

Executive Summary of the Boddington Bauxite Mine Triennial Aquifer Review July 2017 – June 2020

South32 Worsley Alumina Pty Ltd (Worsley) commissions triennial aquifer reviews of the Boddington Bauxite Mine (BBM) to assess the management of the aquifer in line with Ministerial Statement 719 requirements and Worsley's Water Management Plan (2017). These reviews consider the abstraction volumes from the aquifer, water-level and chemistry data from the aquifer and climate data. The following is an executive summary of the Boddington Bauxite Mine Triennial Review July 2017 – June 2020.

Climate

BBM is located in the Low Rainfall Zone (LRZ, <900 mm/yr) of the northern jarrah forest, the climate is Mediterranean with warm dry summers and much of the rainfall occurring in winter. Rainfall in the area has been declining over recent decades and this trend has continued over the review period (see Figure 1). The average rainfall over the review period (596 mm/annum) is 22% below the pre-1975 average (760 mm/yr). There has also been a decline in rain-days, this further affects aquifer recharge due to higher evapotranspiration on dry days.

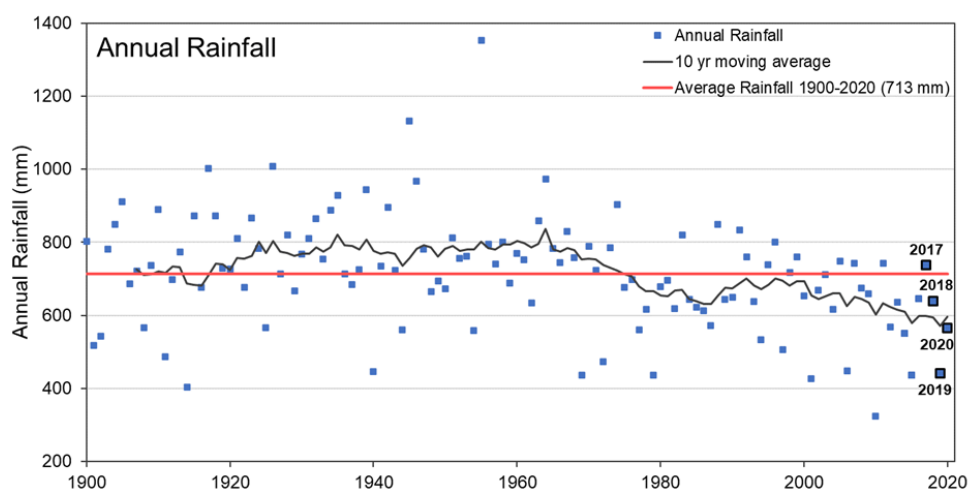


Figure 1: Annual Rainfall Plot 1900 – 2020 (calendar years)

As a result of the reduced rainfall, current groundwater-levels of forested catchments are significantly below historic levels. Figure 2 shows the groundwater level at A04 (in Hunt A control catchment), Q08 (in Quindanning area), and MP21 (in Marradong area), with Q08 and MP21 levels adjusted to present in the same plot. Groundwater level at A04 declined steadily from 1976 levels until the commencement of mining activities in Hunt A catchment, groundwater levels have continued to decline in Q08 and MP21 forested catchments. The modelled groundwater changes due to bauxite mining at BBM over the next ten years (2020-2030) are quite modest at up to 5 m level change (Croton, et al., 2020), and therefore there is a low risk of saline-water discharge above 1975 levels.

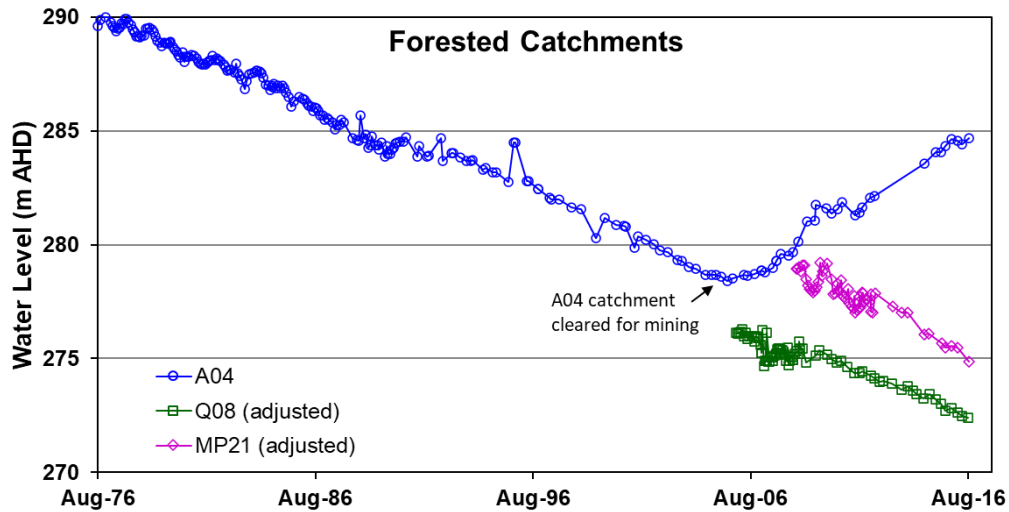


Figure 2: Groundwater level plot for A04, Q08(adjusted) and MP21(adjusted)

Groundwater abstraction

Worsley abstracts groundwater from the aquifer for use in mining activities and dust suppression. Groundwater was abstracted from twenty-five production bores over the review period including one newly commissioned bore. The locations of the production bores are shown as red circles in Figure 3 below. An average of 607 ML per annum was abstracted over the review period, the total abstraction averaged across the last twenty years remains below the Ministerial Statement 719 averaged annual permitted amount of 500 ML per annum. The annual abstraction from each borefield was significantly below their total recommended-yields. The combined recommended yield of all production bores is 2.4 times the targeted average abstraction-rate, which demonstrates that Worsley has significant flexibility in meeting its water requirements with the current borefields.

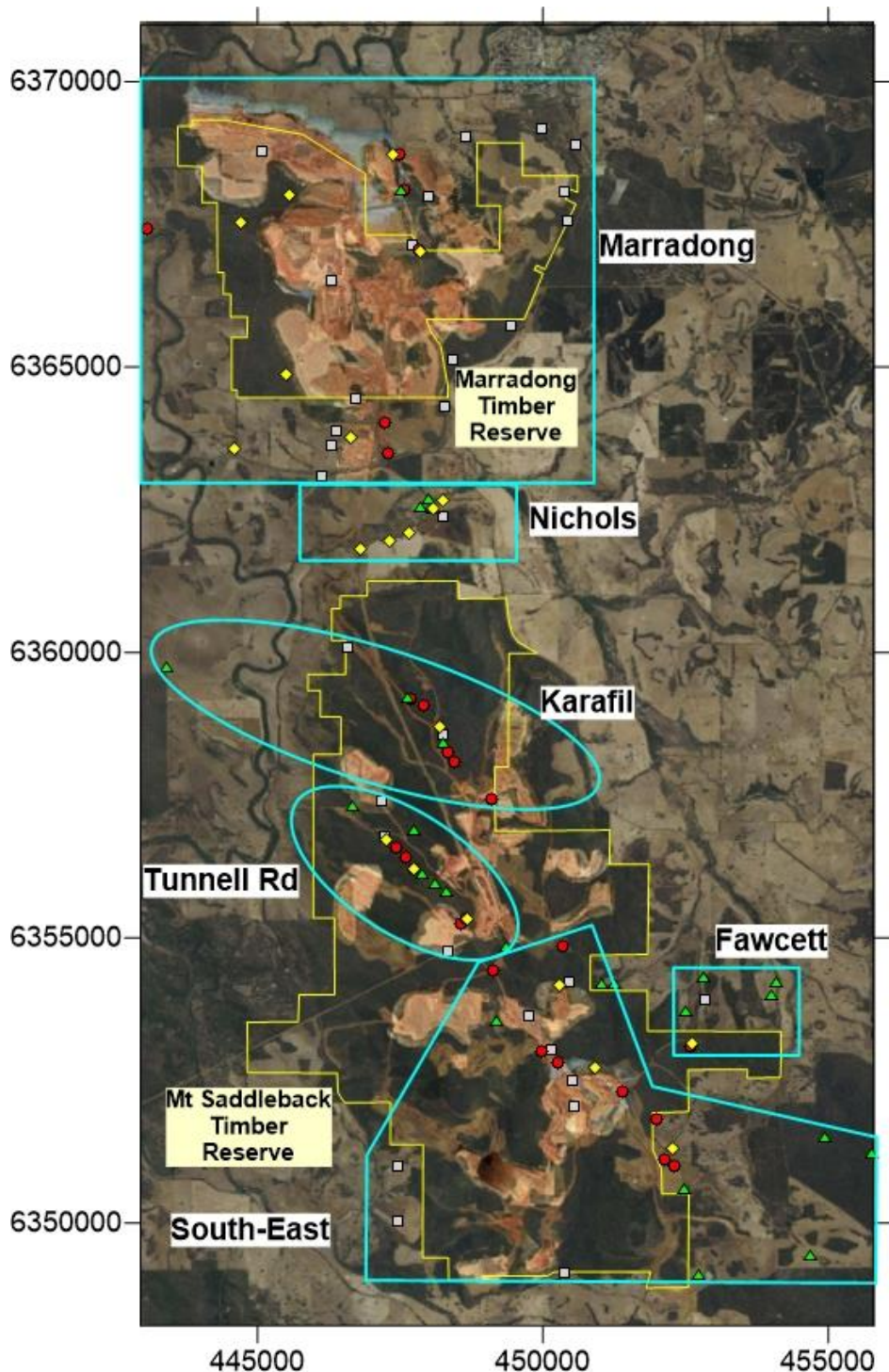


Figure 3: Map of BBM areas, timber reserves, production bores (red circles) and monitoring bores (yellow diamonds, green triangles and grey squares)

Groundwater monitoring

Worsley has a network of monitoring bores across the BBM area located to capture the potential effects of mining activities, groundwater abstraction, and climate on the aquifer. Monitoring over the review period included the use of in-bore water-level and conductivity loggers; field water-level and conductivity measurements; and laboratory chemical analysis of groundwater samples. The 2017 Water Management Plan involved significant changes to the monitoring program with the use of loggers and trigger points at twenty key bores. Minor deviations from the plan occurred, as expected, as the logger frequency and trigger levels were refined. Monitoring exceeded the plan with field

monitoring and laboratory-samples collected from an additional twenty-six bores in December 2019. Figure 3 shows the location of monitoring bores, the twenty bores with telemetry-loggers are shown as yellow diamonds, the twenty-six other monitored bores are shown as green triangles, with other bores not monitored over the review period shown as grey squares. No significant new trends in the groundwater levels, salinity, or chemistry were noted over the review period across BBM. Water levels were generally stable or declining, with some rises continuing downslope of mining areas, no significant effects of abstraction were noted.

Groundwater salinity across the monitoring area ranges from <1,000 mg/L to about 8,000 mg/L, salinity is generally higher in areas with agricultural clearing but varies across the monitoring area due to natural irregularities in the soil profiles. There has been no significant increase in the salinity of any monitored bore over the last ten years.

An extensive monitoring network exists within and downslope of the Tunnell Rd borefield where a groundwater dependent heathland ecosystem (GDE) has been identified. Figure 4 shows the water level at Tunnell Rd monitoring bores, it can be seen that the water-level has remained stable, with seasonal fluctuations, across the entire monitoring period since 1994.

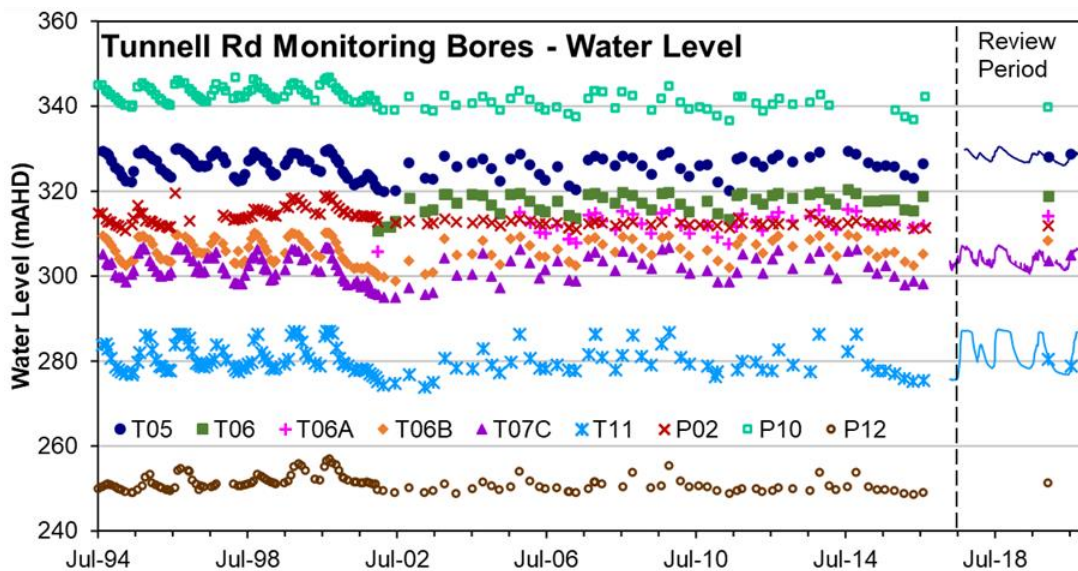


Figure 4: Groundwater level at Tunnell Rd groundwater monitoring bores 1994 - 2020.

Conclusion

The major aquifer risk of bauxite mining at BBM is the potential for mine-site clearing to cause groundwater level rises, which may cause surface-discharge of saline-groundwater. Due to the continuation of the low-rainfall period (1975 to present), the risk of groundwater-levels rising above their historical levels during the time between clearing for mining and rehabilitation has continued to diminish. The groundwater level and quality in the Tunnell Rd borefield has remained stable over the review period suggesting that the heathland GDE is being well protected. Overall, Worsley appear to be managing their water and land use well in order to ensure that the environmental values of groundwater resources are maintained and protected from adverse effects of bauxite-mining activities and construction of bauxite-transport corridors.

References

South32 Worsley, 2017. MS719 Management Plan - Water Management Plan, Business Blueprint Version 3.0. South 32 Worsley Alumina Pty. Ltd Report to Department of Water W.A., pp21

Croton, J.T, Mauger, G.W. & Dalton, J.A., 2020. Review of the Piezometer Network at the Boddington Bauxite Mining. Water & Environmental Consultants Report to South32 Worsley Alumina Pty. Ltd., pp37