grid**
- **Project Mining Lease Boundary**
- **Surrounding Mines**
- **CVM Heyford Pit**
- **CVM Horse Pit**

**Maximum Drawdown (m)**
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200

**Solid Geology**
- Ki-CQ (Ki)
- Bundarra Granodiorite (Kgb)
- Clematis Group (Re)
- Rewan Group (Rt)
- Rangal Coal Measures, Bandanna Formation, Baralaba Coal Measures (Pwj)
- Fair Hill Formation, Fort Cooper Coal Measures (Pwt)
- Moranbah Coal Measures (Pwb)
- Blackwater Group (Pw)
- German Creek Formation (Pbd)
- Back Creek Group (Pb)

**Scale:** 1:175,000

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FIGURE 6-12

Maximum Cumulative Drawdown in P Seam (Layer 14)

LEGEND

- Extent of Maximum Predicted 5m Drawdown - Project Only
- Drawdown Contours (m)
- Model Boundary
- Model Grid
- Project Mining Lease Boundary
- Surrounding Mines
- CVM Heyford Pit
- CVM Horse Pit

Maximum Drawdown (m):

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200

Solid Geology:

- Ki-CQ (Ki)
- Bundarra Granodiorite (Kgb)
- Clematis Group (Re)
- Rewan Group (Rr)
- Rangal Coal Measures, Bandanna Formation, Baralaba Coal Measures (Pwij)
- Fair Hill Formation, Fort Cooper Coal Measures (Pwi)
- Moranbah Coal Measures (Pwb)
- Blackwater Group (Pw)
- German Creek Formation (Pbd)
- Back Creek Group (Pb)

Extent of Maximum Predicted 2m Drawdown - Project Only (refer Figure 3-9)

Model Boundary
Model Grid
Project Mining Lease Boundary
Surrounding Mines
CVM Heyford Pit
CVM Horse Pit

Scale: 1:175,000
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FIGURE 6-13

Maximum Cumulative Drawdown in H Seam (Layer 16)
Maximum Cumulative Drawdown in D Seam (Layer 18)

Legend:
- Extent of Maximum Predicted 5m Drawdown - Project Only
- Drawdown Contours (m)

Solid Geology:
- Ki-CQ (Ki)
- Bundarra Granodiorite (Kgb)
- Clematis Group (Re)
- Rewan Group (Rr)
- Rangal Coal Measures, Bandanna Formation, Baralaba Coal Measures (Pwj)
- Fair Hill Formation, Fort Cooper Coal Measures (Pwi)
- Moranbah Coal Measures (Pwb)
- Blackwater Group (Pw)
- German Creek Formation (Pbd)
- Back Creek Group (Pb)

Maximum Drawdown (m):
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200

Model Boundary
Model Grid
Project Mining Lease Boundary
Surrounding Mines
CVM Heyford Pit
CVM Horse Pit

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FIGURE 6-14
Figure 6-15  Sensitivity of Maximum Drawdown in Rangal Coal Measures to CSG Production
(HydroSimulations, 2018)
6.6 Post-Mining Equilibrium

Post-mining impacts were investigated with a Project recovery model, commencing from the end of mining at the Project and simulations were run for 200 years. The model used post-mining predicted groundwater levels as the starting heads, and removed all drain cells simulating the proposed mining area to allow groundwater levels to equilibrate. At the end of mining, the properties of the final void cells were converted to values representative of void values. The location of the final void for the Project is shown on Figure 6-16.

The final void will accumulate water over time due to rainfall and inflows from recovered groundwater levels. The equilibrated final void water level was determined by the balance between the direct rainfall, and rainfall runoff from the surrounding catchment against the evaporation loss from the lake surface. This was achieved through surface water balance modelling conducted by SLR (2021). A time variant constant head boundary condition was then used to implement the predicted final void water level at equilibrium obtained from the final void water balance model into the groundwater recovery model. This recovery model was then re-run for 200 years to maintain consistency with the Surface Water and Flooding Assessment prepared for the Project (SLR, 2021).

Figure 6-17 illustrates the predicted recovery of water levels in the Project final void. The graph shows that the void water level recovery is a slow process with the recovery rate declining as it reaches equilibrium conditions. The long-term equilibrated water level in the final void achieved after 142 years would be about 120 mAHD. Freeboard, i.e. the difference in elevation between the long-term equilibrated water level in the final void (above) and the surrounding crest elevation, is approximately 100 m.

The long-term equilibrated water levels predicted as part of the numerical groundwater modelling is generally consistent with the results of the final void modelling undertaken for the Surface Water and Flooding Assessment (SLR, 2021).

The predicted equilibrium water levels (at 200 years) for the Quaternary alluvium (Layer 1), the regolith (Layer 2) and the Q Seam, P Seam, H Seam and D Seam of the Moranbah Coal Measures (Layer 12, 14, 16 and 18 respectively) are shown in Figure 6-18 through to Figure 6-23. Groundwater levels around the Project final void range from approximately 125 mAHD in the H Seam and D Seam, to 215 mAHD in the regolith. This range is above the predicted lake water levels in the void of 120 mAHD, indicating that the void is predicted to behave as a groundwater sink with an inwards hydraulic gradient from all surrounding aquifers, and therefore unlikely to impact on water quality within the surrounding strata.
Figure 6-17  Project Final Void Water Level Recovery over Time
FIGURE 6-18

Predicted Groundwater Levels in Alluvium (Layer 1) – Post Mining Equilibrium

LEGEND

- Water Level Contours (mAHD)
- Major Drainage
- Model Boundary
- Inferred Alluvium Extent
- Alluvium Extent
- Final Void Location
- Horse Pit Extension Project Area
- Project Mining Lease Boundary
- Surrounding Mines

Water Level (mAHD)

- 125
- 135
- 145
- 155
- 175
- 220

- 25
- 50
- 80
- 100
- 110

Scale: 1:500,000
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Predicted Groundwater Levels in Regolith (Layer 2) – Post Mining Equilibrium

FIGURE 6-19
Predicted Groundwater Levels in Q Seam (Layer 12) – Post Mining Equilibrium

FIGURE 6-20
Predicted Groundwater Levels in H Seam (Layer 16) – Post Mining Equilibrium

LEGEND
- Water Level Contours (mAHD)
- Water Level (mAHD)
  - 25
  - 50
  - 80
  - 100
  - 110
  - 125
  - 135
  - 145
  - 150
  - 155
  - 170
  - 175
  - 180
  - 185
  - 190
  - 195
  - 200
  - 205
  - 210
  - 215
  - 220

Major Drainage
Model Boundary
Final Void Location
Horse Pit Extension Project Area
Project Mining Lease Boundary
Surrounding Mines

Scale: 1:500,000
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