2021 Annual Environmental Review

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Name of Mining Lease Holder	Contained within Table 6 of this report
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I, *Anthony Morris*, certify that this audit report is a true and accurate record of the compliance status of Hunter Valley Operations for the period 1st January 2021 to 31st December 2021 and that I am authorised to make thisstatement on behalf of Hunter Valley Operations.

Note.

a) The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.

b) The Crimes Act 1900 contains other offences relating to the false and misleading information: section 192G (Intention to defraud by false or misleading statement- maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents – maximum penalty 2 years imprisonment or $22,000, or both).

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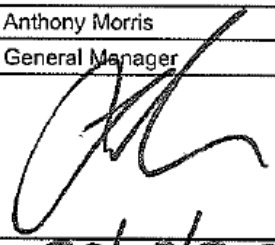
Title of Authorised Reporting Officer	General Manager
Signature of Authorised Reporting Officer	
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TABLE OF CONTENTS

1 STATEMENT OF COMPLIANCE 14

2 INTRODUCTION 15

2.1 DOCUMENT PURPOSE 15
2.2 BACKGROUND 15
2.3 MINE CONTACTS 18

3 APPROVALS 19

3.1 APPROVALS, LEASES AND LICENCES 19
3.1.1 Current Approvals 19
3.1.2 Management Plans, Programs, Strategies 38

4 OPERATIONS SUMMARY 40

4.1 MINING 40
4.1.1 Mineral Processing 41
4.1.2 Production Statistics 42
4.1.3 Summary of Changes 43
4.2 FORECAST OPERATIONS FOR NEXT REPORTING PERIOD 43

5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW 43

6 ENVIRONMENTAL PERFORMANCE 44

6.1 METEOROLOGICAL DATA 44
6.2 NOISE 45
6.2.1 Noise Management 45
6.2.2 Sound Attenuation of Heavy Equipment 45
6.2.3 Real Time Noise Management 45
6.2.4 Operational Noise Performance 47
6.2.5 Comparison with Predictions 48
6.3 BLASTING 50
6.3.1 Blasting Management 50
6.3.2 Blasting Performance 50
6.3.3 Blast Fume Management 56
6.4 AIR QUALITY 58
6.4.1 Air Quality Management 58
6.4.2 Air Quality Monitoring 58
6.4.3 Air Quality Performance 58
6.4.4 Comparison Against EA Predictions 75
6.5 GREENHOUSE GAS AND ENERGY MANAGEMENT 77
6.6 WASTE AND HAZARDOUS MATERIALS 78
6.6.1 Recycling 78
6.6.2 Sewage Treatment/Disposal 78
6.6.3 Hydrocarbons 78
6.6.4 Contaminated Soil 78
6.6.5 Acid Rock Drainage 79
6.6.6 Waste/Hazardous Materials Non-Compliances 79
6.6.7 Building Demolition 79
6.7 HERITAGE 79
6.7.1 Aboriginal Cultural Heritage Management and Community Consultation 79
6.7.2 Aboriginal Archaeological and Cultural Heritage Investigations 80
6.7.3 Heritage Audits and Incidents 81
6.7.4 Historic Heritage – Management and Community Consultation 82

7 WATER MANAGEMENT 82

7.1 WATER BALANCE 86
7.1.1 Water Inputs 86
7.1.2 Water Outputs 87
7.2 SURFACE WATER 87
7.2.1 Surface Water Monitoring 89
7.3 COMPARISON WITH EIS PREDICTIONS 99
7.3.1 South Pit EIS Predictions 99
7.3.2 Carrington EIS Predictions 99
7.3.3 West Pit EIS Predictions 99
7.4 PERFORMANCE RELATING TO HRSTS DISCHARGES 100
7.5 GROUNDWATER 100
7.5.1 Groundwater Management 100
7.5.2 Groundwater Performance 101
7.5.3 Groundwater Monitoring Summary 104
7.6 COMPENSATORY WATER SUPPLY 135

8 REHABILITATION AND LAND MANAGEMENT 136

8.1 SUMMARY OF REHABILITATION 136
8.2 REHABILITATION OVERVIEW 137
8.3 REHABILITATION PERFORMANCE 138
8.4 REHABILITATION PROGRAMME VARIATIONS 141
8.5 REHABILITATION TRIALS 141
8.6 KEY ISSUES THAT MAY AFFECT REHABILITATION 141
8.7 REHABILITATION MONITORING 142
8.7.1 IEM Pasture Results 142
8.7.2 LTM Pasture Results 143
8.7.3 IEM Woodland Results 143
8.7.4 LTM Woodland Results 144
8.8 OVERVIEW OF REHABILITATION TRAJECTORY 147
8.9 REHABILITATION MAINTENANCE 149
8.10 VERTEBRATE PEST MANAGEMENT 152
8.11 RENOVATIONS 161
8.11.1 Derelict Rural Buildings 161
8.12 TAILINGS MANAGEMENT 161
8.13 RIVER RED GUM RESTORATION AND REHABILITATION 162
8.13.1 River Red Gum Overview 162
8.13.2 RRG Monitoring Activities 167
8.13.3 Ecological Risk Assessment 172
8.13.4 Management Actions 174
8.13.5 River Red Gum Condition Summary 179
8.14 BIODIVERSITY OFFSETS 179
8.14.1 Goulburn River Biodiversity Area Overview 179
8.14.2 Weather Records 180
8.14.3 Biodiversity Area Management Activities 182

9 COMMUNITY 187

9.1 COMPLAINTS 187
9.2 REVIEW OF COMMUNITY ENGAGEMENT 196
9.2.1 Communication 196
9.2.2 Consultation and Engagement Activities 196
9.2.3 Community Consultative Committee 196
9.2.4 Community Grants 197
9.2.5 HVO Continuation Project 197

10 INDEPENDENT AUDIT 199

11 INCIDENTS AND NON-COMPLIANCES 207

11.1 AIR QUALITY 207

11.2 WATER 207
11.3 NOISE 208

12 ACTIVITIES TO BE COMPLETED IN 2022 209

12.1 NOISE 209
12.2 AIR QUALITY 209
12.3 BLASTING 209
12.4 HISTORIC HERITAGE 209
12.5 WATER 209
12.6 REHABILITATION 210
12.7 TAILINGS STORAGE FACILITIES 210
12.8 STAKEHOLDER ENGAGEMENT 210
12.9 TIMELINE FOR IMPLEMENTATION OF IMPROVEMENT PROJECTS 210
Appendix A - Annual Air Quality Review 212
Appendix B - Annual Groundwater Review 213
Appendix C - HVO S240 Rehabilitation Maintenance Schedule 214
Appendix D - 2021 Heritage Compliance Inspection Audits 216

Figures

Figure 1 Regional Context 16
Figure 2 Hunter Valley Operations Site Overview 17
Figure 3 Open Cut Mining Schematic 40
Figure 4 HVO Corporate Meteorological Station 2019 - 2021 Rainfall Data 44
Figure 5 HVO Attended and Real Time Noise Monitoring Locations 46
Figure 6 HVO Blast Monitoring Network 51
Figure 7 Jerrys Plains Blast Monitoring Results 2021 54
Figure 8 Knodlers Lane Blast Monitoring Results 2021 54
Figure 9 Maison Dieu Blast Monitoring Results 2021 55
Figure 10 Moses Crossing Blast Monitoring Results 2021 55
Figure 11 Warkworth Blast Monitoring Results 2021 56
Figure 12 Air Quality Monitoring Locations 59
Figure 13 Equipment Downtime Hours for Air Quality Management 2021 60
Figure 14 Areas Aerial Seeded in 2021 – HVO North (West Pit) 62
Figure 15 Areas Aerial Seeded in 2021 - HVO North (Carrington Pit) 62
Figure 16 Areas Aerial Seeded in 2021 - HVO South 63
Figure 17 Annual Average Insoluble Matter Deposition Rates 2016-2021 65
Figure 18 Maximum Allowable Increase in Deposited Dust Level 2021 65
Figure 19 Annual Average TSP Concentrations 2017 to 2022 (Excludes Extraordinary Events) 66
Figure 20 24-hour Average Total PM_{10} results- 2021 70
Figure 21 Annual Average HVAS PM10 results 2015 to 2021 71
Figure 22 24-hour Average PM2.5 Results 2021 73
Figure 23 West Pit Water Management Infrastructure 83
Figure 24 North Pit Water Management Infrastructure 84
Figure 25 South Pit Water Management Infrastructure 85
Figure 26 Surface Monitoring Locations 88
Figure 27 Hunter River pH Trends 2017 – 2021 92
Figure 28 Hunter River EC Trends 2017- 2021 92
Figure 29 Hunter River TSS Trends 2017 - 2021 92
Figure 30 Wollombi Brook pH Trends 2017 – 2021 93
Figure 31 Wollombi Brook EC Trends 2017 – 2021 93
Figure 32 Wollombi Brook TSS Trends 2017 – 2021 ..... **Error! Bookmark not defined.**
Figure 33 Other Tributaries pH Trends 2017 – 2021 96
Figure 34 Other Tributaries EC Trends 2017 – 2021 96
Figure 35 Other Tributaries TSS Trends 2017 – 2021 97
Figure 36 NSW2 Emu Creek TSS Trends 2017 - 2021 97
Figure 37 HVO Site Dams pH Trends 2017 – 2021 98
Figure 38 HVO Site Dams EC Trends 2017 – 2021 98
Figure 39 HVO Site Dams TSS Trends 2017 – 2021 98
Figure 40 Groundwater Monitoring Network at HVO – 2021 103
Figure 41 Carrington Broonie Groundwater pH Trends 2017 – 2021 105
Figure 42 Carrington Broonie Groundwater EC Trends 2017 – 2021 105
Figure 43 Carrington Broonie Groundwater SWL Trends 2017 – 2021 105
Figure 44 Carrington Alluvium Groundwater pH Trends 2017 – 2021 108
Figure 45 Carrington Alluvium Groundwater EC Trends 2017 – 2021 108
Figure 46 Carrington Alluvium Groundwater SWL Trends 2017 – 2021 108
Figure 47 Carrington Interburden Groundwater pH Trends 2017 – 2021 109
Figure 48 Carrington Interburden Groundwater EC Trends 2017 – 2021 109
Figure 49 Carrington Interburden Groundwater SWL Trends 2017 – 2021 110
Figure 50 Carrington West Wing Alluvium Groundwater pH Trends 2017 – 2021 110
Figure 51 Carrington West Wing Alluvium Groundwater EC Trends 2017 – 2021 111
Figure 52 Carrington West Wing Alluvium Groundwater SWL Trends 2017 – 2021 111
Figure 53 Carrington West Wing Flood Plain Groundwater pH Trends 2017 – 2021 112
Figure 54 Carrington West Wing Flood Plain Groundwater EC Trends 2017 – 2021 112
Figure 55 Carrington West Wing Flood Plain Groundwater SWL Trends 2017 – 2021 112

Figure 56 Cheshunt/North Pit Alluvium Groundwater pH Trends 2017 – 2021 113
Figure 57 Cheshunt/North Pit Alluvium Groundwater EC Trends 2017 – 2021 113
Figure 58 Cheshunt/North Pit Alluvium Groundwater SWL Trends 2017 – 2021 114
Figure 59 Cheshunt Interburden Groundwater pH Trends 2017 – 2021....114
Figure 60 Cheshunt Interburden Groundwater EC Trends 2017 – 2021 115
Figure 61 Cheshunt Interburden Groundwater SWL Trends 2017 – 2021 115
Figure 62 Cheshunt Mt Arthur Groundwater pH Trends 2017 – 2021 116
Figure 63 Cheshunt Mt Arthur Groundwater EC Trends 2017 – 2021 117
Figure 64 Cheshunt Mt Arthur Groundwater SWL Trends 2017 – 2021 117
Figure 65 Cheshunt Piercefield Groundwater pH Trends 2017 – 2021 118
Figure 66 Cheshunt Piercefield Groundwater EC Trends 2017 – 2021....118
Figure 67 Cheshunt Piercefield Groundwater SWL Trends 2016 – 2021....118
Figure 68 Lemington South Alluvium Groundwater pH Trends 2017 – 2021....119
Figure 69 Lemington South Alluvium Groundwater EC Trends 2017 – 2021 120
Figure 70 Lemington South Alluvium Groundwater SWL Trends 2017 – 2021 120
Figure 71 Lemington South Arrowfield Groundwater pH Trends 2017 – 2021 121
Figure 72 Lemington South Arrowfield Groundwater EC Trends 2017 – 2021....121
Figure 73 Lemington South Arrowfield Groundwater SWL Trends 2017 – 2021 122
Figure 74 Lemington South Bowfield Groundwater pH Trends 2017 – 2021....123
Figure 75 Lemington South Bowfield Groundwater EC Trends 2017 – 2021 123
Figure 76 Lemington South Bowfield Groundwater SWL Trends 2017 – 2021 123
Figure 77 Lemington South Interburden Groundwater pH Trends 2017 – 2021....124
Figure 78 Lemington South Interburden Groundwater EC Trends 2017 – 2021 125
Figure 79 Lemington South Interburden Groundwater SWL Trends 2017 – 2021....125
Figure 80 Lemington South Woodlands Hill Groundwater pH Trends 2017 – 2021 126
Figure 81 Lemington South Woodlands Hill Groundwater EC Trends 2017 – 2021....126
Figure 82 Lemington South Woodlands Hill Groundwater SWL Trends 2017 – 2021....126
Figure 83 Lemington South Glen Munro Groundwater pH Trends 2017 – 2021 127
Figure 84 Lemington South Glen Munro Groundwater EC Trends 2017 – 2021....127
Figure 85 Lemington South Glen Munro Groundwater SWL Trends 2017 – 2021 128
Figure 86 North Pit Spoil Groundwater pH Trends 2017 – 2021....129
Figure 87 North Pit Spoil Groundwater EC Trends 2017 – 2021 129
Figure 88 North Pit Spoil Groundwater SWL Trends 2017 – 2021 129
Figure 89 West Pit Alluvium Groundwater pH Trends 2017 – 2021....130
Figure 90 West Pit Alluvium Groundwater EC Trends 2017 – 2021 130
Figure 91 West Pit Alluvium Groundwater SWL Trends 2017 – 2021 131
Figure 92 West Pit Sandstone/Siltstone Groundwater pH Trends 2017 – 2021 132
Figure 93 West Pit Sandstone/Siltstone Groundwater EC Trends 2017 – 2021....132
Figure 94 West Pit Sandstone/Siltstone Groundwater SWL Trends 2017 – 2021....132
Figure 95 Carrington West Wing Bayswater Groundwater pH Trends 2017 to 2021 133
Figure 96 Carrington West Wing Bayswater Groundwater EC Trends 2017 to 2021....133
Figure 97 Carrington West Wing Bayswater Groundwater SWL Trends 2017 to 2021 134
Figure 98 HVO Rehabilitation Areas as of 2021....139
Figure 99 Overview of 2021 Rehabilitation Monitoring Locations 146
Figure 100 2021 Rehabilitation Maintenance Work....151
Figure 101 A Lace Monitor captured on motion sensor camera at bait site 19 11/2/2021....153
Figure 102 Wild Dog at Bait Site 19 8/2/2021 154
Figure 103 HVO Vertebrate Pest Management Bait Locations – Summer 2021....158
Figure 104 HVO Vertebrate Pest Management Bait Locations – Autumn 2021 159
Figure 105 HVO Vertebrate Pest Management Bait Locations – Spring 2021 160
Figure 106 Eucalyptus camaldulensis stands being managed at HVO.....163
Figure 107 Eucalyptus camaldulensis monitoring sites at Carrington billabong. 164
Figure 108 Eucalyptus camaldulensis priority site monitoring locations 165
Figure 109 Eucalyptus camaldulensis monitoring locations at the Reference Sites. 166
Figure 110 Receded flood waters within the Carrington billabong 167
Figure 111 Prior (left) and post (right) hand weeding carried out in native planting plots, Carrington billabong in June 2021. 174

Figure 112 Weed control undertaken in River Red Gum Areas 2021 175
Figure 113 Location of the 2021 tubestock plantings at the Carrington billabong 177
Figure 114 Feral bee beard identified in the Billabong during September 2021 178
Figure 115 Feral bee population identified within a tree guard in Billabong in September 2021 178
Figure 116 Rainfall records recorded at the Merriwa (Roscommon Gauge) - 2021 180
Figure 117 HVO's Goulbourn River Offset and adjoining Warkworth Mine Offset 181
Figure 118 Access locations from the MTW offset to HVO's Goulbourn River Offset 183
Figure 119 Aerial shooting of feral vertebrate pests at the Goulbourn River BA 186
Figure 120 Summary of Community Complaints in 2021 187
Figure 121 Number of Complaints per Type 188
Figure 122 Community Complaints 2014 – 2021 188
Figure 123 Proposed Timeline for Implementation of 2022 Improvement Projects 211

Tables

Table 1 Statement of Compliance 14
Table 2 Non-Compliances 14
Table 3 Compliance Status Key for Table 2 14
Table 4 Mine Contacts 18
Table 5 HVO Major Approvals 19
Table 6 Summary of Mining Tenements 19
Table 7 HVO Licences and Permits 25
Table 8 Water Related Approvals 26
Table 9 Surface Water Access Licences 2020/21 Water Year 34
Table 10 Groundwater Access Licences 36
Table 11 Management Plans and Mining Operations Plans (MOPs) Required for HVO North 38
Table 12 Management Plans and MOPs Required for HVO South 39
Table 13 HVO Equipment Used 2020-2021 41
Table 14 Stockpile Capacities 41
Table 15 Methods of Coal Transportation 42
Table 16 Production Statistics and Correlating Project Approval Limits 42
Table 17 Production Operations Forecast 43
Table 18 Actions recommended in 2020 Annual Review and HVO response 43
Table 19 Comparison of Attended and Real Time Noise Monitoring 2021 47
Table 20 Comparison of 2021 Noise Monitoring Results Against Previous Years 48
Table 21 Comparison of 2021 monitoring against HVO North (Year 14, West Pit EIS, 2003) - Night Period 48
Table 22 Comparison of 2021 monitoring against HVO South (Stage 2 HVO South Modification 5 EA- 2017) 49
Table 23 Historical blasting data for HVO North/West 52
Table 24 Historical blasting data for HVO South 53
Table 25 Visible Blast Fume Rankings According to the AEISG Colour Scale 57
Table 26 Real Time PM_{10} Air Quality Monitoring Data Availability 2021 61
Table 27 Dust Deposition Annual Average Assessment 64
Table 28 Assessment of Annual Average TSP 2021 67
Table 29: PM_{10} 24hr Mis-captures 68
Table 30:2021 PM_{10} 24hr Exceedance Investigations 68
Table 31 Short Term Impact Assessment Criteria – $PM_{2.5}$ Results 2021 72
Table 32 PM2.5 Annual Average Monitoring Data 2021 74
Table 33 Annual $PM_{2.5}$ / PM_{10} Ratios in Upper Hunter 74
Table 34 UHAQMN Annual Average PM 2.5 Results for 2021 75
Table 35 HVO South PM_{10} Annual Average Results Compared Against Cumulative Predictions^ 75
Table 36 HVO South TSP Annual Average Results Compared Against Cumulative Predictions^ 76
Table 37 HVO 2021 PM_{10} Annual Average Results Compared Against Cumulative Predictions^ 76
Table 38 2021 TSP Annual Average Results Compared Against Cumulative Predictions^ 77
Table 39 Greenhouse Gas Emission Summary 77
Table 40 2021 HVO Water Balance 86
Table 41 HVO Water Monitoring Data Recovery for 2021 (by exception) 89
Table 42 Hunter River Internal Trigger Tracking Results 91
Table 43 Other Tributaries Internal Trigger Exceedance Results 94
Table 44 Representative Water Quality for West Pit 99
Table 45 HVO Groundwater Monitoring Data Recovery for 2021 (by exception) 101
Table 46: Carrington Broonie Internal Trigger Tracking 2021 104
Table 47 HVO Carrington Alluvium Groundwater 2021 Monitoring Internal Trigger Tracking 106
Table 48 HVO Carrington Interburden Groundwater 2021 Monitoring Internal Trigger Tracking 109
Table 49 HVO Carrington West Wing Flood Plain Groundwater 2021 Monitoring Internal Trigger Tracking 111
Table 50 HVO Cheshunt/North Pit Alluvium Groundwater 2021 Monitoring Internal Trigger Exceedances 113
Table 51 Cheshunt Interburden Groundwater 2021 Monitoring Internal Trigger Tracking 114
Table 52 Cheshunt M t Arthur Groundwater 2021 Monitoring Internal Trigger Tracking 116
Table 53 Lemington South Alluvium Groundwater 2021 Monitoring Internal Trigger Tracking 119
Table 54 Lemington South Bowfield Groundwater 2021 Monitoring Internal Trigger Tracking 122
Table 55 Lemington South Interburden Groundwater 2021 Monitoring Internal Trigger Tracking 124

Table 56 Lemington South Woodlands Hill Groundwater 2021 Monitoring Internal Trigger Tracking 125
Table 57 Lemington South Glen Munro Groundwater 2021 Monitoring Internal Trigger Tracking 127
Table 58 North Pit Spoil Groundwater 2021 Monitoring Internal Trigger Tracking 128
Table 59 West Pit Sandstone/Siltstone Groundwater 2021 Monitoring Internal Trigger Tracking 131
Table 60 Key Rehabilitation Performance Indicators 136
Table 61 Summary of new rehabilitation completed in 2021 137
Table 62 Summary of rehabilitation and disturbance completed in 2021 138
Table 63 Variations to the Rehabilitation Program in 2021 141
Table 64 Assessment of IEM Pasture Monitoring Blocks against MOP TARP 143
Table 65 Assessment of LTM Pasture Monitoring Blocks against MOP TARP 143
Table 66 Assessment of IEM Non-specific native vegetation Monitoring Blocks against MOP TARP 144
Table 67 Assessment of LTM Non-specific native vegetation Monitoring Blocks against MOP TARP 145
Table 68 Assessment of LTM Pasture Monitoring Blocks against Rehabilitation Completion Criteria 147
Table 69 Assessment of LTM Woodland Monitoring Blocks against Ecosystem and Land Use Establishment Rehabilitation Completion Criteria 148
Table 70 Assessment of LTM Woodland Monitoring Blocks against Ecosystem and Land Use Sustainability Rehabilitation Completion Criteria 148
Table 71 Summary of Vertebrate Pest Management 2021 152
Table 72 Comparison of Results Between Baiting Programmes at HVO 155
Table 73 HVO Tailings Storage Facilities 161
Table 74 A comparison of the remnant ecological health assessment scores between monitoring events 169
Table 75 Observations that relate to the monitoring objectives outlined in the strategy 170
Table 76 Factors to be considered to detect a notable decline in ecological condition of the RRG community in accordance with the ERA (Umwelt 2020) 173
Table 77 Biodiversity Area Management Activities 2021 182
Table 78 Summary of bird species identified during the supplementary assessment within the HVO Goulbourn River BA in 2021 184
Table 79 Details of Complaints Received in 2021 189
Table 80 Independent Environmental Audit Findings and Recommendations – 2020 200

Executive Summary

This Annual Environmental Review (Annual Review) reports on the environmental performance of Hunter Valley Operations (HVO) during the 2021 calendar year and satisfies the requirements of HVO's Development Consents and Mining Leases. The structure of the 2021 Annual Review intends to align with the *NSW Government Post - approval requirements for State significant mining developments – Annual Review Guideline* (October 2015).

Operations Summary

HVO extracted 14.86 million tonnes of run-of-mine (ROM) coal during 2021 against an approved ROM extraction rate of 42 million tonnes per annum (mtpa). The Coal Handling Preparation Plants (CHPPs) produced 10.57 million tonnes of saleable coal.

Noise

HVO received and responded to 1115[1] internal noise alarms and recorded over 620 hours of equipment downtime for the management of noise during 2021.

All operational haul trucks at HVO have been fitted with sound attenuation kits. A routine sound power level testing schedule was implemented across site in 2021 and this will continue throughout 2022.

During 2021, there was one incident related to noise monitoring. On 22 July during the monthly attended noise monitoring at the Jerrys Plains East monitoring location an $LA_1(_{1\ min})$ result of 55dB(A) was recorded against the compliance criteria of 45dB(A). HVO followed its approved Management Plan in response to the exceedance. The exceedance constitutes non-compliance with EPL but not the HVO South Development Consent.

Blasting

A total of 214 blast events were initiated at HVO, 153 from HVO South and 61 from HVO North. HVO complied with all blasting related overpressure and vibration development consent and licence criteria during 2021.

HVO employs a blast fume management protocol to mitigate generation of post blast fume emissions. During 2021, there was once incident related to blast fume. On 10 June 2021, a level 4 post blast fume event was identified after firing a blast in the West Pit (WN45ULD01A) following high rainfall. The blast was fired when wind conditions were predicted to carry the fume over the mine and dissipated without leaving the site.

The HVO South approval was modified permitting manufacturing of Ammonium Nitrate Emulsion on site.

Air Quality

A total of 27 air quality monitoring exceedances were recorded in 2021, including a total of 20 exceedances of the short term (24 hr) PM_{10} criteria over a period over 13 days. Each of the 27 exceedances was investigated to determine the level of contribution from either HVO North, HVO South, or where relevant, both. Four of the recorded exceedances were deemed to be attributable to HVO. One exceedance of the short term (24hr) PM_{10} criteria was due to incremental contributions from HVO. The other three exceedances are against "Total" criteria where HVO contributed but was not the cause of the exceedance.

HVO continued to implement operational controls to manage dust emissions in accordance with its Air Quality Management Plan during 2021 including response to internal air quality alerts. During the reporting

[1] Noise alarm triggers are based on internally set noise criteria. Alarms received include noise exceedances from other mines and non-mine sources.

period, HVO responded to 797 air quality alerts and recorded over 1054 hours of operational downtime to manage dust in response to real time monitoring alerts and visual inspections. Aerial seeding was conducted over an approximate area of 300 ha to reduce dust from wind erosion of mine stockpiles.

Heritage

Under the provisions of both the HVO South and HVO North Aboriginal Cultural Heritage Management Plans (ACHMP), eight field based due diligence assessments where undertaken at various locations across HVO in 2021. A number of artefacts were identified and managed in accordance with relevant Management Plans.

Two compliance inspections were conducted under the provision of the HVO South ACHMP and one inspection was conducted under the HVO North Heritage Management Plan (HMP). The inspections found that all sites have been managed in conformance with the ACHMP/HMP requirements. Additional sites were recorded and sites requiring maintenance and upgrades to site barricading and fencing were identified. Upgrade and maintenance work will be implemented in 2022.

Maintenance works were undertaken to preserve and maintain Heritage infrastructure. The ‘dog leg fence’ that was the subject of a State Significance assessment in October 2019 had vegetation cleared around it prior to an archival recording of its features planned for 2022. Preparatory works were undertaken to remediate the Archerfield Stables.

There were no incidents, nor any unauthorised disturbance caused to heritage sites at HVO during 2021.

Water

A total of 910mm of rainfall was recorded at HVO Corporate Meteorological (MET) Station in 2021 producing an estimated 11,647ML of runoff. No water was pumped from the Hunter River during 2021. HVO discharged 3,083ML of water under the Hunter River Salinity Trading Scheme (HRSTS).

Surface and ground water monitoring activities continued in 2021 in accordance with the HVO Water Management Plan (WMP), the HVO Surface Water Monitoring Program (SWMP) and the HVO Ground Water Monitoring Program (GWMP).

HVO progressed its Water Containment Pollution Reduction Programme, completing preliminary engineering stages fora majority of the projects. Detailed design commenced for the Load Point area upgrade and construction commenced on automated dam level monitoring and burst pipe protection.

Controls identified through the Pollution Reduction Programme (PRP) to mitigate seepage from the North Void Tailings Facility Analysis continued with management of water levels on the surface and increased monitoring of groundwater. Groundwater monitoring results indicate that current management practices are effective in minimising seepage from the facility. A conceptual design was undertaken for installation of a groundwater barrier wall.

There were two reportable incidents related to water. On 23 March 2021 a sediment control dam (Dam 2N) collecting water from an old rehabilitation area spilled to a drainage line reporting to Farrells Creek. HVO received 107.4mm of rainfall which exceeded the regulated design capacity for the dam. On 24 March 2021 during HRSTS discharge from Parnells Dam, the Total Suspended Solids criteria was exceeded. Neither incident were considered to have potential for environmental harm.

An application was submitted to modify the HVO South approval to permit storage of excess surface water in the abandoned Lemington Underground workings. This is currently under assessment by the Department.

Rehabilitation and Land Management

Rehabilitation at HVO is undertaken in accordance with commitments made in the Mining Operations Plan (MOP). During 2021, HVO prepared a new MOP which consolidated all operations and site rehabilitation into a single document. Three amendments have since been made to the MOP.

A total of 164.9 ha of rehabilitation was completed to “Ecosystem Establishment” phase during 2021 including 72.7 ha of new rehabilitation and 92.2 ha of “Growth Medium Development” phase rehabilitation. The total rehabilitation footprint is consistent with commitments for progressive rehabilitation establishment.

Rehabilitation areas monitored were assessed to be generally trending well. Initial TARP triggers relating to erosion and species composition have been activated and will inform response actions during the forward period.

Rehabilitation maintenance works aligned with previous NSW Resources Regulator Section 240 Notice commitments and continued to be implemented. Key activities included progression of 92.2 ha of historic Growth Medium Development phase rehabilitation to native covers, weed control within areas of concern, and preparation works for ongoing progression of areas to final vegetation covers.

As part of HVO’s Vertebrate Pest Action Plan a number of baiting programmes are carried out on a seasonal basis. These programmes are conducted at a level of frequency designed to disrupt pest species such as wild pigs, wild dogs, feral cats, foxes, hares and rabbit’s breeding/colonisation cycles. A variety of methodologies are employed including baiting, trapping and ground-based shooting.

A total of 163 baits were taken by dogs and 47 by foxes. 55 feral pigs were trapped, 17 feral pigs were shot while no wild dogs and foxes were shot. 20 hares / rabbits were shot.

Biodiversity areas were managed in accordance with approved management plans and restoration strategies. Management activities included ecological monitoring, seed collection, removal of redundant fence posts, fencing and pest and weed controls. Monitoring of the Carrington Billabong indicated relatively stable health of the River Red Gum population despite increasing exotic species with increased rainfall.

Community

A total of 25 community complaints were received related to noise, blasting, air quality, and lighting. Four CCC meetings were held during to discuss operations, projects and mine activities however due to COVID19 restrictions, normal face to face consultation and engagement activities did not occur.

HVO provided $37,000 to 14 local projects and initiatives and continues its partnership with Jerrys Plains Public School providing funding for their pre-school program.

To keep the community informed of HVO Continuation Project’s Environmental Impact Statement’s (EIS) progression, the Project website was regularly updated. Newsletters were distributed to the community in June and December 2021.

1 Statement of Compliance

Table 1 is a Statement of compliance against the relevant approvals. **Table 2** provides a brief summary of the non-compliances against development consents and a reference to where these are addressed within this Annual Review. **Table 3** shows the compliance status descriptions relating to **Table 2.**

Table 1 Statement of Compliance

Were all conditions of the relevant approvals complied with?	
PA 06_02161 (HVO South)	No
DA 450-10-2003 (HVO North)	No

Table 2 Non-Compliances

Relevant Approval	Condition Number	Condition Description	Compliance Status	Where addressed in Annual Review
DA 450-10-2003	Schedule 3 Condition 21(b)	TSS exceedance during HRSTS discharge from Parnells Dam – 24 March 2021	Non-compliant (low)	12.1
PA 06_02161	Schedule 3 Condition 19	PM_{10} exceedance Knodlers Lane – 28 July 2021	Non-compliant (low)	12.1
DA 450-10-2003	Schedule 3 Condition 4A	PM_{10} exceedance Cheshunt East – 12 September 2021	Non-compliant (low)	12.1

Table 3 Compliance Status Key for Table 2

Risk Level	Colour Code	Description
High	Non-compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium	Non-compliant	Non-compliance with: Potential for serious environmental consequences, but is unlikely to occur; or Potential for moderate environmental consequences, but is unlikely to occur
Low	Non-compliant	Non-compliance with: Potential for moderate environmental consequences, but is unlikely to occur; or Potential for low environmental consequences, but is unlikely to occur
Administrative Non-compliance	Non-compliant	Only to be applied w here the non-compliance does not result in any risk of environmental harm (e.g., submitting a report to government later than required under approval conditions)

2 Introduction

2.1 Document Purpose

This Annual Review is written to satisfy the requirements of the Development Consents and conditions of mining leases held by Hunter Valley Operations (HVO) for events which occurred during the 2021 calendar year (the reporting period). The Annual Review has been written in accordance with the *Post-approval requirements for State significant mining developments – Annual Review Guideline (NSW Government, October 2015).*

This report is distributed to:

- NSW Department of Planning, Industry and Environment (DPE);
- NSW Resource Regulator (RR);
- NSW Environment Protection Authority (EPA);
- Natural Resource Access Regulator (NRAR);
- Singleton Council.
- Muswellbrook Shire Council; and
- HVO Community Consultative Committee (CCC).

2.2 Background

HVO is situated in the Upper Hunter Valley between Singleton and Muswellbrook, approximately 24 km northwest of Singleton, and approximately 100 km northwest of Newcastle. The Hunter River geographically divides HVO into HVO North (DA 450-10-2003) and HVO South (PA_06_0261); however, they are integrated operationally with personnel, equipment and materials utilised as required. This improves operational efficiency, rationalisation of infrastructure and resource utilisation.

HVO is a jointly controlled operation through a Joint Venture (JV) between Glencore (49%) and Yancoal (51%).

The regional context and layout of the HVO pits and facilities are shown in **Figure 1** and **Figure 2** respectively.

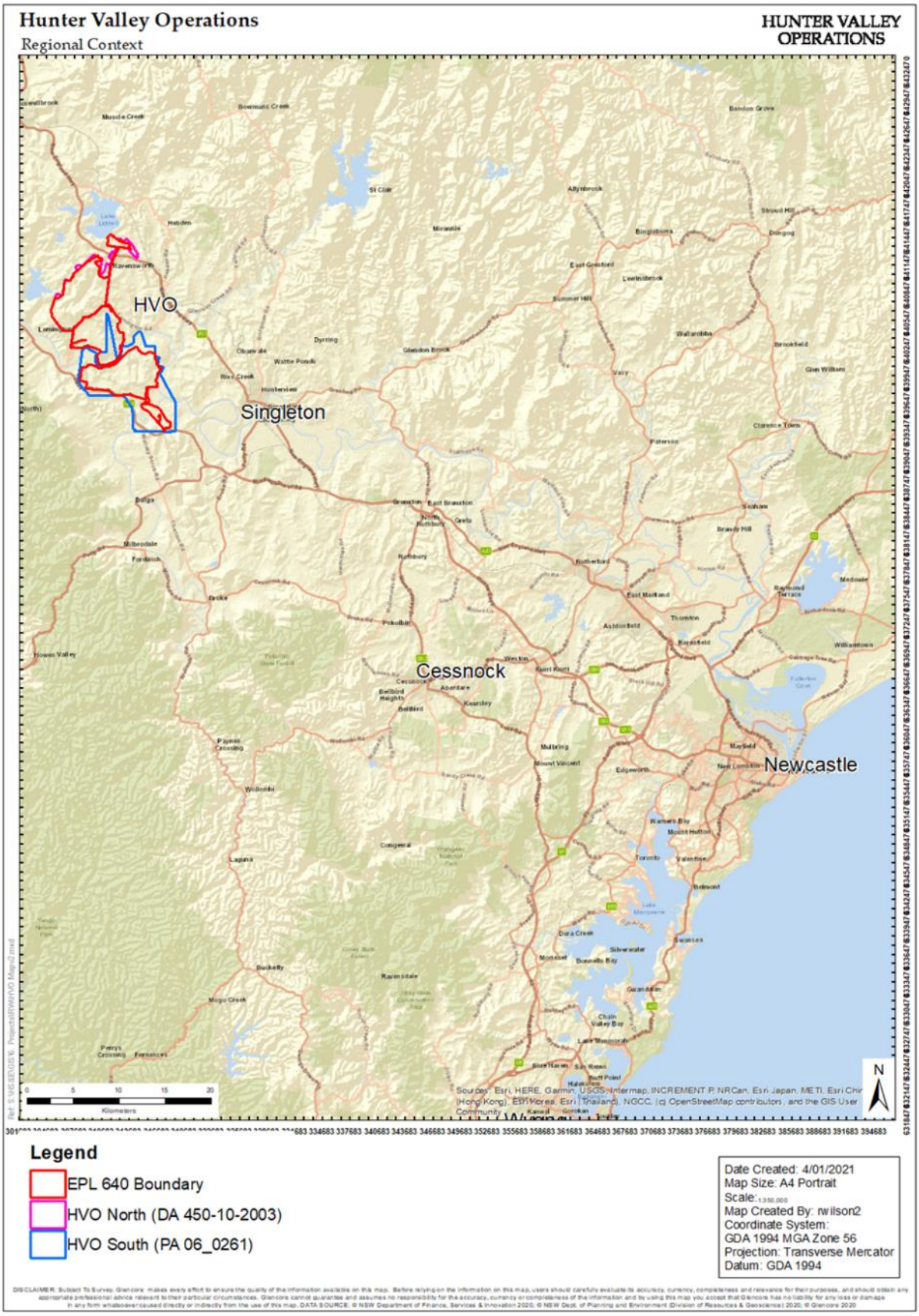

Figure 1 Regional Context

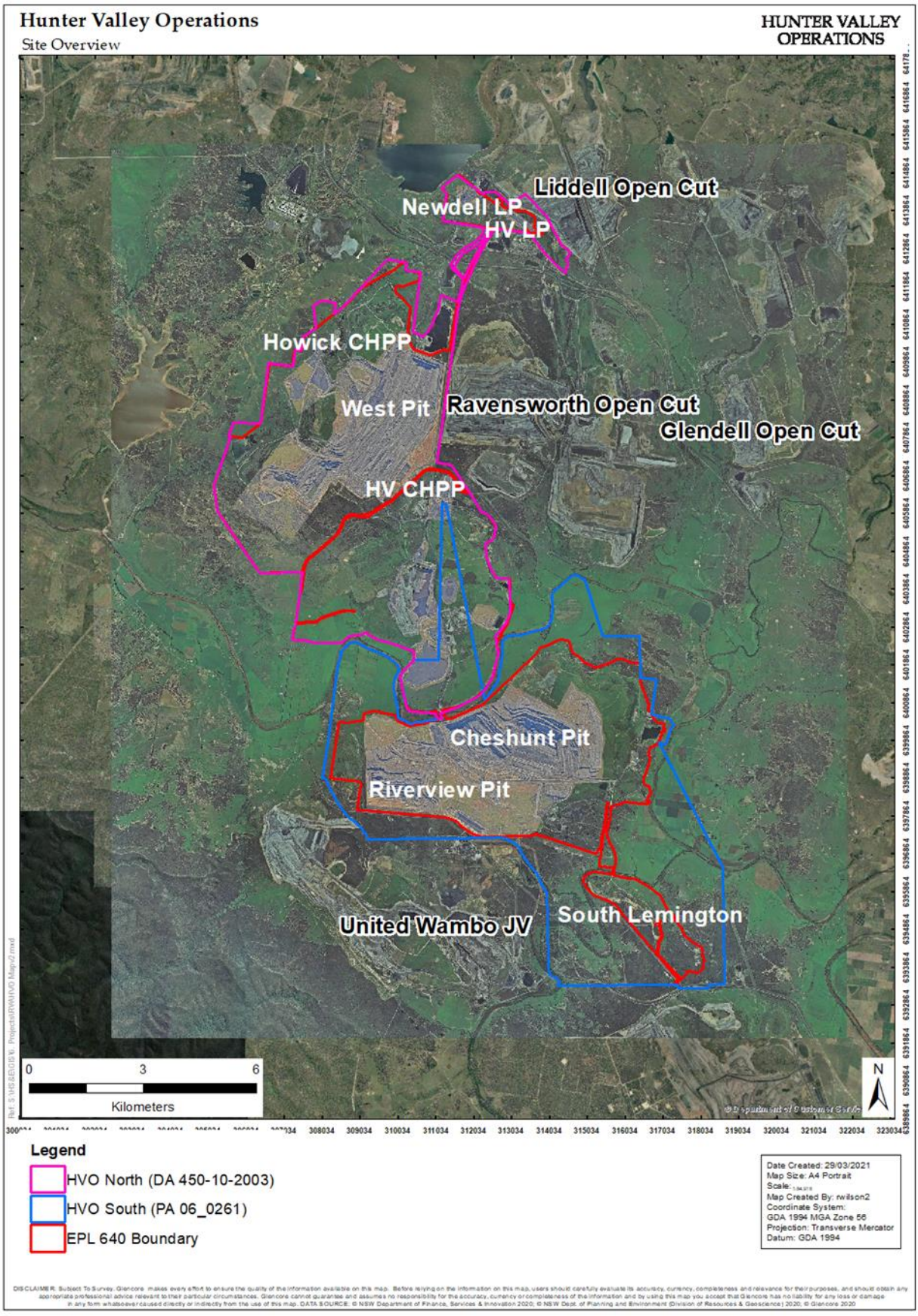

Figure 2 Hunter Valley Operations Site Overview

2.3 Mine Contacts

Key mine contacts are listed in **Table 4.**

Table 4 Mine Contacts

Contact	Role	Phone	Email
Anthony Morris	General Manager	6570 0300	anthony.morris@hvo.com.au
Michael Redman	Operations Manager		michael.redman@hvo.com.au
Andrew Speechly	Environment & Community Manager		andrew.speechly@hvo.com.au

3 Approvals

3.1 Approvals, Leases and Licences

3.1.1 Current Approvals

The status of HVO development consents, licenses and relevant approvals are listed in:

Table 5: HVO Major Approvals

Table 6: Summary of Mining Tenements

Table 7: HVO Licences and Permits

Table 8: Water Related Approvals

Table 9: Surface Water Licences

Table 10: Groundwater Access Licences

Table 5 HVO Major Approvals

Approval Number	Description	Issue Date	Expiry Date
HVO North DA 450-10-2003 MOD 7	HVO West Pit Extension & Minor Modifications (2003); and associated modifications. MOD 7 approved July 2017. Covers West Pit (approved production limit of 12mtpa), Carrington Pit (approved production limit of 10mtpa), HVCHPP (approved processing limit of 20mtpa) and WCHPP (approved processing limit of 6mtpa).	28/07/2017	12/06/2025
HVO South PA 06_0261 MOD 6	Hunter Valley Operations – South Coal Project & associated modifications MOD 6 Approved 26 November 2021 Permits onsite Manufacturing of Ammonium Nitrate Emulsion. MOD 5 approved February 2018 The modification covered: - the progression of mining to the base of the Bayswater seam from Cheshunt Pit into Riverview Pit, and to the base of the Vaux seam in South Lemington Pit 2. - increased overburden emplacement height in some areas to 240m AHD and incorporation of micro-relief - extraction rate increase from 16Mpta to 20Mtpa of ROM coal at peak production and increased processing rate from 16Mpta to 20Mtpa of ROM coal across HVO coal preparation plants.	26/11/2021	24/03/2030
EPBC 2016/7640	Hunter Valley Operations – State approved mining Hunter Valley NSW	10/10/2016	31/12/2030

Table 6 Summary of Mining Tenements

Title	Mining Tenement	Titleholder	Purpose	Grant Date	Expiry Date	Status
AL 32	Assessment Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	04/11/2020	03/11/2026	Granted
AL 33	Assessment Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	04/11/2020	03/11/2026	Granted
AL 34	Assessment Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	04/11/2020	03/11/2026	Granted
AUTH 72	Authorisation	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	08/03/1977	24/03/2018	Renewal Pending
EL 5291	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	28/04/1997	28/04/2023	Granted
EL 5292	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	28/04/1997	27/04/2020	Renewal Pending
EL 5417	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	23/12/1997	08/05/2018	Renewal Pending
EL 5418	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	23/12/1997	08/05/2017	Renewal Pending
EL 5606	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	11/08/1999	10/08/2019	Renewal Pending
EL 8175	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	23/09/2013	23/09/2018	Renewal Pending
EL 8821	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	13/02/2019	13/02/2025	Granted
(Part) CCL 708	Sub lease	Liddell Tenements Pty Ltd	Prospecting and Mining Coal	17/05/1990	29/12/2023	Granted
CCL 714	Consolidated Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	23/05/1990	30/08/2030	Granted

Title	Mining Tenement	Titleholder	Purpose	Grant Date	Expiry Date	Status
CCL 755	Consolidated Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	24/01/1990	05/03/2030	Granted
CL 327	Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	06/03/1989	06/03/2031	Granted
CL 359	Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	21/05/1990	21/05/2032	Granted
CL 360	Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	29/05/1990	29/05/2032	Granted
CL 398	Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	04/06/1992	04/06/2034	Granted
CL 584	Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	01/01/1982	31/12/2023	Granted
CML 4	Consolidated Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	02/03/1993	03/06/2033	Granted
ML 1324	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	19/08/1993	19/08/2035	Granted
ML 1337	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	01/02/1994	01/02/2034	Granted
ML 1359	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	01/11/1994	31/10/2015	Renewal Pending
ML 1406	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	27/02/1997	10/02/2027	Granted
ML 1428	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	15/04/1998	14/04/2019	Renewal Pending
ML 1465	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	21/02/2000	21/02/2021	Expired

Title	Mining Tenement	Titleholder	Purpose	Grant Date	Expiry Date	Status
ML 1474	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	24/11/2000	23/11/2021	Expired
ML 1482	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	19/03/2001	14/04/2019	Renewal Pending
ML 1500	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	21/12/2001	20/12/2022	Granted
ML 1526	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	03/12/2002	02/12/2023	Granted
ML 1560	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	28/01/2005	27/01/2026	Granted
ML 1589	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	02/11/2006	01/11/2027	Granted
ML 1622	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	22/10/2010	10/03/2027	Granted
ML 1634	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	31/07/2009	31/07/2030	Granted
ML 1682	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	16/12/2012	15/12/2033	Granted
ML 1704	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	05/12/2014	05/12/2035	Granted
ML 1705	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	17/12/2014	17/12/2035	Granted
ML 1706	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	09/12/2014	0912/2035	Granted
ML 1707	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	09/12/2014	09/12/2035	Granted

Title	Mining Tenement	Titleholder	Purpose	Grant Date	Expiry Date	Status
ML 1710	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	22/12/2016	10/03/2027	Granted
ML 1732	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	06/04/2016	06/04/2037	Granted
ML 1734	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	06/04/2016	06/04/2037	Granted
ML 1748	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	05/12/2016	04/12/2037	Granted
ML 1753	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	19/04/2017	19/04/2038	Granted
ML 1810	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	04/11/2020	04/11/2041	Granted
ML 1811	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	04/11/2020	04/11/2041	Granted
MLA 495	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	Mining Lease Application lodged 12th May 2015		Application Pending
MLA 496	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	Mining Lease Application lodged 12th May 2015		Application Pending
MLA 520	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	Mining Lease Application lodged 23rd December 2015		Application Pending
MLA 535	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	Mining Lease Application lodged 28th October 2016		Application Pending
MLA 542	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities (Mining Purposes)	Mining Lease Application lodged 27th July 2017		Application Pending
MLA 543	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities (Mining Purposes)	Mining Lease Application lodged 27th July 2017		Application Pending

Title	Mining Tenement	Titleholder	Purpose	Grant Date	Expiry Date	Status
MLA 562	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities (Mining Purposes)	Mining Lease Application lodged 21st December 2018		Application Pending

Table 7 HVO Licences and Permits

Type	Licence Number	Description	Authority	Expiry Date
Environment Protection Licence	EPL640	Environment Protection Licence	EPA	N/A
Dangerous Goods/ Explosives	RR12709	Licence to Store	Work Cover	06/07/2022
Radiation Licence	RML5085293	Radiation Management Licence	EPA	14/11/2022
Aboriginal Heritage Permit	C0001890	Care Agreement	OEH	03/06/2036
	C0002193	Aboriginal Heritage Impact Permit	OEH	06/12/2026
Road Closure Permit	1543350	Road Occupancy Licences– Golden Highway	RMS	30/06/2022
	N/A	Road Closure Approval - Lemington Road	Singleton Council	30/06/2022

Table 8 Water Related Approvals

Licence Number	Type of Licence	Purpose	Legislation	Description	ExpiryDate
20BL030566	Bore	Well	Part 5 Water Act 1912	East Open Cut	Perpetuity
20BL141584	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – Carrington Work Licence	Perpetuity
20BL166637	Bore	Monitoring Bore	Part 5 Water Act 1912	No Current Bores	Perpetuity
20BL168820	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – Bores: CGW39, CGW45a, CGW46,CGW47, CGW47a, CGW48, CGW49, P50/38.5, ,CGW56, 4036C, 4035P, 4032P, 4034P, 4033P, 4053P, 4052P, 4051C, 4040P, 4038C, 4037P Destroyed: CGW7, CGW50, CGW57, CGW58, CGW59, CGW60, CGW61, CGW62, CGW63	Perpetuity
20BL169241	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – Bores: DM1, HF3, HF7 Destroyed: DM2	Perpetuity
20BL169641	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – Bores: CGW5, CGW51A, CGW52, CGW53, CGW54, CGW55A, CGW53A, CGW52A, CGW54A, CGW6, CFW55, CFW57, CFW57A, CFW59, and CFW55R. Destroyed: CGW1, CGW2, CGW3, CGW5, CGW8, CGW9, CGW10, CGW12, CGW13, CGW14, CGW30,CGW33, CGW34,CGW35, CGW36, CGW37, CGW38,CGW40, CGW41,CGW42, CGW43, CGW44, CFW56, CFW56A, CFW58	Perpetuity
20BL170496	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ10 (CHPZ 2A), BZ11 (CHPZ 3A), BZ18 (CHPZ 10A), BZ20 (CHPZ 12A), BZ21 (CHPZ 13D), BZ21A (CHPZ 13A), BZ20A (CHPZ 12D), BZ11A (CHPZ 3D) Destroyed: AP50/47.5, AQ52,	Perpetuity

Licence Number	Type of Licence	Purpose	Legislation	Description	ExpiryDate
				AV50/56.5, AS50/62.5, AR55, Bunc 3,BZ25 (Bunc 12), BZ23 (Bunc 14), BZ24 (Bunc13),	
20BL170497	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ15 (CHPZ 7A), BZ16 (CHPZ 8D), BZ17 (CHPZ 9A), BZ19 (CHPZ 11A), BZ16A(CHPZ 8A), Bunc 46D Destroyed: Bunc 39 (Shallow & Deep), Bunc44D	Perpetuity
20BL170498	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ12 (CHPZ 4A), BZ13 (CHPZ 5A), BZ14, BZ9 (CHPZ 1A), BC1, BC1a, BZ8-1, BZ8-2, BZ8-3, HG1, HG2, HG2a, HG3, S4, S6, BZ22 (CHPZ14D), BZ22A (CHPZ 14A), BZ5-1, BZ5-2 Destroyed: S2, S3, S9,S11	Perpetuity
20BL171423	Bore	Monitoring Bore	Part 5 Water Act 1912	E1.5	Perpetuity
20BL171424	Bore	Monitoring Bore	Part 5 Water Act 1912	Destroyed: GW9711	Perpetuity
20BL171425	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: GW9701, GW9710	Perpetuity
20BL171426	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: GW9702 Destroyed: D2(WH236)	Perpetuity
20BL171427	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: C335, C630 (BFS)	Perpetuity
20BL171428	Bore	Monitoring Bore	Part 5 Water Act 1912	D807	Perpetuity
20BL171429	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: B925 (BFS), C122 (BFS), C122 (WDH)	Perpetuity
20BL171430	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: C613 (BFS), C809 (GM/WDH)	Perpetuity
20BL171431	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: B631 (BFS), B631 (WDH)	Perpetuity

Licence Number	Type of Licence	Purpose	Legislation	Description	ExpiryDate
20BL171432	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: C130 (AFSH1), C130 (ALL), C130(BFS), C130 (WDH)	Perpetuity
20BL171433	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bore B334(BFS)	Perpetuity
20BL171434	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: C317(BFS), C317 (WDH)	Perpetuity
20BL171435	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ3-1, BZ3-2, BZ3-3	Perpetuity
20BL171436	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ4A(1), BZ4A(2), BZ4B	Perpetuity
20BL171437	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: WG1, WG2, WG3	Perpetuity
20BL171439	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: BRN, E012	Perpetuity
20BL171492	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: C1(WJ039), GW9704, North,GWAR981	Perpetuity
20BL171681	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: Bunc45A, Bunc 45D	Perpetuity
20BL171725	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: B425(WDH), BRS, C621 (BFS),C919 (ALL), D317 (BFS),D317(ALL), D317(WDH) Destroyed: D420, D425,D621, PB02	Perpetuity
20BL171726	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: SR002, SR003, SR004, SR005, SR006,SR007	Perpetuity
20BL171727	Bore	Monitoring Bore	Part 5 Water Act 1912	SR001	Perpetuity
20BL171728	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ2B, BZ1-1, BZ1-2, BZ1-3, BZ2-1, BZ2-2	Perpetuity

Licence Number	Type of Licence	Purpose	Legislation	Description	ExpiryDate
20BL171762	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: C817, D010 (BFS), D214 (BFS), D406 (BFS) (AFS),D510 (BFS), PB01 (ALL),D510 (AFS), D010 (GM), D010 (WDH), D406 (BFS) (AFS), D612 (AFS), D612(BFS)	Perpetuity
20BL171851	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North/South – Bores:HV2, PZ1CH200, PZ2CH400, PZ3CH800, 4118P, 4119P	Perpetuity
20BL171852	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – PZ4CH1380	Perpetuity
20BL171853	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – DM3	Perpetuity
20BL171854	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – Bores: DM5, PZ6CH2450	Perpetuity
20BL171855	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – PZ5CH1800	Perpetuity
20BL171433	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bore B334(BFS)	Perpetuity
20BL171434	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: C317 (BFS), C317 (WDH)	Perpetuity
20BL171435	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ3-1, BZ3-2, BZ3-3	Perpetuity
20BL171436	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ4A(1), BZ4A(2), BZ4B	Perpetuity
20BL171437	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: WG1, WG2, WG3	Perpetuity
20BL171439	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: BRN, E012	Perpetuity
20BL171492	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: C1(WJ039), GW9704, North,GWAR981	Perpetuity

Licence Number	Type of Licence	Purpose	Legislation	Description	ExpiryDate
20BL171681	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: Bunc45A, Bunc 45D	Perpetuity
20BL171725	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: B425 (WDH), BRS, C621 (BFS), C919 (ALL), D317 (BFS), D317(ALL), D317(WDH) Destroyed: D420, D425,D621, PB02	Perpetuity
20BL171726	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: SR002, SR003, SR004, SR005, SR006,SR007	Perpetuity
20BL171727	Bore	Monitoring Bore	Part 5 Water Act 1912	SR001	Perpetuity
20BL171728	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ2B, BZ1-1, BZ1-2, BZ1-3, BZ2-1, BZ2-2	Perpetuity
20BL171762	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: C817, D010 (BFS), D214 (BFS), D406 (BFS) (AFS),D510 (BFS), PB01 (ALL),D510 (AFS), D010 (GM), D010 (WDH), D406 (BFS) (AFS), D612 (AFS), D612(BFS)	Perpetuity
20BL171851	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North/South – Bores:HV2, PZ1CH200, PZ2CH400, PZ3CH800, 4118P, 4119P	Perpetuity
20BL171852	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – PZ4CH1380	Perpetuity
20BL171853	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – DM3	Perpetuity
20BL171854	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – Bores: DM5, PZ6CH2450	Perpetuity
20BL171855	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – PZ5CH1800	Perpetuity
20BL171856	Bore	MonitoringBore	Part 5 Water Act 1912	HVO North – Bores: HV6,HV3, DM6, HV2 (2), 4113P, 4114P. 4116P, 4117P	Perpetuity

Licence Number	Type of Licence	Purpose	Legislation	Description	ExpiryDate
20BL171857	Bore	MonitoringBore	Part 5 Water Act 1912	Bores: HV4, HV4 (2)(GA3), GA3,	Perpetuity
20BL171858	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – DM4	Perpetuity
20BL171895	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO West – Destroyed: NPZ4	Perpetuity
20BL171896	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO West – NPZ2	Perpetuity
20BL171897	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO West – Bores: NPZ1 Destroyed: NPZ5	Perpetuity
20BL171898	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO West – NPZ3	Perpetuity
20BL173062	Bore	Monitoring Bore	Part 5 Water Act 1912	RC14	Perpetuity
20BL173065	Bore	Monitoring Bore	Part 5 Water Act 1912	HQ11	Perpetuity
20BL173063	Bore	Monitoring Bore	Part 5 Water Act 1912	RC07, RC08	Perpetuity
20BL173064	Bore	Monitoring Bore	Part 5 Water Act 1912	RC06	Perpetuity
20BL173069	Bore	Monitoring Bore	Part 5 Water Act 1912	RC11	Perpetuity
20CA201247	Works Approval	Pumping Plant	Water Management Act2000	Associated with WAL965	Perpetuity
20CA212713	Works Approval	Pumping Plant	Water Management Act2000	Associated withWAL36190	30/05/2025

Licence Number	Type of Licence	Purpose	Legislation	Description	ExpiryDate
20FW213280	Flood Work Approval	Levee	Water Management Act2000	HVO North CarringtonLevee 5	21/09/2027
20FW213281 Formerly 20CW802613	Flood Work Approval	Levee	Water Management Act2000	HVO South – Barry Levee	21/09/2027
20FW213277 Formerly 20CW802603	Flood Work Approval	Block Dam	Water Management Act2000	HVO South – Hobden Gully Levee	21/09/2027
20FW213278 Formerly 20CW802604	Flood Work Approval	Levee	Water Management Act2000	HVO North – North PitLevee 3	21/09/2027
20WA210991 (See WAL 18307) Formerly 20SL050903	Stream Diversion	Stream Diversion	Water Management Act2000	HVO West – Parnells Creek Dam	09/01/2023
20WA211427 Formerly 20SL061290	Stream Diversion	Cutting (Diversion Drain)	Section 10 Water Act 1912	Pikes Gully Creek Stream Diversion	07/09/2023
20WA210985 (See WAL18327) 20SL042746	Diversion Works	Industrial	Water Management Act 2000	HV Loading Point Pump Bayswater Creek	08/09/2022
20WA211428 20SL061594	Stream Diversion	Cutting (Diversion Drain)	Water Management Act 2000	HVO North – CarringtonStream Diversion	31/07/2022
20WA201238 (see WAL 962)	Diversion Works	PumpingPlant	Water Management Act 2000	HVCPP River Pump	16/03/2028
20WA201257 (see WAL 970)	Diversion Works	PumpingPlant	Water Management Act 2000	HVO South – LCPP RiverPump	Perpetuity
20WA201338 (See WAL1006)	Diversion Works	PumpingPlant	Water Management Act 2000	HVO South – LCPP RiverPump	Perpetuity
20WA201501 (See WAL1070)	Diversion Works	PumpingPlant	Water Management Act 2000	HVO South – LCPP RiverPump	Perpetuity
20WA201685 (See WAL13387)	Diversion Works	PumpingPlant	Water Management Act 2000	HVO West – "Lake Liddell" Licence	Perpetuity

Licence Number	Type of Licence	Purpose	Legislation	Description	ExpiryDate
20FW213274	Flood Work Approval	Levee	Water Management Act 2000	Riverview	26/10/2028

Table 9 Surface Water Access Licences 2020/21 Water Year

Licence Number	Description	Water Source	Water Sharing Plan	Water Source Management Zone	Entitlement (ML)	Passive take / inflows (ML)	Active Pumping (ML)	Total Take (ML)
WAL867	Comleroi,farming &irrigation	Hunter River	Hunter RegulatedRiver WSP	Zone 2a (Hunter River from Glennies Creek Junctionto Wollombi Brook Junction)	486	0	0	0
WAL962	HVO North – HVCPP River Pump – Water AccessLicence	Hunter River	Hunter RegulatedRiver WSP	Zone 1b (Hunter River from Goulburn River Junctionto Glennies Creek Junction)	3,165	0	186.7	186.7
WAL969	HVO South – Former Riverview pump	HunterRiver	Hunter RegulatedRiver WSP	Zone 1b (Hunter River from GoulburnRiver Junction toGlennies Creek Junction)	39	0	0	0
WAL970	HVO South – LCPP River Pump – Water AccessLicence	HunterRiver	Hunter RegulatedRiver WSP	Zone 2a (Hunter River from GlenniesCreek Junction toWollombi Brook Junction)	500	0	386	386
WAL1006	HVO South – LCPP River Pump – Water AccessLicence	HunterRiver	Hunter RegulatedRiver WSP	Zone 2a (Hunter River from GlenniesCreek Junction to Wollombi Brook Junction)	500	246	0	246
WAL1070	HVO South - LCPP River Pump – Water AccessLicence	HunterRiver	Hunter RegulatedRiver WSP	Zone 2a (Hunter River from GlenniesCreek Junction to Wollombi Brook Junction)	500	0	0	0
WAL13387	Macquarie Generation Hunter River Pump Station	HunterRiver	Hunter RegulatedRiver WSP	Zone 1b (Hunter River from GoulburnRiver Junction to Glennies Creek Junction)	20	0	0	0
WAL 13391	HVO North – Alluvial Rehabilitation Irrigation.	HunterRiver	Hunter RegulatedRiver WSP	Zone 1b (Hunter River from GoulburnRiver Junction to Glennies Creek Junction	420 (908 ML after transfers)	0	144.1	144.1
WAL18127	CarringtonBB1	Hunter River Alluvium	Hunter Unregulatedand AlluvialWater Sources WSP	Hunter Regulated River Alluvial Water Source – Upstream Glennies Creek management zone	383	360	0	360
WAL18158	Ollenberry	Hunter River Alluvium	Hunter Unregulatedand AlluvialWater Sources WSP	Hunter Regulated River Alluvial Water Source – Upstream Glennies Creek managementzone	65	0	0	0
WAL18307	HVO West – Parnells Creek Dam (Diversion Works By wash)	Unregulated River	Hunter Unregulatedand AlluvialWater Sources WSP	Jerrys Water Source; JerrysManagement Zone	500	319[2]	0	319
WAL18327	HV LoadingPoint PumpBayswater Creek (Diversion Works)	Unregulated River	Hunter Unregulatedand AlluvialWater Sources WSP	Jerrys Water Source; JerrysManagement Zone	150	0	0	0

Licence Number	Description	Water Source	Water Sharing Plan	Water Source Management Zone	Entitlement (ML)	Passive take / inflows (ML)	Active Pumping (ML)	Total Take (ML)
WAL23889	Greenleek	Wollombi Brook	Hunter Unregulatedand AlluvialWater Sources WSP	Low er Wollombi Brook WaterSource	144	0	0	0
WAL36190	HVO North, old farm bore	Hunter River Alluvium	Hunter Unregulatedand AlluvialWater Sources WSP	Hunter Regulated River Alluvial Water Source – Jerrys ManagementZone	120	0	0	0

Table 10 Groundwater Access Licences

Groundwater Licences								
Licence Number	**Description**	**Water Source**	**Water Sharing Plan (WSP)**	**Water Source – Management Zone**	**Entitlement (ML)**	**Passive take / inflows (ML)**	**Active Pumping (ML)**	**Total (ML)**
WAL39798[1]	Lemington Underground (LUG) Bore	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (Commenced 1/7/16)	Permian Coal Seams	1,800	0	80.4 (use by MTW)	80.4 (use by MTW)
WAL40462	HVO North Pit Alluvial Lands Bores(x4)	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (Commenced 1/7/16)	Permian CoalSeams	2,400	0	0	0
WAL40463	HVO West Pit Excavation	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (Commenced 1/7/16)	Permian CoalSeams	180	180	0	180
WAL40466	HVO South Pit Excavation	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (Commenced 1/7/16)	Permian CoalSeams	460	460	0	460
WAL41527	HVO North –Carrington Pit	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (Commenced 1/7/16) Previously Water Act 1912	Permian CoalSeams	700	434	0	434

WAL 41533	HVO North – Pit Excavation	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (Commenced 1/7/16)	Permian Coal Seams	20	0	0	0

[1] HVO commenced permanent transfer of WAL39798 to MTW during the reporting period, transfer of the Title remains in process.

[2] Passive take, conservative estimate calculated from rainfall runoff volumes to Dam18W.

3.1.2 Management Plans, Programs, Strategies

HVO is required by the development consent approvals to develop and submit a range of environmental management plans for approval prior to implementation. Approved management plans are made publicly available on the HVO website (https://hvo.com.au/).

Many updated plans were submitted to DPE in 2021. Some plans remain under review and will be submitted to DPE in 2022. The status of management plans is shown in **Table 11** and **Table 12**.

Table 11 Management Plans and Mining Operations Plans (MOPs) Required for HVO North

Management Plan	Date Approved
Agricultural Lands Reinstatement Management Plan	26/02/2017 (With 2017 MOP)
Fine Reject Management Strategy	07/12/2018
HVO Air Quality and Greenhouse Gas Management Plan	12/09/2019
HVO Blast Management Plan	03/04/2019
HVO Bushfire Management Plan	20/10/2017
HVO Environmental Management Strategy	08/01/2019
HVO Greenhouse and Energy Efficiency Plan (Addressed in HVO Air Quality and Greenhouse Gas Management Plan)	12/09/2019
HVO Noise Management Plan	16/12/2021
HVO North Heritage Management Plan	09/02/2020
HVO River Red Gum Rehabilitation & Restoration Strategy	24/03/2010
HVO Water Management Plan	16/10/2018
Final Void Management Plan	Submitted 20/12/2021
MOP 2020 (30 September 2020 – 31 December 2022) Incorporates: - Conceptual Landscape and Rehabilitation Strategy	08/04/2021

*The Agricultural Lands Reinstatement Management Plan states that the agricultural reinstatement activities and monitoring results will be reported in the HVO Annual Environment Review (Annual Review). However, work has not yet commenced hence no monitoring or reporting against the management plan specific to the Carrington West Wing project is provided in this report.

Table 12 Management Plans and MOPs Required for HVO South

Management Plan	Date Approved
HVGC Amenity Management Plan	22/01/2013 (revision submitted 28/12/2021)
HVO Air Quality and Greenhouse Gas Management Plan	12/09/2019
HVO Biodiversity Offset Strategy	23/10/2017
HVO Blast Management Plan	03/04/2019
HVO Bushfire Management Plan	20/10/2017
HVO Environmental Management Strategy	08/01/2019
HVO Integrated Biodiversity Management Plan	02/08/2018
HVO Noise Management Plan	16/12/2021
HVO River Red Gum Rehabilitation & Restoration Strategy	24/03/2010
HVO South Aboriginal Cultural Heritage Management Plan	09/02/2020
HVO Water Management Plan	16/10/2018
MOP 2020 (30 September 2020 – 31 December 2022)	08/04/2021
Biodiversity Management Plan (Offsets component)	26/06/2017- Goulburn River Biodiversity Area Management Plan

4 Operations Summary

4.1 Mining

Areas to be mined are geologically modelled, a mine plan is formed, and the relevant mining locations are surveyed prior to mining. The mining process is illustrated in **Figure 3**. There are no active underground workings at HVO.

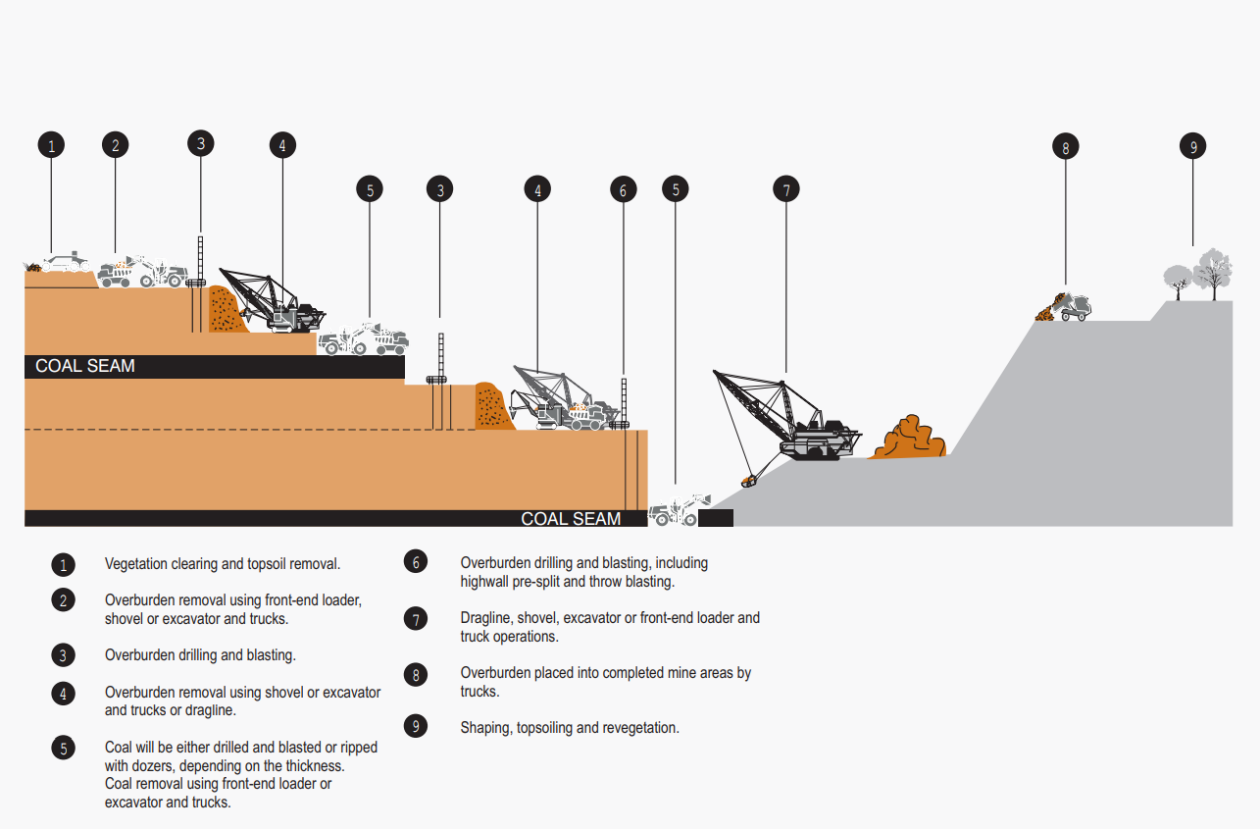

Figure 3 Open Cut Mining Schematic

No material changes were made to the mining method during the reporting period. Mining progress deviated slightly from the schedule of the MOPs as a result of normal variations in productivity and utilisation.

The mining equipment fleet employed to carry out mining operations at HVO in 2020 and 2021 is detailed in **Table 13** along with the fleet forecast for 2022.

Table 13 HVO Equipment Used 2020-2021

Equipment Type	Number Used in 2020	Number Used in 2021	Forecast Numbers in 2022
Scrapers	2	2	2
Drills	8	7	8
Draglines	2	2	1
Shovels	3	3	3
Excavators	8	7	10
Trucks	82	73	84
Loaders	6	6	7
Service Trucks	5	5	5
Track Dozers	27	27	30
Rubber Tyre Dozers	5	4	4
Graders	11	11	11
Water Trucks	11	10	10
Floats	1	1	1
Cable Reeler	1	1	1
Cable Tractors	5	5	5
Total	**177**	**164**	**182**

4.1.1 Mineral Processing

Coal is transported to one of two Coal Handling and Preparation Plants (CHPPs) (Coal Handling and Preparation Plant) where it is crushed to size and processed to remove impurities. Processing produces saleable coal, along with coarse and fine reject materials. Coarse rejects are disposed of in-pit and fine rejects are placed in a tailings dam in accordance with the MOP. Each CHPP site has storage facilities for processed (saleable) and raw (unprocessed) coal. The capacity of each site is listed in **Table 14**.

No material changes or additions were made to process or facilities during the reporting period.

Table 14 Stockpile Capacities

Location	Raw Stockpile (t)	Saleable Stockpile (t)
Hunter Valley CHPP	176,000	330,000
Howick CHPP	15,000	30,000
Newdell Load Point	0	400,000

Processed, or product coal is transported to one of the two loading points via conveyor belt or road, detailed in **Table 15**. The coal from Hunter Valley CHPP(HVCHPP) is transported to the Hunter Valley Load Point (HVLP) by means of overland conveyor whereas coal from Howick CHPP is typically trucked to Newdell Load Point (NLP) but can receive coal from HVLP via overland conveyor if required. After the coal has reached either HVLP or the NLP it is transported to the Port of Newcastle by rail.

Table 15 Methods of Coal Transportation

Transport Category	Quantity (Mt)
Coal transported from the site via trains	11.2
Amount of coal received from Hunter Valley Operations South of the Hunter River	7.5
Amount of coal hauled by road to the Hunter Valley Loading Point	Nil
Coal hauled by road to the Newdell Load Point	0.37
Amount of coal hauled by road from the Newdell Loading Point to the Ravensworth Coal Terminal	Nil
Amount of coal hauled by road from the Hunter Valley Loading Point to the Ravensworth Coal Terminal	Nil
Number of coal haulage truck movements generated by the development. (Includes -coal hauled to stockpile, coal hauled to bins, coal hauled from stockpile to bins)	111,008 (truck movements)

4.1.2 Production Statistics

Project approvals allow for the extraction of up to 22 million ROM tonnes from operations north of the Hunter River and 20 million ROM tonnes from operations south of the Hunter River. A summary of production and waste at HVO during 2021 in comparison to previous years and approval limits is provided in **Table 16**.

Product coal includes low-ash, semi-soft and steaming coals.

Table 16 Production Statistics and Correlating Project Approval Limits

	Approved Limit (PA 06_0261 and DA 450-10-2003)	Reporting Period 2020	Reporting Period 2021	Forecast for 2022
Prime Waste(Mbcm)	-	90.83	81.19	101.24
ROM Coal (Mtpa) (mined)	42	16.83	14.41	18.34
- *HVO South*	20	10.23	9.87	11.67
- *West Pit*	12	6.60	4.54	6.67
- *Carrington Pit*	10	0	0	0
Coarse Reject (Mt)	-	3.17	3.02	3.20
Fine Reject-Tailings (Mt)	-	1.63	1.43	1.91
Product (Mtpa)	-	11.98	10.57	13.79
ROM Coal Processed	26	15.85	14.86	18.90
- *Hunter Valley CHPP*	20	13.45	14.59	16.36
- *Howick CHPP*	6	2.40	0.25	2.54

4.1.3 Summary of Changes

Production and equipment numbers were maintained at reduced levels throughout 2021 in response to changing market conditions. Howick Coal Processing Plant restarted in November 2021 due to an improvement in market conditions towards the end of the year.

Mining in the Carrington West Wing location has not yet commenced. As of the time of reporting, mining in this area is not planned to commence during 2022.

Tailings emplacement continued in the Carrington mining void in 2021.

4.2 Forecast Operations for Next Reporting Period

Table 17 outlines the forecast operations for the next reporting period.

Table 17 Production Operations Forecast

Material	Unit	2021 (Forecast)	2021 (Actual)	2022 Forecast	2023 Forecast
Stripped Topsoil	M^3	212.87	10.60	217.16	94.55
Rock / Overburden	Mbcm	90.47	94.46	108.39	111.74
ROM Coal	Mt	15.24	14.86	18.90	18.70
Reject Material	Mt	3.89	4.29	5.11	5.15
Product	Mt	11.35	10.57	13.79	13.55

5 Actions Required from Previous Annual Review

DPE responded to HVO on 29 July 2021 accepting the 2020 Annual Review. DPE did not require any changes to the 2020 Annual Review, however actions from the 2020 Annual Review for future reviews and HVO's response are detailed in **Table 18**. The NSW Resources Regulator did not provide any feedback in response to the 2020 Annual Review.

Table 18 Actions recommended in 2020 Annual Review and HVO response

Action recommended in 2020 Annual Review	Action taken by HVO
Section 6.3 – include a discussion on the trends in blasting data as required by Schedule 5, Condition 4 of the project approval.	HVO has tabulated blasting compliance trends in this Annual Review. This is included in **Section 6.3.2 Blasting performance**.
Section 7 -include a table as per table 7 of the Departments *Annual Review Guideline* (October 2015) outlining the projects water take for the previous water year.	**Table 9** and **Table 10** have been updated to include a total water take column as per table 7 of the Departments *Annual Review Guideline* (October 2015).

6 Environmental Performance

6.1 Meteorological Data

The collection of meteorological (weather) data is carried out to assist in day-to-day operational decisions, planning, environmental management and to maintain a historic record. The meteorological stations record:

- wind speed
- wind direction
- temperature
- humidity
- solar radiation
- rainfall

HVO operates two real-time meteorological stations; the HVO Corporate Meteorological Station and the Cheshunt Meteorological Station. The locations of these monitors are shown in **Figure 12**. Daily average data is publicly available via the Monthly Environmental Monitoring Reports published on the HVO website.

Total annual rainfall for 2021 was 910.2mm (recorded at the HVO Corporate Meteorological Station) compared to 793mm in 2020 and 368.8mm in 2019. (**Figure 4**).

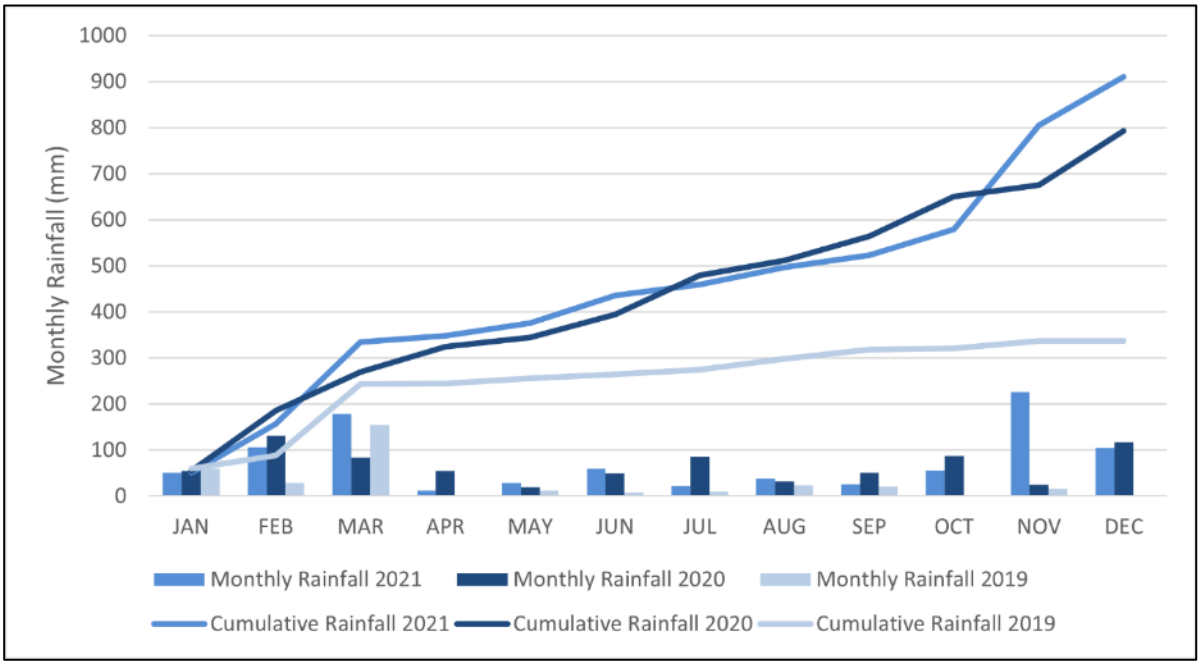

Figure 4 HVO Corporate Meteorological Station 2019 - 2021 Rainfall Data

6.2 Noise

6.2.1 Noise Management

Mining activities at HVO are managed to minimise adverse noise impacts and to maintain compliance with permissible noise limits at nearby private residences. A combination of proactive and reactive noise controls are employed to ensure effective management of noise. Noise controls are as detailed in the HVO Noise Management Plan (NMP).

6.2.2 Sound Attenuation of Heavy Equipment

All operational haul trucks at HVO have been fitted with sound attenuation kits. During 2021, three haul trucks were fitted with the updated version three sound attenuation kits.

A routine sound power level testing schedule was implemented across site in 2021 and this will continue throughout 2022.

6.2.3 Real Time Noise Management

HVO operates a network of directional real-time noise monitors to measure and manage noise emissions and to minimise community impact.

The real-time system generates alarms when elevated noise is measured, triggering the implementation of reactive controls to reduce noise levels. HVO received and responded to 1115[1] noise alarms during 2021 and recorded over 620 hours of equipment downtime for the management of noise. The location of real-time noise monitoring locations as per the approved NMP are shown in **Figure 5**.

[1] Noise alarm triggers are based on internally set noise criteria. Alarms received include noise exceedances from non-mine sources.

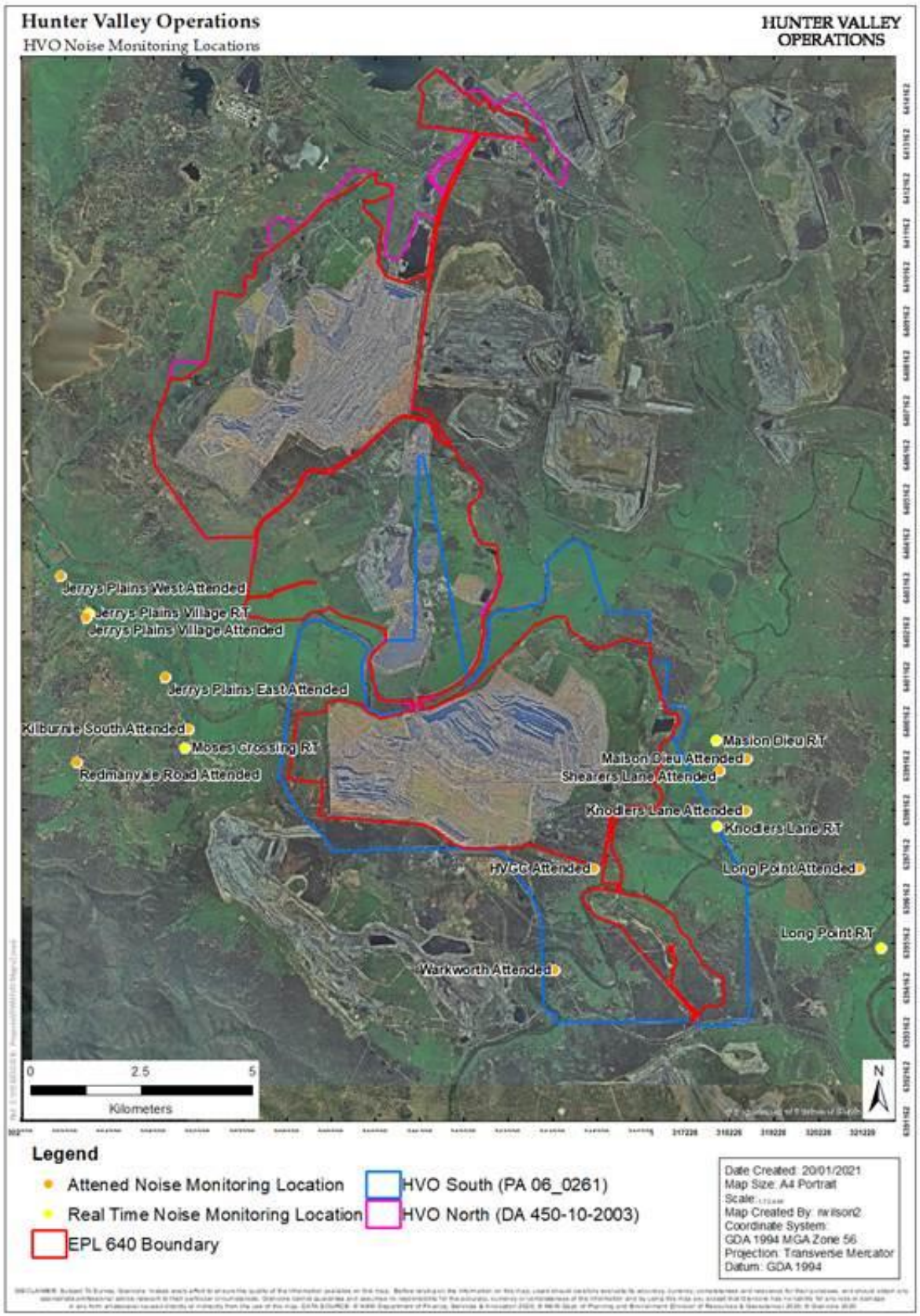

Figure 5 HVO Attended and Real Time Noise Monitoring Locations

Attended monitoring during 2021 was compared to real time noise monitoring results where a comparison could be made (e.g., where HVO was audible) in order to validate real time noise monitoring systems. Where comparisons were able to be made, results indicated that the real time monitoring system generally aligned with values recorded during attended noise measurements. Where they didn't align, the majority of real time measurements were higher than attended noise measurements.

Details of this assessment is provided in **Table 19**.

Table 19 Comparison of Attended and Real Time Noise Monitoring 2021

Monitoring Location	Number of attended noise measurements where comparison could be made[1]		Real Time measurements that aligned[2] with attended measurements		Real Time measurements with positive variance > 3dB(A) of attended measurements		Real Time measurements with a negative variance > 3dB(A) of attended measurements	
	South	North	South	North	South	North	South	North
Maison Dieu	2	-	0	-	1	-	1	-
Knodlers Lane[3]	1	-	0	-	1	-	0	-
Long Point	-	-	-	-	-	-	-	-
Kilburnie South	3	-	2	-	1	-	0	-
Jerrys Plains Village[3]	-	4	-	0	-	4	0	-

Notes:
[1] Includes measurements under all meteorological conditions

[2] Aligned indicates measurements were within 3dB (A) of each other or measurement results <25dB indicated that source could not be was in audible or not measurable.

[3] One or more data points not available for attended and / or real time monitoring events.

6.2.4 Operational Noise Performance

HVO engages a suitably qualified and experience acoustic consultant to undertake routine attended noise compliance monitoring at nearby private residences to assess compliance with the relevant Project Approval and EPL noise criteria, in accordance with the HVO NMP. Monitoring is undertaken at a frequency of one night per month and an additional one night per quarter as required by the HVO North Approval. This monitoring is undertaken to evaluate and assess noise impacts under a range of meteorological conditions throughout the year.

A total of 121 measurements were recorded during 2021. Each measurement involves an assessment of HVO mine noise against the various $L_{Aeq,\ 15minute}$ and $L_{A1,1min}$ noise criteria in place under the HVO North and South Approvals. Full details for all noise assessments completed can be found in HVO Monthly Environmental Monitoring Reports published on the HVO website.

HVO was compliant with relevant noise criteria for all measurements recorded in 2021. There was one exceedance of the $LA_{1(1\ min)}$ criteria on 22 July at the Jerrys Plains East monitoring location. Attended monitoring recorded a result of 55dB, above the compliance criteria of 45dB. The acoustic consultant contacted the Senior OCE to explain the monitoring result and that the source of the noise was coming from the dragline bucket in Riverview Pit. The dragline was shut down and progressively restarted while monitoring noise levels. Follow up monitoring was below criteria with five additional 1-minute measurements taken on the night and additional measurement taken the following week.

The EPA and DPE were notified of the incident and report provided. Constitutes non-compliance with EPL but not the HVO South Development Consent.

Comparison between the 2021 L_{Aeq} attended noise monitoring results (maximum HVO contribution levels measured under applicable meteorological conditions) and previous years are shown in **Table 20**.

Table 20 Comparison of 2021 Noise Monitoring Results Against Previous Years

Year	Number of Measurements	Number of measurements which exceeded allowable noise (under applicable meteorological conditions)	Number of non-compliances
2021	121	1	0
2020	110	0	0
2019	101	1	0
2018	105	3	0
2017	100	1*	0
2016	109	2*	0

* The now superseded NSW Industrial Noise Policy (INP) allowed for the measured result to be less than or equal to 2 dB above the applicable noise limit without constituting a non-compliance. Note: Where the measured result is greater than 2dB above the applicable noise limit, the site has 75 minutes to reduce noise levels below applicable noise limits before constituting a non-compliance. As of late October 2017, the NSW INP was superseded by the Noise Policy for Industry (NPfI), with the requirements of this policy implemented in late 2017.

6.2.5 Comparison with Predictions

Comparisons against the predicted noise levels in the HVO West Pit Extension and Minor Modifications Environmental Impact Statement (EIS) (2003) have been made against the modelled scenario for Year 14 (indicative of activities carried out during 2020) of the development. (Table 5.2 of Part J – Hunter Valley Operations West Pit Extension and Minor Modifications Technical Reports Part 3) are shown in **Table 21**.

Table 21 Comparison of 2021 monitoring against HVO North (Year 14, West Pit EIS, 2003) - Night Period

Location	Units	EIS Prediction (INP)	2021 (max. measured $L_{Aeq\ 15min}$ under applicable met conditions)
Knodlers Lane (5)	dB(A)	27	Inaudible
Maison Dieu (6)	dB(A)	26	Inaudible
Shearers Lane (5)	dB(A)	27	Inaudible
Kilburnie South (4)	dB(A)	34	29
Jerrys Plains (13)	dB(A)	N/A	33
Jerrys Plains East (1)	dB(A)	38	30

Comparison of measured results against the modelled predictions for Year 14 in the HVO West Pit EIS (2003) demonstrates noise levels lower than predicted at all monitoring locations.

Comparisons against the predicted noise levels in the HVO Carrington West Wing EA (2010) have not been made in this years' Annual Review as this project has not commenced. Mining activity in the Carrington Pit area was limited to a short-term mining campaign prior to the proposed deposition of tailings material.

Comparisons against the predicted noise levels in the HVO South Modification 5 Environmental Assessment have been made against Stage 2 modelling scenario (indicative of activities carried out during 2021), (Table 6.10 of Appendix E– Hunter Valley Operations South Modification 5 Approval Environmental Assessment Report Volume 2). The comparison (**Table 22**) indicates that during 2021, noise was lower than predicted levels for all receptors.

Table 22 Comparison of 2021 monitoring against HVO South (Stage 2 HVO South Modification 5 EA- 2017)

Location	Units	EIS Prediction (INP)	2021 (max. measured $L_{Aeq\ 15min}$ under applicable met conditions)
Knodlers Lane (120)	dB(A)	40	38
Maison Dieu (258)	dB(A)	40	<30
Shearers Lane (160)	dB(A)	41	31
Kilburnie South (307)	dB(A)	39	34
Jerrys Plains (399)	dB(A)	34	Inaudible
Jerrys Plains East (321)	dB(A)	35	32

6.3 Blasting

6.3.1 Blasting Management

HVO operates a blast monitoring network to assess and evaluate blast vibration and overpressure impacts against the HVO North and HVO South Consent Criteria. There was 100% blast data capture for all blast monitors in 2021.

Monitors are located at or in close proximity to nearby privately owned residences as shown in Figure 2 in Appendix D of the HVO Blast Management Plan (HVO, 2019). The monitors function as regulatory compliance monitors. These monitors are located at:

- Jerrys Plains Village
- Warkworth
- Maison Dieu
- Moses Crossing
- Knodlers Lane

See **Figure 6** for the blast monitoring locations.

6.3.2 Blasting Performance

214 blast events were initiated at HVO during the reporting period. 153 blasts were fired at HVO South, and 61 at HVO North. HVO complied with all blasting related consent and licence conditions. Air blast overpressure and ground vibration results for all blasts fired during the reporting period are presented in **Figure 7** to **Figure 11**.

There were no blasts that recorded overpressure greater than 115 dB(L) during the reporting period, therefore, HVO complied with this requirement during the reporting period. There were no exceedances of the 5 mm/s or 10 mm/s ground vibration criteria at any residence on privately-owned land.

Blasting occurred only between the hours of 7am and 6pm Monday to Saturday during the reporting period. No blasting was carried out on Sundays or Public Holidays. No more than 3 blasts were fired per day and the maximum number of blasts fired during any week was nine, which is less than the maximum weekly blasting frequencies as specified in both project approvals.

During the reporting period, HVO closed Lemington Road on 4 occasions for an average of 17 minutes, and the Golden Highway on 16 occasions for an average of 13 minutes. In addition, on three occasions the closure of Golden Highway was initiated however was cancelled due to changes in operational requirements.

In accordance with PA 06_0261, long term blast monitoring data has been reviewed to identify any trends in the monitoring data over the life of the project. Both ground vibration and overpressure monitoring results have remained generally consistent since monitoring commenced, with no increasing trends developing in the data. Notably in 2021 there were no exceedances of 115 dB(L) air blast overpressure criteria.

See **Table 23** and **Table 24** for a review of long-term blasting data for both ground vibration and overpressure.

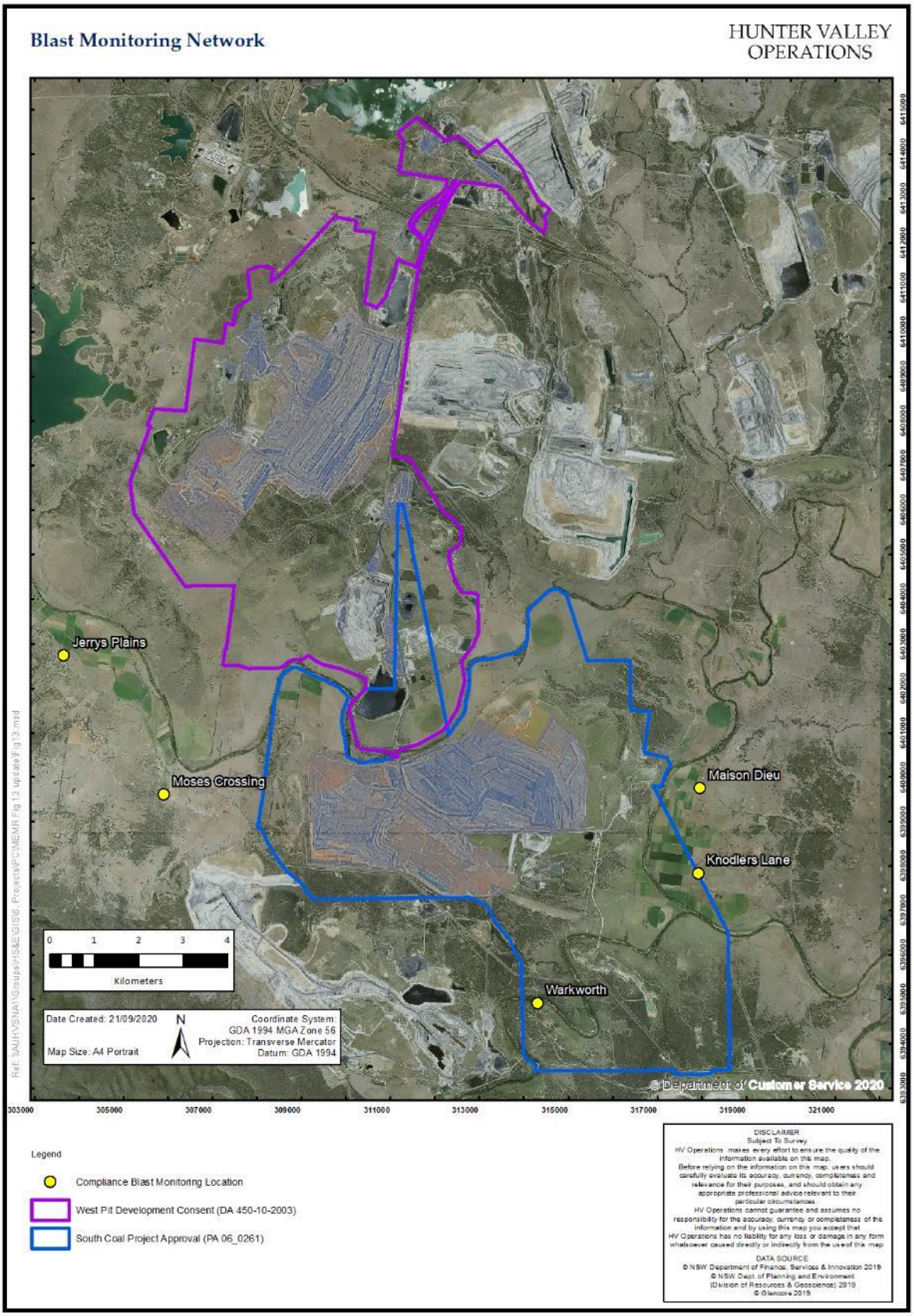

Figure 6 HVO Blast Monitoring Network

Table 23 Historical blasting data for HVO North/West

Monitoring Location	2019		2020		2021	
	Percentage of blasts over 115dB(L) (%)	Percentage of blasts >5mm/s (%)	Percentage of blasts over 115dB(L) (%)	Percentage of blasts >5mm/s (%)	Percentage of blasts over 115dB(L) (%)	Percentage of blasts >5mm/s (%)
Moses Crossing	0	0	0	0	0	0
Jerrys Plains	0	0	0	0	0	0
Warkworth	0	0	0	0	0	0
Maison Dieu	1.2	0	1.5	0	0	0
Knodlers Lane	1.2	0	0	0	0	0

Uncontrolled when printed

Table 24 Historical blasting data for HVO South

Monitoring Location	2019		2020		2021	
	Percentage of blasts over 115dB(L) (%)	Percentage of blasts >5mm/s (%)	Percentage of blasts over 115dB(L) (%)	Percentage of blasts >5mm/s (%)	Percentage of blasts over 115dB(L) (%)	Percentage of blasts >5mm/s (%)
Moses Crossing	0.7	0	0	0	0	0
Jerrys Plains	1.4	0	0	0	0	0
Warkworth	1.4	0	0.8	0	0	0
Maison Dieu	0.7	0	2.5	0	0	0
Knodlers Lane	1.4	0	0.8	0	0	0

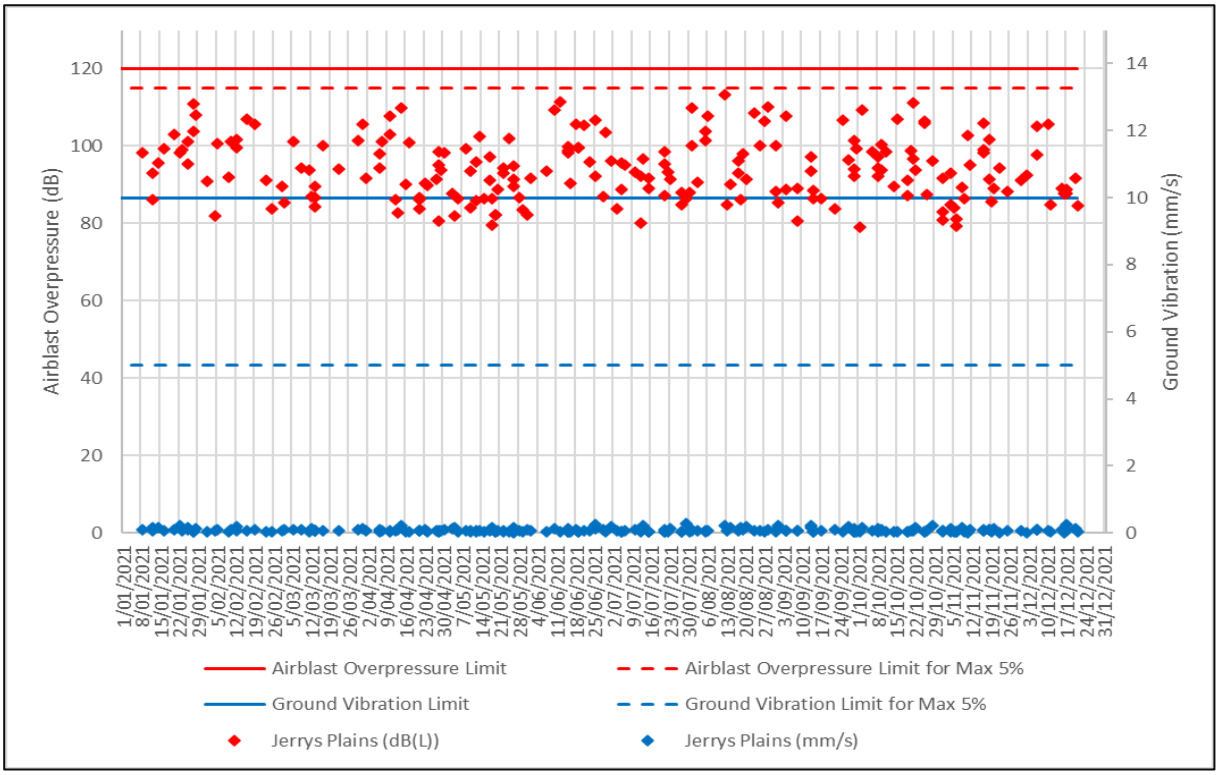

Figure 7 Jerrys* Plains Blast *Monitoring Results 2021

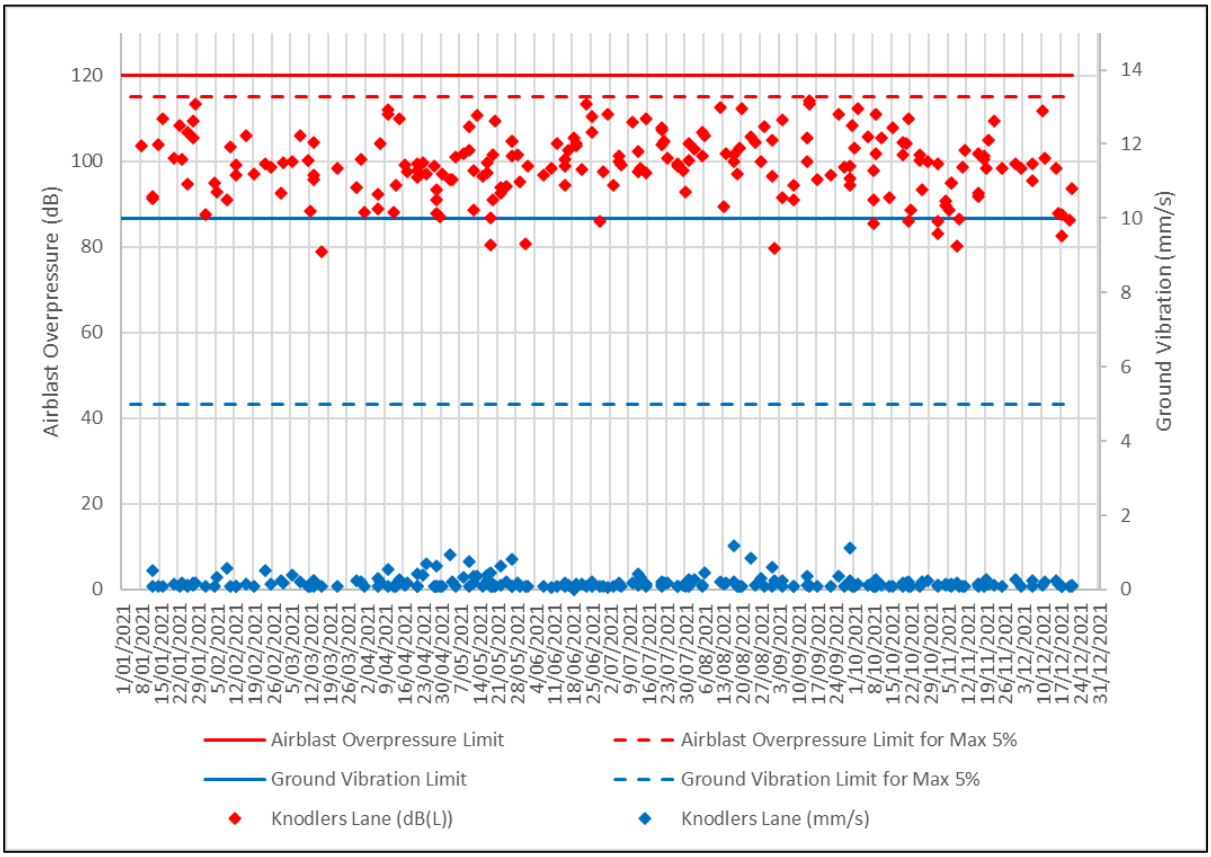

Figure 8 Knodlers Lane Blast Monitoring Results 2021

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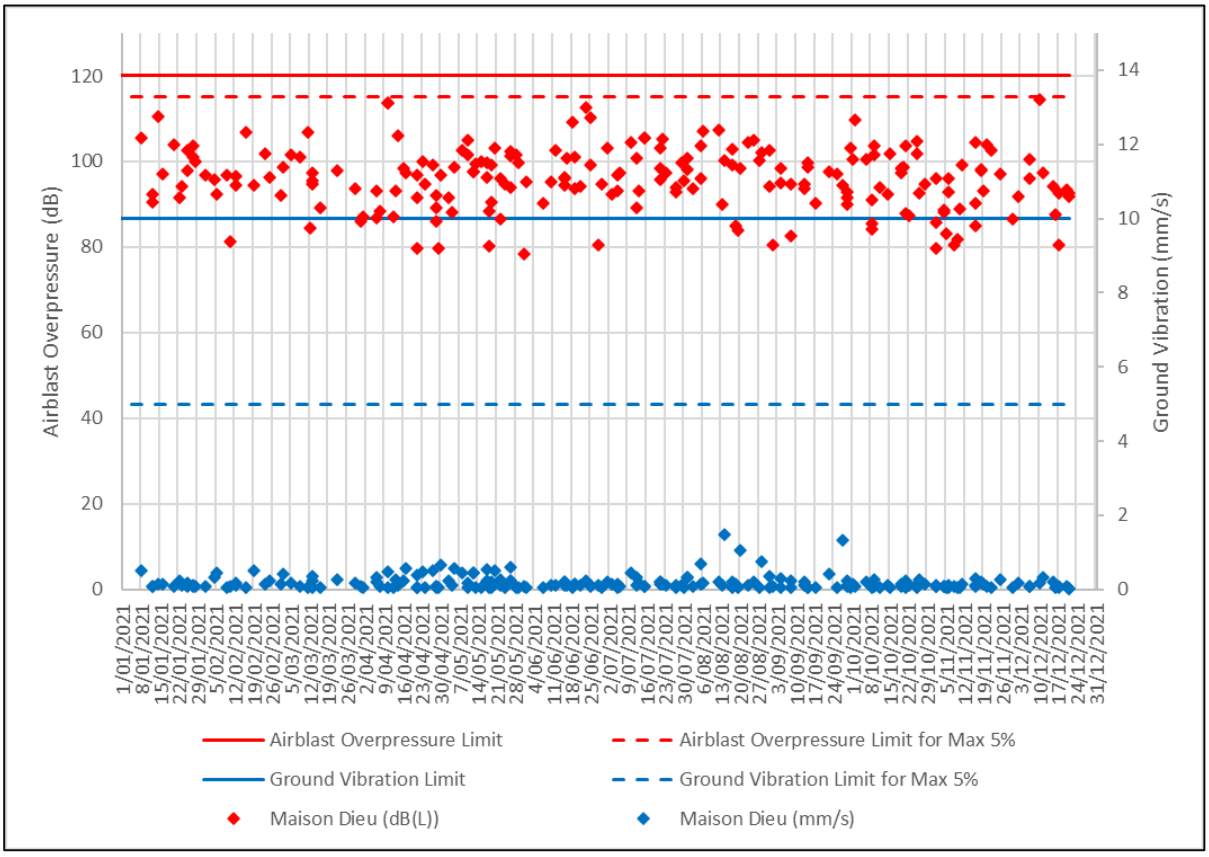

Figure 9 Maison Dieu Blast Monitoring Results 2021

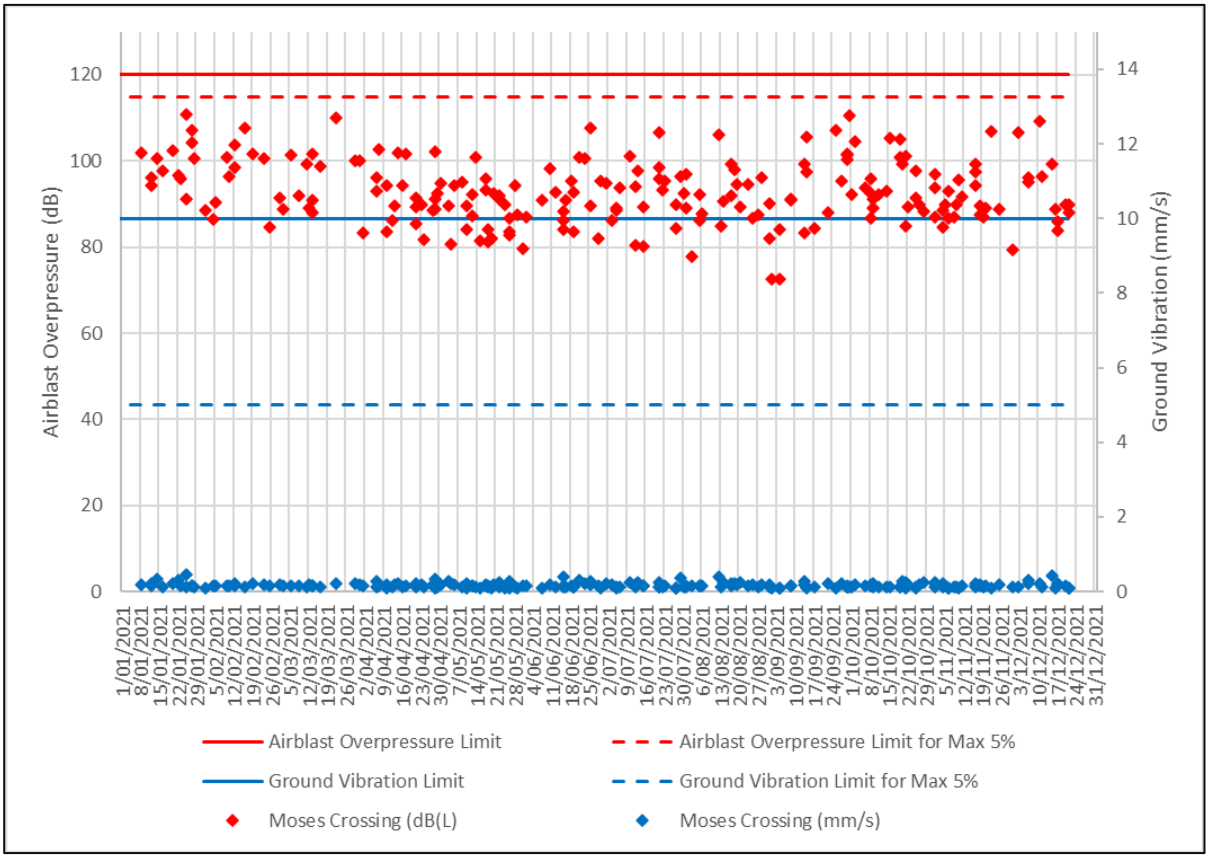

Figure 10 Moses Crossing Blast Monitoring Results 2021

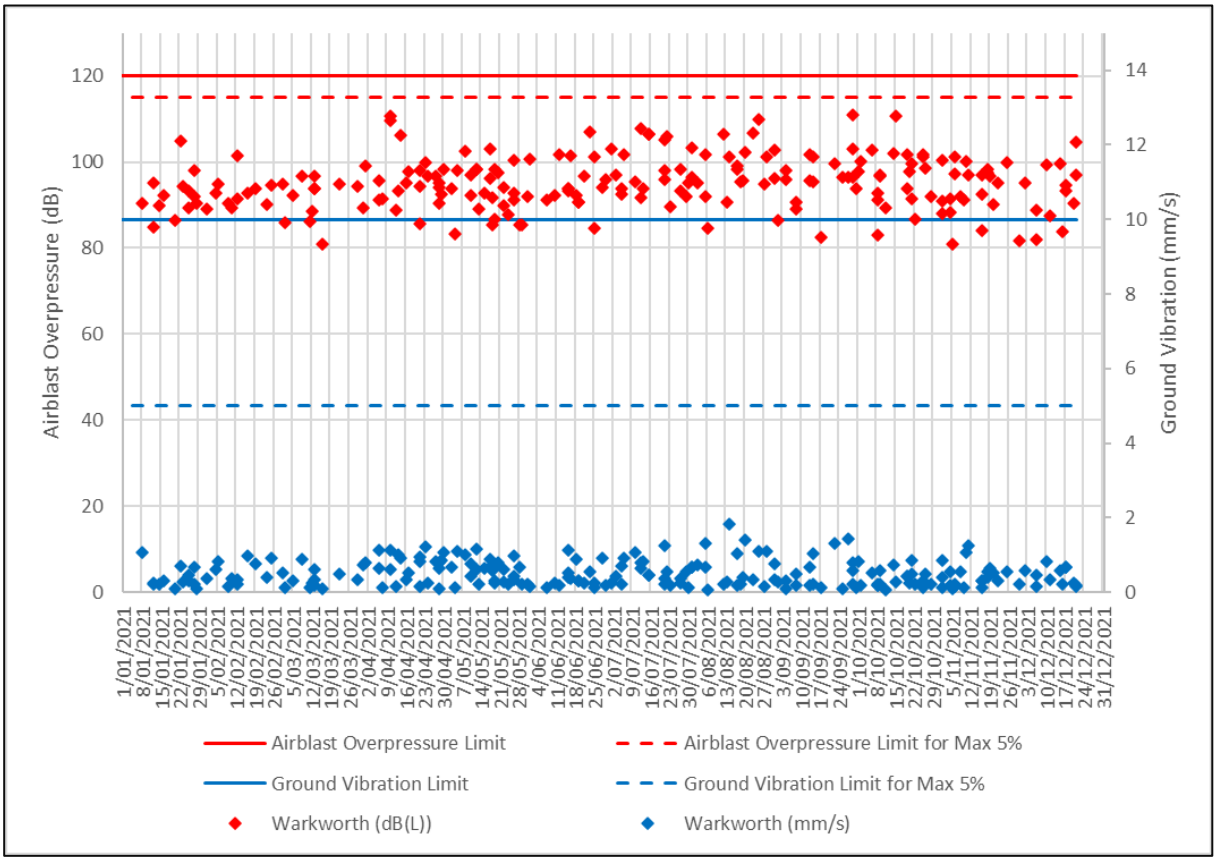

Figure 11 Warkworth Blast Monitoring Results 2021

6.3.3 Blast Fume Management

Blasting operations at HVO are undertaken in accordance with the HVO Post Blast Fume Generation Mitigation and Management Plan. The plan outlines the practices to be utilised to reduce the risk of generation of post blast fume and reduce potential offsite impact from any fume which may be produced. This includes specialised blasting design, appropriate product selection, on-bench water management, implementation of fume management zones and use of existing blasting permissions to identify likely path of any fume which may be produced and restrictions on firing.

All blasts are observed for fume and any fume produced is ranked according to the Australian Explosive Industry & Safety Group (AEISG) Scale.

Fume rankings for shots fired during 2021 and comparison to previous years is provided in **Table 25**. No blast fume ranked as category 5 was observed at HVO during the reporting period and no fume was observed to leave the site. A level 4 post blast fume event was identified after firing a blast in the West Pit. Dry product was loaded into a portion of the blast holes and slumped following unexpected high rainfall in following days. The remaining holes were loaded with emulsion to reduce the risk of blast fume. A pre-blast risk assessment identified the risk of fume, and the blast was fired when wind conditions carried the fume over the mine, where it dissipated without leaving the site. The event was notified to DPE. The increase in category 1 and 2 fume rankings compared to previous years is thought to be due to above average rainfall recorded in 2021.

Table 25 Visible Blast Fume Rankings According to the AEISG Colour Scale

AEISG Ranking	2017	2018	2019	2020	2021
0	272	214	202	160	170
1	39	19	39	22	45
2	11	16	15	27	27
3	2	4	4	0	3
4	0	0	0	0	1
5	0	0	0	0	0
Total*	324	253	260	209	246

* Where a number of individual blasts were fired as a blast event, fume was assessed for each individual blast pattern rather than for the event as a whole.

6.4 Air Quality

6.4.1 Air Quality Management

Air quality management initiatives are implemented at HVO to ensure that:

- Air quality impacts on surrounding residents are minimised;
- All statutory requirements are adhered to; and
- Local community and regulators are kept informed through prompt and effective response to issues and complaints.

Air quality control mechanisms employed at HVO are described in detail in *the Hunter Valley Operations Air Quality and Greenhouse Gas Management Plan (AQGHMP),* publicly available via the HVO website.

HVO continued to implement operational controls to manage dust emissions in accordance with the AQGHMP. HVO also continued implementation of additional dust management measures including the further training of Dispatch officers in response to alarms.

6.4.2 Air Quality Monitoring

Air quality monitoring at HVO is undertaken in accordance with the HVO Air Quality Monitoring Program (AQMP). An extensive network of monitoring equipment is utilised to assess performance against the relevant conditions of HVO's approvals. Air quality monitoring locations are shown in **Figure 12**. Air quality monitoring data is made publicly available through the HVO Monthly Environmental Monitoring Report, available on the HVO website.

6.4.3 Air Quality Performance

Real Time Air Quality Management

HVO's real time air quality monitoring stations continuously log information and transmit data to a central database, generating alarms when particulate matter levels exceed internal trigger limits to guide the operational management of air quality on site.

A total of 797 real time alarms for air quality and meteorological conditions were received and acknowledged during 2021, which is a decrease from 1363 alarms recorded during 2020. This decrease is likely due to the increase in wet weather days recorded across site and the optimisation of air quality alarm trigger criteria.

In response, 1054 hours of equipment downtime was recorded due to air quality management. A detailed breakdown of air quality related equipment stoppages (per month, per equipment type) presented in **Figure 13**. Note that these delays are instances where operations were completely stopped and does not include occasions where operations were changed/modified but not stopped (e.g., changed from exposed dump to in-pit dump).

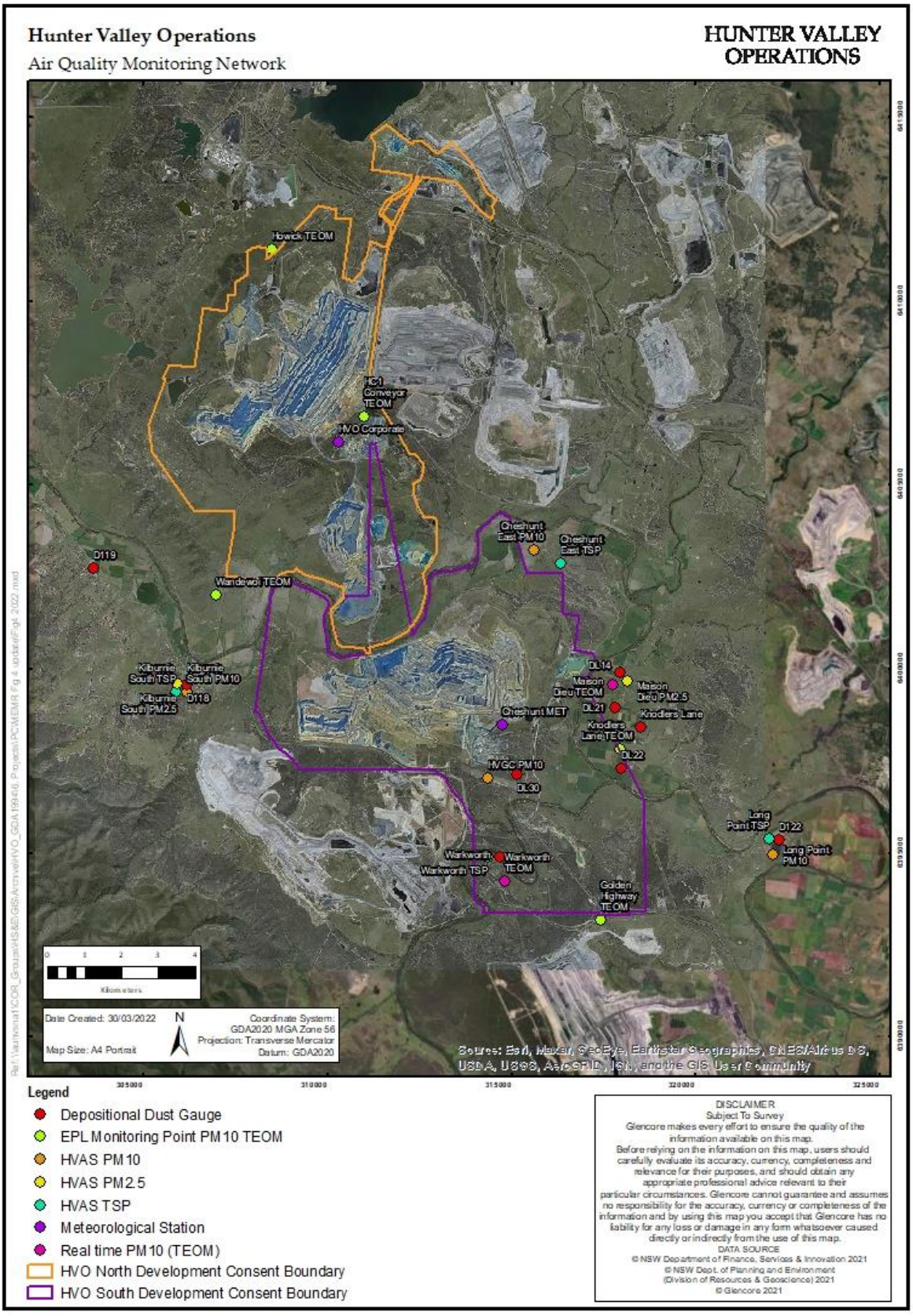

Figure 12 Air Quality Monitoring Locations

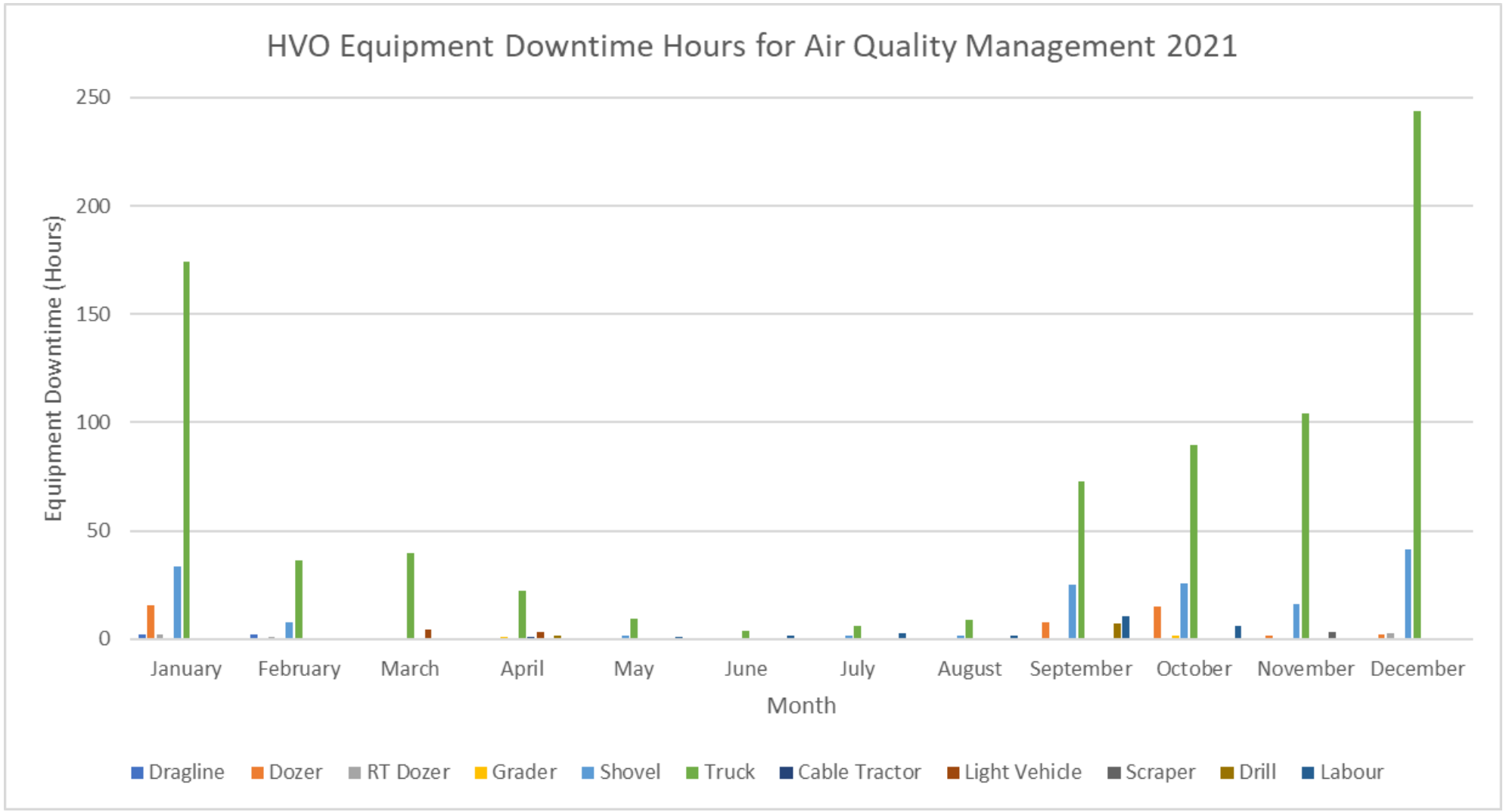

Figure 13 Equipment Downtime Hours for Air Quality Management 2021

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Data availability from HVO's real time air quality monitoring stations is presented in **Table 26**. There was high data availability across the network with common reasons for data mis-captures being data-logger lockups, power failures and storms.

Table 26 Real Time PM_{10} Air Quality Monitoring Data Availability 2021

Monitoring Location	2021 Data Availability
Warkworth	95.9%
Knodlers Lane	99.2%
Maison Dieu	97.8%
Howick	99.7%
HC1	95.9%
Wandewoi	98.1%
Golden Highway	98.4%
Jerrys Plains	97.8%

Note: Data availability calculated across 2021 is based on availability of a 24-hour average result. Greater than 75% data capture is required to record a 24hr average result.

Temporary Stabilisation

Aerial Seeding was undertaken in June 2021 by fixed wing aircraft to provide temporary cover to areas exposed to wind generated dust and erosion at HVO. Waste dumps and exposed areas were selected for seeding if they were not planned to be disturbed within six months. A total area of 335 ha was seeded which included waste dumps ahead of mining re-disturbance (**Figure 14 to Figure 16**). All areas were seeded using an exotic pasture and legume mix suitable for autumn sowing. A starter fertiliser was mixed with the seed prior to loading to provide sufficient nutrients for plant growth.

Figure 14 Areas Aerial Seeded in 2021 – HVO North (West Pit)

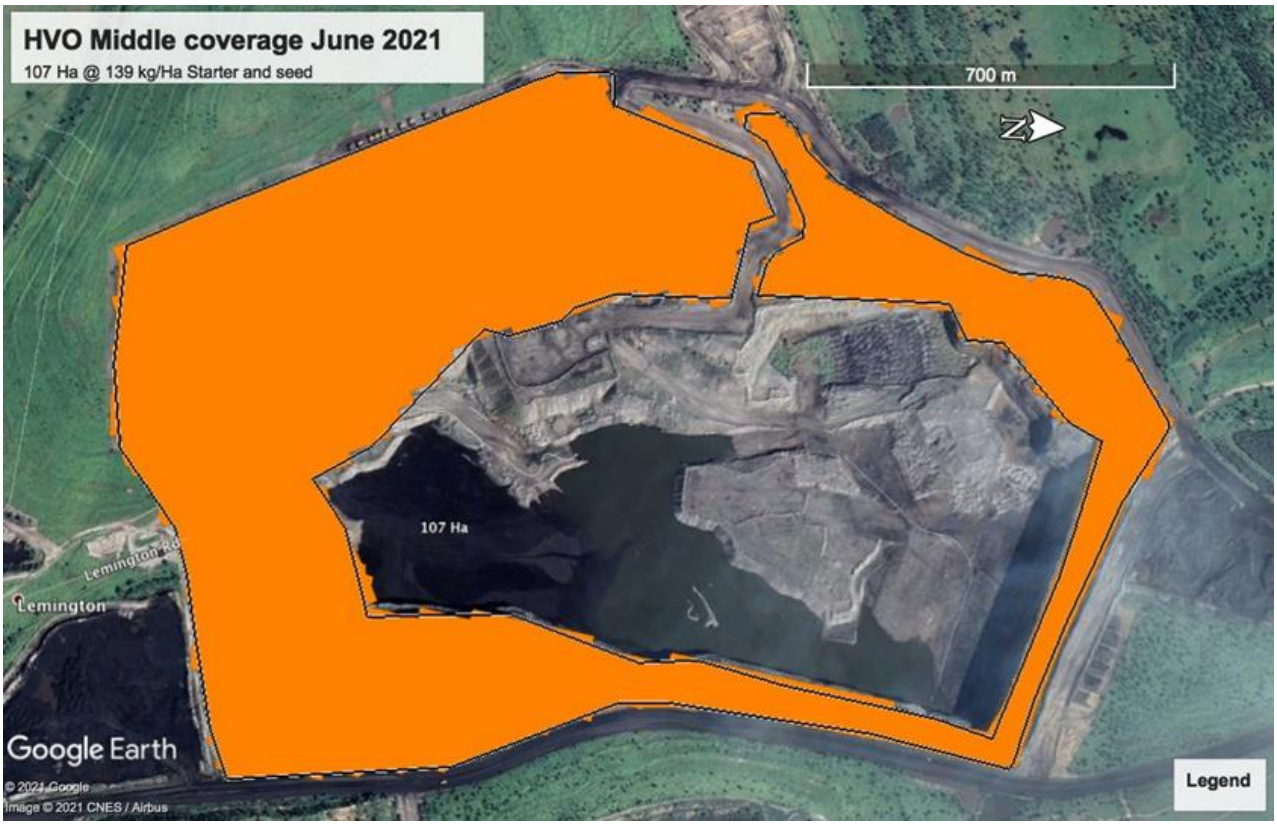

Figure 15 Areas Aerial Seeded in 2021 - HVO North (Carrington Pit)

Figure 16 Areas Aerial Seeded in 2021 - HVO South

Depositional Dust

Depositional dust is monitored at nine locations in accordance with the AQGHMP. The annual average insoluble matter deposition rates in 2021 compared with the depositional dust impact assessment criterion and previous years' data are shown in **Figure 17**.

Depositional dust samples are collected monthly. Where field observations denote a sample as contaminated (typically with insects, bird droppings or vegetation), the results are excluded from annual average compliance assessment.

The Warkworth monitoring location exceeded the annual average insoluble matter deposition rate criteria of 4 g/m^2/month (HVO North only) during 2021. However, all results were below the maximum insoluble solids incremental increase criterion of 2 g/m^2/month (**Figure 18**).

Meteorological conditions and the results of nearby monitors for the sampling period are also considered when determining level of HVO contribution to any elevated result. An external specialist investigation (See Appendix A) determined the exceedance to be due to local sources of dust in close proximity to the monitor. Most of the deposited dust monitors are located in close proximity to HVO South, on the opposite side of HVO South from HVO North. Given the significant separation distances between HVO North and these monitors, HVO North's contribution to these monitoring sites would always be low and likely indiscernible from background concentrations and the influences of other mines. Therefore, HVO North could only reasonably have a tangible impact at its nearest monitors which include D118 and D119. These monitors recorded annual average deposited dust levels below both the incremental and cumulative criteria. It is considered that HVO North could not have had significant contribution to the Warkworth deposited dust level.

The elevated Warkworth level was assessed to estimate the maximum contribution from HVO North to the annual result. The HVO North maximum contribution to the incremental increase was 0.5 g/m^2/month and was not deemed to have caused the exceedance (**Table 27**).

Table 27 Dust Deposition Annual Average Assessment

Date	Site	Measured Annual Average Dust Deposition (g/m^2/month)	Annual Average Dust Deposition Criteria (g/m^2/month)	HVO's Contribution to Dust Deposition (g/m^2/month)	Discussion
2021	Warkworth	9.3	4	0.5	An external consultant was engaged to investigate the exceedance, which determined that HVO North could have only provided a minor contribution to the exceedance which is attributable to local sources of dust near the monitor.

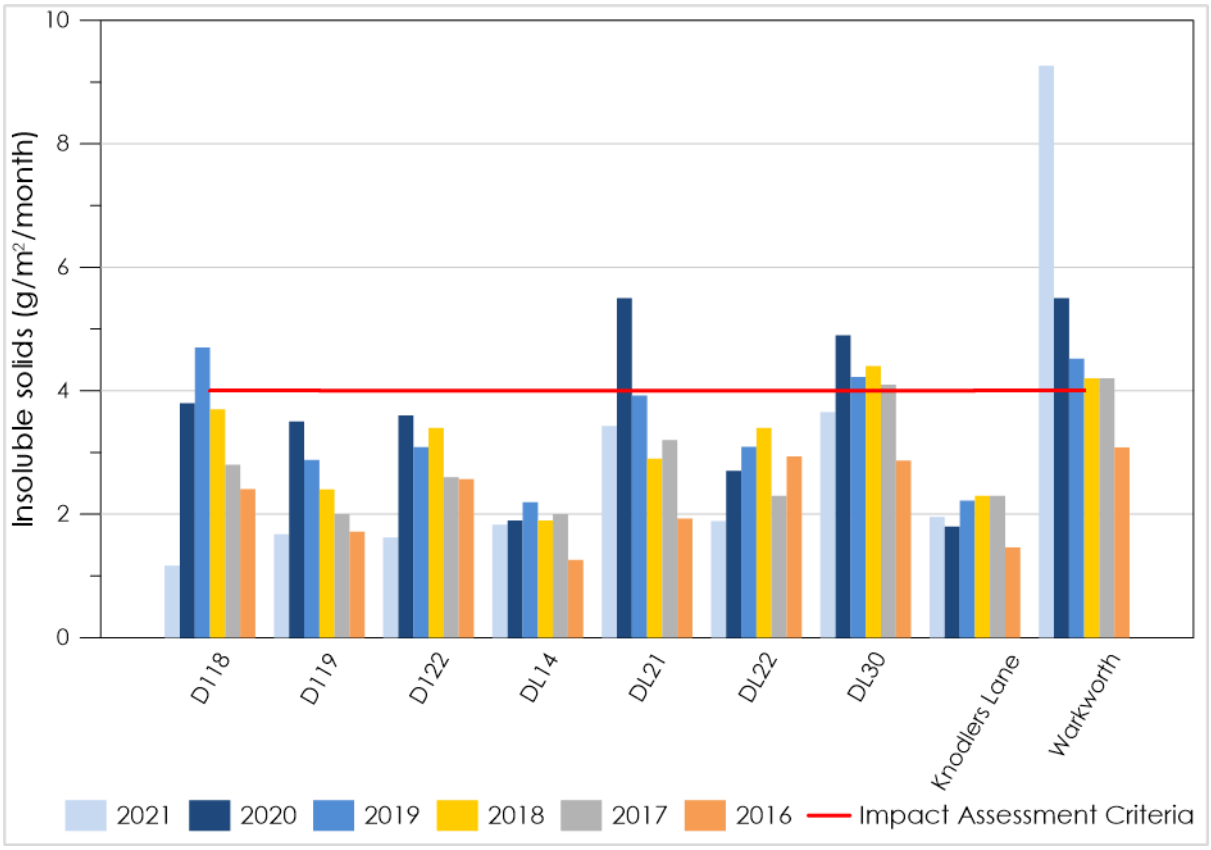

Figure 17 Annual Average Insoluble Matter Deposition Rates 2016-2021

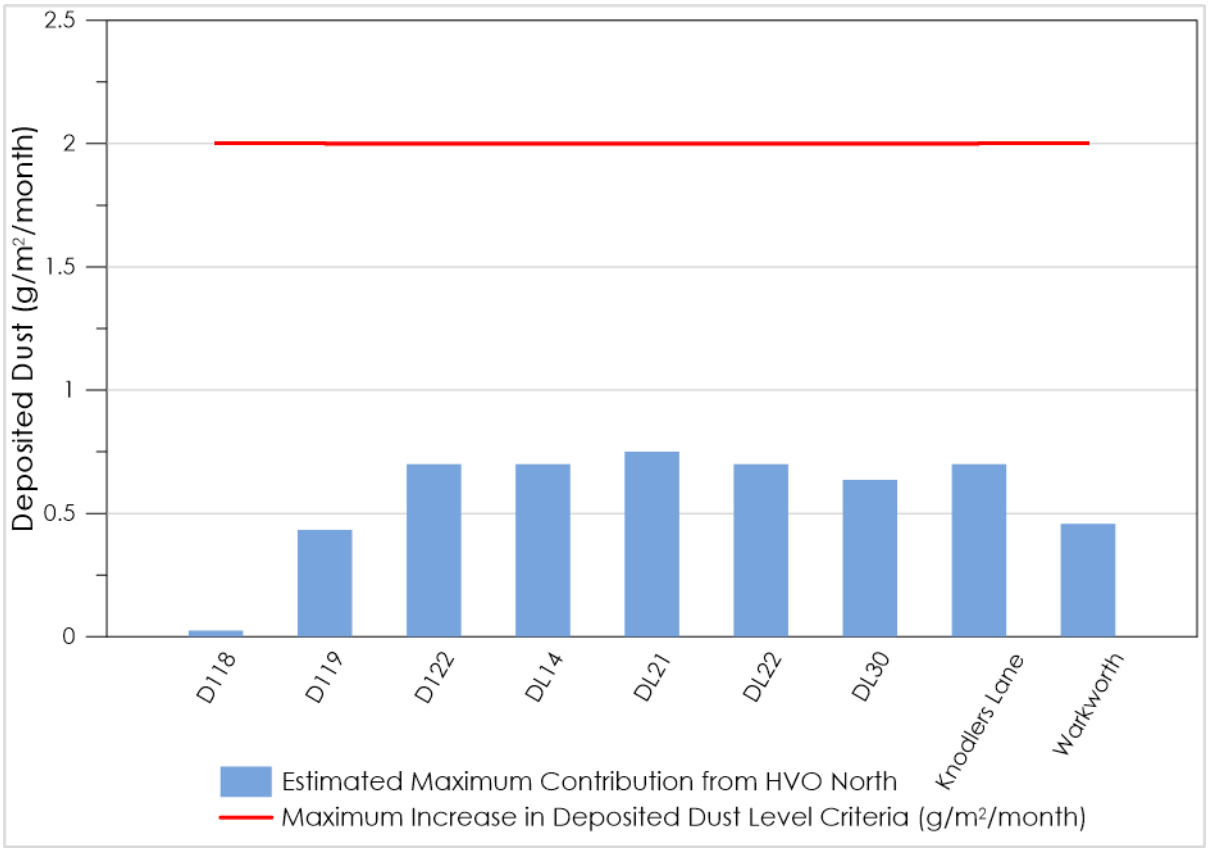

Figure 18 Maximum Allowable Increase in Deposited Dust Level 2021

Total Suspended Particulates (TSP)

TSP is monitored using High Volume Air Samplers (HVAS) at six locations in accordance with the AQGHMP.

Annual average TSP concentrations recorded in 2021 compared with the long-term impact assessment criterion and data from previous years are shown in **Figure 19**. TSP results in 2021 are considered to be generally lower than with those recorded in previous years, with the exception of Warkworth.

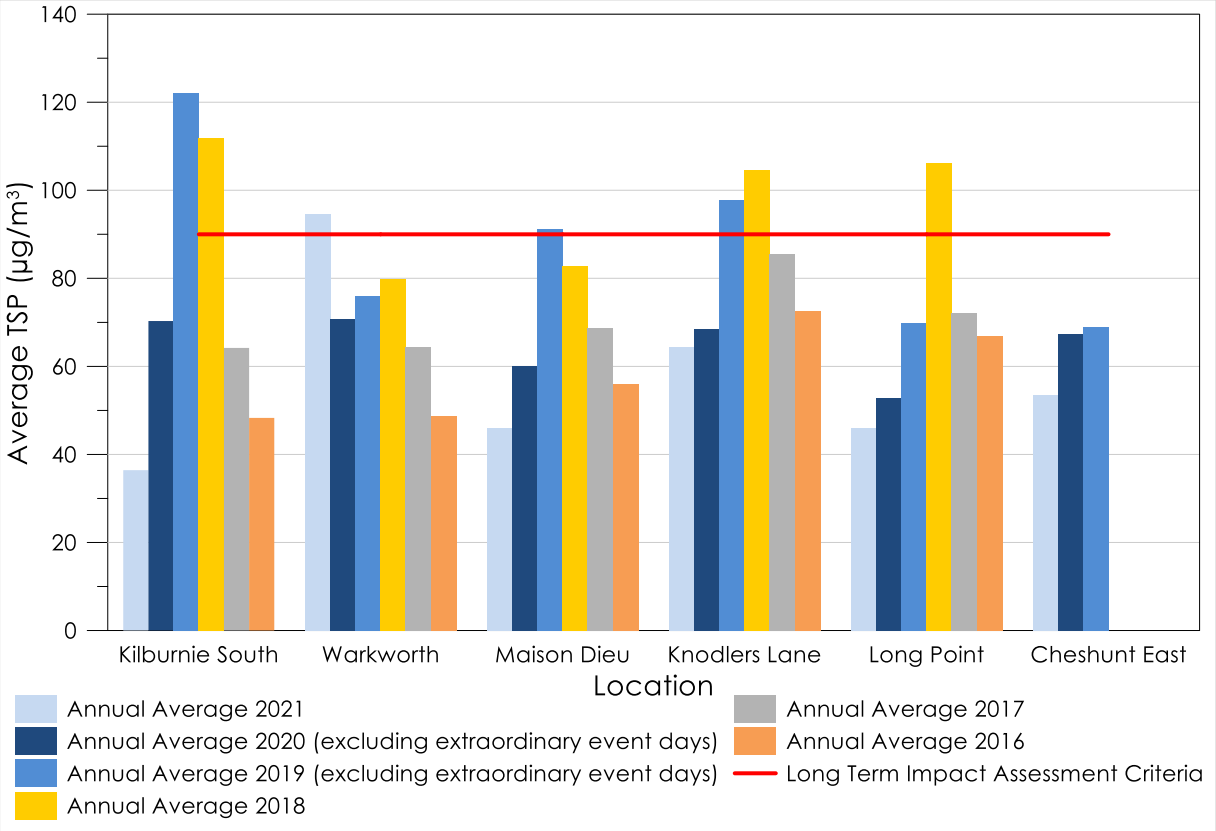

Figure 19 Annual Average TSP Concentrations 2017 to 2022 (Excludes Extraordinary Events)

Annual average TSP levels were elevated above the impact assessment criteria at the Warkworth monitor. It is noted that the annual average level of 94.6µg/m^3 measured is below the cumulative (HVO and other sources) Stage 2 modelled impact of 106µg/m^3 at this location and there are no privately owned residences remaining in Warkworth represented by this monitor. The result at the Warkworth HVAS was investigated by an external specialist consultant (see **Appendix A**) to determine the level of contribution from HVO activities, in accordance with the AQGHMP.

The investigation estimated the HVO South contribution would have been a maximum of 32.8µg/m^3 or 35% of the 94.6µg/m3. It is important to note that this estimation is conservative and due to the limited data provided by the HVAS monitoring method, the influence of other likely significant sources cannot be isolated from HVO South's contribution, including the influence of HVO North (which cannot be separated from HVO South given the similar downwind wind angles), and localised sources near to the monitor.

The Warkworth HVAS monitor recorded significantly higher TSP levels compared with the other monitors in HVO's monitoring network. This trend was not apparent in the Warkworth TEOM PM_{10} monitoring, which is located further away, approximately 850m from the Warkworth HVAS. There are numerous large mines in the vicinity and all of the monitors in Warkworth are at relatively similar distances and relative wind angles to each of these large mines.

Thus, if any (or all) of the mining activities were the key source of impacts being recorded at the Warkworth HVAS, all of the other monitors in Warkworth would record similar trends, but they do not. The Warkworth dust gauge and HVAS monitor records much higher levels relative to the other monitors. As the larger, heavier particles of dust (in TSP) generally deposit out of the air rapidly within a few tens to hundreds of

metres of the source, the indications from the data are that the Warkworth HVAS are most likely impacted by highly localised source/s of dust. An investigation of the area in the vicinity of the Warkworth monitor identified the Golden Highway clearing works at the northern end of Warkworth Bridge and a material stockpile area as potential localised sources of dust. Results of the investigation is presented in **Table 28.**

Table 28 Assessment of Annual Average TSP 2021

Monitoring Location	Measured TSP Annual Average (µg/m^3)	Annual Average TSP Criteria (µg/m^3)	Estimated contribution to annual average TSP (µg/m^{3*})	Discussion
Warkworth (HVAS)	94.6	90	32.8 (HVO South)	An investigation was undertaken by an external consultant which concluded that HVO South's contribution was not the primary cause of the exceedance. Highly localised source dust is likely to be the primary source of elevated levels.

Particulate Matter <10µm (PM_{10})

Particulate Matter <10 µm^3 (PM_{10}) is monitored using High Volume Air Samplers (HVAS) and Real Time Tapered Element Oscillating Microbalance (TEOM) monitors.

Assessment of annual averages is presented against the full year results recorded against the current approved monitoring program and compliance protocol detailed in the AQGHMP.

Particulate Matter <10µm (PM_{10}) - Short Term (24-hour average) Impact Assessment Criteria

Short Term (24-hour average) PM_{10} concentrations were calculated for both HVAS and TEOM monitors and assessed against the relevant criteria as per the AQGHMP. For TEOM monitors, this is calculated daily using measured hourly average data. The HVAS samples are taken over a 24-hour period every sixth day.

Short term (24-hour average) results recorded by HVO's compliance monitoring network during 2021 is presented in **Figure 20**.

Two PM_{10} measurements at the Gliding Club HVAS and two PM_{10} measurements at the Kilburnie South HVAS were not able to be collected on the scheduled sampling date (based on a sampling frequency of every six days). Details of these mis-captures are provided in **Table 29.**

The data presented includes total measured results including contribution from all particulate sources. There were a total of 20 exceedances recorded over 13 days during the reporting period. Each exceedance was investigated to determine the level of contribution from either HVO North, HVO South or where relevant both. Outcomes of these assessments is provided in **Table 30.** HVO reported two of these exceedances to DPE in accordance with incident reporting conditions in the Consents. The remainder were assessed to have received incremental dust contributions below HVO criteria.

Table 29: PM_{10} 24hr Mis-captures

HVAS Location	Date	Reason for Mis-capture
Gliding Club PM_{10}	6/10/2021	Cause identified as a localised power outage due to construction works at the HVGC
Gliding Club PM_{10}	18/10/2021	Cause identified as a localised power outage due to construction works at the HVGC
Kilburnie South PM_{10}	23/11/2021	Issue with the plug on the power lead thought to have caused the RCD to trip at the HVAS
Kilburnie South PM_{10}	29/11/2021	The unit was showing an error message which read 'motor drive or filter blockage error'

Table 30:2021 PM_{10} 24hr Exceedance Investigations

Date	Site	Measured 24-hour average PM_{10} level ($\mu g/m^3$)	HVO 24-hour average PM_{10} Criteria ($\mu g/m^3$)	Estimated HVO maximum Incremental contribution to PM_{10} level ($\mu g/m^3$)	Discussion
15/1/2021	Gliding Club	56	50[2]	21	Investigated based on wind direction, site increment below criteria.
16/4/2021	Knodlers Lane	108	50[2]	21.6 – South[3]	Investigated based on wind direction, site increment below criteria.
28/7/2021	Knodlers Lane	70.77	50[2]	55.8 – South[3]	Specialist investigation. HVO reportable exceedance. See section 12 for further detail
1/8/2021	Knodlers Lane	51.93	50[2]	32.9 - South[3]	Investigated based on wind direction, site increment below criteria.
12/9/2021	Knodlers Lane	66.32	50[2]	44.8 - South[3]	Investigated based on wind direction, site increment below criteria.
12/9/2021	Warkworth	64.62	50[2]	32.3 - South[3]	Investigated based on wind direction, site increment below criteria.
12/9/2021	Cheshunt East	63.4	50[4]	36.4	Specialist investigation. HVO reportable exceedance due to "Total" criteria. See section 12 for further detail
12/9/2021	Long Point	56.7	50[2]	38.0	Investigated based on wind direction, site increment below criteria.
12/9/2021	Gliding Club	88.1	50[2]	48.1	Investigated based on wind direction, site increment below criteria.
18/9/2021	Gliding Club	50.4	50	37.8	Investigated based on wind direction, site increment below criteria.

[2] HVO South (PA06_0261) – Incremental Air Quality Criterion (HVO increment only)

[3] Estimated maximum incremental PM_{10} concentration from HVO South alone.

[4] HVO North (DA450-10-2003) – Total Air Quality Criterion (HVO increment plus all other sources of dust)

Date	Site	Measured 24-hour average PM_{10} level ($\mu g/m^3$)	HVO 24-hour average PM_{10} Criteria ($\mu g/m^3$)	Estimated HVO maximum Incremental contribution to PM_{10} level ($\mu g/m^3$)	Discussion
24/9/2021	Knodlers Lane	51.89	50[2]	43.4 - South[3]	Investigated based on wind direction, site increment below criteria.
25/9/2021	Knodlers Lane	52.40	50[2]	34.7 - South[3]	In Investigated based on wind direction, site increment below criteria.
5/10/2021	Knodlers Lane	63.11	50[2]	46.5 - South[3]	Investigated based on wind direction, site increment below criteria.
7/10/2021	Knodlers Lane	58.22	50[2]	33.4 - South[3]	Investigated based on wind direction, site increment below criteria.
7/10/2021	Warkworth	61.79	50[2]	27.5 - South[3]	Investigated based on wind direction, site increment below criteria.
10/10/2021	Warkworth	56.53	50[2]	7.4 - South[3]	Investigated based on wind direction, site increment below criteria.
29/10/2021	Knodlers Lane	67.15	50[2]	37.7 - South[3]	Investigated based on wind direction, site increment below criteria.
29/10/2021	Maison Dieu	60.63	50[2]	16.4 - South[3]	Investigated based on wind direction, site increment below criteria.
29/10/2021	Warkworth	78.92	50[2]	17.5 - South[3]	Investigated based on wind direction, site increment below criteria.
30/10/2021	Gliding Club	52.9	50[2]	29.7	Investigated based on wind direction, site increment below criteria.

[2] HVO South (PA06_0261) – Incremental Air Quality Criterion (HVO increment only)
[3] Estimated maximum incremental PM_{10} concentration from HVO South alone.
[4] HVO North (DA450-10-2003) – Total Air Quality Criterion (HVO increment plus all other sources of dust)

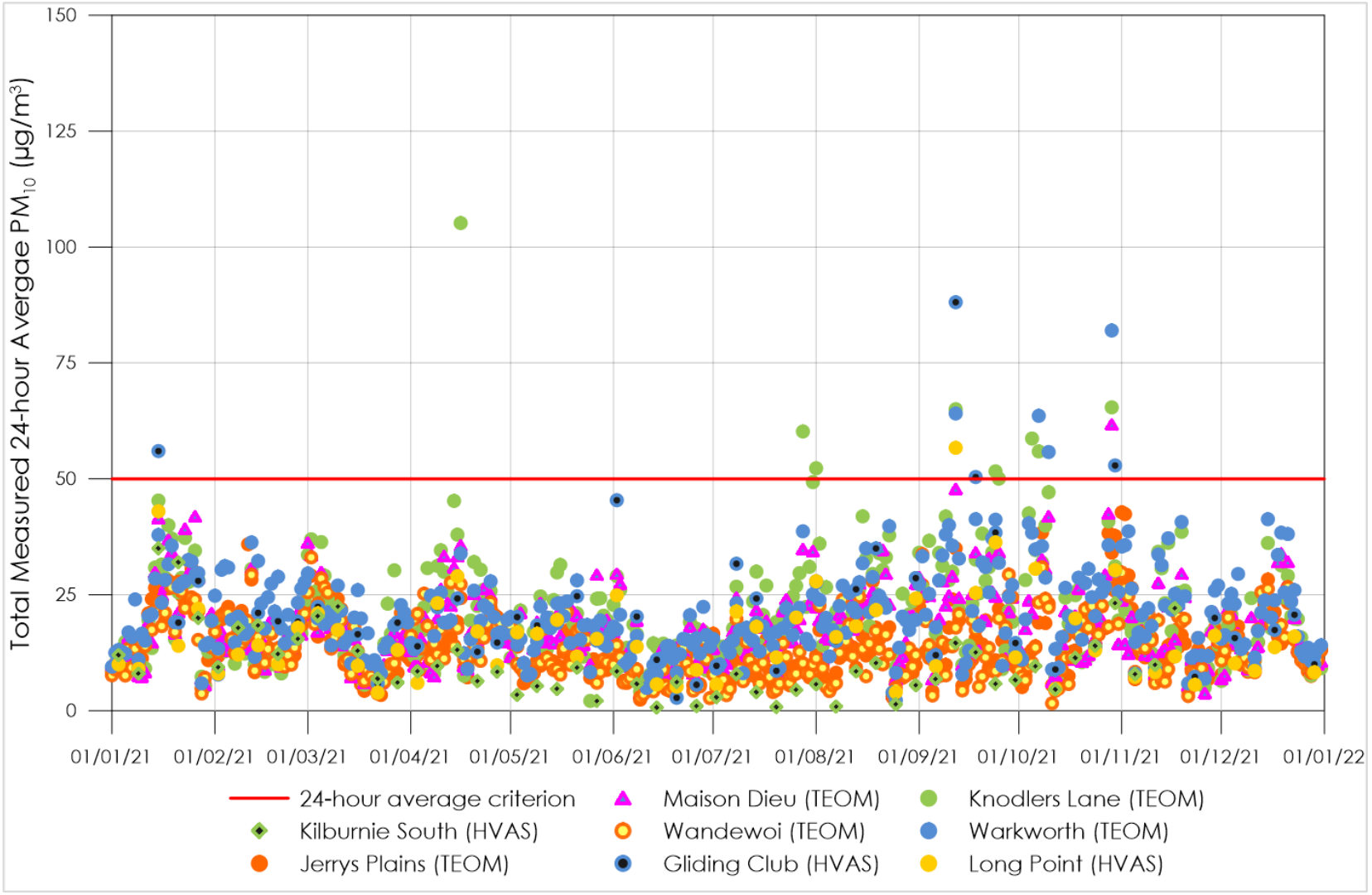

Figure 20 24-hour Average Total PM_{10} results- 2021

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Long term PM_{10} impact assessment criteria

Annual average PM_{10} concentrations were calculated for both HVAS and TEOM monitors and assessed against the relevant criteria as per the AQGHMP. This was undertaken for TEOM monitors using hourly average data and was calculated for HVAS units using 24-hour average concentrations on each of the run days.

Annual average PM_{10} levels were below the impact assessment criteria at all compliance monitoring locations during the reporting period.

A comparison of the long term PM_{10} impact assessment criterion and previous years' data are shown in **Figure 21**.

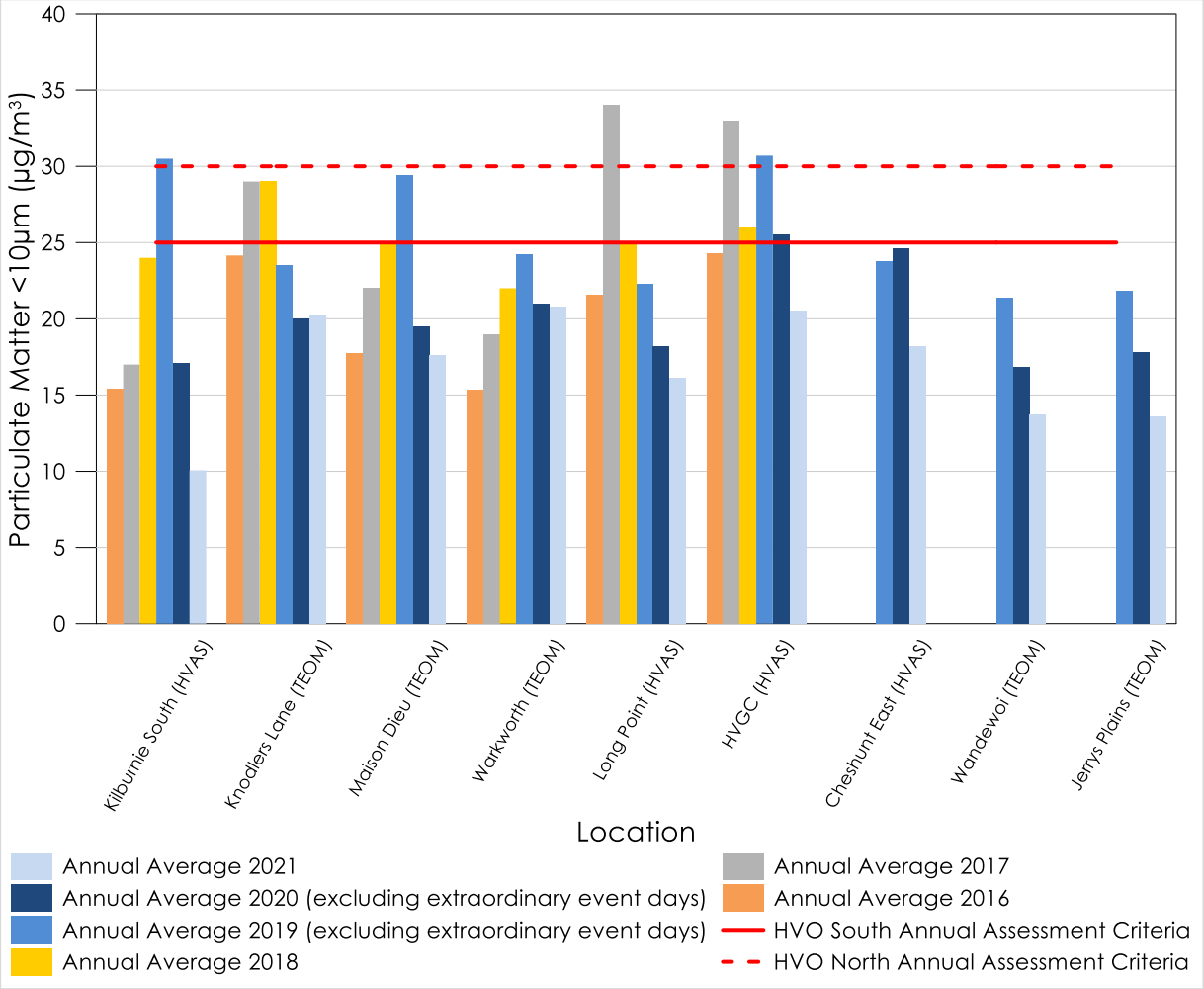

Figure 21 Annual Average HVAS PM_{10} results 2015 to 2021

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$PM_{2.5}$ Impact Assessment Criteria

$PM_{2.5}$ samples were collected at Maison Dieu and Kilburnie South using HVAS, and these results are provided in **Table 31** and **Figure 22**.

One $PM_{2.5}$ measurement on 23 November at the Maison Dieu HVAS was not able to be collected on the scheduled sampling date (based on a sampling frequency of every six days) due to a crack in the plug casing which is thought to have allowed water ingress.

4 results above criteria were recorded over 4 monitoring days during 2021. The results were assessed through investigation to have not been significantly contributed to by HVO and are therefore compliant against 24-hour impact assessment criteria. As discussed in the Long-Term Impact section the $PM_{2.5}$ levels recorded appear to be anomalous when compared to co-located PM_{10} monitor results.

Table 31 Short Term Impact Assessment Criteria – PM $_{2.5}$ Results 2021

Date	Site	Measured 24-hour average $PM_{2.5}$ level ($\mu g/m^3$)	HVO South 24-hour average $PM_{2.5}$ Incremental Criteria ($\mu g/m^3$)	Estimated HVO South Incremental contribution to $PM_{2.5}$ level ($\mu g/m^3$)	Discussion
15/1/2021	Maison Dieu	48.0	25	19.7	Investigated based on wind direction, site increment below criteria
27/1/2021	Maison Dieu	39.0	25	0	Investigated based on wind direction, site increment below criteria
10/3/2021	Kilburnie South	29.0	25	0.2	Investigated based on wind direction, site increment below criteria
12/9/2021	Maison Dieu	29.1	25	14.7	Investigated based on wind direction, site increment below criteria

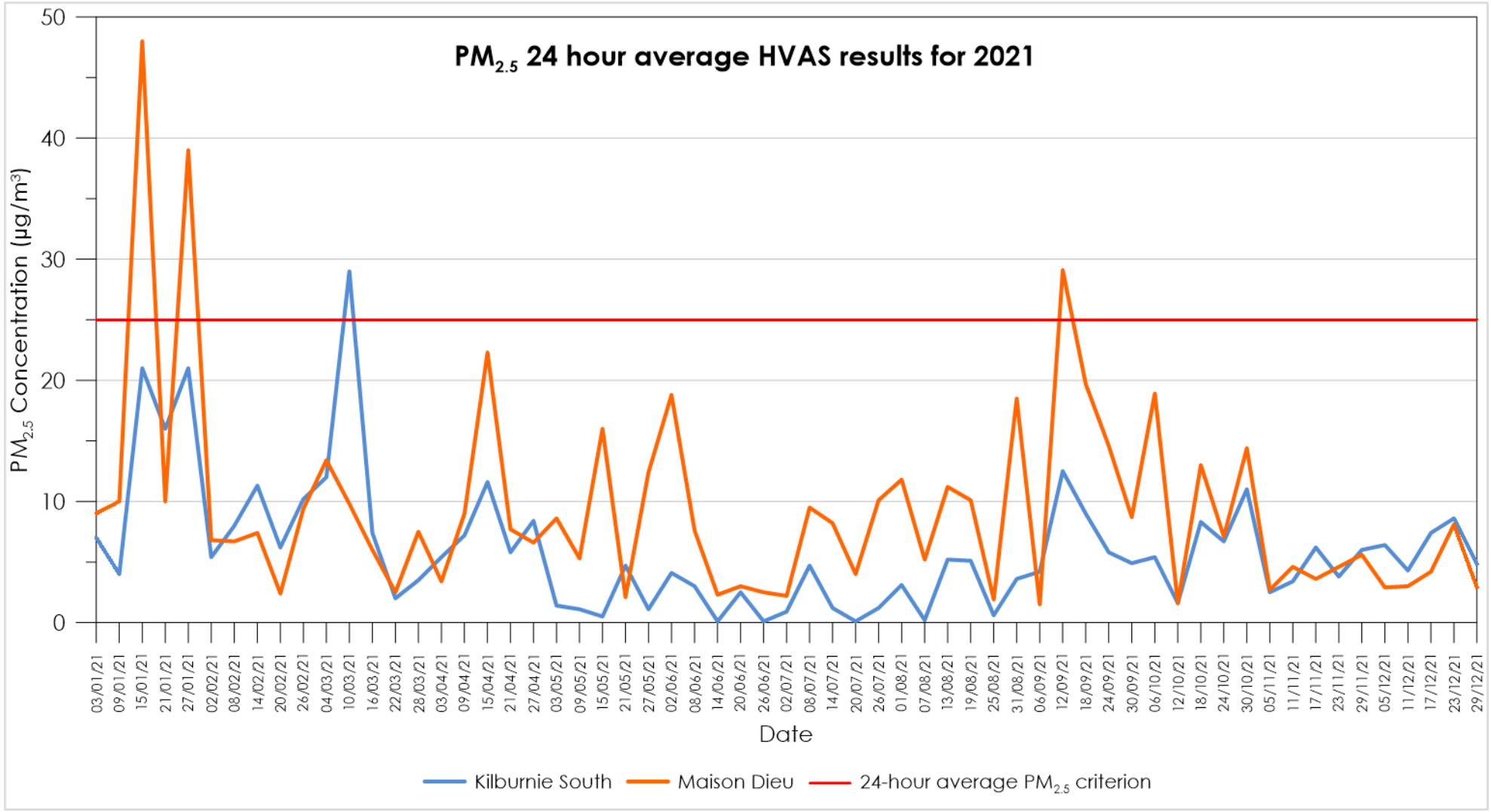


Figure 22 24-hour Average $PM_{2.5}$ Results 2021

Particulate Matter <2.5µm (PM2.5) – Long Term (Annual average) Impact Assessment Criteria

Annual average $PM_{2.5}$ was elevated above the annual average criteria of 8 µg/m3 at Maison Dieu for the reporting period, as presented in **Table 32**. While HVO's contribution is not calculated to be significant, the elevated total levels are considered to be anomalous. $PM_{2.5}$ levels recorded have been investigated throughout the year. Investigations have included the following:

- Monitoring locations have been inspected multiple times to identify any local $PM_{2.5}$ sources, with none identified.
- Monitoring operations were reviewed. These reviews did not identify any issues with the monitor condition, calibration or operation that would impact on the result. Reviews included:
  - Review of monitoring records and methods against Australian Standards.
  - Inspection of instrumentation by an independent monitoring contractor.
  - Sampling run between normal HVAS runs by an independent monitoring contractor.
- Calculation of PM_{10}:$PM_{2.5}$ ratios for monitoring equipment for co-located units (as shown in **Table 33**). The ratio in the Hunter Valley is typically 0.3 to 0.4. Ratios measured at HVO range from 0.7 to above 1. A ratio above 1 suggests that $PM_{2.5}$ fractions are above PM_{10} fractions, which is not possible and suggests error.
- Installation of a $PM_{2.5}$ E-Sampler unit at Maison Dieu as a trial. This unit recorded elevated $PM_{2.5}$ levels above PM_{10} levels, and above those measured by the $PM_{2.5}$ HVAS.

These investigations have not been conclusive to identify source of errors. It is believed that the source of the errors is due to the high-volume air sampler monitoring method. HVO have engaged an air quality consultant to review the air quality monitoring network. This review has recommended the implementation of real-time $PM_{2.5}$ monitoring at Maison Dieu and Kilburnie South. HVO propose to implement units such as E-BAMs in these locations in 2022.

Table 32 $PM_{2.5}$ Annual Average Monitoring Data 2021

Monitoring Location	HVO South Annual average $PM_{2.5}$ Criteria ($\mu g/m^3$)	Measured Annual average $PM_{2.5}$ level ($\mu g/m^3$)	Estimated contribution to Annual average $PM_{2.5}$ level($\mu g/m^3$)*
Maison Dieu	8	9.6	3.4
Kilburnie South	8	6.1	0.9

*Excludes extraordinary events

Table 33 Annual $PM_{2.5}$ / PM_{10} Ratios in Upper Hunter

Year	$PM_{2.5}$ / PM_{10} ratios					
	Muswellbrook	Singleton	Camberwell	Merriwa	MaisonDieu	Kilburnie South
2015	0.46	0.39	0.33	*	*	*
2016	0.44	0.41	0.31	*	*	*
2017	0.43	0.39	0.27	*	*	*
2018	0.35	0.34	0.27	*	*	*
2019	0.35	0.36	0.26	*	*	*
2020	0.41	0.41	0.31	*	0.63	0.78
2021	0.41	0.37	0.30	0.38	0.48	0.54

* Monitoring locations were not in place during this year

$PM_{2.5}$ levels measured at the Maison Dieu and Kilburnie South HVAS units were higher than UHAQMN annual average $PM_{2.5}$ results in comparable locations, as shown in **Table 34**.

Table 34 UHAQMN Annual Average PM 2.5 Results for 2021

UHAQMN Monitor	Measured Annual Average 2021 $PM_{2.5}$ level ($\mu g/m^3$)
Muswellbrook	7.3
Singleton	6.3
Camberwell	5.7
Merriwa	4.2

6.4.4 Comparison Against EA Predictions

Table 35 and **Table 36** to show a comparison between 2021 air quality data and the Stage 2 predictions made in the HVO South Modification 5 EIS. Comparisons have been made against the predictions listed in the EA for the nearest private residence to each monitoring location.

Annual average PM_{10} measurements in 2021 were similar to or below predicted levels for all monitoring locations for both short term (24-hour average) and long term (annual average) criteria as shown in **Table 35**. Annual average TSP measurements in 2021 were below predicted levels for all monitoring locations as shown in .

Table 35 HVO South PM_{10} Annual Average Results Compared Against Cumulative Predictions^

Site (EA receptor)	Short Term (24hr) criteria		Long Term (annual average) criteria	
	Predicted maximum 24hr PM_{10} due to HVO South alone ($\mu g/m^3$)	2021 maximum 24hr PM_{10} HVO contribution ($\mu g/m^3$)*	Predicted PM_{10} annual averages ($\mu g/m^3$)	2021 PM_{10} annual average ($\mu g/m^3$)*
	Stage 2		Stage 2	
Maison Dieu (256)	36	10	21	17.6
Warkworth (90)	95	32.3	46	20.8
Kilburnie South (307)	31	11.6	27	10.1
Knodlers Lane (117)	59	55.8	28	20.3
Long Point (137)	36	38.0	20	16.1
Hunter Valley Gliding Club***	>50	48.1	>30	20.5

^ Cumulative predictions for Stage 2 of the HVO South Mod 5 Environmental Assessment.

*** The HVGC has entered into an Amenity Management Plan with Hunter Valley Operations.

Table 36 HVO South TSP Annual Average Results Compared Against Cumulative Predictions^

Site (EA receptor)	Long Term (annual average) TSP criteria	
	Stage 2 prediction (µg/m^3)	**2021 PM_{10} annual average (µg/m^3)***
Maison Dieu (256)	60	46.1
Warkworth (90)	106	94.6
Kilburnie South (307)	76	36.4
Knodlers Lane (117)	75	64.5
Long Point (137)	61	46.1

^ Cumulative predictions for Stage 2 of the HVO South Mod 5 Environmental Assessment.

* Excludes extraordinary events.

Table 37 and **Table 38** detail comparisons between 2021 air quality monitoring results and the modelled predictions from the 2010 HVO North Carrington West Wing Air Quality Impact Assessment. Predictions have been sourced from modelled scenarios of Year One of the Carrington West Wing development. It should be noted that while Approval has been granted for the commencement of that project, works have not yet commenced.

Table 37 HVO 2021 PM_{10} Annual Average Results Compared Against Cumulative Predictions^

Site (EA receptor)*	Long Term (annual average) criteria			
	Predicted PM_{10} annual average (µg/m^3)	**2021 PM_{10} annual average (µg/m^3)**+**	**HVO Estimated Contribution to 2021 PM_{10} annual average (µg/m^3)* (North)**	**HVO Estimated Contribution to 2021 PM_{10} annual average (µg/m^3)* (South)**
Maison Dieu (6)	19.1	17.6	2.6	0.9
Warkworth (39)	20.8	20.8	0.4	1.9
Kilburnie South (4)	19.7	10.1	0.2	0.8
Jerrys Plains (13)	16.6	13.6	0.3	1.0
Cheshunt East (7)	20.8	18.2	6.2	2.8

^ Cumulative predictions for Year One (CWW) of the HVO North Environmental Assessment.

*No modelled predictions for the Long Point area

+. Measured result includes both HVO North and South

*Table 38 2021 TSP Annual Average Results Compared Against Cumulative Predictions^*

Site (EA receptor)*	Long Term (annual average) criteria	
	Predicted TSP annual average (µg/m^3)	2021 TSP annual average (µg/m^3)**
Maison Dieu (6)	44.7	46.1
Warkworth (39)	46.6	94.6
Kilburnie South (4)	45.2	36.4
Cheshunt East (7)	46.5	53.4

^ Cumulative predictions for Year One (CWW) of the HVO North Environmental Assessment.

*No modelled predictions for the Long Point area

Annual average TSP and PM_{10} measurements in 2021 were generally similar to modelled predictions, with the exception of Warkworth TSP. Given that the Warkworth TSP HVAS recorded significantly higher levels than the other monitors in the network and that the PM_{10} level at the Warkworth TEOM, which is located approximately 850m to the southeast of the HVAS, corresponds reasonably well with the modelled predictions, it is considered that the Warkworth HVAS monitoring location is likely impacted by highly localised sources of dust.

6.5 Greenhouse Gas and Energy Management

During 2021, HVO continued to comply with Emissions Reporting (EERs) under the National Greenhouse and Energy Reporting (NGERs) Act 2007. As such HVO is required to report its annual greenhouse gas emissions, energy use and energy production. Results of greenhouse gas and energy information from corporations is publicly available online at www.cleanenergyregulator.gov.au. A summary of greenhouse gas emissions for HVO compared to the previous reporting year are provided in **Table 39**.

Total emissions in 2021/2022 reporting year decreased slightly from the previous reporting year. This is largely reflected by a reduction in fuel usage emissions and electricity consumption. Increasing fugitive emissions is due to new coal seam gas estimates as the mine exposes deeper coal seams.

Table 39 Greenhouse Gas Emission Summary

HVO Emissions	FY2020	FY2021
Fuel Usage (Kt CO^2e)	315.13	261.33
Fugitive Emissions (Kt CO^2e)	247.32	301.80
Industrial Processes (Kt CO^2e)	0.02	0.03
Waste emissions by waste disposal (Kt CO^2e)	-	-
Electricity consumption (Scope 2) (Kt CO^2e)	111.92	94.93
Total (Kt CO^2e)	674.39	658.09

6.6 Waste and Hazardous Materials

6.6.1 Recycling

HVO has continued reinforcing the principles of effective waste management across the site, including recycling.

During the reporting period, 24% of non-mineral waste material generated at HVO was disposed of in licensed offsite landfill facilities and 76% of waste was recycled. These results are consistent with 2020.

HVO will continue to maintain high recycling rates in 2022.

Details of waste and recyclables removed from demolition activities undertaken during the reporting period are included in **Section 7.6.7** and **9.11**.

6.6.2 Sewage Treatment/Disposal

The sewage treatment and disposal facilities at HVO consist of sewage treatment plants which treat, disinfect and re-use the treated effluent on-site where practicable. The remaining effluent from some septic systems that is unable to be treated on site is sent to approved facilities for disposal.

HVO currently operates 3 main grouped on-site sewage management facilities that are interconnected from multiple systems. These facilities are located at Howick, HVO North and HVO South. Design works continued towards upgrade of these systems.

6.6.3 Hydrocarbons

A total of 810kL of waste oil was taken offsite to be refined into a base oil for reuse in new oil products during the reporting period. Other hydrocarbons recycled via a licenced waste hydrocarbon disposal company include approximately 26 tonnes of waste grease.

6.6.4 Contaminated Soil

HVO operates and maintains three bioremediation areas to manage hydrocarbon contaminated soil.

Contaminated soil is taken to one of the bioremediation areas and placed in cells based on the time of contamination. Contaminated soil is spread out in beds approximately 300 mm in height and turned in order to provide aeration for beneficial microbial activity.

Soil in the treatment area is sampled and tested as required until total hydrocarbon levels are below relevant guidelines. Soil meeting these criteria is then removed and disposed of in the spoil dump.

Due to a proposed extension of a waste rock overburden dump in the South Lemington Area (SLA), a Detailed Site Investigation (DSI) was conducted in 2020. The DSI recommended further supplementary investigation was required in two areas known as the SLA Bioremediation Area and the Equipment Graveyard. The supplementary investigation was undertaken during 2021 to characterise the nature and distribution of hydrocarbon impacts in soils within the SLA Bioremediation Area and Equipment Graveyard sampling locations. The data collected as part of the supplementary investigation was used to identify and evaluate potential contamination risks to human health and ecological receptors, principally potential future site users, and potential offsite receptors east and south of the SLA boundaries.

Data was evaluated in the context of an ongoing commercial / industrial land use and the proposed extension of waste rock overburden into the area. The sampling confirmed that some hydrocarbon contamination exists in the area as a result of historical operations. However, based on the updated conceptual model, the identified hydrocarbon impacts are unlikely to present an unacceptable level of risks to human health or the environment (on-site or off-site).

Therefore, further assessment of potential off-site risks is not warranted. Based on the results from the DSI and this Supplementary Assessment, remediation of the identified hydrocarbon impacts is not required within the context of the proposed future land use where application of overburden to the site is proposed. However, the bioremediation area has since been removed and any surface contamination in the graveyard area would be excavated ahead of rehabilitation.

6.6.5 Acid Rock Drainage

There were no observed issues relating to Acid Rock Drainage during 2021. The Geochemical Monitoring Programme was reviewed during the reporting period, and this will be implemented from 2022.

6.6.6 Waste/Hazardous Materials Non-Compliances

There were no externally reportable incidents related to waste or hazardous material management during the reporting period.

6.6.7 Building Demolition

A total of 4.24 tonnes of mixed waste and 50 square metres of asbestos were removed during demolition of the old Clay Target Club facilities in June 2021 (on HVO land) and disposed of at appropriate facilities during the reporting period.

6.7 Heritage

6.7.1 Aboriginal Cultural Heritage Management and Community Consultation

Aboriginal cultural heritage is managed under the provisions of separate Aboriginal Cultural Heritage Management Plans (ACHMP) approved for the project approvals. At HVO North, where mining or associated development activities may impact Aboriginal cultural heritage sites, an Aboriginal Heritage Impact Permit (AHIP) must also be sought from Heritage New South Wales (formerly Office of Environment and Heritage) under Part 6 of the National Parks and Wildlife Act 1974 (NPW Act), on the basis of the management requirements established through the ACHMP process.

The HVO South ACHMP area was approved as a State Significant Development which excludes the requirement for obtaining AHIPs prior to implementing cultural heritage management measures authorised under the provisions of the ACHMP.

HVO consults jointly with the Upper Hunter Valley Aboriginal Cultural Heritage Working Group (CHWG) The CHWG is comprised of representatives from HVO and Registered Aboriginal Parties (RAPs) from Upper Hunter Valley aboriginal community groups, corporations and individuals. The CHWG met and discussed cultural heritage management matters associated with HVO at meetings held on the 26 May and the 20 December 2021.

Aboriginal cultural heritage at HVO is managed in consultation with the RAPs associated with the CHWG, in accordance with the ACHMPs, and development consent conditions, to protect, manage and mitigate cultural heritage at HVO. Management measures include:

- Ongoing consultation and involvement of the local Aboriginal community in all matters pertaining to Aboriginal cultural heritage management.
- Compliance with existing ACHMP’s and Development Consent conditions.
- A cultural heritage Geographic Information System (GIS) and Cultural Heritage Zone Plan (CHZP) incorporating cultural heritage spatial and spatial data (site location, description, assessments, date recorded, associated reports, management provisions and various other details to assist with the management of sites).
- A Ground Disturbance Permit (GDP) system for the assessment and approval of ground disturbing activities to ensure these activities do not disturb cultural heritage places.
- Limit of Disturbance Boundary (LODB) procedures to demarcate approved disturbance areas and delineate areas not to be disturbed.
- Ongoing cultural heritage site inspections, monitoring and auditing along with regular compliance inspections of development works.

- Protective management measures such as fencing/barricading sites to avoid disturbance, protective buffer zones, cultural heritage off-set areas; and
- Communicating cultural heritage issues and site awareness to personnel via internal electronic and face to face processes.

In consultation with the CHWG and Office of Environment and Heritage (OEH), a Cultural Heritage Storage Facility (CHSF) was established at Hunter Valley Services. The CHSF is a storage shed, with an adjacent shipping container, fitted out to allow safe and secure storage of cultural materials, such as stone artefacts. It is a central repository for all materials collected during community collection and salvage activities on all lands related to HVO (including offset properties).

6.7.2 Aboriginal Archaeological and Cultural Heritage Investigations

Following consultation with members of the HVO Cultural Heritage Working Group (CHWG) in 2020, HVO engaged Arrow Heritage Solutions and Glen Morris to provide technical support to a team of Registered Aboriginal Parties conducting a site inspection and verification of a previously identified scar tree, a possible hearth, and a remnant artefact scatter at HVO South. Two of the three sites are in proximity to future mine operations. The verification inspection was conducted on Monday 8 February 2021 and concluded that the scar trees markings was likely to be non-cultural in origin and that the sites AHIM's registration be updated to reflect the tree as 'not a site'. The inspection of the possible hearth site revealed no evidence of hearth features but identified the previously surveyed background artefact scatter and the inspecting team recommended that this area be fenced off and revegetated in order to assist preservation of artefacts in situ. The inspection of the remnant artefact scatter at HVO South resulted in a recommendation to salvage artefacts from this area which had been the subject of previous surveys and salvage activities in 1981, 1985, 2001 and 2014. Subsequent consultation with the CHWG at meetings held on the 26 May and the 20 December 2021 endorsed the recommendations for the scar tree and possible hearth site. Discussion is ongoing regarding the proposal to salvage the remnant artefact scatter at HVO South.

A due diligence assessment and survey was conducted by Arrow Heritage Solutions on 5 March 2021 at four separate areas, which are the subject of internal Ground Disturbance Permits (GDPs). These areas are located at Parnells Dam, the HVO North Conveyor, Lake James and west of the Glider Strip. Proposed works in these areas include, respectively, vegetation slashing, mining pre-strip clearance, water infrastructure maintenance and creation of topsoil stockpiles. No artefacts were identified within the Parnellls Dam GDP area. Existing artefact site barricading was identified on the HVO North conveyor. Two sites identified in previous surveys were located and barricaded at Lake James and the review of the survey of the Glider Pit area confirmed cultural heritage salvage and management activities in this area were completed.

In addition, Arrow Heritage Solutions were engaged to provide to provide aboriginal cultural heritage site identification and barricading support for two proposed GDPs on 5 July 2021.

During 2021 HVO has conducted consultation and cultural heritage field investigations for the Aboriginal Cultural Heritage Assessment (ACHA) required by the Secretary's Environmental Assessment Requirements (SEARs) for the HVO Continuation Project (HVO South (SSD1186621) and HVO North (SSD 11826681)). Aboriginal consultation activities have been undertaken in accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW 2010) and has included two face to face meetings with Registered Aboriginal Parties.

Field investigations have included:

- Archaeological survey (24 days).
- Archaeological test excavation (25 days).
- CM-CD1 test excavation and Optically Stimulated Luminescence (OSL) dating (7 days).
- Independent scarred tree assessment (1 day).
- Cultural values assessment interviews.

Consultation with Registered Aboriginal Parties and preparation of the ACHA for the HVO Continuation Project will continue during the 2022 Annual Review period, with the aim of submitting the development application to DPE in around mid-2022.

6.7.3 Heritage Audits and Incidents

Under the provisions of the HVO South ACHMP, two compliance inspections were conducted in 2021 and under the provisions of the HVO North HMP, a single compliance inspection was conducted during 2021. The purpose of the compliance inspections is to provide RAPs with:

- The opportunity to visit mine operations and mine areas to inspect operational compliance with ACHMP/HMP provisions and GDP procedures.
- To inspect and monitor the condition and management of sites; and
- To review the effectiveness and performance of the ACHMP/HMP provisions in the management of cultural heritage at the mine.

These compliance inspections were conducted by RAP representatives of the CHWG PCWP with the assistance of a qualified archaeologist and HVO personnel.

The biannual 2021 HVO South compliance inspection was conducted on 8 April 2021 by RAP representatives of the CHWG. A total of 37 aboriginal heritage sites were inspected focusing on buffer property areas north of Cheshunt Pit primarily used for livestock grazing. The findings and recommendations of these inspections are documented in the Hunter Valley Operations South Aboriginal Heritage Management Plan August Compliance Audit Inspections report dated May 2021.

The annual 2021 HVO South and HVO North compliance inspection was conducted over several days between 27 and 29 of October 2021 by two RAP representatives of the CHWG and a suitably qualified and experienced archaeologist. During the HVO South portion of the compliance inspection, a total of 21 aboriginal heritage sites were inspected in the HVO Southern Area to the west and east of the Lemington South Park Pit, these areas are not active mining areas with some utilised for grazing by third party users. During the HVO North portion of the compliance inspection, a total of 21 heritage sites were assessed including the key sites in proximity to the HVO North conveyor, Farrells Creek at Lemington road and the CM CD1 area. The findings and recommendations of these inspections are documented in the Hunter Valley Operations Aboriginal Heritage Management Plans October 2021 Compliance Audit Inspections report.

The inspections found that all sites have been managed in conformance with the ACHMP/HMP requirements. Sites requiring maintenance and upgrades to site barricading, fencing and sediment controls were identified, with upgrade and maintenance work to be implemented in 2022. Three sites at HVO South were identified for salvage due to proximity to water courses and tracks. Inspections were hampered by high vegetation and ground cover resulting from recent rainfall. The CM CD1 site was reported to be managed well, with program of fencing upgrades proposed to assist with demarcation of control zones for various activities including exclusion areas and areas where specific land management activities can be conducted.

During the reporting period there were 59 GDPs assessed for cultural heritage management considerations at HVO.

There were no incidents, nor any unauthorised disturbance caused to cultural heritage sites at HVO during 2021.

6.7.4 Historic Heritage – Management and Community Consultation

Consultation was conducted at the Hunter Valley Operations Community Consultative Committee (CCC) Meetings held on 17 February, 19 May, 26 August, and 17 November 2021 as outlined in **Section 10.2.3**.

At the CCC meeting held on 17 February, The HVO Environment and Community Team advised attendees of a recent visit to the Chain of Ponds Inn by family members of former residents. A summary of proposed activities at heritage properties

At the CCC meeting on 19 May, the HVO Environment and Community team advised of reinstatement of security boarding to the Chain of Ponds Inn, proposed maintenance works to the Archerfield Stables and vegetation maintenance work around the Cockatoo Fence.

The HVO Environment and Community Team advised the CCC committee members at the meeting held on the 26 August of completion of vegetation maintenance work around the Cockatoo Fence and that the Significance Assessment for the Fence and a Timber Bridge on the former Jerrys Plains Road were now available to view on the HVO website. Members were also provided with an update on maintenance works at other buildings.

The CCC Meeting held on the 17 November were advised of the delay to the start of maintenance work at the Archerfield Stables due to the need to complete arboreal maintenance before structural work could commence. Temporary measures for onsite storage of artefacts at the Stables was also discussed.

7 Water Management

HVO manages surface and ground water according to three main objectives:

- Fresh water usage is minimised.
- Impacts on the environment and HVO neighbours are minimised; and
- Interference to mining production is minimal.

This is achieved by:

- Minimising freshwater use from the Hunter River.
- Preferentially using mine water for coal preparation and dust suppression.
- Emphasis on control of water quality and quantity at the source.
- Segregating waters of different quality where practical.
- Recycling on-site water.
- Ongoing maintenance and review of the system; and
- Disposing of water to the environment in accordance with statutes and regulations.

Plans showing the layout of all water management structures and key pipelines are shown in **Figure 23** to **Figure 25.** The HVO Water Management Plan contains further detail on management practices and is available on HVO website.

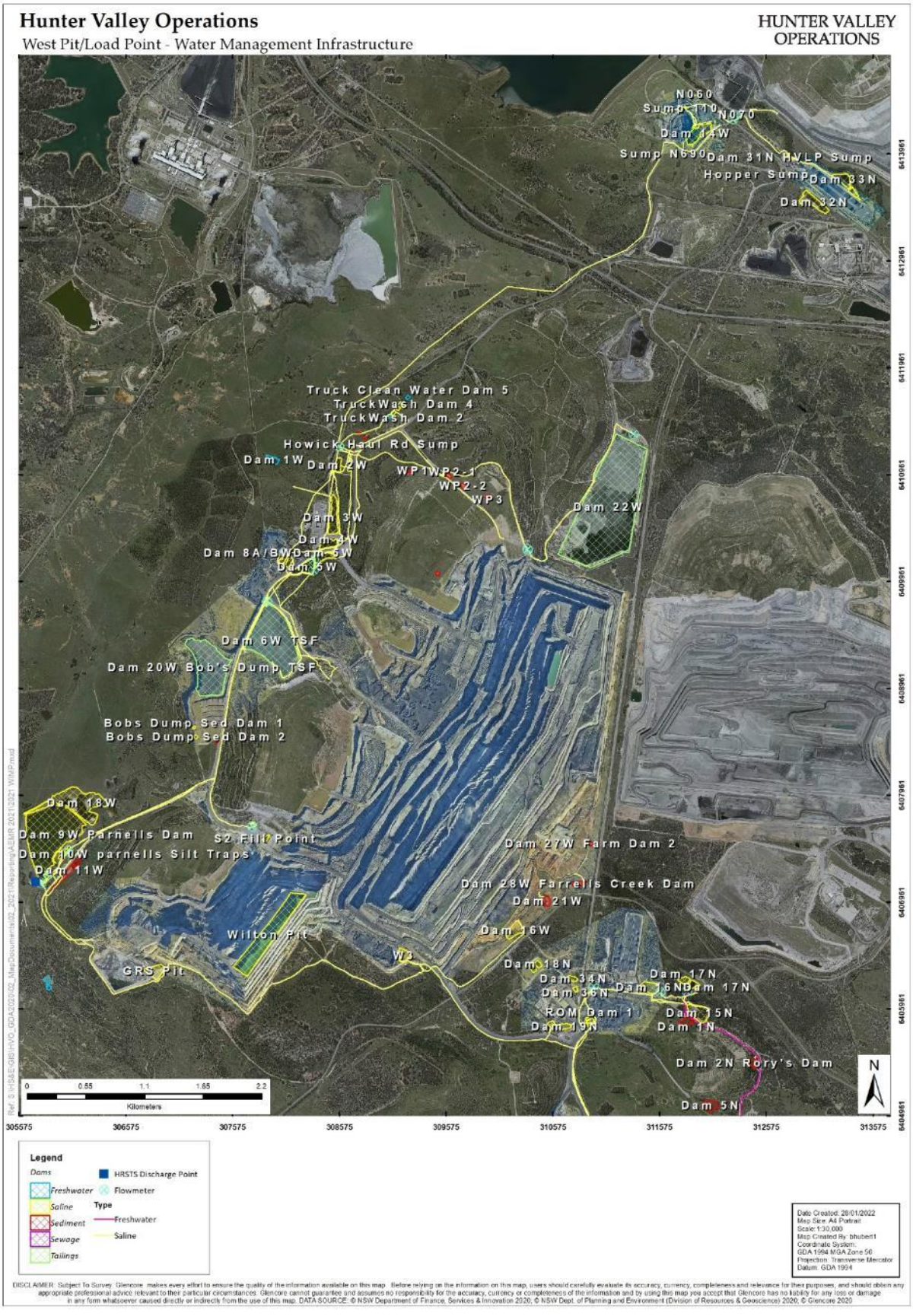


Figure 23 West Pit Water Management Infrastructure

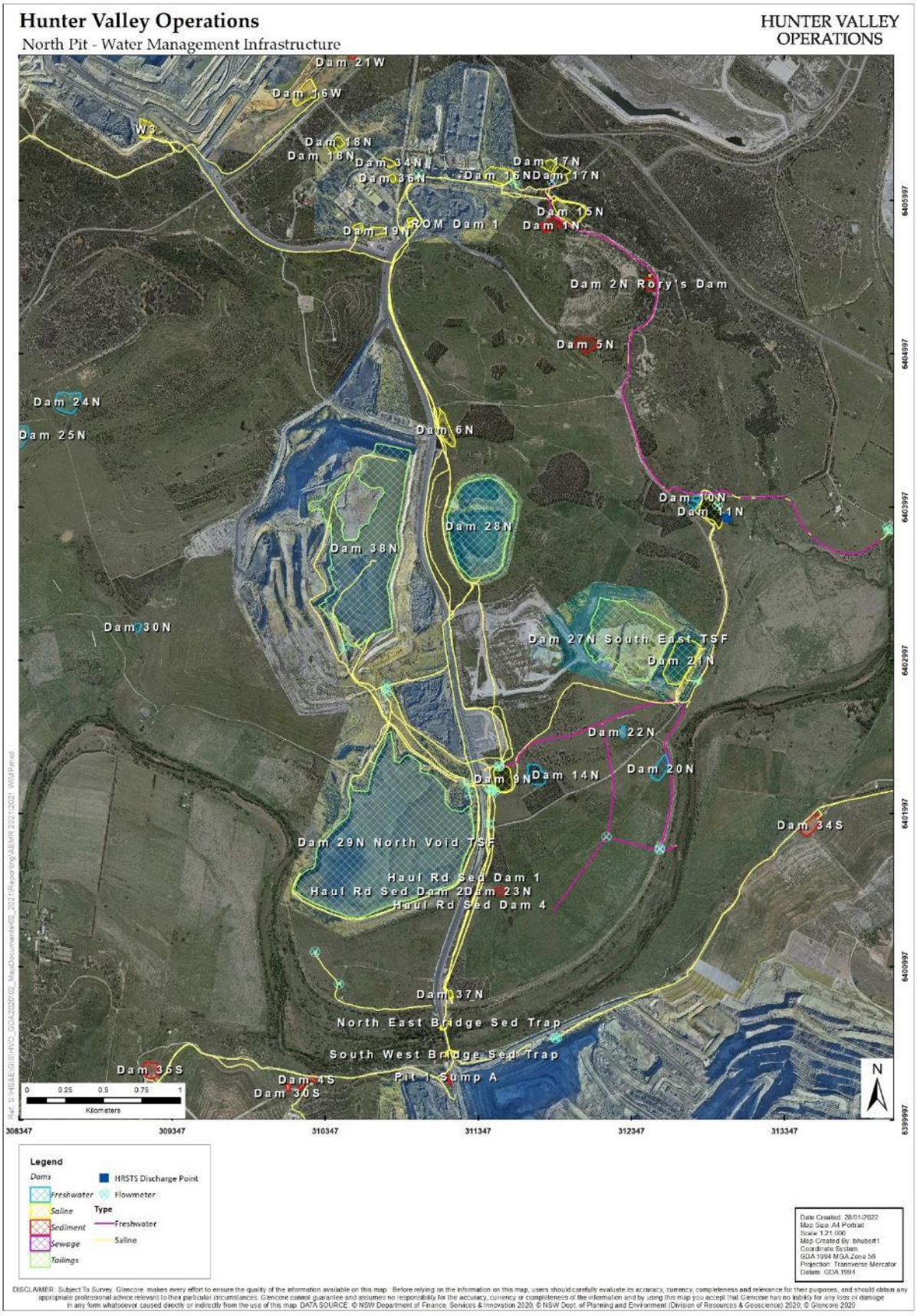


Figure 24 North Pit Water Management Infrastructure

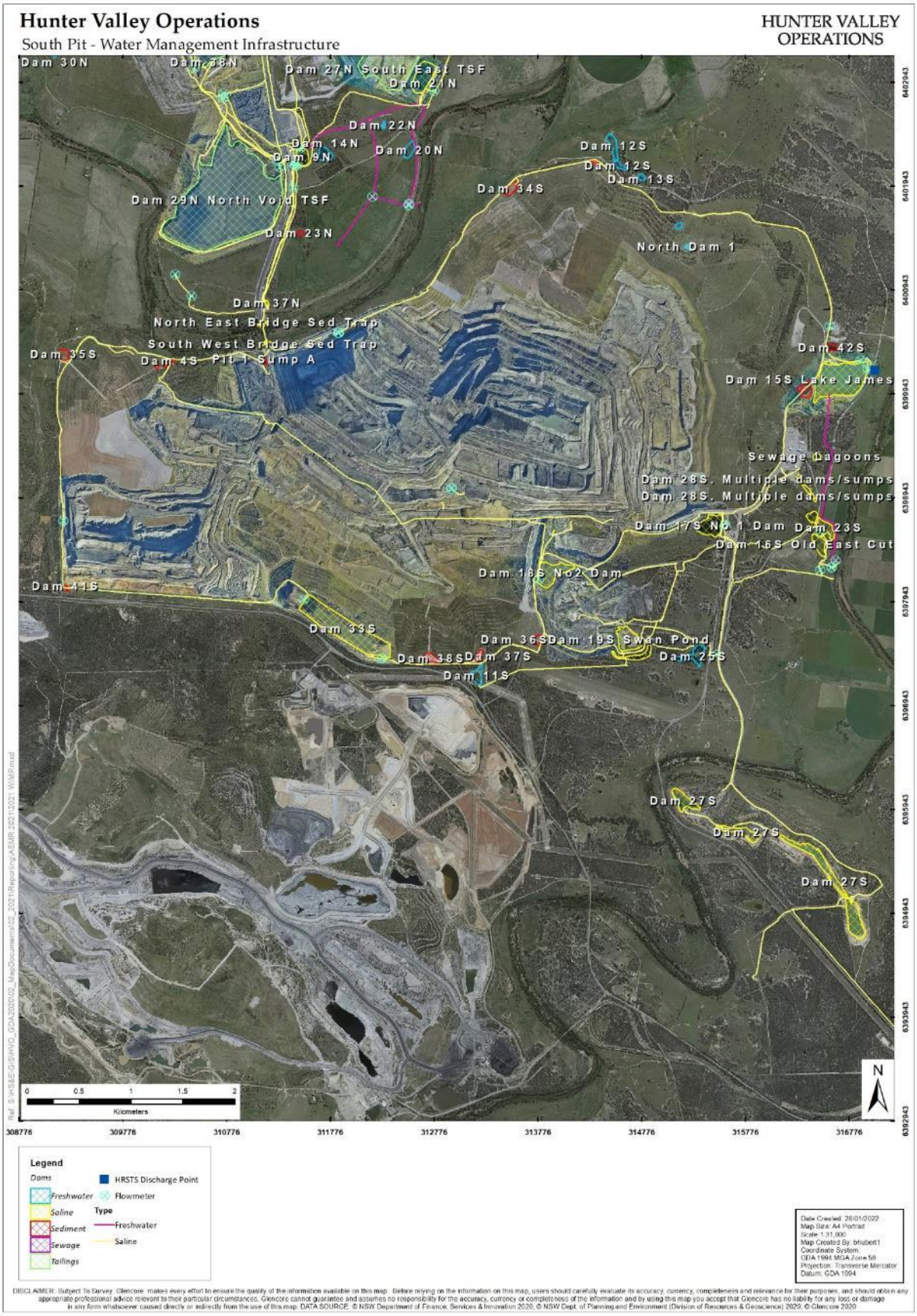


Figure 25 South Pit Water Management Infrastructure

7.1 Water Balance

The 2021 static water balance for HVO is presented in **Table 40.**

Table 40 2021 HVO Water Balance

Water Stream	Volume (ML)
Inputs	
Fresh Water (potable)	37 (0.3%)
Fresh Water (Hunter River extraction)	0 (0%)
Groundwater	1,074 (7.8%)
Rainfall Runoff	11,647 (84.6%)
Recycled to CHPP from Tails & Storage (not included in total)	3,623 (25.6%)
Imported (Liddell/Ravensworth (via Cumnock))	0 (0%)
Water from ROM Coal	1,012 (7.3%)
Total Inputs	**13,770**
Outputs	
Dust Suppression	2,320 (19.4%)
Evaporation - Mine Water & Tailings Dams	2,061 (17.2%)
Entrained in Process Waste	1,951 (16%)
Discharged (HRSTS)	3,083 (26%)
Vehicle Wash-down	311 (2.6%)
Sent to Third Party	27 (0.2%)
Miscellaneous Industrial Use	351 (3%)
Water in Coarse Reject	522 (4.4%)
Water in Product Coal	1,338 (11.2%)
Total Outputs	**11,964**
Change in Pit Storage	**959 (increase)**

7.1.1 Water Inputs

A total of 910 mm of rainfall was recorded at the HVO Corporate Meteorological Station in 2021 producing an estimated 11,647 ML of runoff. Water falling on undisturbed clean water catchments is diverted off site into natural systems where practicable.

Groundwater inflows to the pits are calculated via numerical groundwater modelling methods. Groundwater inflows were estimated to have contributed 1434 ML to the site during 2021. No fresh water was extracted from the Hunter River during the reporting period.

Further detail regarding water take for the 2020/2021 water year are presented in **Table 9** and **Table 10.**

7.1.2 Water Outputs

The main outputs were water discharged via the Hunter River Salinity Trading Scheme (HRSTS), use for dust suppression (2,320 ML), evaporation from dams (2.061 ML), water entrained in process waste (1,951 ML) and water in product coal (1,338 ML).

HVO participates in the allowing discharge from licensed discharge points during declared discharge events, associated with increased flow in the Hunter River. HVO maintains three licensed discharge monitoring locations:

- Dam 11N, located at HVO North, which discharges to Farrell's Creek.
- Lake James, located at HVO South, which discharges to the Hunter River; and
- Parnell's Dam, located at HVO West, which discharges to Parnell's Creek.

During 2021, Hunter Valley Operations discharged 3083ML under the Hunter River Salinity Trading Scheme and Environment Protection Licence 640.

7.2 Surface Water

Surface water monitoring activities continued in 2021 in accordance with the HVO WMP and HVO Surface Water Monitoring Program (SWMP). HVO maintains a network of surface water monitoring sites located on mine site dams, discharge points and surrounding natural watercourses (Figure 26). Water quality monitoring is undertaken to verify the effectiveness of the water management system onsite, and to identify the emergence of potentially adverse effects on surrounding watercourses. A number of mine water dams are monitored routinely to verify the quality of mine water. This water is used in coal processing, dust suppression, and other day to day activities around the mine.

Surface water monitoring data is reviewed on a quarterly basis. The review involves a comparison of measured pH, Electrical Conductivity (EC) and Total Suspended Solids (TSS) results against internal trigger values which have been derived from the historical data set. The response to measured excursions outside the trigger limits is detailed in the HVO WMP.

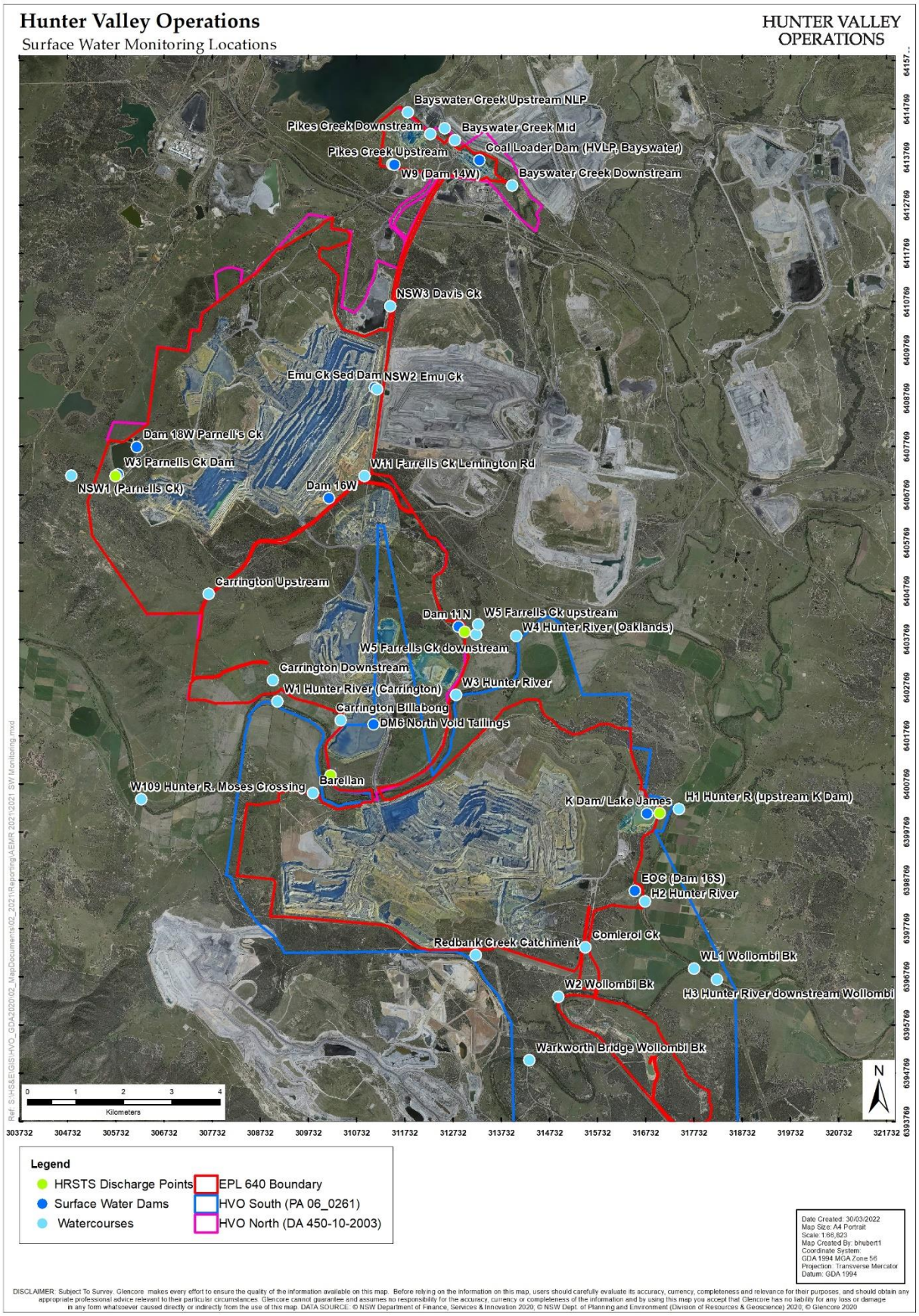


Figure 26 Surface Monitoring Locations

7.2.1 Surface Water Monitoring

Routine surface water monitoring was undertaken in 2021 in accordance with the HVO SWMP. All laboratory analysis of surface water was carried out in accordance with approved methods by a NATA accredited laboratory.

Water quality is evaluated through the parameters of pH, EC and TSS. Pertinent surface water sites are also sampled for comprehensive analysis annually. Long term water quality trends for the Hunter River, Wollombi Brook, other surrounding tributaries, and site dams are also presented in this section. The sampling frequency for ephemeral water sites was modified in 2016, from quarterly to a rain-event trigger system, in an effort to ensure samples taken were more representative of typical water quality for those streams - up to eight sampling events per annum can now be taken under the revised sampling protocol.

All required sampling and analysis was undertaken, except as detailed in **Table 41.** Australia and New Zealand Environment and Conservation Council (ANZECC) criteria are shown in the figures for comparative purposes.

Table 41 HVO Water Monitoring Data Recovery for 2021 (by exception)

Location	Data Recovery (%)	Comments
Barellan	25%	This monitoring location was recorded as dry during three sampling events.
Carrington Billabong	0%	This monitoring location was unable to be sampled on four occasions. On three occasions, this location was recorded as dry. On one occasion, this location was unable to be accessed due to a large rainfall event.
DM6 North Void Tailings	58%	This monitoring location recorded 58% data recovery due to low water levels in the dam.
EOC	71%	This monitoring location was unable to be sampled on two occasions due to low water levels in the dam.
H1 – Hunter River	75%	This monitoring location was unable to be sampled on one occasion due to accessing issues relating to property ownership.
H3 – Hunter River	75%	This monitoring location was unable to be sampled on one sampling occasion due to localised flooding.
NSW1 (Parnell's Ck)	0%	This monitoring location was unable to be sampled during 2021 due to unsafe access following rainfall events.
NSW3 Davis Ck	75%	This monitoring location was recorded as dry during three sampling events.
Pikes Creek Upstream	50%	This monitoring location was recorded as dry during two sampling events.
W2 – Wollombi Brook	75%	This monitoring location was unable to be sampled on one occasion due to accessing issues.
W3 – Hunter River	75%	This monitoring location was unable to be sampled on one sampling occasion due to localised flooding.
W5 (Farrell's Creek Downstream)	75%	This monitoring location was recorded as dry during one sampling event.
WL1	85%	This monitoring location was unable to be sampled on one sampling occasion due to localised flooding.

Hunter River

The Hunter River was sampled on 50 occasions from eight monitoring locations during 2021. Long term trends for pH, EC and TSS are shown in **Figure 27** to **Figure 29.**

The elevated TSS levels recorded at multiple locations throughout 2021 are likely due to higher than average rainfall received for the year and the variable flow volumes through the catchment.

Trigger exceedance results are detailed in **Table 42.**

Table 42 Hunter River Internal Trigger Tracking Results

Location	Date	Trigger Limit	Action Taken in Response
H2 – Hunter River	20/01/2021	TSS – 50mg/L	First breach of TSS trigger (59mg/L). Field observations indicate that the water at the sample site was slightly turbid when the sample was taken. The only comparative upstream sample taken was W1 which also showed elevated TSS levels (40mg/L). No evidence to suggest elevated TSS is associated with mining influence.
H2 – Hunter River	18/02/2021	TSS – 50mg/L	Second breach of TSS trigger (54mg/L). Results are consistent with observations and water quality expected in the Hunter River following rainfall in the week preceding monitoring. Only comparative upstream sample taken was W1 which also showed elevated TSS levels (34 mg/L). No evidence to suggest elevated TSS is associated with mining influence.
H3 – Hunter River	08/06/2021	EC – 95th Percentile	First consecutive trigger exceedance Watching Brief*
W1 – Hunter River	05/07/2021	TSS – 50mg/L	First breach of TSS trigger (58mg/L). Field observations indicate that the water at the sample site was slightly turbid when the sample was taken. W1 is an upstream surface water monitoring location. Downstream sampling site H2 was also elevated (47 mg/L) indicating the result at W1 is representative of prevailing water quality in the river. No evidence to suggest elevated TSS is associated with mining influence.
H2 – Hunter River	02/08/2021	TSS – 50mg/L	Third breach of TSS trigger (56mg/L). Field observations indicate that the water at the sample site was clear when the sample was taken. Upstream monitoring site W1 had a lower TSS (14 mg/L) indicating the TSS results at H2 may be isolated to a local source to the sampling location and not from a broader impact. No evidence to suggest elevated TSS is associated with mining influence.
W109 – Hunter River	08/12/2021	TSS – 50mg/L	First breach of TSS trigger (55mg/L). Field observations indicate that the water at the sample site slightly turbid when the sample was taken. W109 is an upstream surface water monitoring location. Results are generally consistent with observations and water quality expected in the Hunter River following rainfall in the 24 hours preceding monitoring. No evidence to suggest elevated TSS is associated with mining influence
H2 – Hunter River	08/12/2021	TSS – 50mg/L	Fourth breach of TSS trigger (54mg/L). Field observations indicate that the water at the sample site was slightly turbid when the sample was taken. H2 is a downstream surface water monitoring location. Water monitoring indicates that water quality is consistent with upstream results at W109 (55mg/L) and W1 (54mg/L) and the water quality expected in the Hunter River following rainfall in the 24 hours preceding monitoring. No evidence to suggest elevated TSS is associated with mining influence.
W1 – Hunter River	08/12/2021	TSS – 50mg/L	Second breach of TSS trigger (54mg/L). Field observations indicate that the water at the sample site was slightly turbid when the sample was taken. W1 is an upstream surface water monitoring. Water monitoring indicates that water quality is consistent with upstream (W109 – 55mg/L) and downstream (H2 – 54mg/L) results and the water quality expected in the Hunter River following rainfall in the 24 hours preceding monitoring. No evidence to suggest elevated TSS is associated with mining influence
W4 – Hunter River	08/12/2021	TSS – 50mg/L	First breach of TSS trigger (61mg/L). Field observations indicate that the water at the sample site was slightly turbid when the sample was taken. W4 is a downstream surface water monitoring location. Water monitoring indicates that water quality is consistent with upstream (W109 – 55mg/L) and downstream (H2 – 54mg/L) results and the water quality expected in the Hunter River following rainfall in the 24 hours preceding monitoring. No evidence to suggest elevated TSS is associated with mining influence.

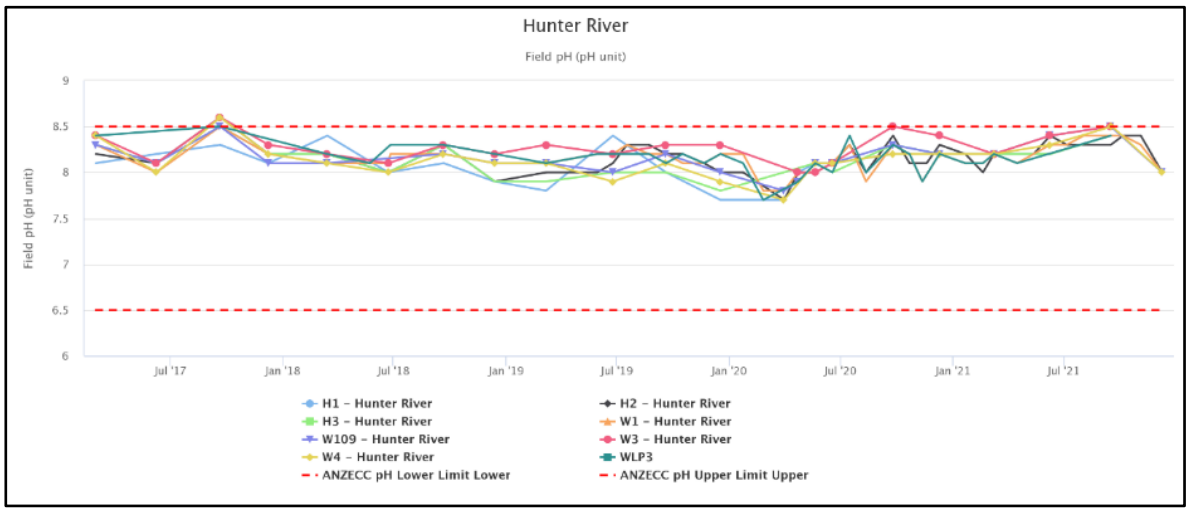


Figure 27 Hunter River pH Trends 2017 – 2021

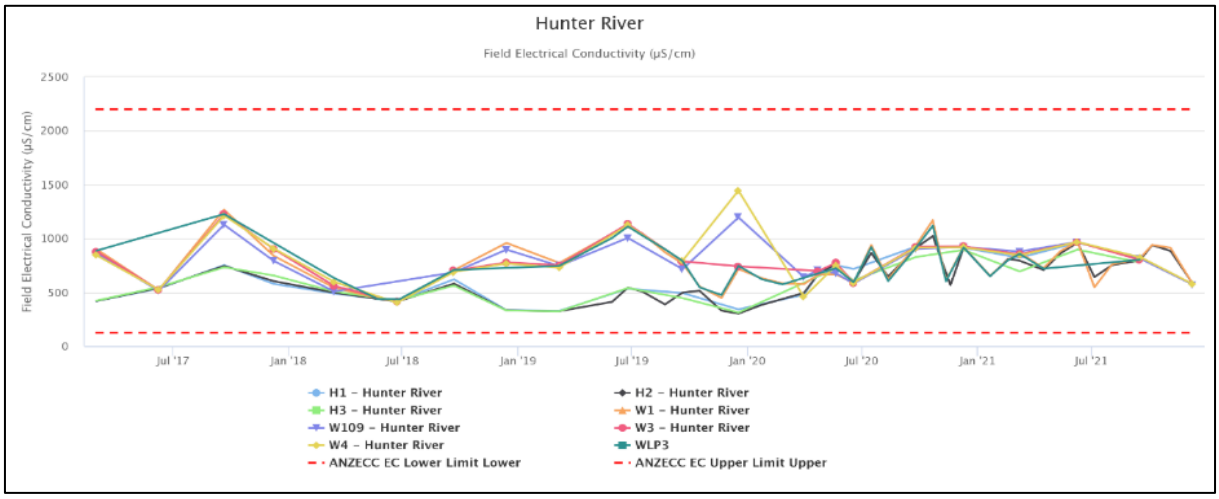


Figure 28 Hunter River EC Trends 2017- 2021

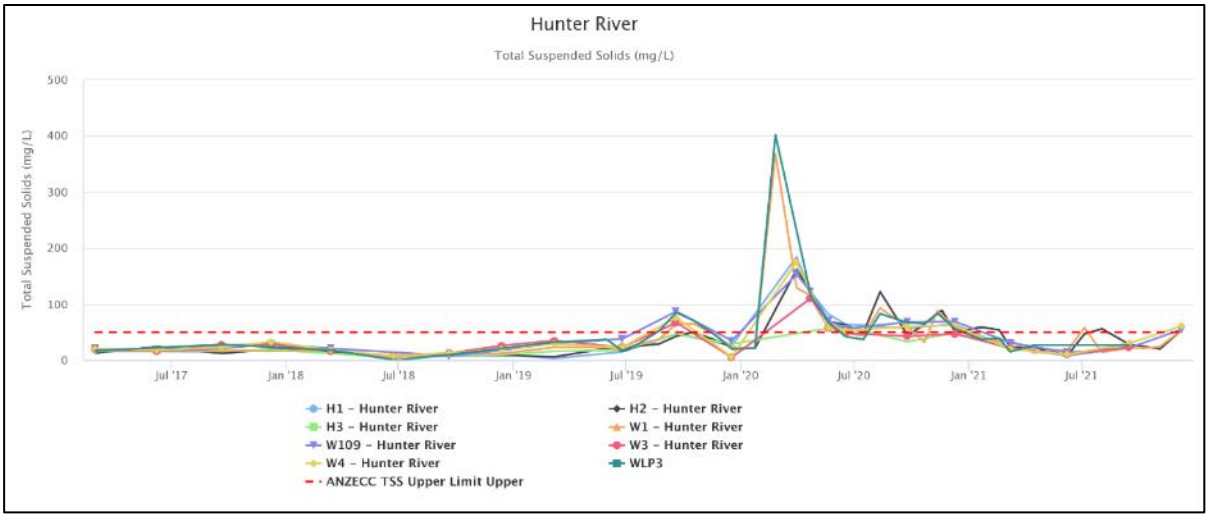


Figure 29 Hunter River TSS Trends 2017 - 2021

Wollombi Brook

Wollombi Brook was sampled on 15 occasions from three monitoring locations during 2021. Long term trends for pH, EC and TSS from Wollombi Brook are shown in **Figure 30** to **Figure 32**.

Results were generally consistent with historical trends and acceptable ranges.

There were no trigger exceedances in 2021.

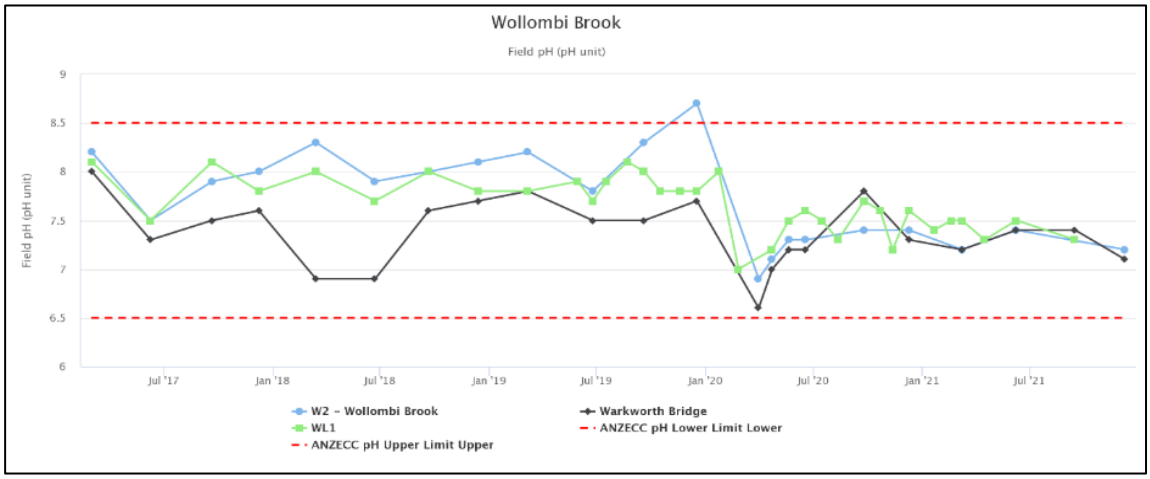


Figure 30 Wollombi Brook pH Trends 2017 – 2021

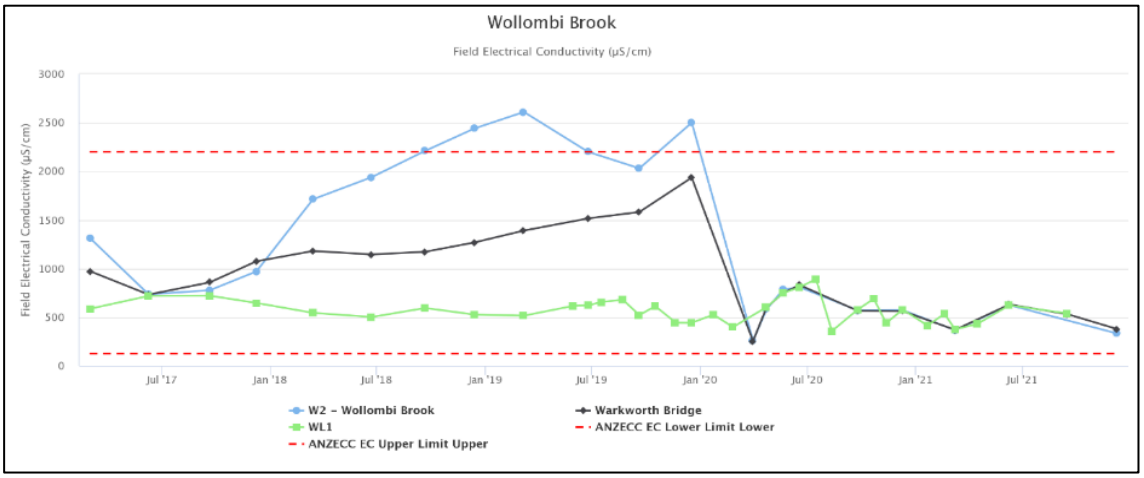


Figure 31 Wollombi Brook EC Trends 2017 – 2021

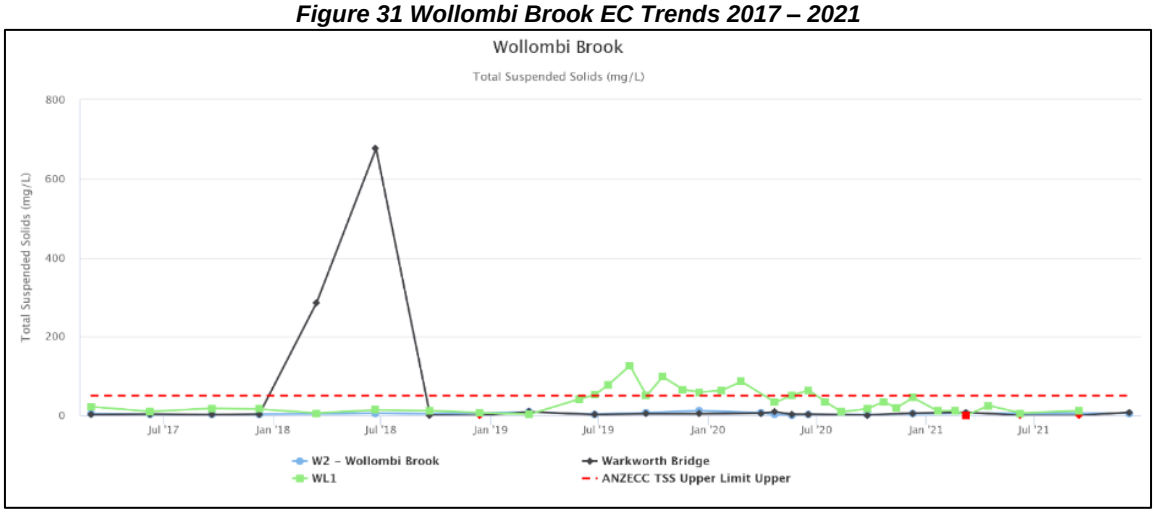


Figure 32 Wollombi Brook TSS Trends 2017 – 2021

Other Surrounding Tributaries

Rain event-based monitoring of natural tributaries surrounding HVO continued during 2021.

In accordance with the *HVO WMP*, four rain event sampling rounds were triggered during 2021. These occurred following rainfall greater ≥30mm in a 24-hour period on the days of 05/01/2021, 02/02/2021, 11/11/2021 and 12/12/2021. Monitoring during these rain events occurred on the following water courses:

- Comleroi Creek.
- Emu Creek.
- Farrells Creek.
- Pikes Creek.
- Redbank Creek.
- Davis Creek.
- Bayswater Creek; and
- Parnells Creek.

Long term trends for pH, EC and TSS are shown **Figure 33** to **Figure 36**. On occasion, some sampling sites recorded results outside of the internal trigger levels however, results for water quality remained generally consistent with historical trends The ephemeral nature of these monitoring locations is the primary reason for the considerable variation in physical water quality.

Trigger tracking results are detailed in **Table 43**.

Table 43 Other Tributaries Internal Trigger Exceedance Results

Location	Date	Trigger Limit	Action Taken in Response
W11 – Farrells Ck Lemington Rd	05/01/2021	TSS – 50mg/L	First exceedance of TSS (71mg/L). Field observations indicate that the water at the sample site was slightly turbid when the sample was taken. Rain event sampling after 44.6mm of rain was recorded <24hours. The ephemeral nature of this monitoring location is the primary reason for considerable variation in physical water quality. The elevated TSS result is consistent with the water quality expected in this tributary after a large rainfall event.
W11 – Farrells Ck Lemington Rd	05/01/2021	pH – 95th Percentile	First consecutive trigger exceedance, Watching Brief*
NSW2 Emu Ck	05/01/2021	TSS – 50mg/L	First exceedance of TSS (237mg/L). Field observations indicate that the water at the sample site was flowing slowly and was turbid when the sample was taken. Rain event sampling after 44.6mm of rain was recorded in previous 24-hour period. The ephemeral nature of this monitoring location is the primary reason for considerable variation in physical water quality. The elevated TSS result is consistent with the water quality expected in this tributary after a large rainfall event. This location flows to a sediment dam at adjacent Ravensworth mine.
Bayswater Creek Upstream NLP	05/01/2021	TSS – 50mg/L	First exceedance of TSS (215mg/L). Rain event sampling after 44.6mm of rain was recorded in the previous 24-hour period. This is an upstream monitoring location. Field observations indicate that the sample was taken from a pool of water as there was no visible flow in the creek line. Based on both of these factors, it can be assumed that the sample taken is not representative of flows in Bayswater Creek and that there is no impact to suggest mining influence. The ephemeral nature of this monitoring location is the primary reason for considerable variation in physical water quality.

Location	Date	Trigger Limit	Action Taken in Response
W11 – Farrells Ck Lemington Rd	02/02/2021	TSS – 50mg/L	Second exceedance of TSS (59mg/L). Rain event sampling after 36mm of rain was recorded in the previous 24-hour period. Field observations indicate that the sample was taken from a pool of water as there was no visible flow in the creek line. Based on both of these factors, it can be assumed that the sample taken is not representative of flows in Farrells Creek and that there is no impact to suggest mining influence. The ephemeral nature of this monitoring location is the primary reason for considerable variation in physical water quality.
W11 – Farrells Ck Lemington Rd	02/02/2021	pH – 5th Percentile	Second consecutive trigger exceedance, Watching Brief*
NSW2 Emu Ck	02/02/2021	TSS – 50mg/L	Second exceedance of TSS (1,850mg/L). Rain event sampling after 36mm of rain was recorded in the previous 24-hour period. Field observations indicate that the water at the sample site was flowing moderately and was very turbid when the sample was taken. The ephemeral nature of this monitoring location is the primary reason for considerable variation in physical water quality. The elevated TSS result is consistent with the water quality expected in this tributary after a large rainfall event.
Pikes Creek Downstream	02/02/2021	TSS – 50mg/L	First exceedance of TSS (142mg/L). Rain event sampling after 36mm of rain was recorded in the previous 24-hour period. Field observations indicate that the sample was taken from a pool of water as there was no visible flow in the creek line. Based on both of these factors, it can be assumed that the sample taken is not representative of flows in Pikes Creek and that there is no impact to suggest mining influence. The ephemeral nature of this monitoring location is the primary reason for considerable variation in physical water quality.
Bayswater Creek Upstream HVLP	02/02/2021	EC – 95th Percentile	First consecutive trigger exceedance, Watching Brief*
W11 – Farrells Ck Lemington Rd	11/11/2021	TSS – 50mg/L	Third exceedance of TSS (64mg/L). Rain event sampling after 58mm of rain was recorded in the previous 24-hour period. Field observations indicate that the sample was taken from an area of slow flow in the creek line. Based on both of these factors, it can be assumed that the sample taken is not representative of flows in Farrells Creek and that there is no impact to suggest mining influence. The ephemeral nature of this monitoring location is the primary reason for considerable variation in physical water quality.
Pikes Creek Downstream	11/11/2021	TSS – 50mg/L	Second exceedance of TSS (264mg/L). Rain event sampling after 58mm of rain was recorded in the previous 24-hour period. Field observations indicate that the sample was taken from a pool of water as there was no visible flow in the creek line. Based on both of these factors, it can be assumed that the sample taken is not representative of flows in Pikes Creek and that there is no impact to suggest mining influence. The ephemeral nature of this monitoring location is the primary reason for considerable variation in physical water quality.
Bayswater Creek Mid	11/11/2021	EC – 95th Percentile	First consecutive trigger exceedance, Watching Brief*
W11 – Farrells Ck Lemington Rd	12/11/2021	pH – 5th Percentile	First consecutive trigger exceedance, Watching Brief*
Bayswater Creek Mid	12/11/2021	pH – 5th Percentile	First consecutive trigger exceedance, Watching Brief*

* = Watching brief established pending outcomes of subsequent monitoring events. No specific actions required.

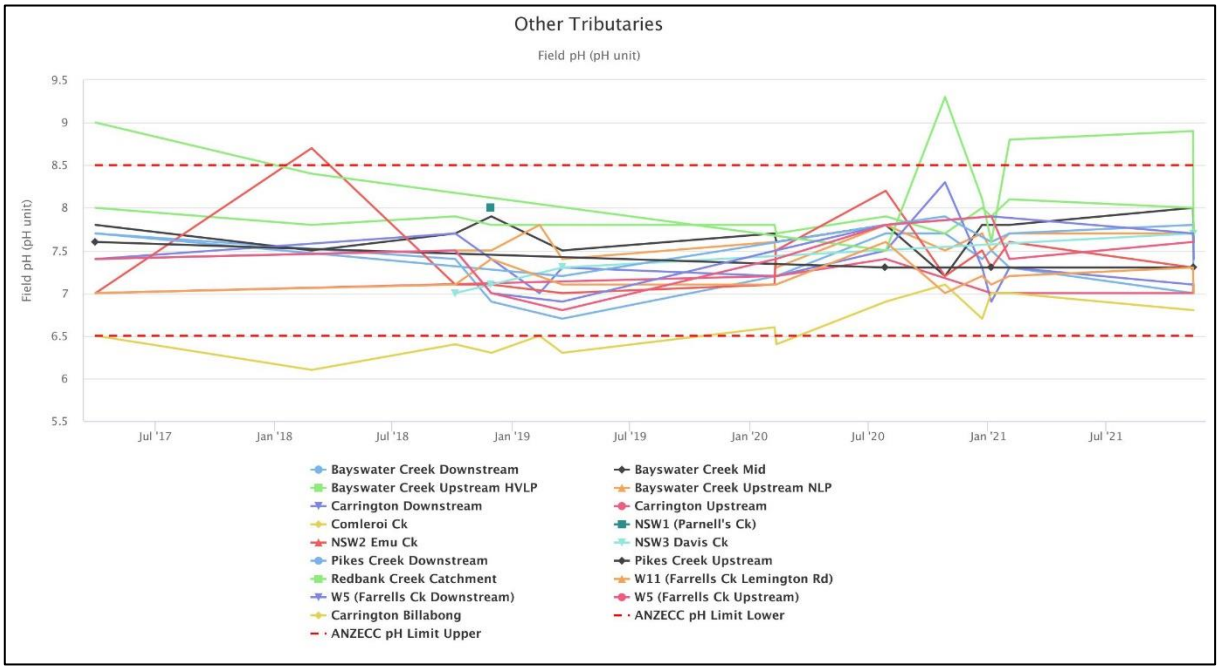


Figure 33 Other Tributaries pH Trends 2017 – 2021

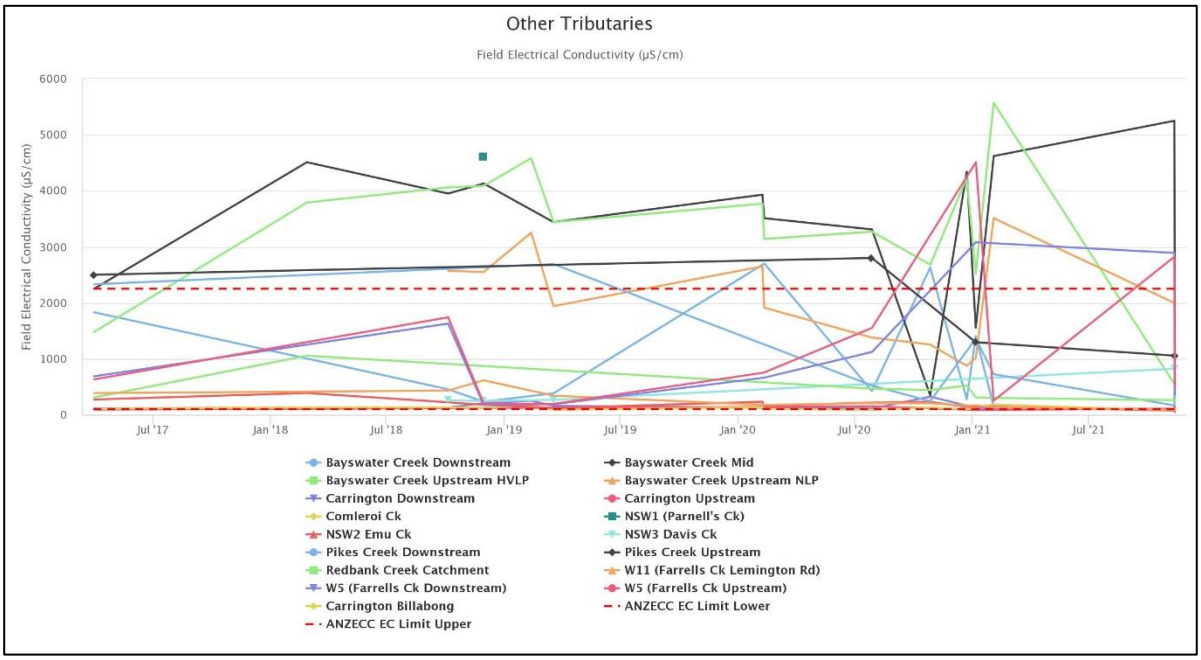


Figure 34 Other Tributaries EC Trends 2017 – 2021

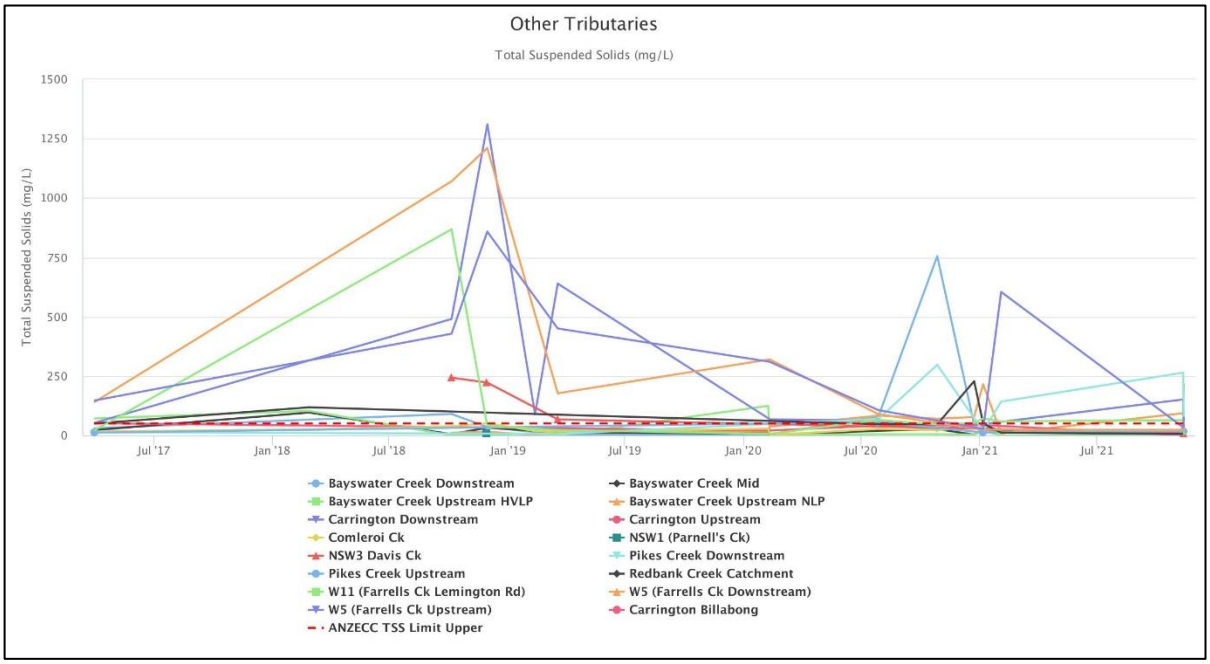


Figure 35 Other Tributaries TSS Trends 2017 – 2021

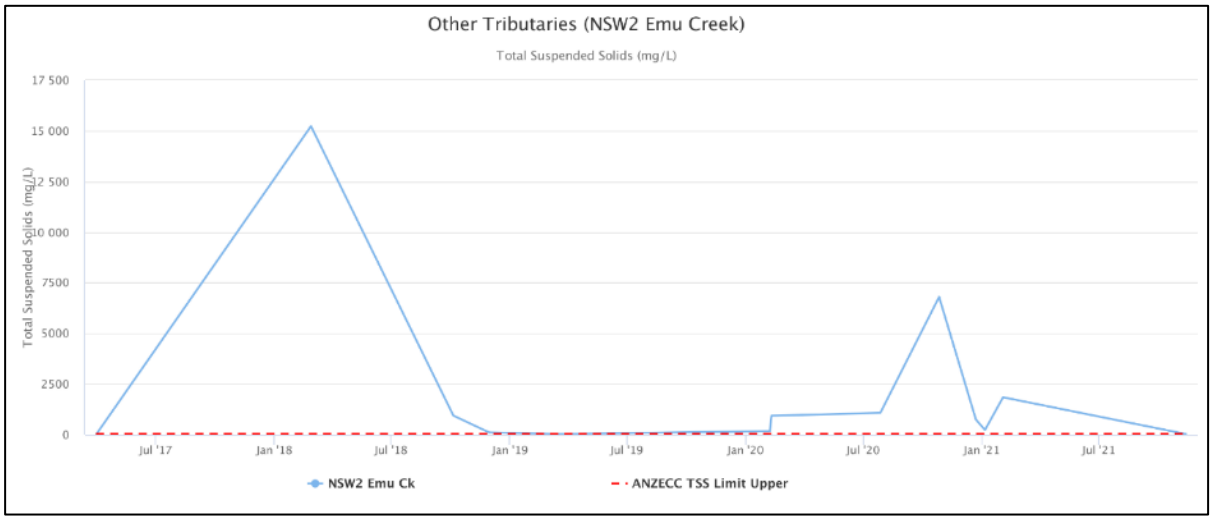


Figure 36 NSW2 Emu Creek TSS Trends 2017 - 2021

HVO Site Dams

During 2021, 77 samples were collected across 10 onsite dams. Long term trends for pH, EC and TSS are shown in **Figure 37** to **Figure 39**. HVO's onsite dams do not have impact assessment criteria. Results for water quality remained generally consistent with historical water quality trends.

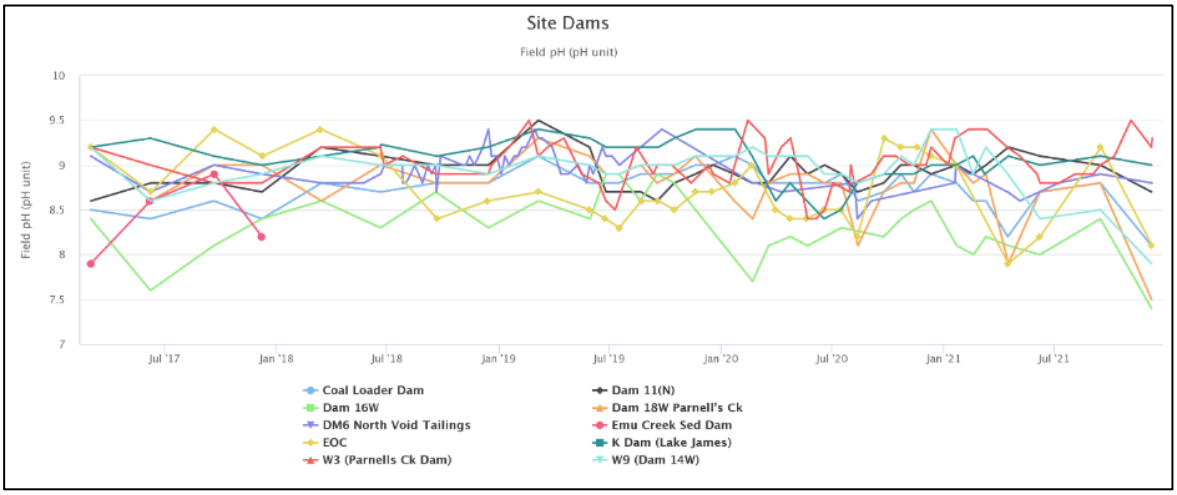


Figure 37 HVO Site Dams pH Trends 2017 – 2021

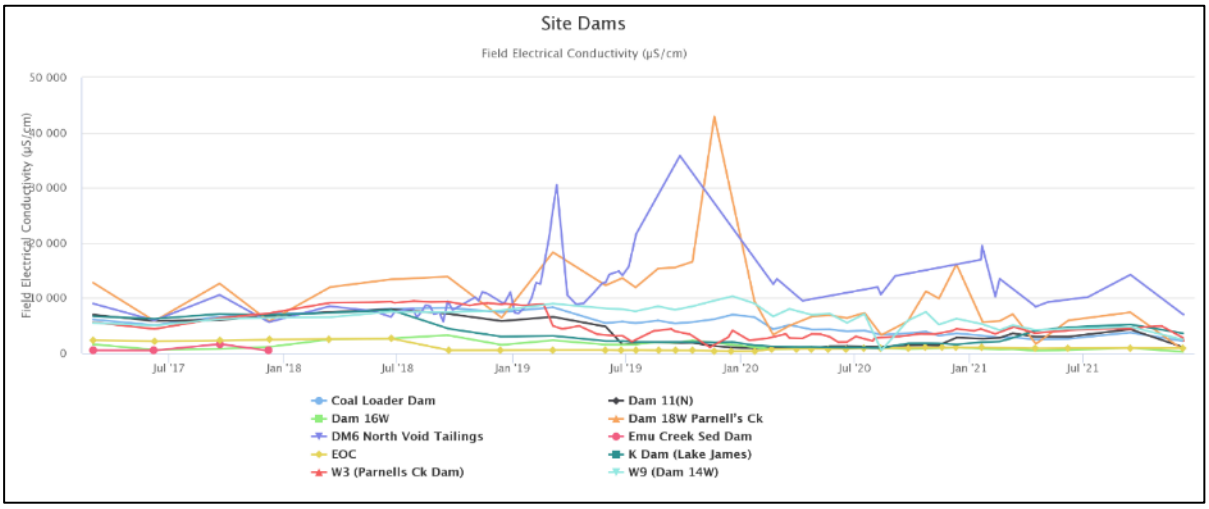


Figure 38 HVO Site Dams EC Trends 2017 – 2021

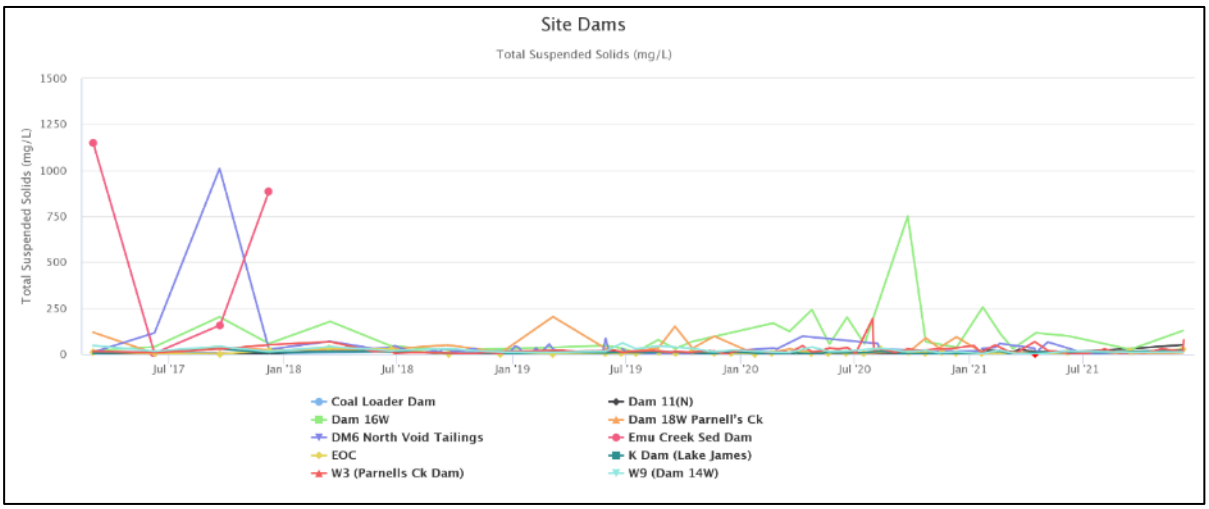


Figure 39 HVO Site Dams TSS Trends 2017 – 2021

7.3 Comparison with EIS Predictions

7.3.1 South Pit EIS Predictions

The South Pit EIS estimated an 'instantaneous' water quality for EC of 5,700 µS/cm as an upper limit. Instantaneous water quality is a simple estimate obtained by dividing the total salt available by the maximum amount of possible void water. Electrical Conductivity measurements at Lake James averaged 3,497 µS/cm during 2021, lower than what was predicted in the EIS. The water quality during this period was influenced by increased rainfall runoff across the site.

The South Pit EIS estimated average runoff water quality from undisturbed catchments to be 400 mg/L for TSS and 615 µS/cm for EC. Comleroi Creek, South of Cheshunt Pit was sampled four times during rain events in 2021 resulting in an average TSS of 14 mg/L and EC of 121.5 µS/cm, demonstrating that runoff water from undisturbed catchments in the HVO South area is of better quality than that which was predicted in the EIS.

7.3.2 Carrington EIS Predictions

The long term mine water quality for Carrington is discussed in the Carrington Mine Environmental Impact Statement (ERM 1999). The EIS estimated an 'instantaneous' water quality for EC of 7,050 µS/cm.

Water in the Carrington pit area is a mixture of surface runoff from overburden emplacements, haul roads, tailings decant, rehabilitation and Hunter River abstraction. Water is directed to Dam 9N and into Dam 11N. The average EC and TSS in Dam 11N during 2021 was 2,917 µS/cm and 23.1 mg/L respectively, this is lower than normal and influenced by increased rainfall runoff.

The Carrington EIS states that runoff from undisturbed catchments within the Carrington Pit will be directed around the mine via contour banks or surface drains to discharge where possible into natural creeks. The salinity of the runoff water was predicted to be approximately 615 µS/cm. Runoff from rehabilitated lands was initially predicted to have higher TSS, with levels approaching pre-mining conditions after several years. Carrington Billabong (where such water quality is currently measured in this catchment) was reported as dry during three rain event monitoring rounds in 2021 with the site unable to be accessed safely following one event following a large rain event, subsequently no samples were able to be collected. The catchment area has changed significantly since the EIS predictions were made with a levee now in place between rehabilitated mine areas and Carrington Billabong.

7.3.3 West Pit EIS Predictions

The West Pit EIS included the data in **Table 44** as representative of water quality in the local catchment area. Emu Creek (NSW2) was sampled four times during 2021. The pH was reported to be 7.4 pH units during the review period, which is within the EIS predictions, and the Electrical conductivity was 127 µS/cm, indicating fresher than predicted EC results. The pH and EC at Farrells Creek (combined upstream and downstream monitoring sites) averaged 7.6 pH and 1,239 µS/cm respectively during the review period; these results were within the EIS predictions. Davis creek (where such water quality would be measured for this comparison) was sampled once during 2021 with a pH of 7.7 and EC of 823. Parnell's Creek Dam (W3) measured an average EC of 4,042 µS/cm in 2021, within the prediction.

Table 44 Representative Water Quality for West Pit

Watercourse	pH (pH Units)	EC (µS/cm)
Davis Creek	7.7 to 8.4	767 to +8,000
Emu Creek	7.5 to 8.8	365 to +1,000
Farrells Creek	7.0 to 9.2	195 to +12,000
Mine Water (Parnell's Dam)	-	2,400 to 6,300

7.4 Performance relating to HRSTS Discharges

HVO participates in the Hunter River Salinity Trading Scheme (HRSTS), allowing it to discharge to the Hunter River via three licensed discharge points, including Dam 11N, Dam 15S (Lake James) and Dam 9W (Parnells Dam). Discharges can only take place subject to the scheme's regulations.

One incident was reported due to a total suspended solids (TSS) result above the 100-percentile concentration limit of 120 mg/L in a grab sample collected on 24 March 2021. This is discussed in 12.1.

As required by the EPL, HVO submitted a discharge report for the 2020/21 financial year. 3,083 ML of water was discharged off site during 2021 via the Hunter River Salinity Trading Scheme (HRSTS).

7.5 Groundwater

7.5.1 Groundwater Management

Groundwater monitoring activities were undertaken in 2021 in accordance with the HVO WMP and Groundwater Monitoring Programme. The monitoring results are used to establish and monitor trends in physical and geochemical parameters of surrounding groundwater potentially influenced by mining.

The groundwater monitoring programme at HVO measures the quality of groundwater against background data, EIS predictions and historical trends. Ground water quality is evaluated through the parameters of pH, EC, and Standing Water Level (SWL) (measured as elevation in metres with respect to the Australian Height Datum, mAHD). On a periodic basis (nominally once per annum) a comprehensive suite of analytes are measured, including major anions, cations and metals. Prior to sampling for comprehensive analysis, bore purging is undertaken to ensure a representative sample is collected.

Groundwater monitoring data is reviewed regularly for trigger exceedances and analysed in detail on a quarterly basis. The review involves a comparison of measured results against internal trigger values which have been derived from the historical data set. Trigger limits are calculated as the 95th percentile maximum value (EC and pH) and the 5th percentile minimum value (pH only) from data collected since 2011. Trigger levels have been set on the basis of geographical proximity and target stratigraphy. Bores that record as dry and bores of unknown seam have not been included in calculation of the trigger limits. The response to measured data outside the trigger limits is detailed in the HVO Water Management Plan. Where investigations and subsequent actions have been undertaken following review of monitoring data, these are detailed in this section. Monitoring locations are shown in **Figure 40**.

The Annual Groundwater Impacts Review conducted during 2021 is provided in **Appendix A.**

7.5.2 Groundwater Performance

Sampling of groundwater was carried out in accordance with the HVO Groundwater Monitoring Programme. Where laboratory analysis was undertaken, this was performed by a NATA accredited laboratory. Sites with a data capture rate of less than 100 per cent are outlined in **Table 45**. Data recovery presented in **Table 45** has been calculated based on the number of times the sampling location was able to be accessed and at least one sampling parameter was able to be collected. Detailed data capture by sampling parameters is provided in Appendix B.

Table 45 HVO Groundwater Monitoring Data Recovery for 2021 (by exception)

Location	Data Recovery	Comments
4036C	0%	Insufficient water to sample and broken standpipe during 2021
4051C	75%	Unable to bail due to bore blockage in Q4 2021.
4116P	75%	Unable to access bore on monitoring occasion due to flooded track access
B425 (WDH)	50%	Insufficient water to sample on one monitoring occasion. Unable to access bore on one monitoring occasion due to flooded track access
C122 (BFS)	0%	Insufficient water to sample during 2021
C630 (BFS)	50%	Unable to access bore on one monitoring occasion due to flooded track access
C919 (All)	25%	Insufficient water to sample on three monitoring occasions
CGW47A	75%	Unable to bail for one monitoring occasion – maintenance required
CGW49	75%	Unable to bail for one monitoring occasion – maintenance required
CHPZ10A	75%	Unable to bail for one monitoring occasion – maintenance required
CHPZ2A	75%	Unable to bail for one monitoring occasion – maintenance required
CHPZ3A	75%	Unable to bail for one monitoring occasion – maintenance required
CHPZ3D	75%	Unable to bail for one monitoring occasion – maintenance required
CHPZ8A	75%	Unable to bail for one monitoring occasion – maintenance required
CHPZ8D	75%	Unable to bail for one monitoring occasion – maintenance required
DM1	75%	Unable to access bore on monitoring occasion due to flooded track access
D214 (BFS)	75%	Unable to access bore on one monitoring occasion – Unsafe access
D510 (AFS)	50%	Unable to access bore on one monitoring occasion
D510 (BFS)	50%	Unable to access bore on one monitoring occasion
D612 (AFS)	0%	D612 (AFS) was recorded as dry during 2021
DM7	0%	DM7 was recorded as dry during 2021
GA3	75%	Unable to access bore on monitoring occasion due to flooded track access
GW-100	75%	Unable to access bore on monitoring occasion due to flooded track access
GW-101	0%	GW-101 was recorded as dry during or unable to be accessed due to flooding in 2021

Location	Data Recovery	Comments
GW-114	50%	Insufficient water to sample on one monitoring occasion. Unable to access bore on one monitoring occasion due to flooding. Top RL data requires re survey.
GW-115	75%	Unable to access sampling site on one monitoring occasion due to flooded track access
HV32	75%	Unable to access sampling site on one monitoring occasion due to flooded track access
MB14HVO01	75%	Unable to access bore on one monitoring occasion due to flooded track access
MB14HVO02	75%	Unable to access bore on one monitoring occasion due to flooded track access
MB14HVO05	75%	Unable to access bore on one monitoring occasion due to flooded track access
NPZ5	0%	Bore NPZ5 has been mined through
PZ4CH1380	75%	Unable to access sampling site on one monitoring occasion due to overgrowth on track

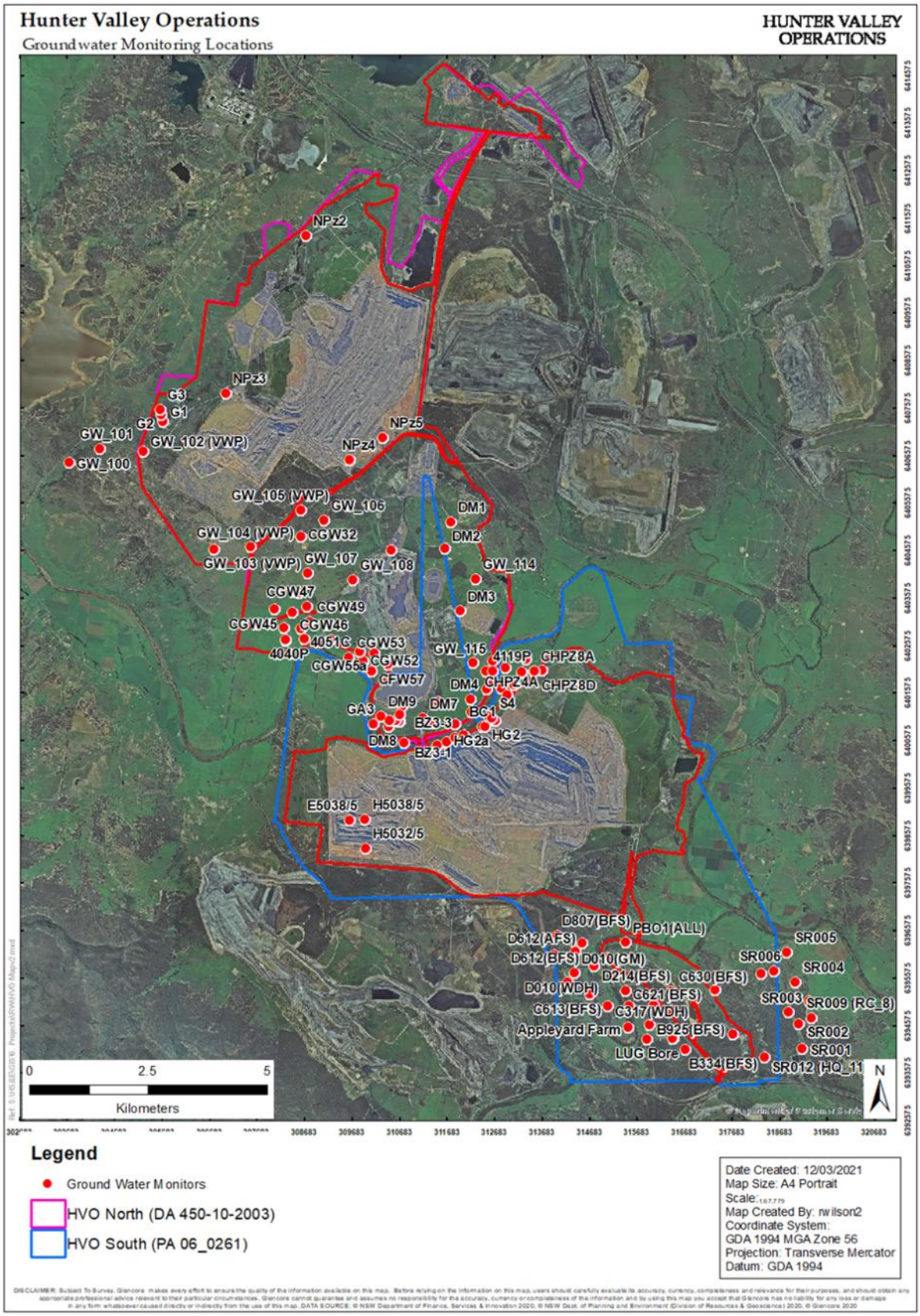


Figure 40 Groundwater Monitoring Network at HVO – 2021

7.5.3 Groundwater Monitoring Summary

The following section presents groundwater monitoring data in relation to the geographic locations and target stratigraphy for groundwater monitoring bores.

Each location is discussed, and a summary of monitoring data presented. Where monitoring results required further investigation following the recording of three consecutive measurements outside the internal statistical limits, these results are summarised in tables for each location. A detailed Annual Groundwater Review is Provided in Appendix B.

Carrington Broonie

The EC, pH and SWL trends for 2017 to 2021 for Carrington Broonie Seam groundwater bores are shown in **Figure 41** to **Figure 43** respectively. Water quality results were generally consistent with historical ranges with some minor variation noted with pH and SWL results.

Trigger exceedance results are shown in **Table 46**.

Table 46: Carrington Broonie Internal Trigger Tracking 2021

Location	Date	Trigger Limit	Action Taken in Response
CGW52	14/04/2021	pH – 95th Percentile	Second consecutive trigger exceedance - watching brief established
CGW53	21/12/2021	pH – 95th Percentile	First consecutive trigger exceedance – watching brief established

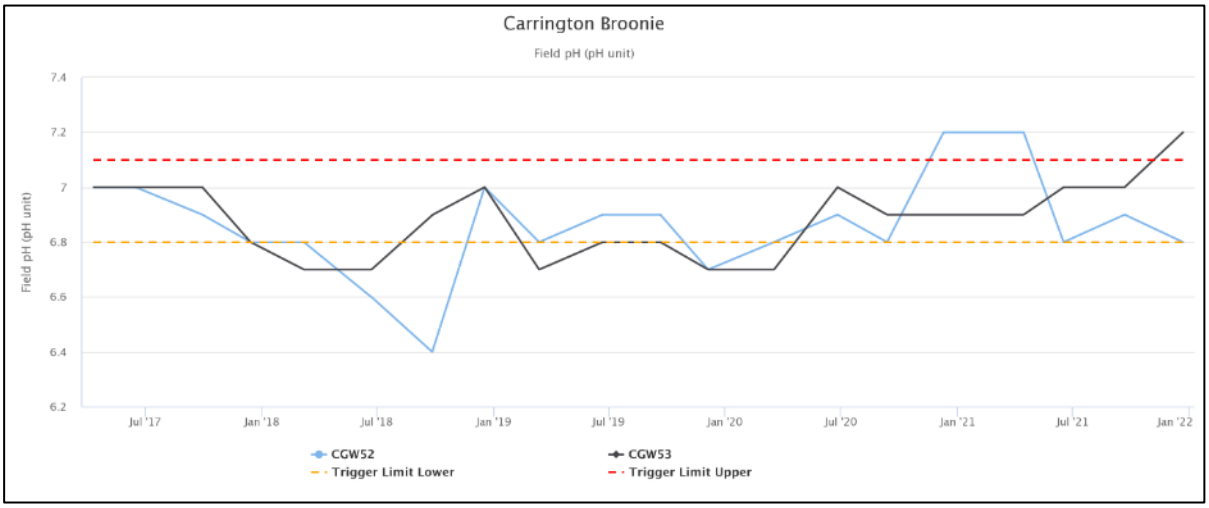


Figure 41 Carrington Broonie Groundwater pH Trends 2017 – 2021

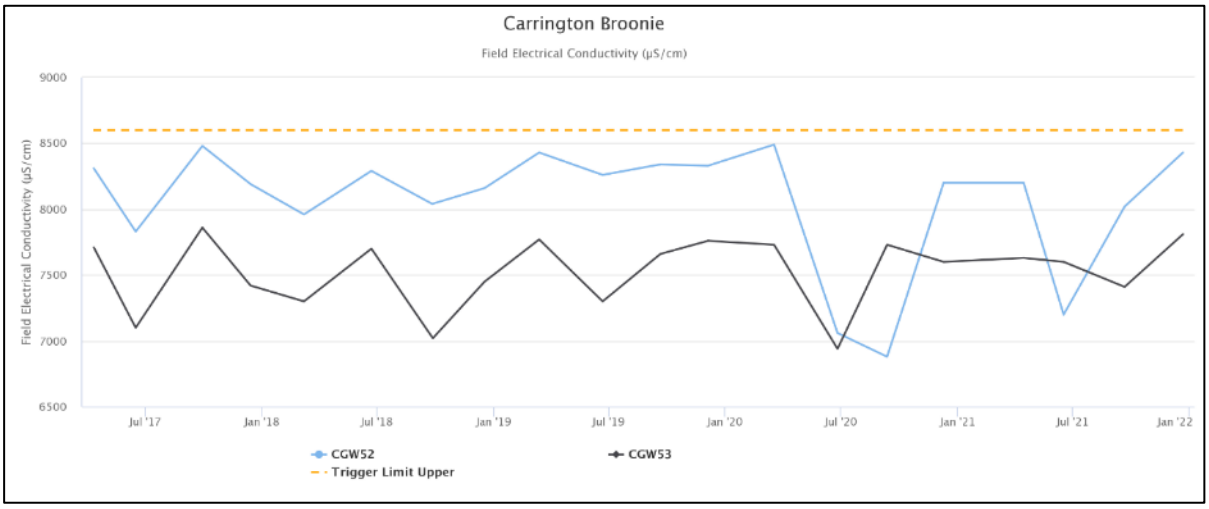


Figure 42 Carrington Broonie Groundwater EC Trends 2017 – 2021

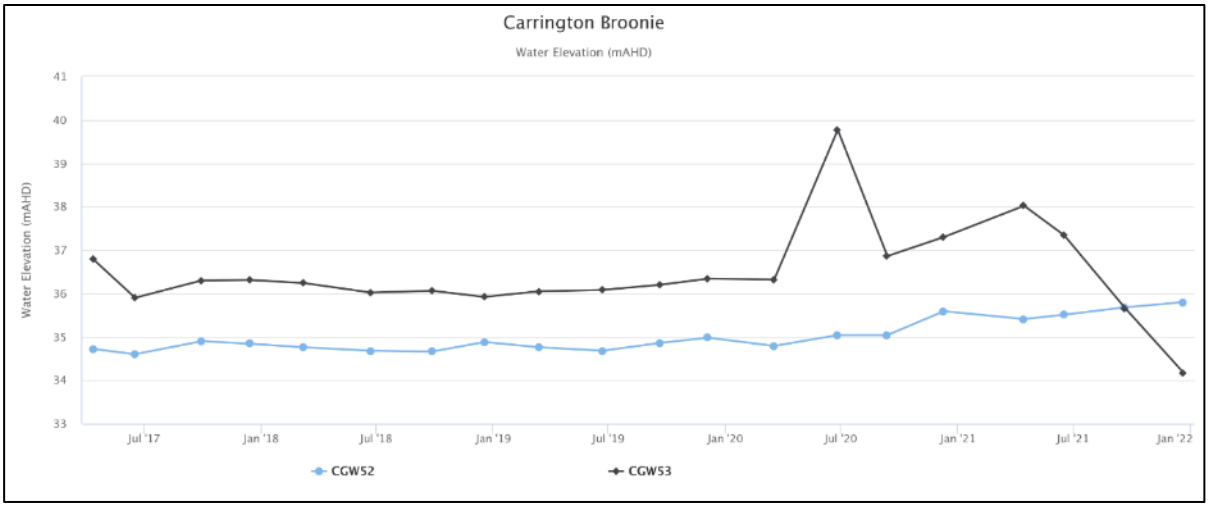


Figure 43 Carrington Broonie Groundwater SWL Trends 2017 – 2021

Carrington Alluvium

The EC, pH and SWL trends for 2017 to 2021 for Carrington Alluvium groundwater bores are shown in **Figure 44** to **Figure 46**. Water quality results were generally consistent with historical trends.

New triggers have been developed following an expert review of the groundwater network and better represent current conditions and monitoring in the area. These have been included in the revised Water Management Plan pending approval. Monitoring results are assessed against these new triggers as part of the North Void Tailings Storage Facility (NV TSF) Pollution Reduction Programme monitoring and reporting requirements via the Environmental Protection Licence. The current EC trigger is considered not to be representative of historical (pre-mining) conditions or adequate to assess improving water quality following seepage from the NV TSF.

HVO continued to mitigate potential impacts of seepage from the NV TSF. This included no deposition of tailings to the TSF and decanting of surface water to allow the tailings to dry and consolidate. Monitoring of the area continues at an increased frequency including data collection from continuous groundwater loggers measuring water level and quality. EC and pH have stabilised and standing water level has declined, this is an indication that current controls are being effective.

A conceptual engineering design was developed for the installation of allow permeability barrier wall between the TSF and the alluvium. As part of a Pollution Reduction Programme, works in 2022 include a detailed engineering design and commencement of construction.

Trigger exceedance results are listed in **Table 47.**

Table 47 HVO Carrington Alluvium Groundwater 2021 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
CFW55R	07/01/2021	EC – 95th Percentile	Investigation Ongoing
CFW55R	07/01/2021	pH – 5th Percentile	First consecutive trigger exceedance – watching brief established
CFW55R	11/02/2021	EC – 95th Percentile	Investigation Ongoing
CFW55R	03/03/2021	EC – 95th Percentile	Investigation Ongoing
CFW57	07/04/2021	SWL – 95th Percentile	First consecutive trigger exceedance - watching brief established
CFW55R	09/04/2021	EC – 9th Percentile	Investigation Ongoing
CGW53A	14/04/2021	SWL – 95th Percentile	First consecutive trigger exceedance - watching brief established
CFW55R	06/05/2021	EC – 95th Percentile	Investigation Ongoing
CFW55R	03/06/2021	EC – 95th Percentile	Investigation Ongoing
CGW52A	16/06/2021	pH – 95th Percentile	First consecutive trigger exceedance - watching brief established
CGW53A	16/06/2021	SWL – 95th Percentile	Second consecutive trigger exceedance – watching brief established
CFW55R	13/07/2021	EC – 95th Percentile	Investigation Ongoing
CFW57	20/07/2021	SWL – 95th Percentile	First consecutive trigger exceedance - watching brief established
CFW55R	05/08/2021	EC – 95th Percentile	Investigation Ongoing
CGW53A	20/09/2021	SWL – 95th Percentile	Third consecutive trigger exceedance – investigation commenced

Location	Date	Trigger Limit	Action Taken in Response
CFW55R	10/09/2021	EC – 95th Percentile	Investigation Ongoing
CFW55R	12/10/2021	EC – 95th Percentile	Investigation Ongoing
CFW55R	15/11/2021	EC – 95th Percentile	Investigation Ongoing
CFW57	02/12/2021	SWL – 95th Percentile	First consecutive trigger exceedance - watching brief established
CGW55A	21/12/2021	SWL – 95th Percentile	First consecutive trigger exceedance - watching brief established
CGW53A	21/12/2021	SWL – 95th Percentile	Investigation Ongoing

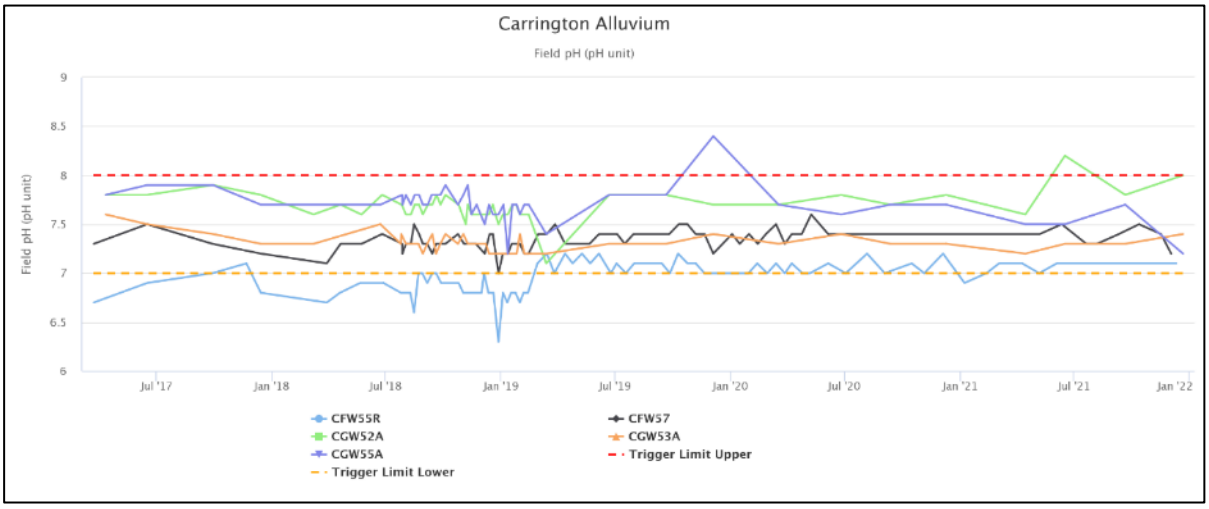


Figure 44 Carrington Alluvium Groundwater pH Trends 2017 – 2021

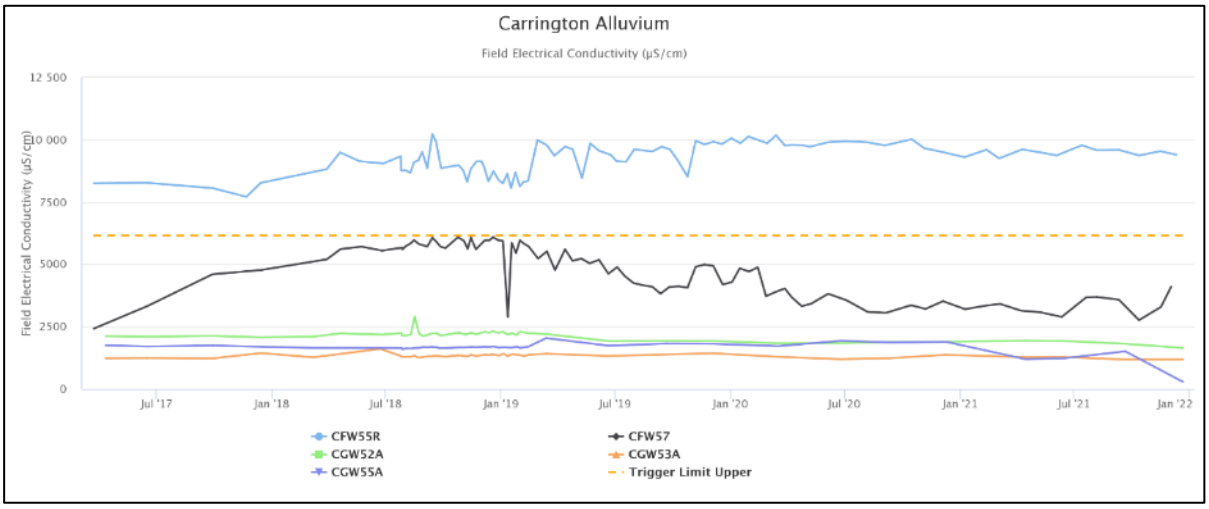


Figure 45 Carrington Alluvium Groundwater EC Trends 2017 – 2021

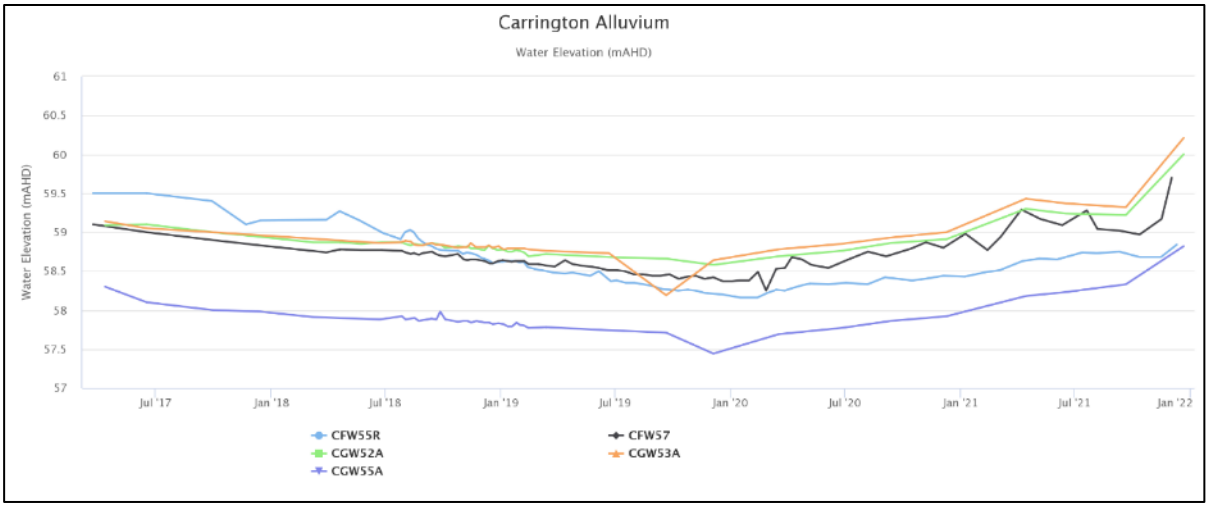


Figure 46 Carrington Alluvium Groundwater SWL Trends 2017 – 2021

Carrington Interburden

The EC, pH and SWL trends for 2017 to 2021 for groundwater bores in the Carrington Interburden are shown in Figure 47 to Figure 49 respectively. Water quality results were generally consistent with historical trends. Bore 4036C was dry and therefore samples were unable to be collected during 2021.

Trigger exceedance results are listed below in **Table 48.**

Table 48 HVO Carrington Interburden Groundwater 2021 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
CGW51A	16/06/2021	pH – 95th Percentile	First consecutive trigger exceedance - watching brief established
GCW51A	21/12/2021	pH – 95th Percentile	Second consecutive trigger exceedance – watching brief established

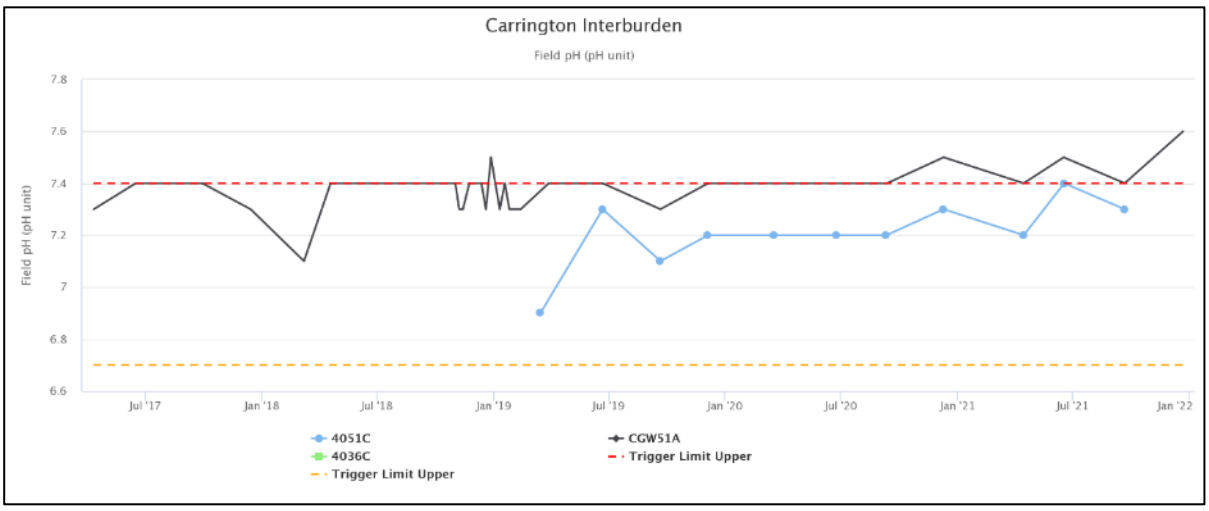


Figure 47 Carrington Interburden Groundwater pH Trends 2017 – 2021

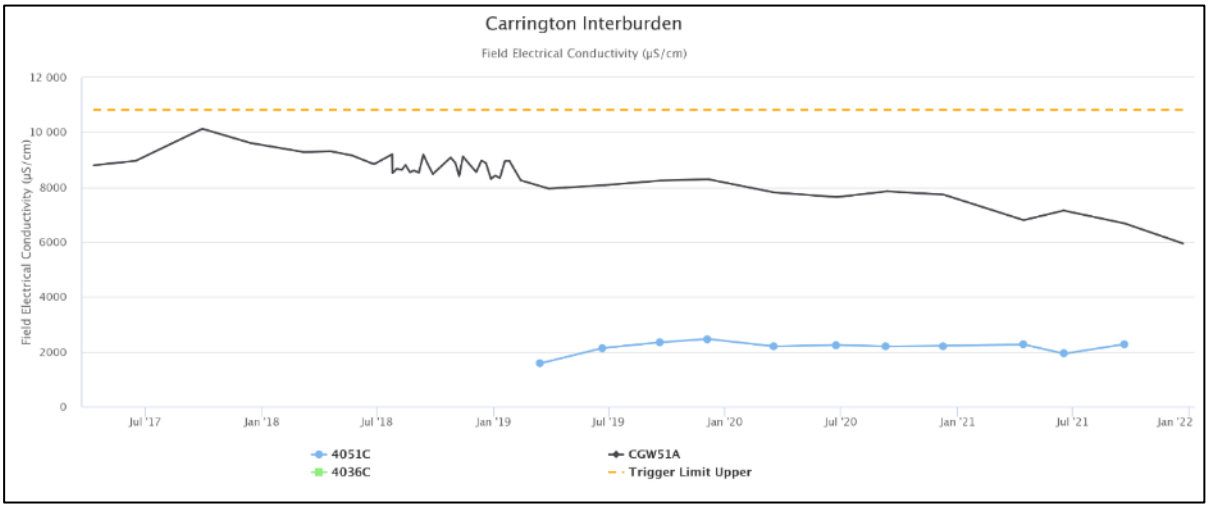


Figure 48 Carrington Interburden Groundwater EC Trends 2017 – 2021

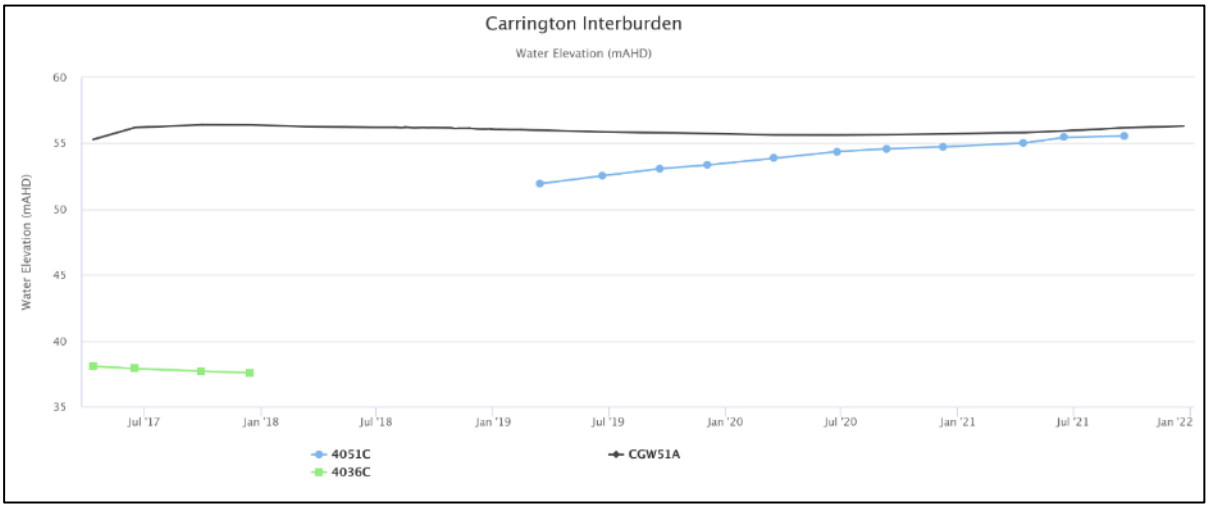


Figure 49 Carrington Interburden Groundwater SWL Trends 2017 – 2021

Carrington West Wing Alluvium

Results are shown in **Figure 50** to **Figure 52.** Water quality results were generally consistent with historical trends.

There were no trigger exceedances recorded in 2021.

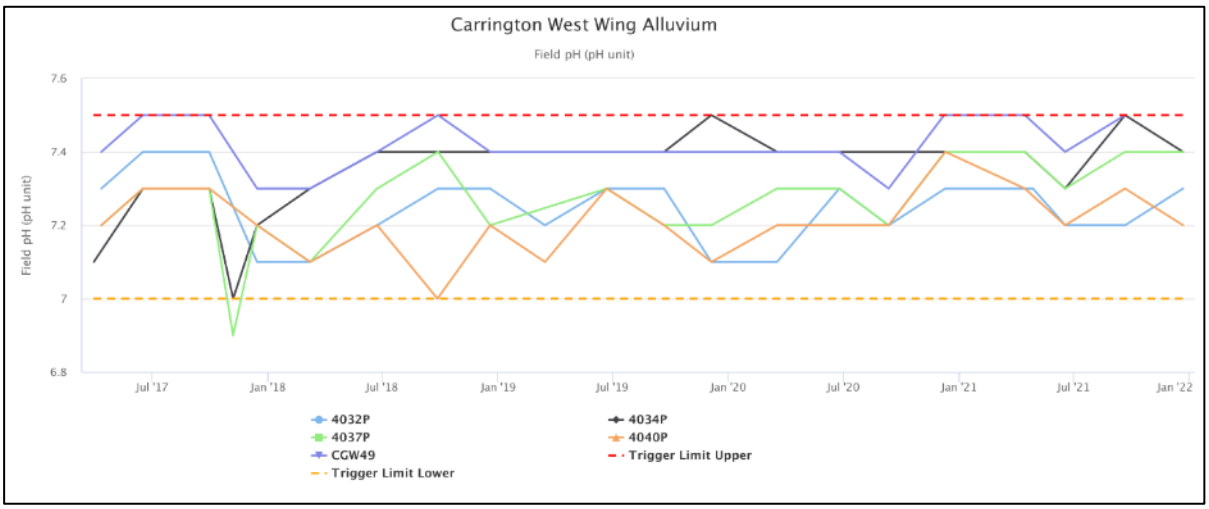


Figure 50 Carrington West Wing Alluvium Groundwater pH Trends 2017 – 2021

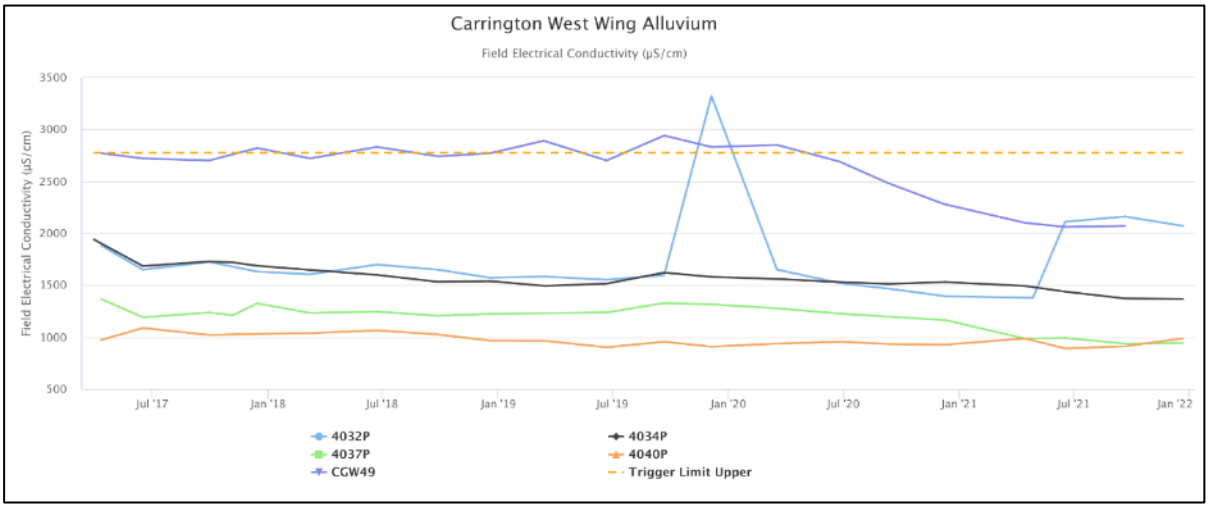


Figure 51 Carrington West Wing Alluvium Groundwater EC Trends 2017 – 2021

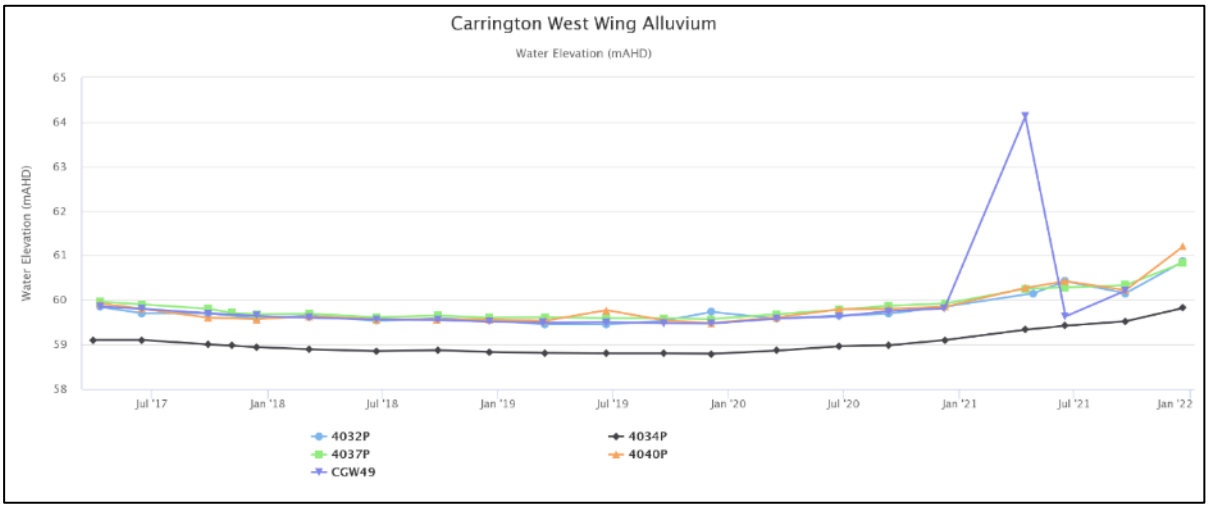


Figure 52 Carrington West Wing Alluvium Groundwater SWL Trends 2017 – 2021

Carrington West Wing Flood Plain

Results are shown in **Figure 53** to **Figure 55**. Water quality results were generally consistent with historical trends.

Trigger tracking results are listed in **Table 49**.

Table 49 HVO Carrington West Wing Flood Plain Groundwater 2021 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
CGW32	21/12/2021	EC – 95th Percentile	First consecutive trigger exceedance - watching brief established
GW-106	21/12/2021	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established

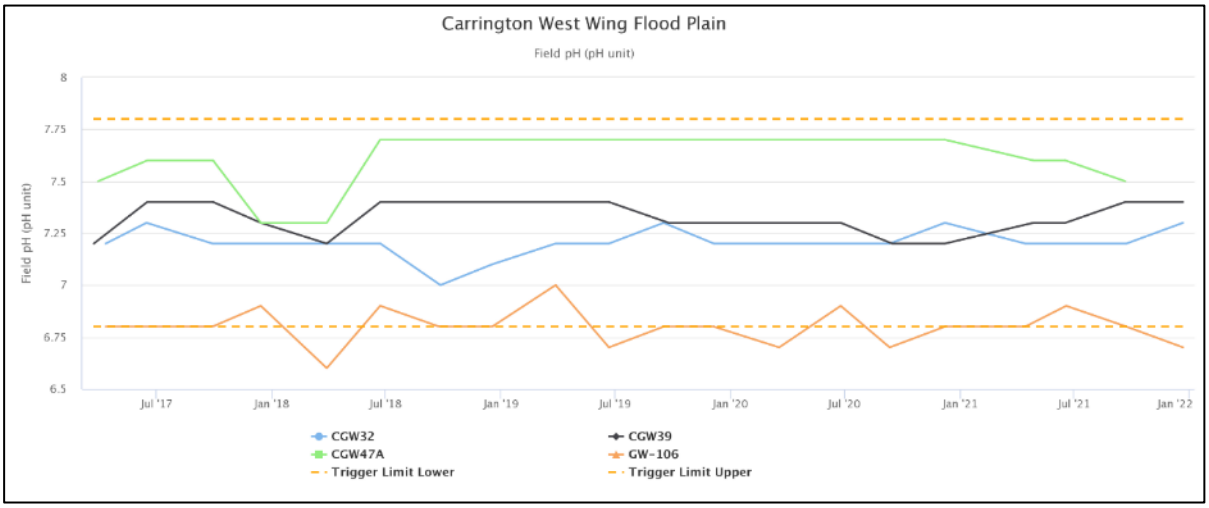


Figure 53 Carrington West Wing Flood Plain Groundwater pH Trends 2017 – 2021

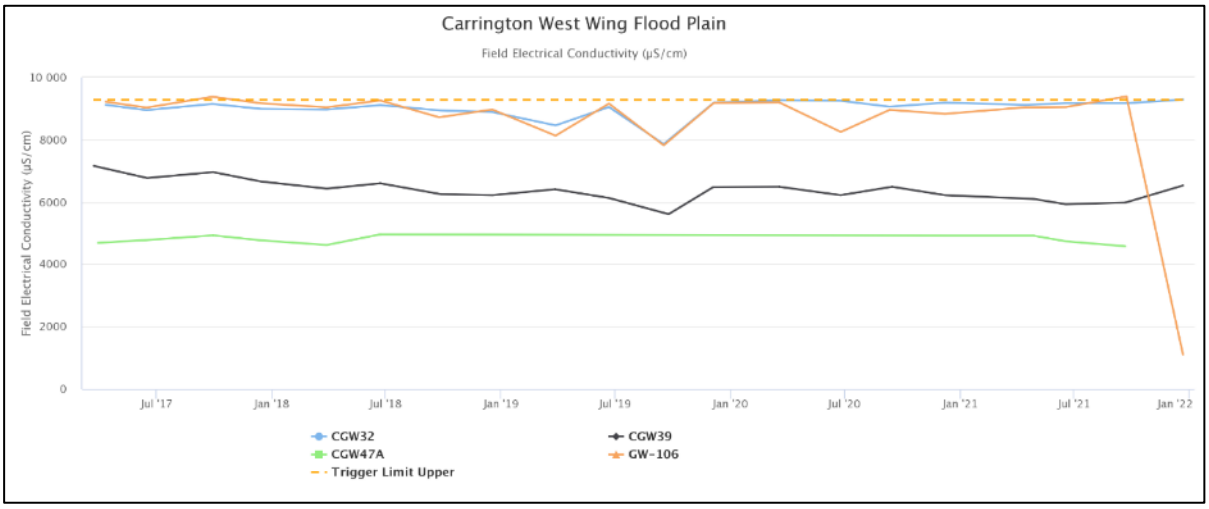


Figure 54 Carrington West Wing Flood Plain Groundwater EC Trends 2017 – 2021

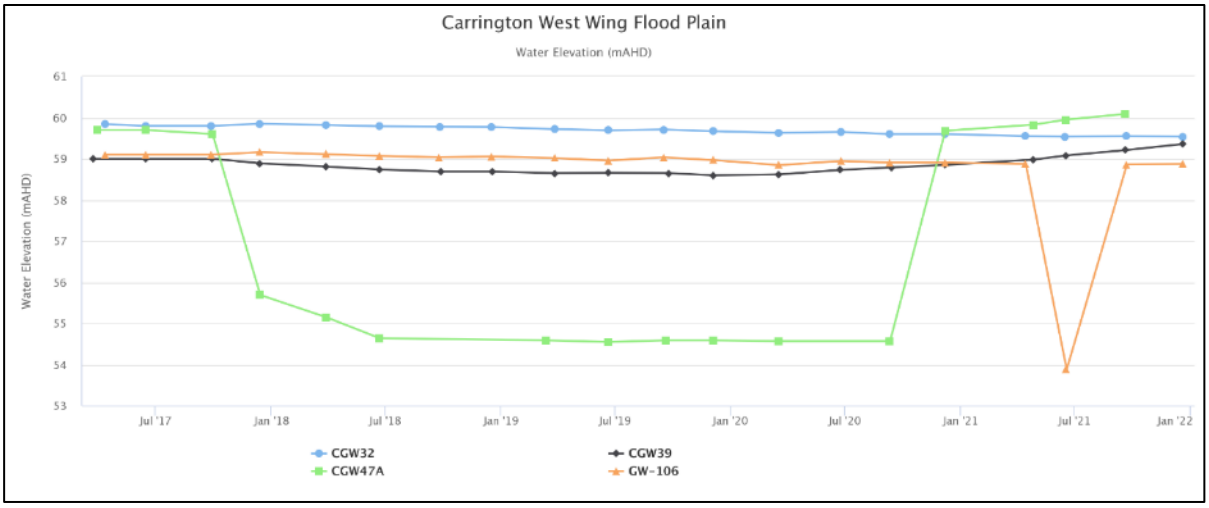


Figure 55 Carrington West Wing Flood Plain Groundwater SWL Trends 2017 – 2021

Cheshunt/North Pit Alluvium

Electrical Conductivity, pH and SWL trends for 2017 to 2021 are shown in **Figure 56** to **Figure 58**. Water quality results were generally consistent with historical trends.

Trigger tracking results are listed in **Table 50.**

Table 50 HVO Cheshunt/North Pit Alluvium Groundwater 2021 Monitoring Internal Trigger Exceedances

Location	Date	Trigger Limit	Action Taken in Response
Hobdens Well	12/05/2021	pH – 95th Percentile	First consecutive trigger exceedance - watching brief established
Hobdens Well	23/08/2021	pH – 95th Percentile	Second consecutive trigger exceedance – watching brief established

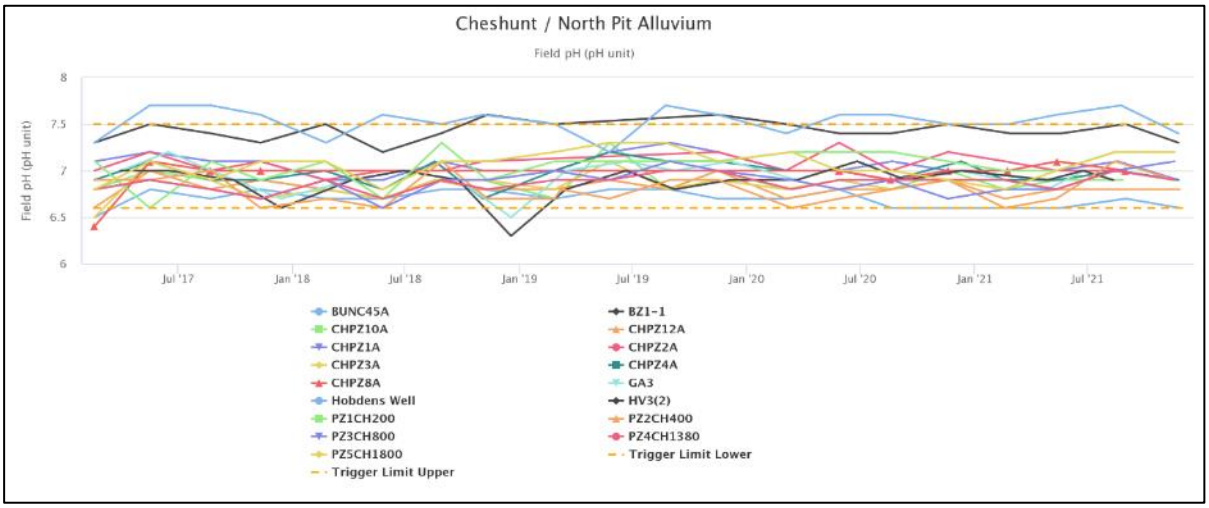


Figure 56 Cheshunt/North Pit Alluvium Groundwater pH Trends 2017 – 2021

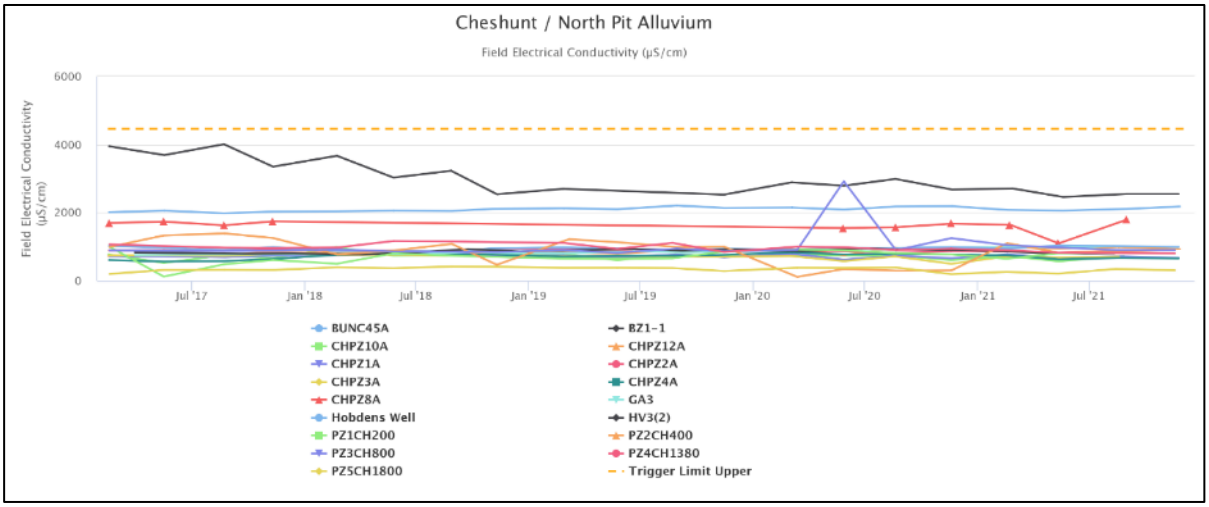


Figure 57 Cheshunt/North Pit Alluvium Groundwater EC Trends 2017 – 2021

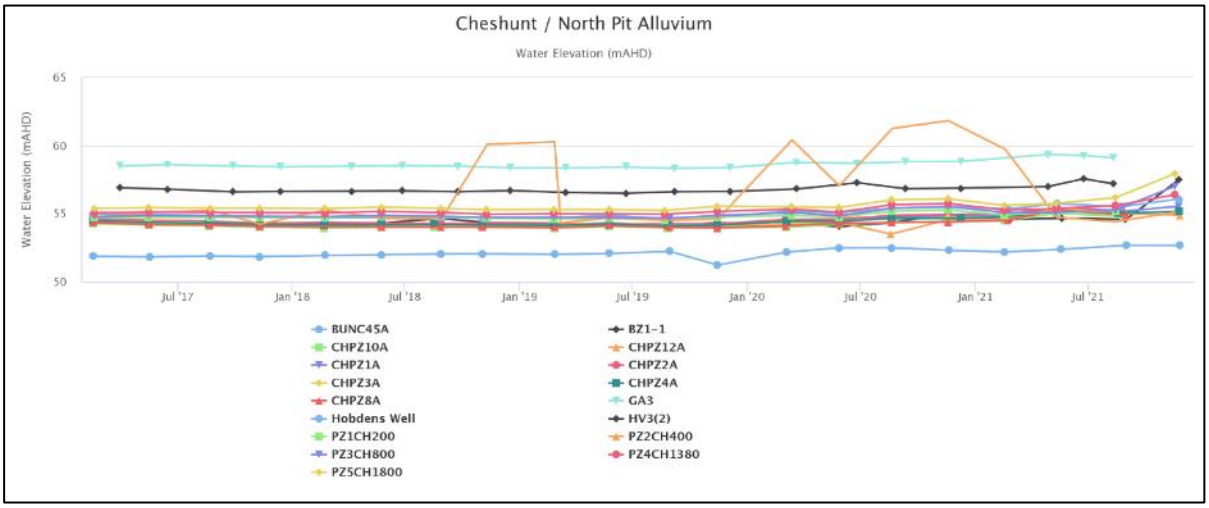


Figure 58 Cheshunt/North Pit Alluvium Groundwater SWL Trends 2017 – 2021

Cheshunt Interburden

The EC, pH and SWL trends for 2017 to 2021 are shown in **Figure 59** to **Figure 61**. Water quality results were generally consistent with historical trends.

Trigger tracking results are listed in **Table 51**.

Table 51 Cheshunt Interburden Groundwater 2021 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
BZ3-1	19/05/2021	pH – 95th Percentile	First consecutive trigger exceedance - watching brief established

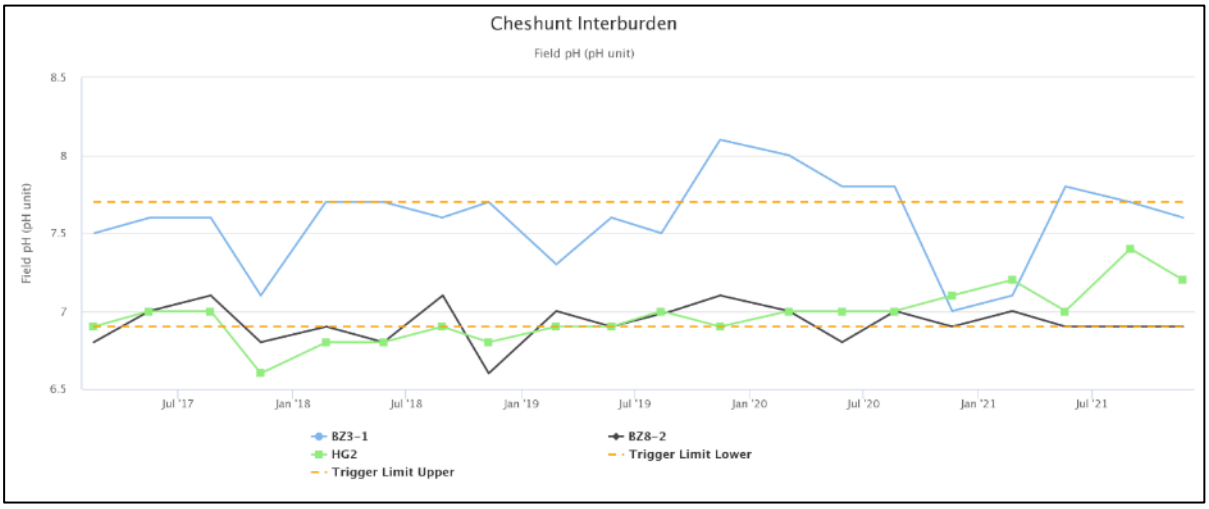


Figure 59 Cheshunt Interburden Groundwater pH Trends 2017 – 2021

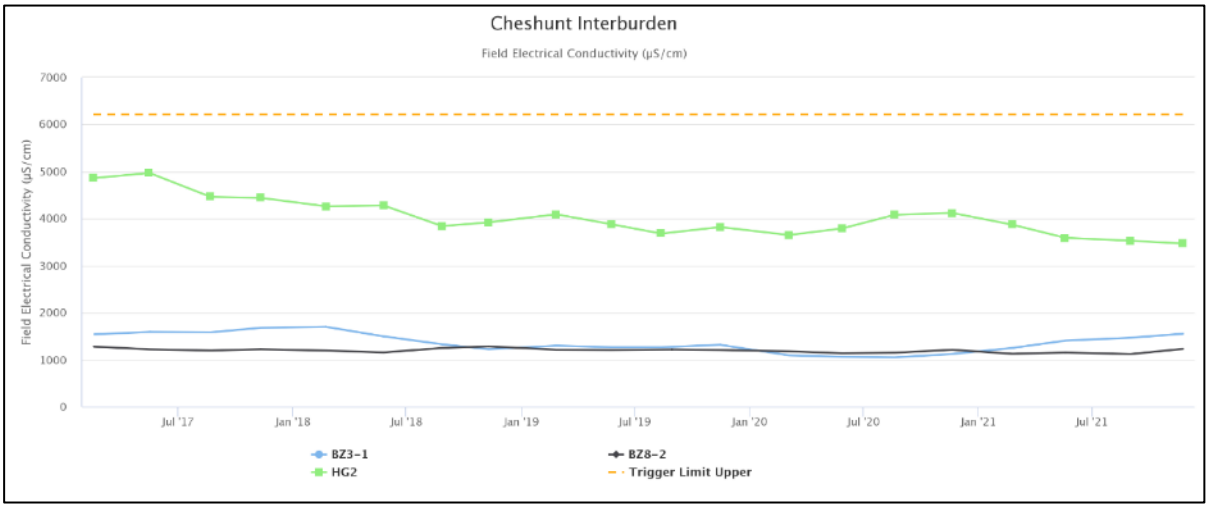


Figure 60 Cheshunt Interburden Groundwater EC Trends 2017 – 2021

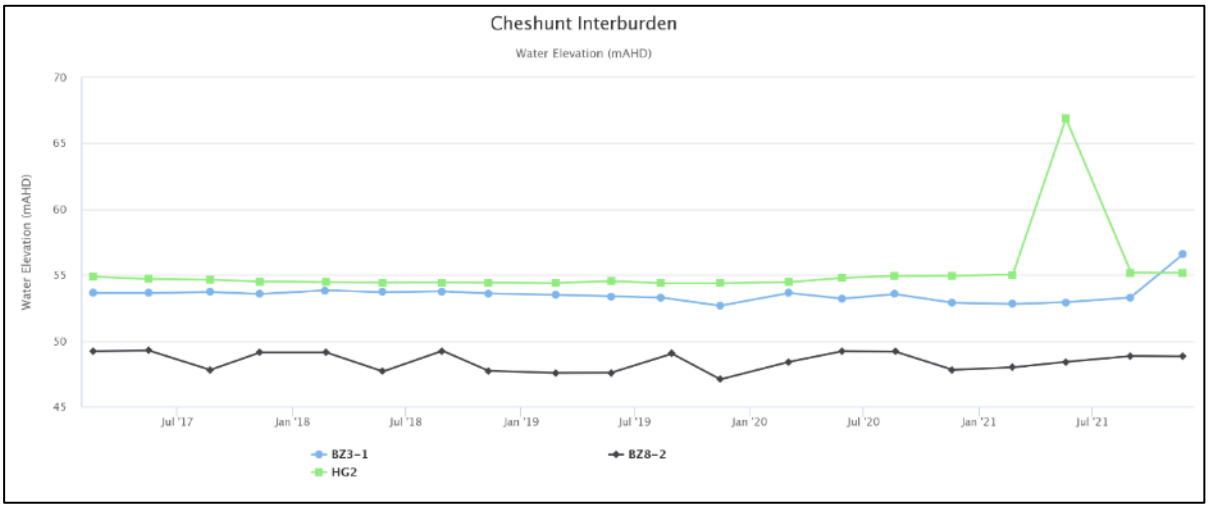


Figure 61 Cheshunt Interburden Groundwater SWL Trends 2017 – 2021

Cheshunt Mt Arthur

The pH, EC and SWL trends for 2017 to 2021 are shown in **Figure 62** to **Figure 64**. Water quality results were generally consistent with historical trends except for pH. Based on historical data, pH results from all three bores have been gradually trending downward since July 2011. The groundwater level measured at the bores has typically been within or below the screened section of bores BZ4A(2) and BZ3-3 (Figure 5.15). Purging/sample collection within bore BZ2A(1) and BZ3-3 may induce localised groundwater drawdown to within the screened section. This may be the cause of the reducing pH measured at these bores. The updated draft WMP includes amendments to the Cheshunt - Mt Arthur seam groundwater monitoring, including:

- BZ2A(1) and BZ3-3 being removed from trigger level assessment, with trigger values remaining for BZ4(A)2; and
- the pH trigger level value reducing to 6.4 (from the current value of 6.5) for all bores monitoring the Cheshunt- Mt Arthur Seam.

As the groundwater level measured at BZ4A(2) has been below the base of the screen, it is unlikely that the water sampled from this bore is representative of groundwater in the Mt Arthur seam. Based on this and the pH trend, exceedance of the pH lower trigger value and dry sampling events at BZ4A(2) is likely to continue. EMM have recommended that the pH trigger level for BZ4A(2) be revised and sampling (for water quality analysis) should not occur where the water level is below the base of the screen.

Trigger tracking results are listed in **Table 52.**

Table 52 Cheshunt M t Arthur Groundwater 2021 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
BZ2A(1)	22/02/2021	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established
BZ4A(2)	19/05/2021	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established
BZ3-3	19/05/2021	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established
BZ2A(1)	19/05/2021	pH – 5th Percentile	Second consecutive trigger exceedance - watching brief established
BZ4A(2)	30/08/2021	pH – 5th Percentile	Second consecutive trigger exceedance - watching brief established
BZ3-3	30/08/2021	pH – 5th Percentile	Second consecutive trigger exceedance - watching brief established
BZ2A(1)	30/08/2021	pH – 5th Percentile	Third consecutive trigger exceedance – investigation commenced
BZ4A(2)	23/11/2021	pH – 5th Percentile	Third consecutive trigger exceedance – investigation commenced
BZ3-3	23/11/2021	pH – 5th Percentile	Third consecutive trigger exceedance – investigation commenced
BZ2A(1)	23/11/2021	pH – 5th Percentile	Investigation Ongoing

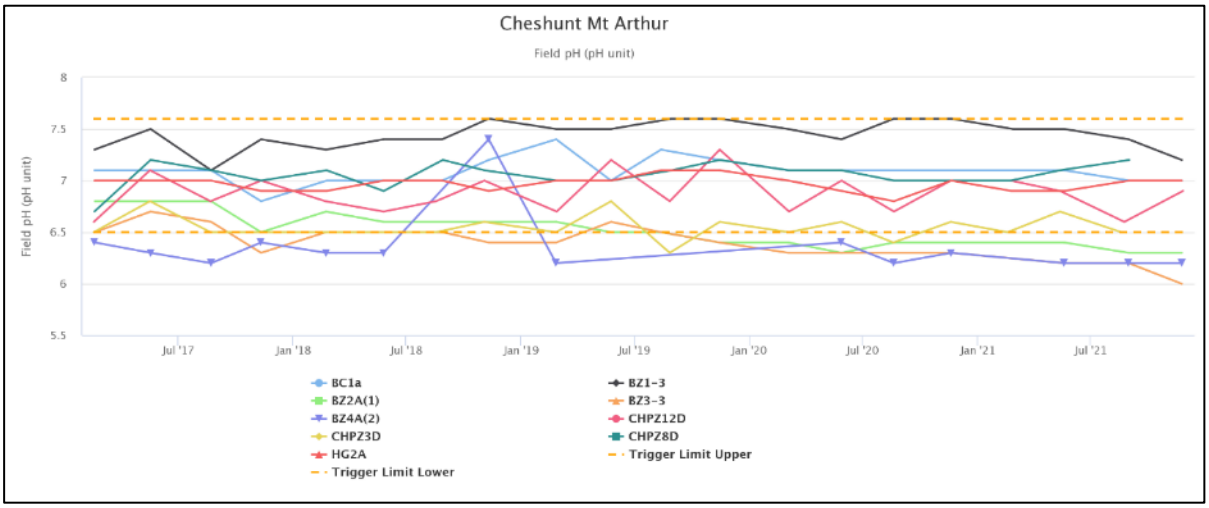


Figure 62 Cheshunt Mt Arthur Groundwater pH Trends 2017 – 2021

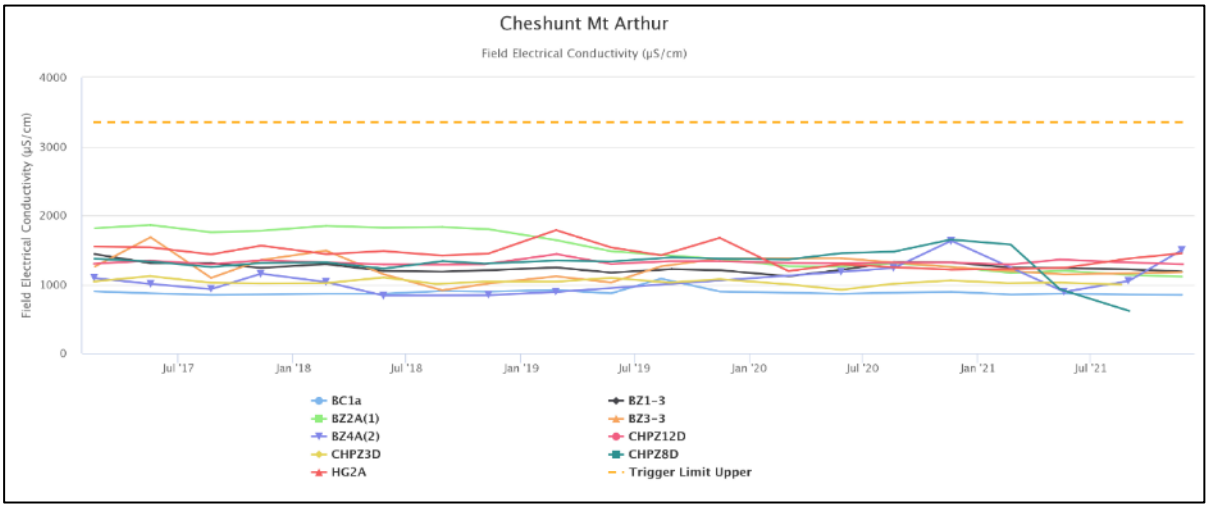


Figure 63 Cheshunt Mt Arthur Groundwater EC Trends 2017 – 2021

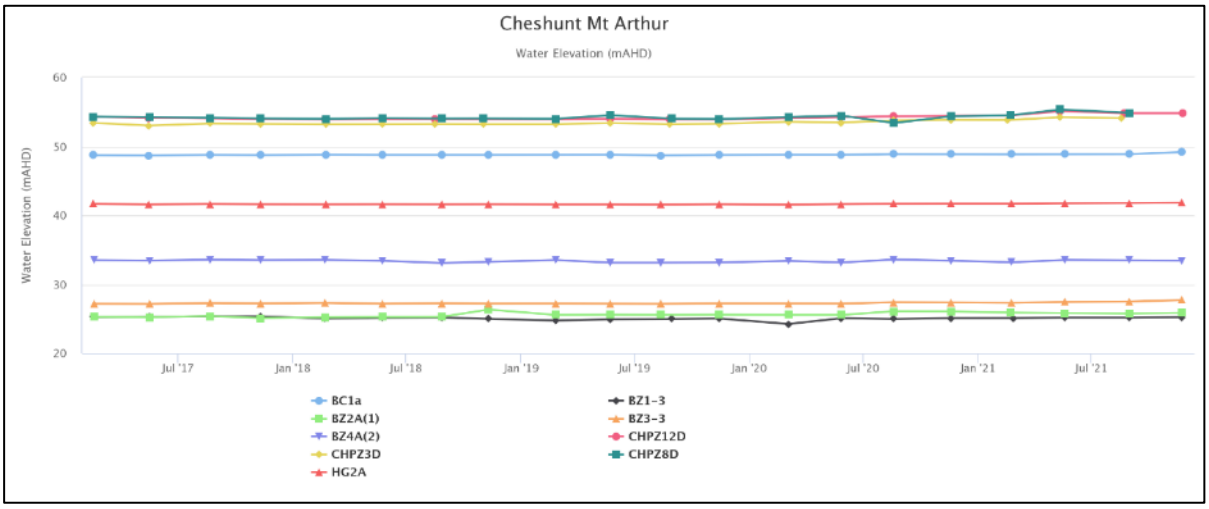


Figure 64 Cheshunt Mt Arthur Groundwater SWL Trends 2017 – 2021

Cheshunt Piercefield

The pH, EC and SWL trends for 2017 to 2021 are shown in **Figure 65** to **Figure 67**. Water quality results were generally consistent with historical trends.

There were no trigger exceedances recorded in 2021.

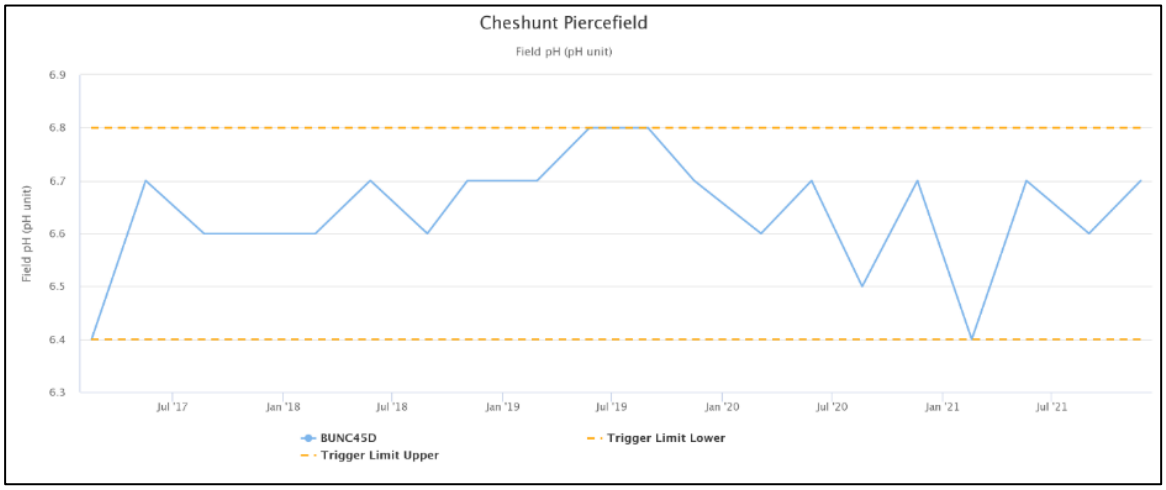


Figure 65 Cheshunt Piercefield Groundwater pH Trends 2017 – 2021

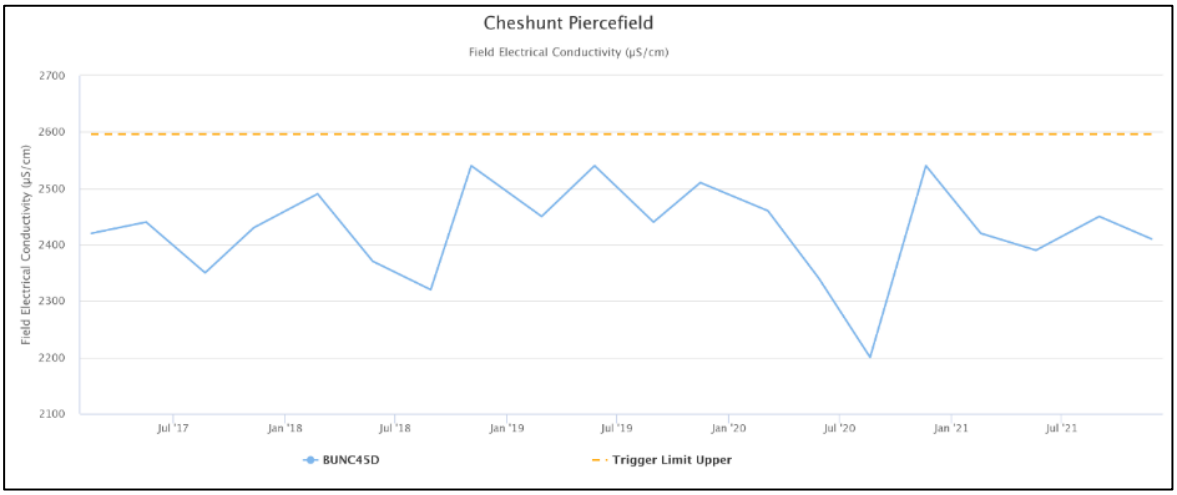


Figure 66 Cheshunt Piercefield Groundwater EC Trends 2017 – 2021

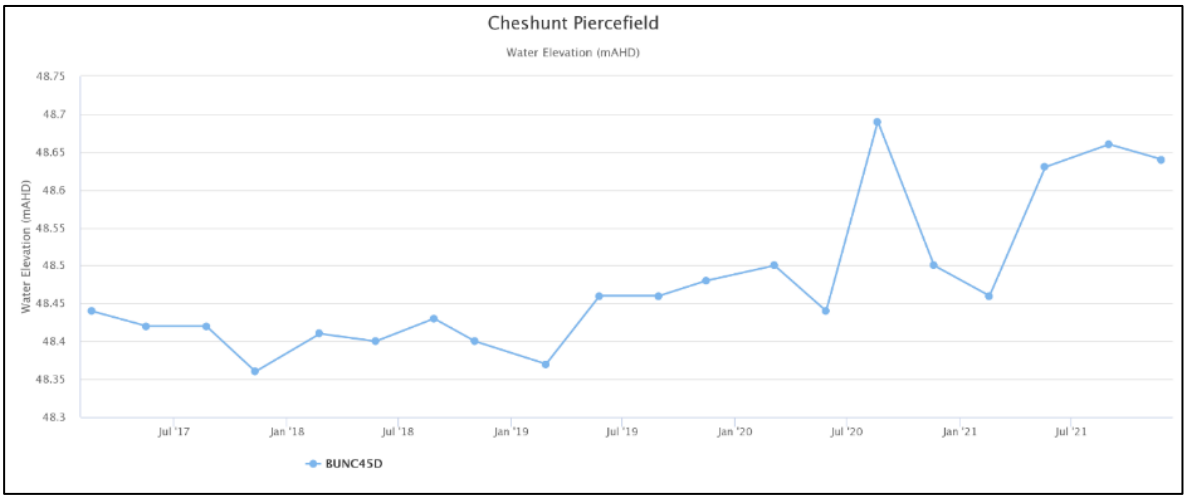


Figure 67 Cheshunt Piercefield Groundwater SWL Trends 2016 – 2021

Lemington South Alluvium

The pH, EC and SWL trends for 2017 to 2021 are shown in **Figure 68** to **Figure 70**. Water quality results were generally consistent with historical trends. Bore C919 (ALL) had insufficient water for water quality sampling on two occasions during 2021.

Trigger limits are listed in **Table 53.**

Table 53 Lemington South Alluvium Groundwater 2021 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
Appleyard Farm	26/02/2021	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established

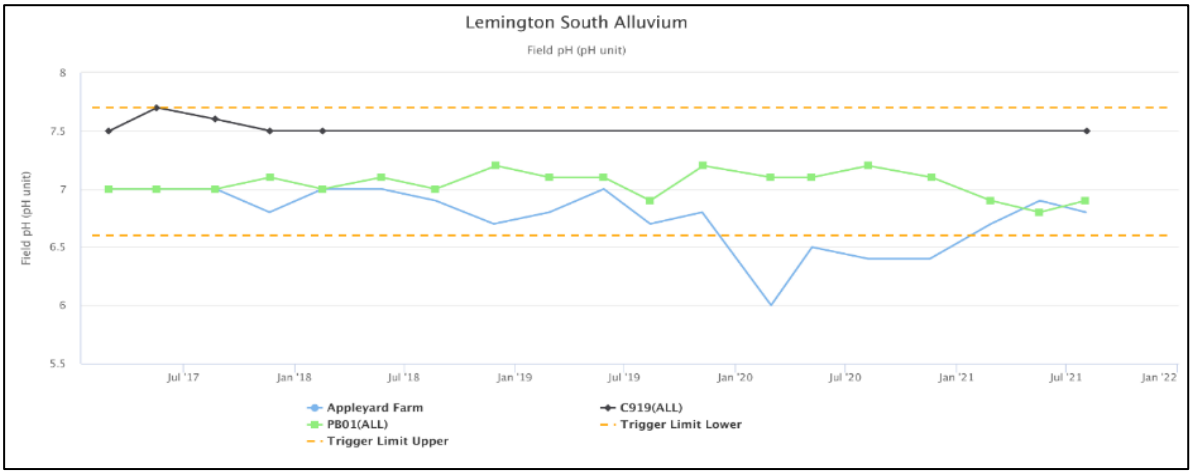


Figure 68 Lemington South Alluvium Groundwater pH Trends 2017 – 2021

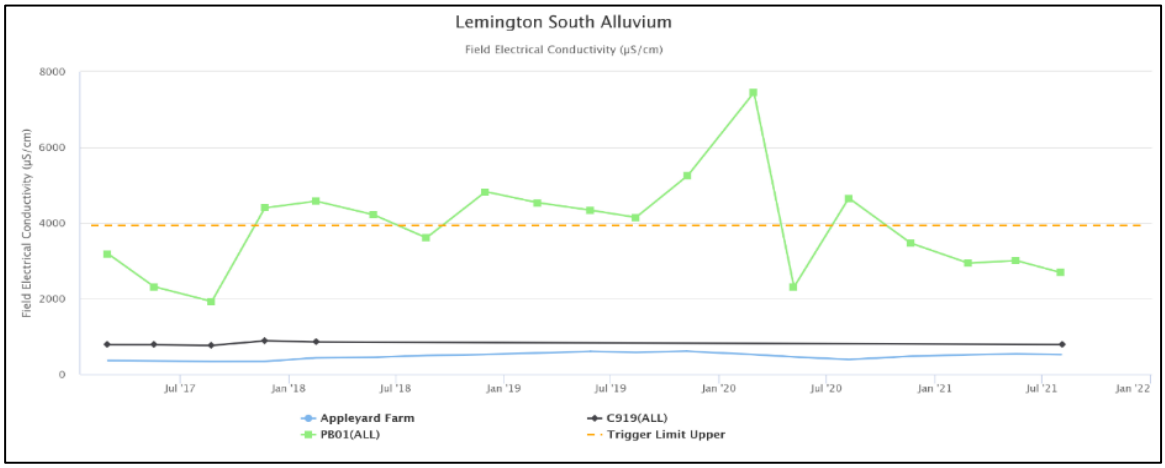
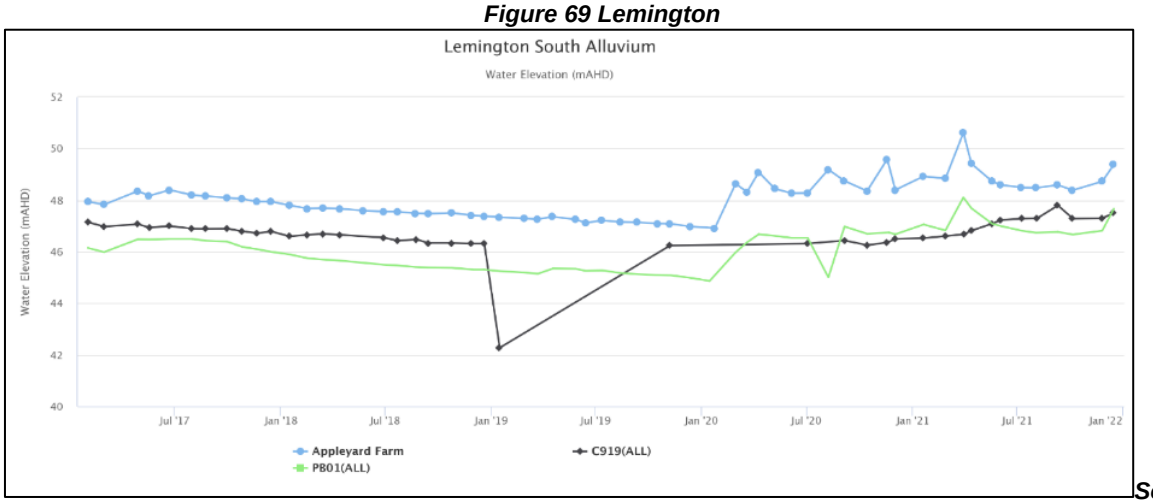


Figure 69 Lemington



South Alluvium Groundwater EC Trends 2017 – 2021

Figure 70 Lemington South Alluvium Groundwater SWL Trends 2017 – 2021

Lemington South Arrowfield

The pH, EC and SWL trends for 2017 to 2021 are shown in **Figure 71** to **Figure 73**. Bore D612 (AFS) was unabled to be sampled due to insufficient water throughout 2021. Water quality results were generally consistent with historical trends.

There were no trigger exceedances recorded in 2021.

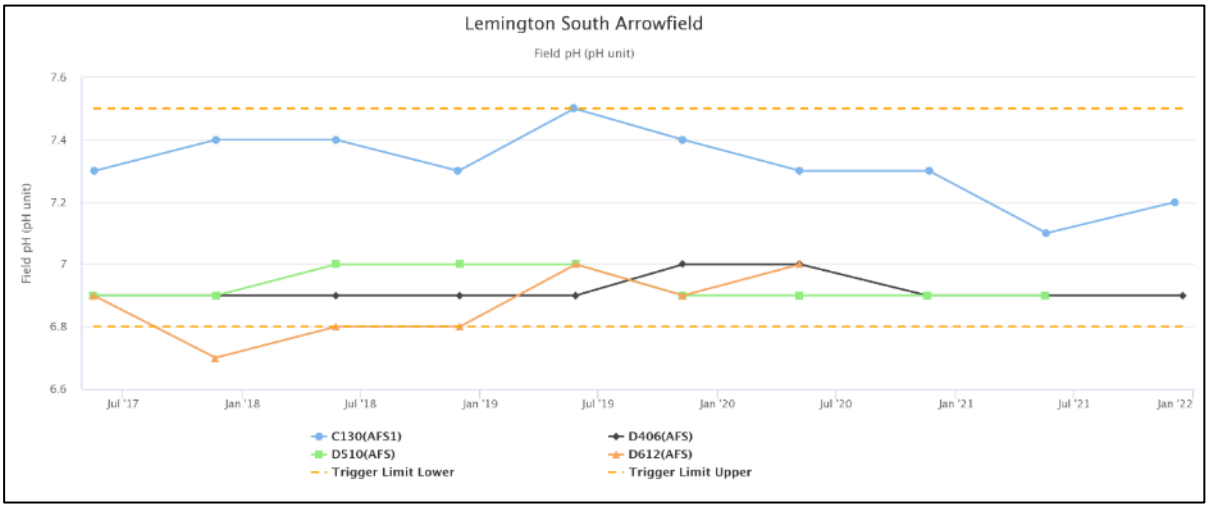


Figure 71 Lemington South Arrowfield Groundwater pH Trends 2017 – 2021

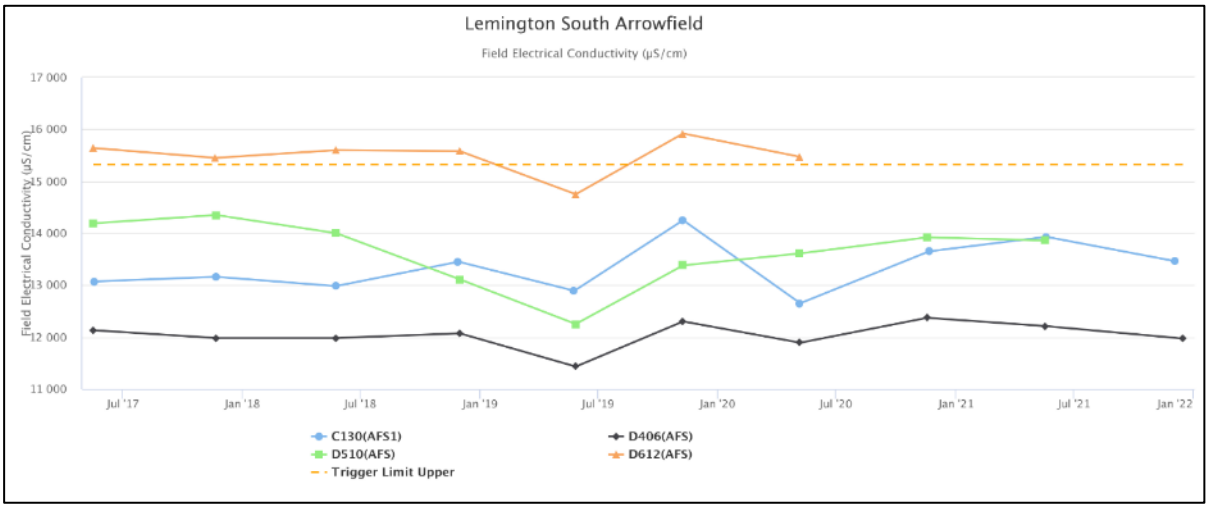


Figure 72 Lemington South Arrowfield Groundwater EC Trends 2017 – 2021

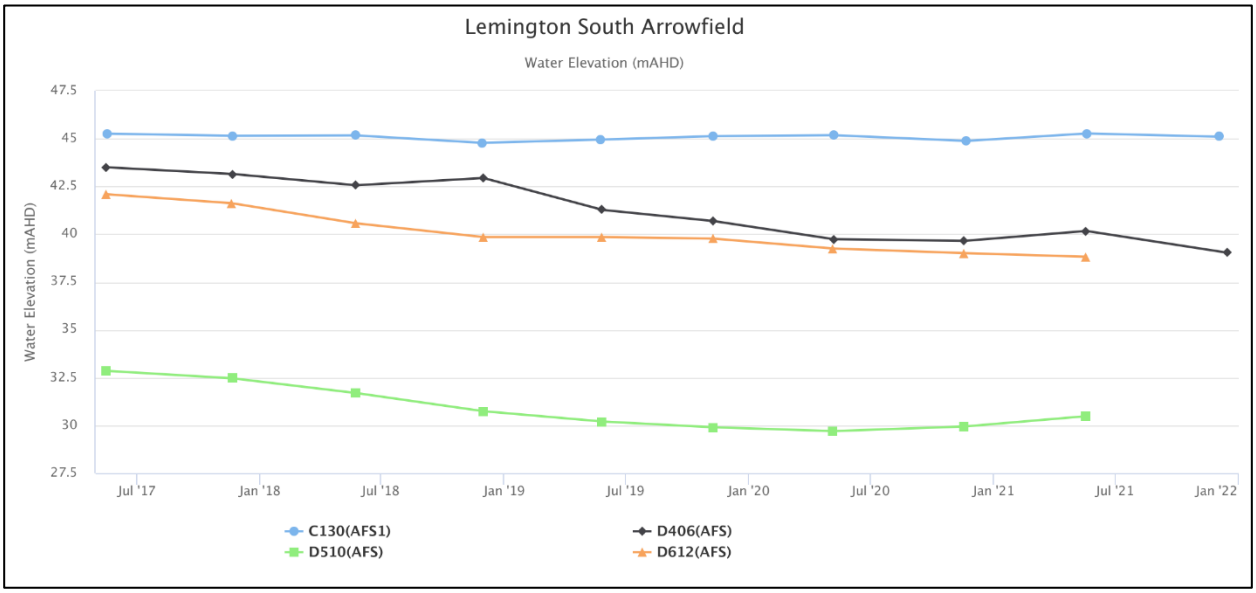


Figure 73 Lemington South Arrowfield Groundwater SWL Trends 2017 – 2021

Lemington South Bowfield

The pH, EC and SWL trends for 2017 to 2021 are shown in **Figure 74** to **Figure 76**. Water quality results were generally considered to be consistent with historical trends with the exception of B631(BFS) and C630(BFS) which exceeded internal triggers as listed in **Table 54**. The 2021 trigger value exceedances are not considered to reflect a mining related impact. Historical monitoring data from July 2011–December 2021 shows that EC values have exceeded the trigger value at bores B631(BFS), D010(GM) and C130(WDH) for approximately 10 years. Therefore, the EC trigger value for the Lemington South - Bowfield Seam, Glen Munro Seam and Woodlands Hill Seam is not considered appropriate to assess mining activity induced groundwater impacts. The WMP (HVO 2021) has been updated to reflect this observation and the assignment of trigger values has been removed for bores B631(BFS) and D010(GM). The draft WMP includes a revised upper EC trigger value for all Woodlands Hill seam bores, including C130(WDH), to 20,900 µS/cm. However, future monitoring results may still exceed this trigger value and therefore may not be suitable for C130(WDH). pH trigger values are no longer assigned to B631(BFS) in the updated draft WMP. In addition, the upper pH trigger value has been increased to 8.0 (from 7.9) for all other Bowfield Seam bores (in the Lemington South area).

Note that C122 (BFS) has been excluded from the graphs as there was insufficient water for sampling during the reporting period.

Table 54 Lemington South Bowfield Groundwater 2021 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
B631 (BFS)	19/05/2021	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established
B631 (BFS)	19/05/2021	EC – 95th Percentile	First consecutive trigger exceedance - watching brief established
C630 (BFS)	31/05/2021	pH – 95th Percentile	Investigation Ongoing
B631 (BFS)	03/12/2021	EC – 95th Percentile	Second consecutive trigger exceedance - watching brief established

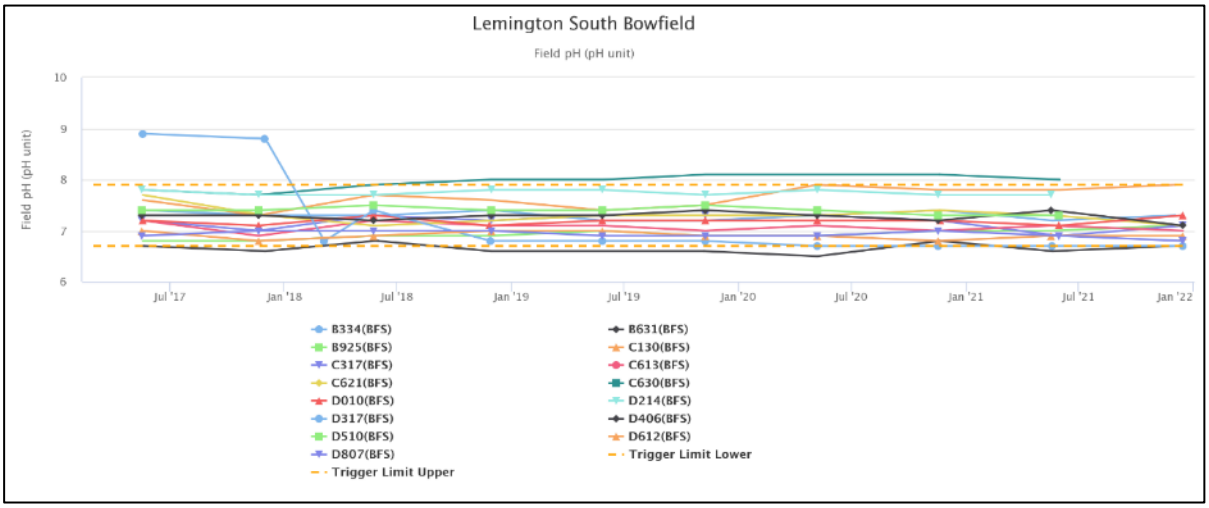


Figure 74 Lemington South Bowfield Groundwater pH Trends 2017 – 2021

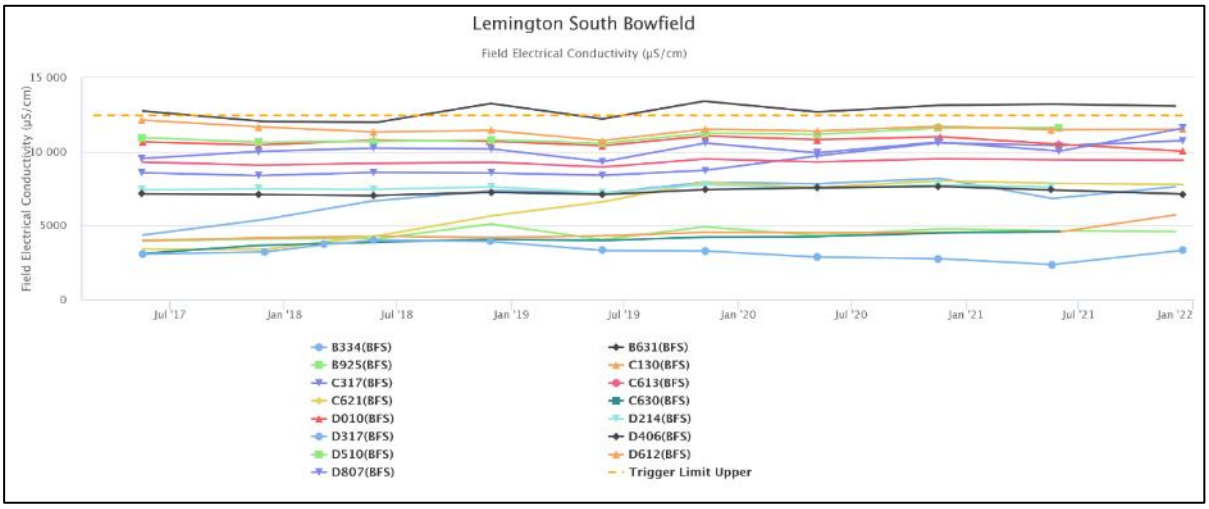


Figure 75 Lemington South Bowfield Groundwater EC Trends 2017 – 2021

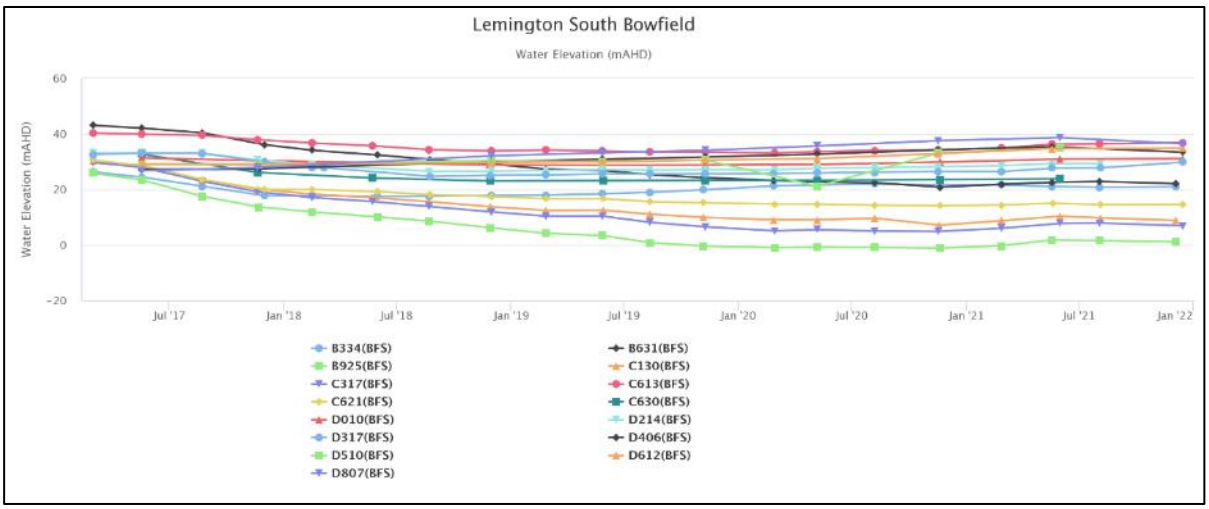


Figure 76 Lemington South Bowfield Groundwater SWL Trends 2017 – 2021

Lemington South Interburden

The pH, EC and SWL trends for 2017 to 2021 are shown in **Figure 77** to **Figure 79**. All of the EC measurements in the period 2011-2021 have exceeded the trigger value of 11,408 µS/cm. Therefore, the EC trigger value for the Lemington South – Interburden is not considered appropriate to assess the potential impact of approved mining activity on groundwater at this bore location. EC values were consistently reported between 20,000 and 22,000 µS/cm from 2011 to 2017 and followed an increasing trend from 2018 to early 2020 reaching a maximum of 32,400 µS/cm in February 2020 as reported in previous annual groundwater reviews.

A downward trend has been observed since early 2020, which coincides with a period of increased rainfall following the recent drought. In the updated draft WMP (HVO 2021), C130(ALL) has been reassigned to Lemington South – Overburden, and the EC trigger value is proposed to increase to 23,500 µS/cm.

Trigger limits tracking is listed in **Table 55.**

Table 55 Lemington South Interburden Groundwater 2021 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
C130 (All)	26/02/2021	EC – 95th Percentile	Investigation Ongoing
C130 (All)	19/05/2021	EC – 95th Percentile	Investigation Ongoing
C130 (All)	04/08/2021	EC – 95th Percentile	Investigation Ongoing
C130 (All)	03/12/2021	EC – 95th Percentile	Investigation Ongoing

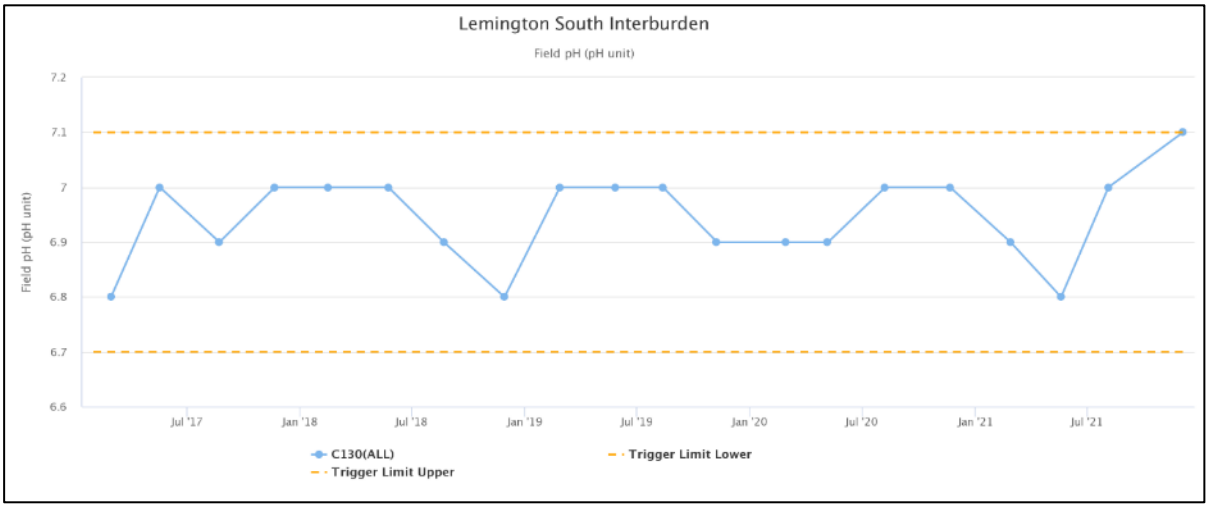


Figure 77 Lemington South Interburden Groundwater pH Trends 2017 – 2021

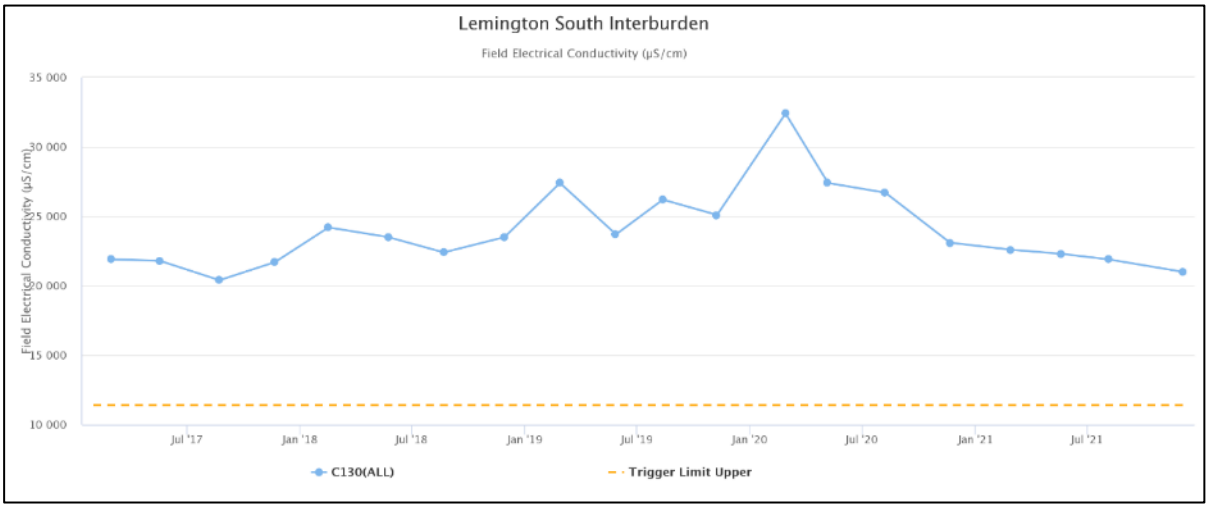


Figure 78 Lemington South Interburden Groundwater EC Trends 2017 – 2021

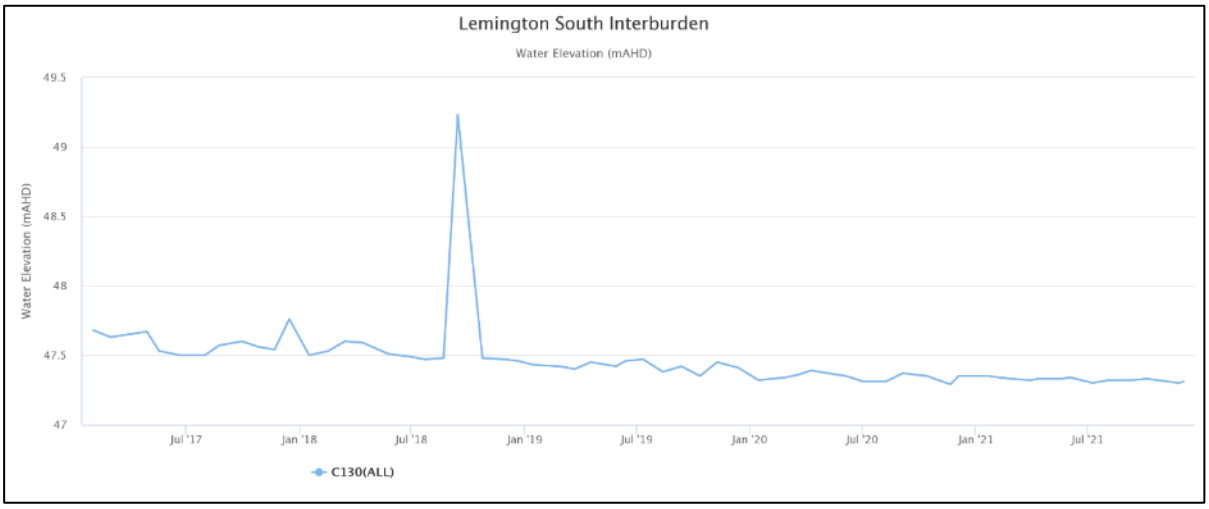


Figure 79 Lemington South Interburden Groundwater SWL Trends 2017 – 2021

Lemington South Woodlands Hill

The pH, EC and SWL trends for 2017 to 2021 are shown in **Figure 80** to **Figure 82**. Water quality results were generally consistent with historical trends.

Internal triggers are listed in **Table 56.** As noted, the trigger limit has been revised in the draft WMP.

Table 56 Lemington South Woodlands Hill Groundwater 2021 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
C130 (WDH)	19/05/2021	EC – 95th Percentile	Investigation Ongoing
C130 (WDH)	03/12/2021	EC – 95th Percentile	Investigation Ongoing

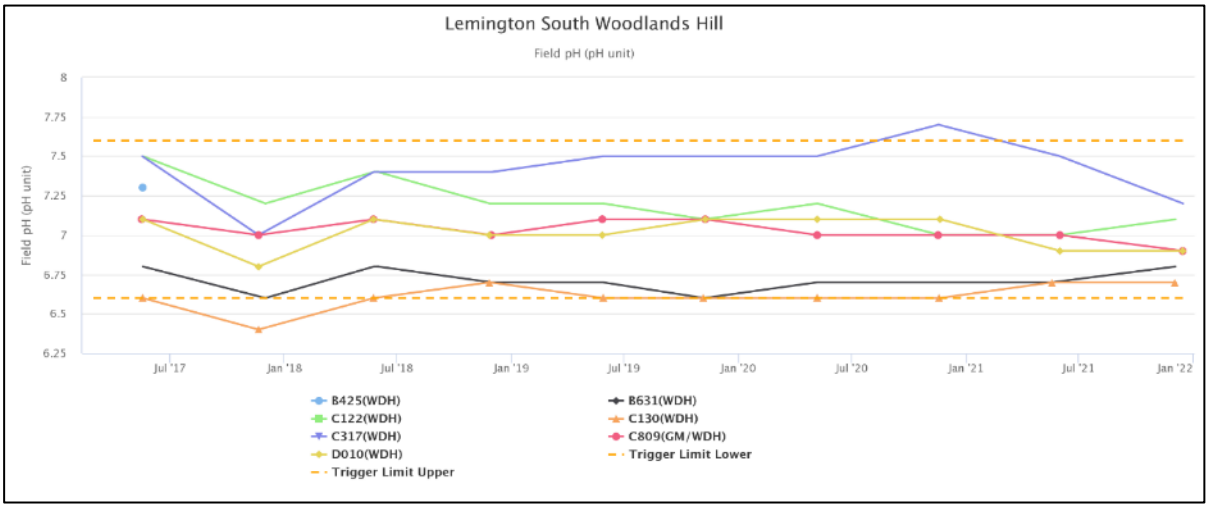


Figure 80 Lemington South Woodlands Hill Groundwater pH Trends 2017 – 2021

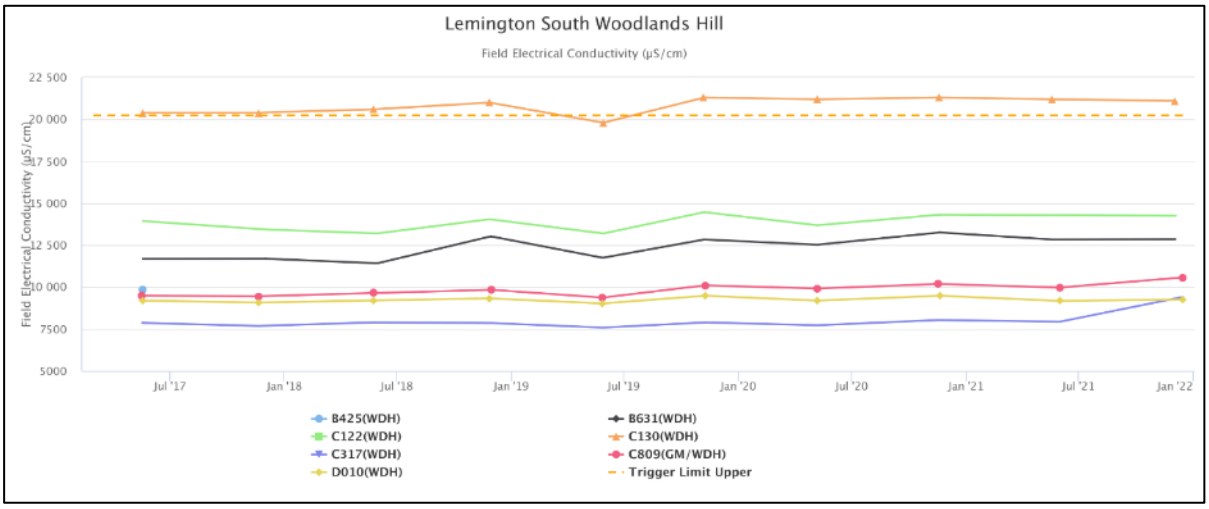


Figure 81 Lemington South Woodlands Hill Groundwater EC Trends 2017 – 2021

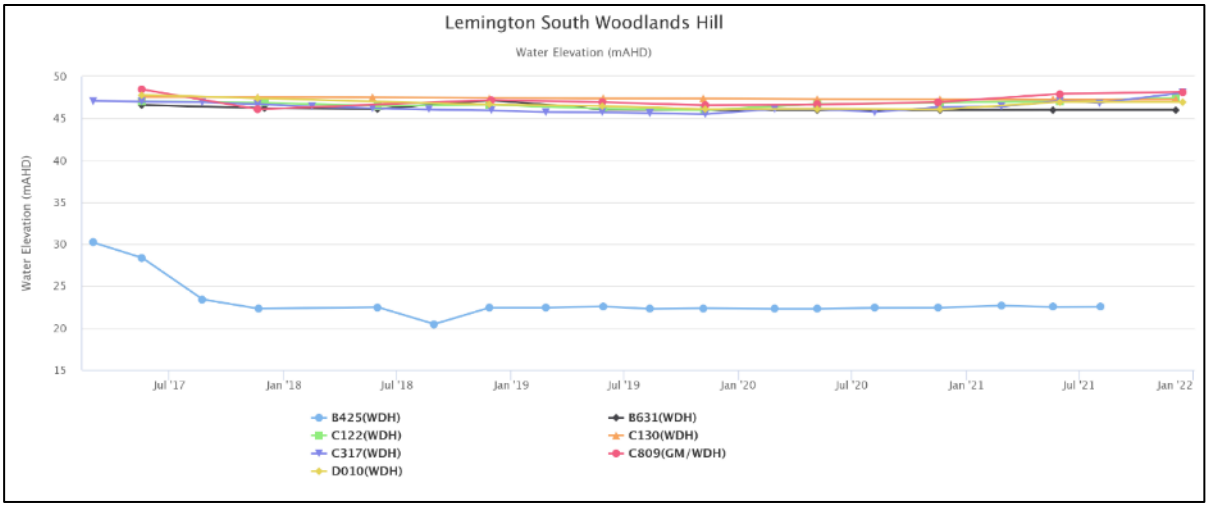


Figure 82 Lemington South Woodlands Hill Groundwater SWL Trends 2017 – 2021

Lemington South Glen Munro

Groundwater monitoring in the Lemington South Glen Munro seam was conducted twice in 2021 from one monitoring location. The pH, EC and SWL trends for 2017 to 2021 are shown in **Figure 83** to **Figure 85**. Water quality results were generally consistent with historical trends, although ground water elevation began to rise throughout 2021.

Internal triggers are listed in **Table 57.** As noted above the assignment of trigger values has been removed for bore D010(GM) in the draft WMP.

Table 57 Lemington South Glen Munro Groundwater 2021 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
D010 (GM)	31/05/2021	EC – 95th Percentile	Investigation Ongoing
D010 (GM)	15/12/2021	EC – 95th Percentile	Investigation Ongoing

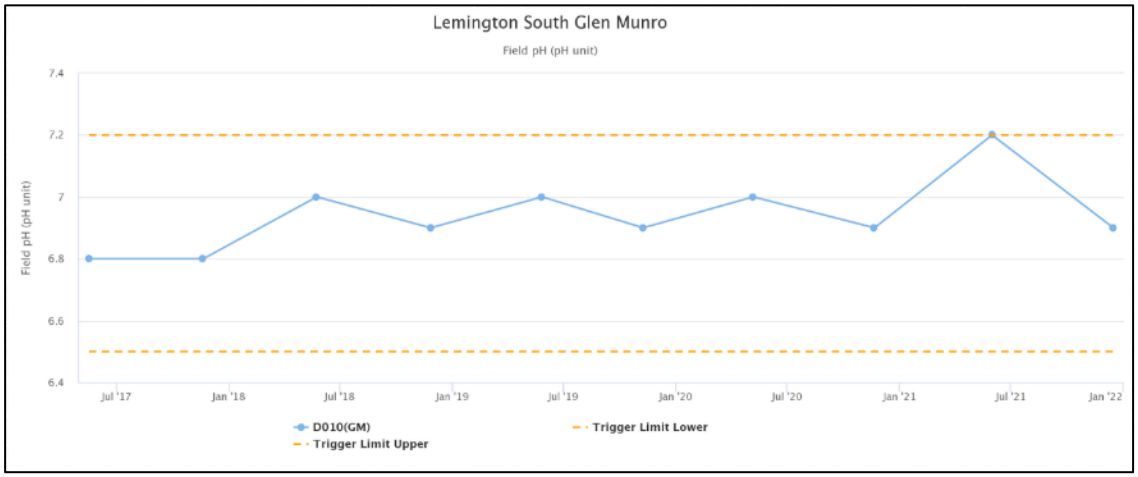


Figure 83 Lemington South Glen Munro Groundwater pH Trends 2017 – 2021

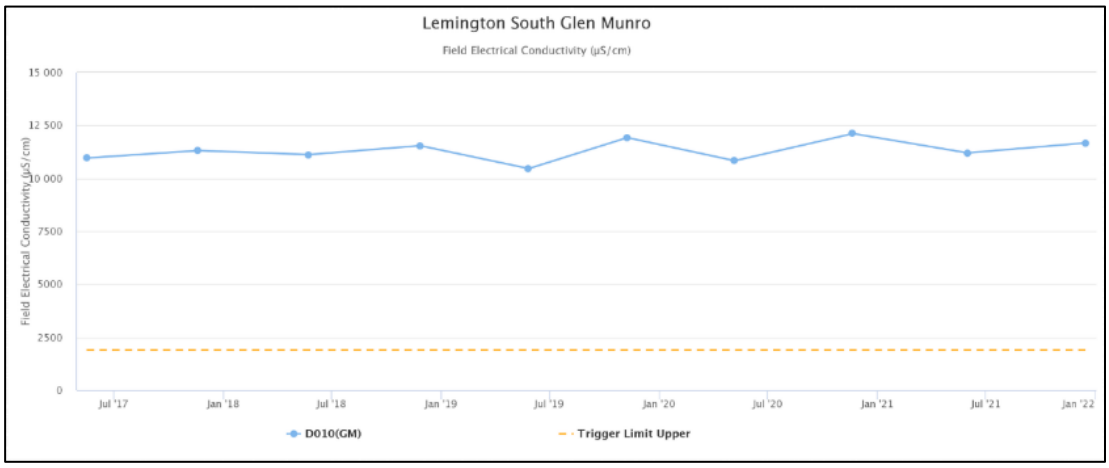


Figure 84 Lemington South Glen Munro Groundwater EC Trends 2017 – 2021

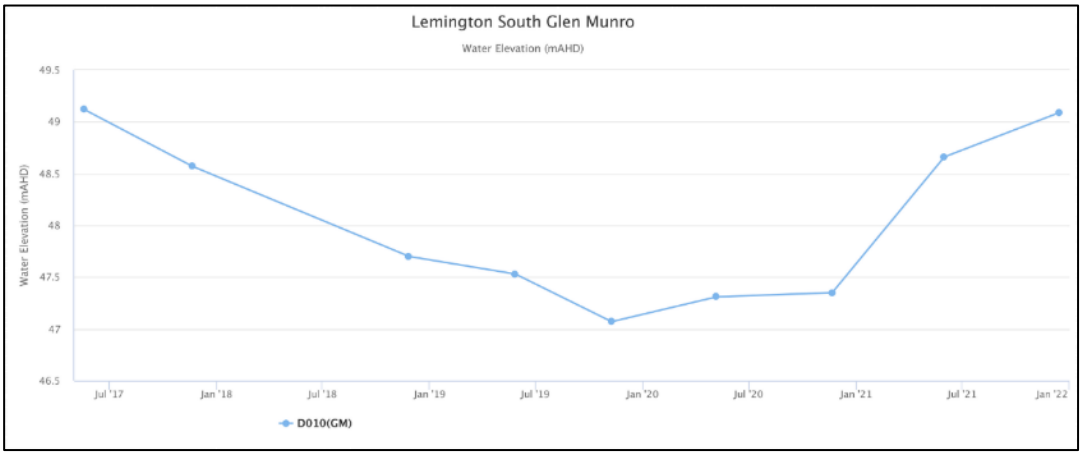


Figure 85 Lemington South Glen Munro Groundwater SWL Trends 2017 – 2021

North Pit Spoil

The pH, EC and SWL trends for 2017 to 2021 are shown in **Figure 86** to **Figure 88**. Water quality results were generally consistent with historical trends, although ground water elevation began to rise throughout 2021. Bore DM7 was dry for the entire reporting period. The groundwater in the spoil is not considered to be connected to the regional water table. In addition, monitoring has shown the effectiveness of the Alluvial Lands Barrier Wall in this area. As such, the updated draft WMP no longer includes trigger values for North Pit – spoil monitoring bores.

Internal triggers are listed in **Table 58**.

Table 58 North Pit Spoil Groundwater 2021 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
4116P	28/04/2021	EC – 95th Percentile	Investigation Ongoing
DM3	29/04/2021	pH – 5th Percentile	First consecutive trigger exceedance – watching brief established
DM1	09/08/2021	pH – 5th Percentile	First consecutive trigger exceedance – watching brief established
DM3	09/08/2021	pH – 5th Percentile	Second consecutive trigger exceedance – watching brief established
4116P	31/08/2021	EC – 95th Percentile	Investigation Ongoing

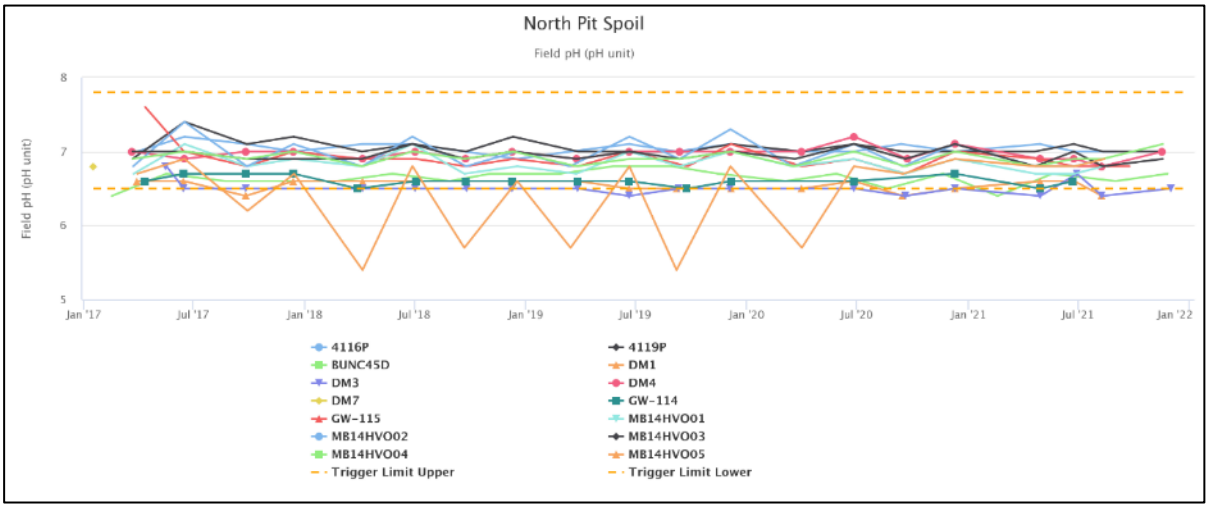


Figure 86 North Pit Spoil Groundwater pH Trends 2017 – 2021

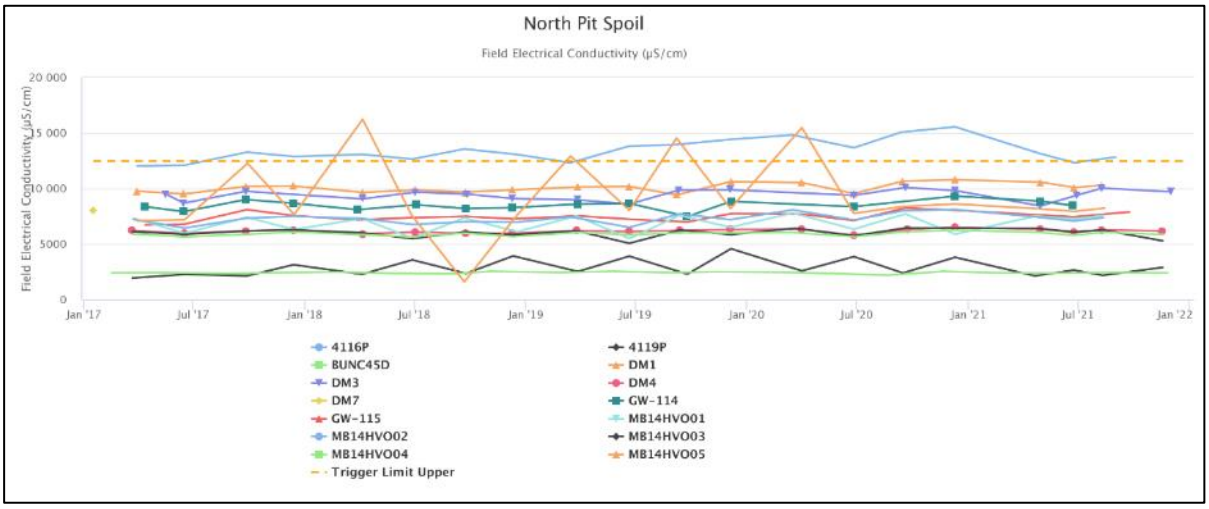


Figure 87 North Pit Spoil Groundwater EC Trends 2017 – 2021

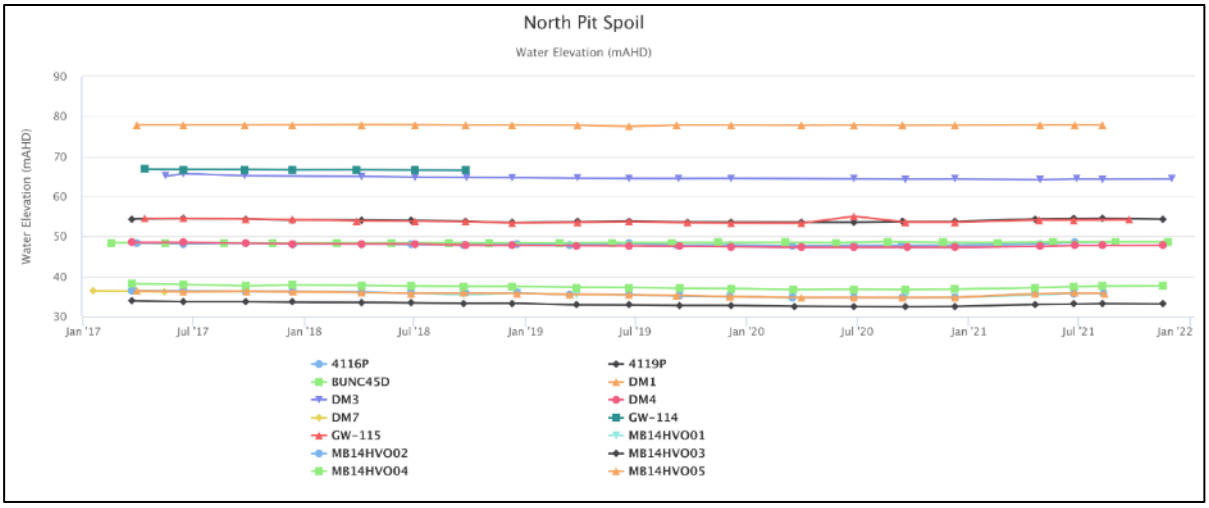


Figure 88 North Pit Spoil Groundwater SWL Trends 2017 – 2021

West Pit Alluvium

The pH, EC and SWL trends for 2017 to 2021 are shown in **Figure 89** to **Figure 91**. Bore GW-101 was unable to be sampled due to insufficient water throughout 2021. Water quality results were generally consistent with historical trends.

Bores G1, G2 and G3 continued to be monitored on a monthly basis during the reporting period. Monitoring frequency of these bores will be reviewed in the next reporting period. Monitoring in bores GW-100 and GW-101 was undertaken quarterly in accordance with the HVO Groundwater Monitoring Programme.

There were no trigger exceedances recorded in 2021.

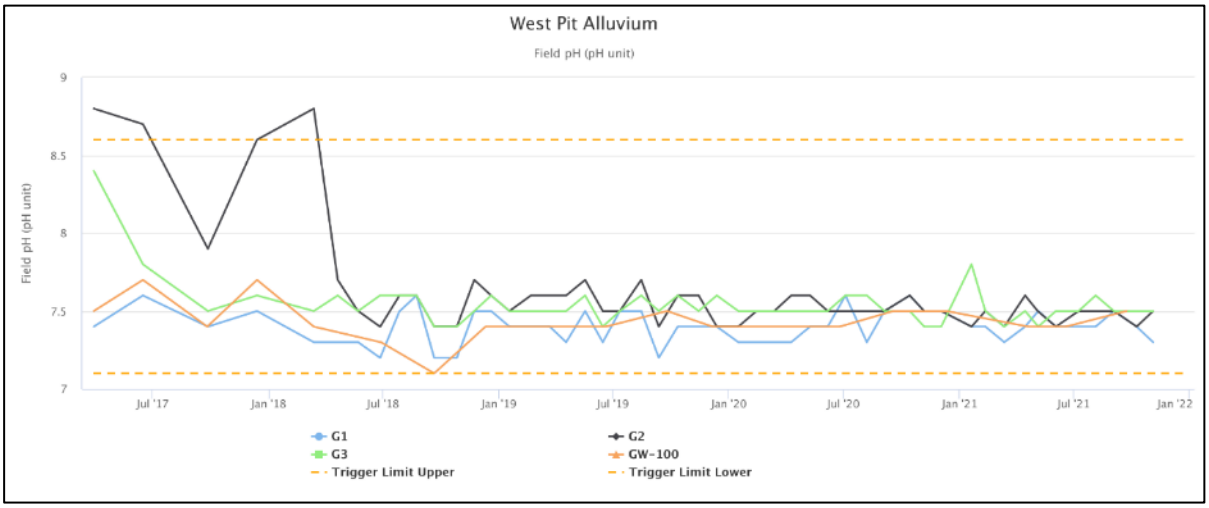


Figure 89 West Pit Alluvium Groundwater pH Trends 2017 – 2021

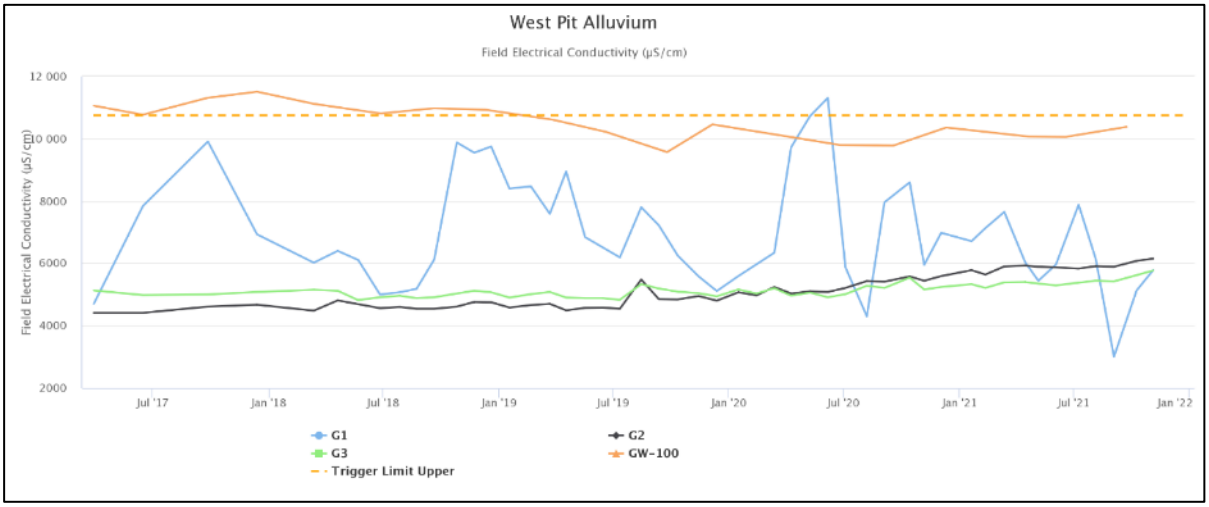


Figure 90 West Pit Alluvium Groundwater EC Trends 2017 – 2021

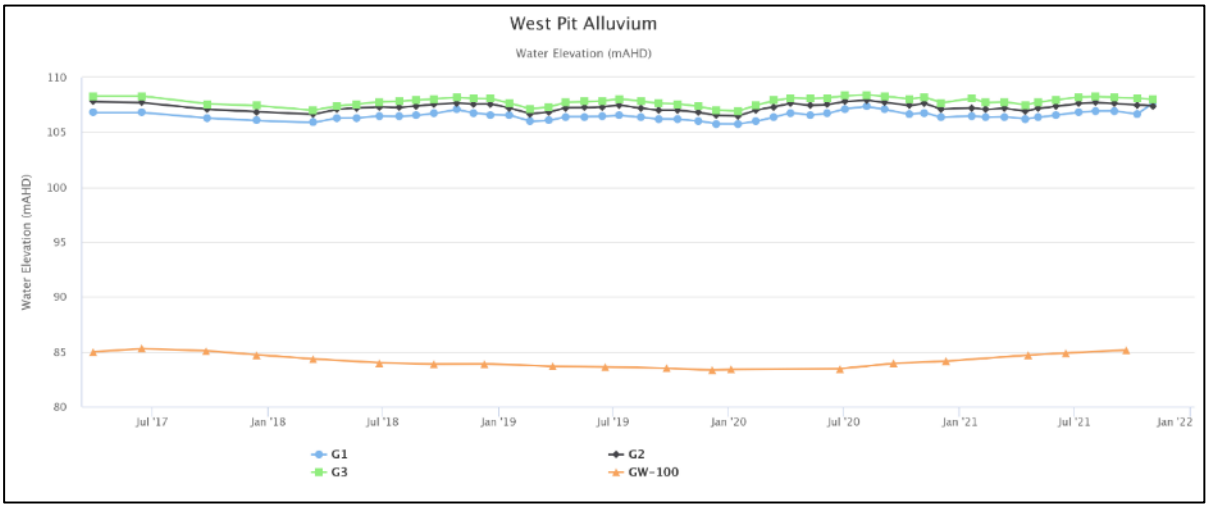


Figure 91 West Pit Alluvium Groundwater SWL Trends 2017 – 2021

West Pit Sandstone/Siltstone

The pH, EC and SWL trends for 2017 to 2021 are shown in **Figure 92** to **Figure 94**. Water quality results were generally consistent with historical trends. Historical data from July 2011–September 2021 shows that EC values have consistently been close to or above the EC trigger value at bore NPZ2. Groundwater salinity (as EC) began gradually increasing from July 2019. Groundwater levels have been stable at this location. The cause for the increasing trend is unclear as the monitoring bore is located north-west of mining-related activity (such as tailings storage, waste emplacement or active mining). The updated draft WMP (HVO 2021), no longer includes groundwater monitoring within the West Pit – Interburden.

Internal triggers are listed in **Table 59**.

Table 59 West Pit Sandstone/Siltstone Groundwater 2021 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
NPZ2	19/04/2021	EC – 95th Percentile	Investigation Ongoing
NPZ2	18/06/2021	EC – 95th Percentile	Investigation Ongoing
NPZ2	12/08/201	EC – 95th Percentile	Investigation Ongoing
NPZ2	01/12/2021	EC – 95th Percentile	Investigation Ongoing

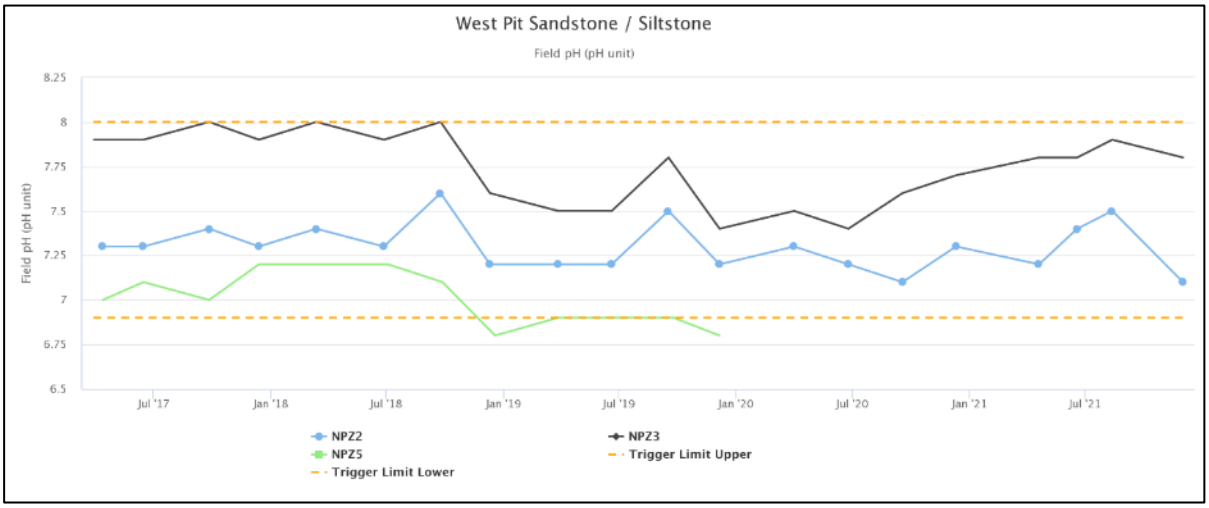


Figure 92 West Pit Sandstone/Siltstone Groundwater pH Trends 2017 – 2021

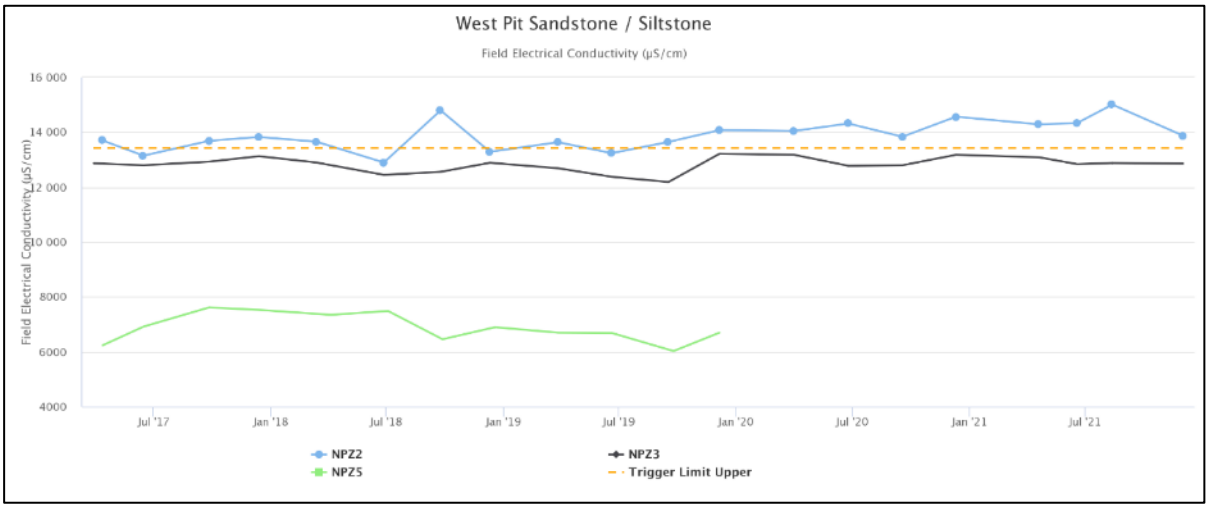


Figure 93 West Pit Sandstone/Siltstone Groundwater EC Trends 2017 – 2021

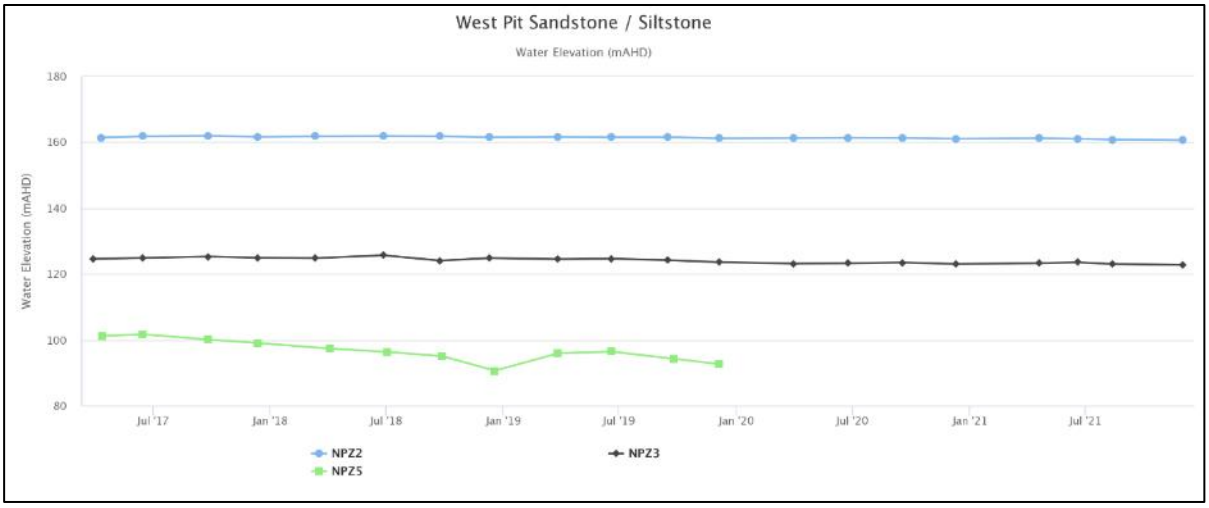


Figure 94 West Pit Sandstone/Siltstone Groundwater SWL Trends 2017 – 2021

Carrington West Wing Bayswater

. The pH, EC and SWL trends for 2017 to 2021 are shown in **Figure 95** to **Figure 97**. Water quality results were generally consistent with historical trends although there was a drop in EC and rise in SWL.

There were no trigger exceedances recorded during the reporting period.

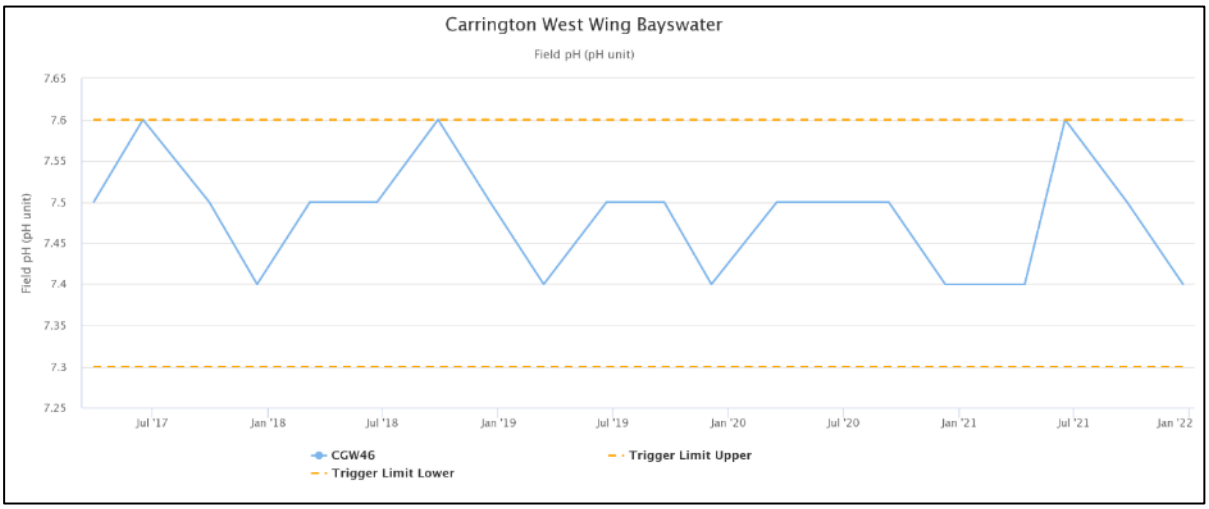


Figure 95 Carrington West Wing Bayswater Groundwater pH Trends 2017 to 2021

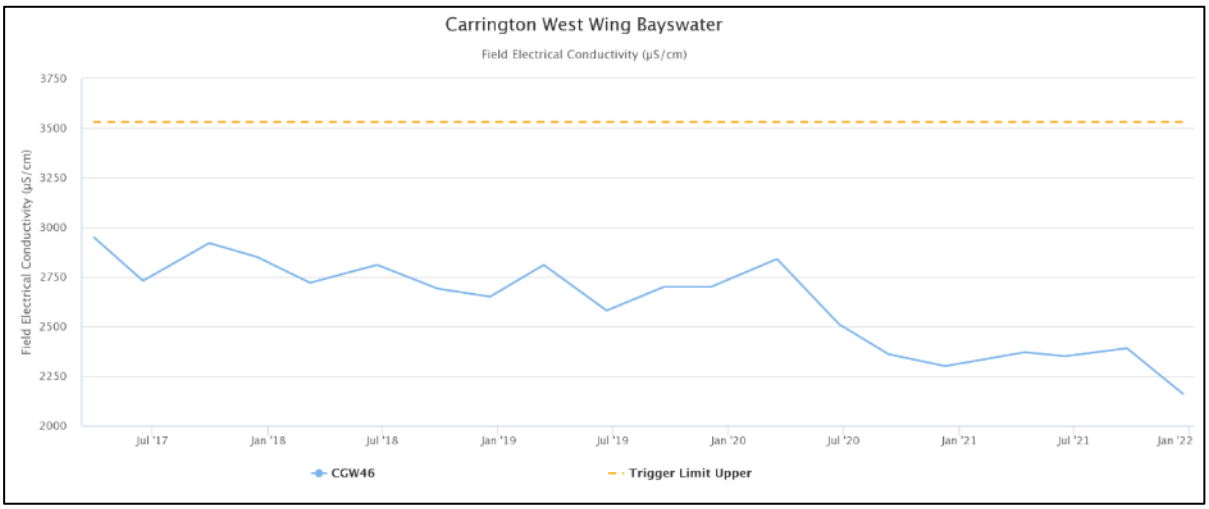


Figure 96 Carrington West Wing Bayswater Groundwater EC Trends 2017 to 2021

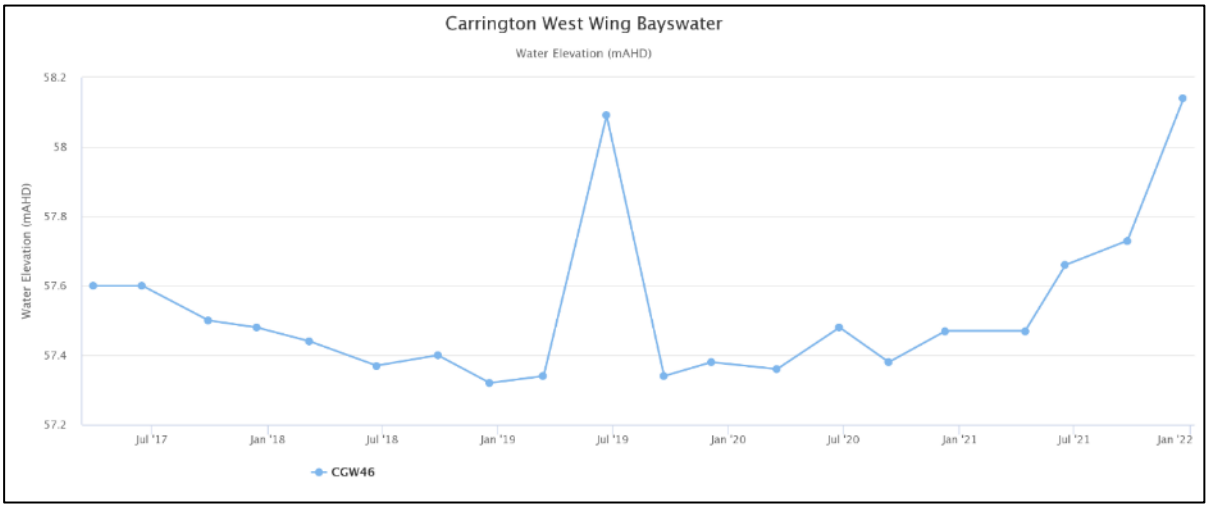


Figure 97 Carrington West Wing Bayswater Groundwater SWL Trends 2017 to 2021

7.6 Compensatory Water Supply

During 2021 HVO did not provide compensatory water supply or alternate compensation in lieu of compensatory water supply under any new or existing agreements, and circumstances which may trigger a requirement to provide a compensatory water supply were not identified.

8 Rehabilitation and Land Management

8.1 Summary of Rehabilitation

Rehabilitation at HVO is undertaken in accordance with commitments made in the 2020 Mining Operation Plan (MOP) which also serves as the Rehabilitation Management Plan required under the Consent.

A summary of the key rehabilitation performance indicators is shown in **Table 60**.

Table 60 Key Rehabilitation Performance Indicators

Mine Area Type	Previous Reporting Period (Actual) Year 2020 (ha)	This Reporting Period (Actual) Year 2021 (ha)	Next Reporting Period (Forecast) Year 2022 (ha)
A. Total mine footprint[5]	6665.0	6666.7	6760.7
B. Total Active Disturbance[6]	3753.8	3697.5	3747.5
C. Land being prepared for rehabilitation[7]	418.2	338.0	266.0
D. Land under active rehabilitation[8]	2492.9	2631.2	2747.2
E. Completed rehabilitation[9]	0	0	0

[5] **Total mine footprint** includes all areas within a mining lease that either have at some point in time or continue to pose a rehabilitation liability due to mining and associated activities. As such it is the sum of total active disturbance, decommissioning, landform establishment, growth medium development, ecosystem establishment, ecosystem development and relinquished lands (as defined in DRE MOP/RMP Guidelines). Please note that subsidence remediation areas are excluded

[6] **Total active disturbance** includes all areas ultimately requiring rehabilitation such as: on-lease exploration areas, stripped areas ahead of mining, infrastructure areas, water management infrastructure, sewage treatment facilities, topsoil stockpiles areas, access tracks and haul road, active mining areas, waste emplacements (active/unshaped/in or out-of-pit), and tailings dams (active/unshaped/uncapped).

[7] **Land being prepared for rehabilitation** – includes the sum of mine disturbed land that is under the following rehabilitation phases – decommissioning, landform establishment and growth medium development (as defined in DRE MOP/RMP Guidelines).

[8] **Land under active rehabilitation** – includes areas under rehabilitation and being managed to achieve relinquishment – includes the following rehabilitation phases as described in the DRE MOP/RMP Guidelines – “ecosystem and land use sustainability” (revegetation assessed as showing signs of trending towards relinquishment OR infrastructure development).

[9] **Completed rehabilitation** – requires formal sign off by DRE that the area has successfully met the rehabilitation land use objectives and completion criteria.

8.2 Rehabilitation Overview

A summary of rehabilitation completed in 2021 is shown in **Table 61**.

Table 61 Summary of new rehabilitation completed in 2021

Rehabilitation Site Name	Rehabilitation Type	Seed Mix	Area (ha)	Summary
West North 230	New Rehabilitation	Pasture	7.9	Final landform sown with final cover
Cheshunt Pit 1 125/152	New Rehabilitation	Woodland	4.0	Final landform sown with final cover
Cheshunt Pit 2 RL165	New Rehabilitation	Woodland	5.1	Final landform sown with final cover
Lemington Portal	New Rehabilitation	Woodland	14.6	Final landform sown with final cover
Riverview Spoils	New Rehabilitation	Woodland	11.2	Interim landform sown with native seed
Riverview 128	New Rehabilitation	Woodland	8.5	Interim landform sown with native seed
West Central 230	New Rehabilitation	Pasture	4.6	Final landform sown with final cover
Cheshunt Pit 2 RL155/165	New Rehabilitation	Woodland	5.1	Final landform sown with final cover
Cheshunt Pit 2 RL165	New Rehabilitation	Woodland	6.3	Final landform sown with final cover
South East TSF	New Rehabilitation	Woodland	5.4	Final landform sown with final cover
Cheshunt Pit 1 RL110	GMD Progression	Pasture	25.8	Final landform sown with final cover
Cheshunt Pit 1 155	GMD Progression	Pasture	33.2	Final landform sown with final cover
West South 210	GMD Progression	Pasture	6.3	Final landform sown with final cover
West North Slopes	GMD Progression	Woodland	15.9	Final landform sown with final cover
West North 230	GMD Progression	Pasture	11.0	Final landform sown with final cover
TOTAL REHABILITATION			**164.9**	

8.3 Rehabilitation Performance

A total of 164.9 ha rehabilitation was undertaken during 2021, including 72.7 ha of new rehabilitation, and 92.2 ha of Growth Media Development (GMD) progression. Details of the rehabilitation areas completed during 2021, including vegetation types are provided in **Figure 98**.

Table 62 details the amount of rehabilitation and disturbance completed during the reporting period compared with proposed area in the respective MOP's.

Table 62 Summary of rehabilitation and disturbance completed in 2021

MOP	2021 Totals (ha)	
	Actual	**Proposed MOP**
Rehabilitation		
HVO North	45.7	0
HVO South	119.2	53.4
HVO Total	164.9	53.4
Rehabilitation Disturbance		
HVO North	4.9	26.3
HVO South	14.0	47.1
HVO Total	18.9	73.4
New Disturbance		
HVO North	0.0	200.7
HVO South	1.7	17.8
HVO Total	1.7	218.5
Net Rehabilitation (Rehabilitation minus Rehabilitation Disturbance)		
HVO North	40.8	-26.3
HVO South	105.2	6.3
HVO Total	146.0	-20.0

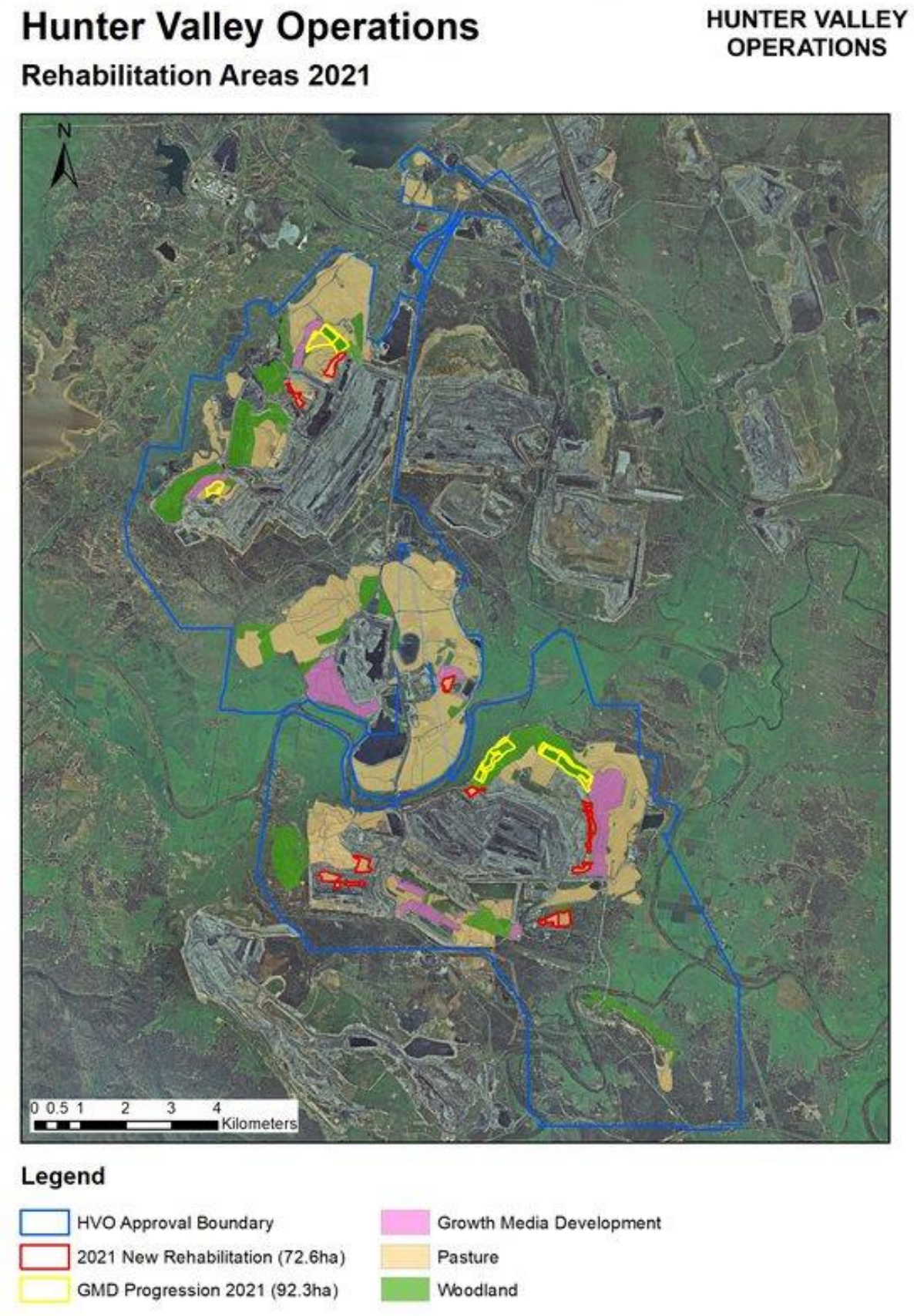


Figure 98 HVO Rehabilitation Areas as of 2021

The area of rehabilitation sown in HVO North during the reporting period was 45.7 hectares above the MOP commitment (0 ha). This is mostly due to the progression of several GMD areas to final cover (33.2 ha) and additional new rehabilitation that was completed ahead of schedule (12.5 ha). As 2021 was the initial year of the MOP, the cumulative rehabilitation total across the MOP period is similarly 45.7 hectares above the MOP projection. The area of rehabilitation completed in HVO South during the reporting period was 65.8 ha above the MOP commitment. A total of 60.2 ha of new rehabilitation and 59 ha of GMD progression were sown, for a total of 119.2 ha against a MOP forecast of 53.4 ha.

A comparison of rehabilitation progression against predictions in the *HVO West Pit Extension and Minor Modifications Environmental Impact Statement (EIS)* (October 2003) and subsequent modifications to the HVO North approval (DA 450-10-2003) indicates that rehabilitation progression is generally consistent with EIS predictions. Planning approval modifications that changed the rate of rehabilitation progression at HVO North include: Carrington East Extension (Modification 2 - 2006); Carrington Out-of-Pit TSF (modification 4 - 2014); and Carrington In-Pit TSF (Modification 6 - 2014). When the modifications listed above are taken into account the EIS projection for rehabilitation area at the end of 2018 was 1766.9 hectares. The EIS projection for average annual rehabilitation between 2018 (Year 14) and 2024 (Year 20) is 26.2 hectares hence projected rehabilitation at the end of 2021 was 1845.5 hectares. Land under active rehabilitation at HVO North at the end of 2021 totalled 1693.8 hectares.A further 149.2 hectares are classified as within growth medium development phase representing a total rehabilitation management footprint at end of 2021 of 1843 hectares which is consistent with EIS projections.

As at the end of 2021, rehabilitation progress for HVO South is consistent with the predictions in the HVO South Coal Project Environmental Assessment Report (January 2008), although with similar considerations to HVO North with respect to current rehabilitation phase classifications. EIS rehabilitation progression at the end of 2021 shows 1092 ha of rehabilitation completed. Land under active rehabilitation at the end of 2021 was 937.3 hectares in association with 157.2 hectares in growth medium development phase. Total rehabilitation management footprint at end 2021 is therefore 1094.5 hectares and consistent with progression to the end of Stage 1.

8.4 Rehabilitation Programme Variations

The 2021 variations to the rehabilitation programme are summarised in **Table 63**.

Table 63 Variations to the Rehabilitation Program in 2021

MOP	Has rehabilitation work proceeded generally in accordance with the conditions of an accepted Mining Operations Plan?	Comment
HVO South	Yes	**New rehab & disturbance** HVO South net rehabilitation (net rehabilitation = rehabilitation minus – rehabilitation disturbance) completed during period 2021 was 117.5 ha compared to 6.3 ha in the MOP. HVO North net rehabilitation (net rehabilitation = rehabilitation minus – rehabilitation disturbance) completed during period 2021 was 5.7 ha compared to -26.3 ha in the MOP. Both areas have progressed ahead of MOP forecasts due to additional rehabilitation becoming available in 2021, as well as some rehabilitation disturbance being delayed. **Historic rehabilitation** Following receipt of a Section 240 notice issued 18/7/19 from the Resources Regulator, rehabilitation in the GMD phase that was only sown with a cover crop was re-classified from completed to temporary rehab and reflected in the 2020 MOP. HVO has since commenced a program of maintenance and re-sowing these areas with its final cover. During 2021, 33.2 ha of GMD was progressed to final cover in HVO North, and 59 ha was progressed in HVO South.
HVO North	Yes	

8.5 Rehabilitation Trials

No rehabilitation trials were conducted during 2021.

8.6 Key Issues that may affect Rehabilitation

HVO has conducted several risk assessments relating to rehabilitation, including during the preparation of the MOP and RMP to identify the main risks to rehabilitation establishment. The key risks to rehabilitation at HVO include:

- Exotic weeds.
- Poor topsoil management.
- Having insufficient biological resources (topsoil, vegetation, seeds etc.);
- Drought (or extended dry conditions); and
- Erosion and sedimentation.

These key risks have been addressed in a rehabilitation Trigger Action Response Plan (TARP) within the HVO MOP. The TARP identifies the required management actions in the event of impacts to rehabilitation, or where rehabilitation outcomes are not achieved in an acceptable timeframe. An assessment of the 2021 rehabilitation monitoring results against the TARP is included in Overview of Rehabilitation Trajectory**,**

8.7 Rehabilitation Monitoring

During 2021 HVO adopted the revised GCAA rehabilitation monitoring program to monitor rehabilitation areas and trajectory towards meeting the rehabilitation objectives and performance and closure criteria. The monitoring framework comprises Initial Establishment Monitoring (IEM) and Long-Term Monitoring (LTM) depending upon the age of the rehabilitation area. Additionally, a walkover assessment is completed whereby the full extent of each monitoring block included in the annual program is assessed for maintenance requirements.

IEM is a rapid style assessment of young (≤3 years old) rehabilitated areas, principally to determine germination success and landform stability, and describes differing methods for HVO's key final land uses of grazing and non-specific woodland.

LTM utilises the Biodiversity Assessment Methodology (BAM) to compare rehabilitation areas with analogue site results. The objective of the LTM program (areas ≥4 years old) is to evaluate progress of rehabilitation towards fulfilling completion criteria and, ultimately, the targeted post-mining land use. Like methods apply for LTM of both rehabilitation and reference monitoring sites.

This program is now aligned with the *Glencore Coal Assets Australia Completion Criteria and Rehabilitation Monitoring Procedure* (GCAA 2020). Monitoring during 2021 represented the second round of a 3-5 year rotating ecological monitoring program which commenced in 2020 with the monitoring of 35 sites. In 2021, the additional 89 sites were monitored. A further 196 sites will be monitored over the next 2-3 years to complete the first full rotation.

During 2021, the eighty-nine sites that were monitored comprised of:

1) 13 sites of Initial Establishment Monitoring for Grazing Pastures.
2) 11 sites of Long Term Monitoring for Grazing Pastures;
3) 38 sites of Initial Establishment Monitoring for Non-specific native vegetation.
4) 23 sites of Long-Term Monitoring Non-specific Native Vegetation.
5) 2 grazing pasture reference sites; and
6) 2 woodland reference sites.

The results of the annual rehabilitation monitoring, combined with the annual walkover, are utilised to assess rehabilitation performance against the sites closure criteria, the MOP TARP and GCAA's Rehabilitation Report Card. An overview of TARP triggers and closure criteria performance are presented in **Overview of Rehabilitation Trajectory.**

8.7.1 IEM Pasture Results

The newly established pasture rehabilitation sites generally recorded a high ground cover percentage with only minor rilling, or sheet erosion being observed. Preferred pastures species cover ranged from 55.5% – 99.4%, whilst priority weed cover ranged from 0 – 12.1%. It was also noted that grazing by kangaroos and rabbits appeared to be impacting vegetation at some sites.

An assessment of IEM pasture rehabilitation blocks against the MOP TARP triggers is presented in **Table 64** below.

Table 64 Assessment of IEM Pasture Monitoring Blocks against MOP TARP

Block Code	Erosion Control	Surface Cover	Species Composition	Weeds
HVORIV201803A	Green	Green	Green	Green
HVORIV201803B	Green	Amber	Green	Green
HVORIV201805	Green	Green	Green	Green
HVORIV201901	Green	Green	Green	Green
HVORIV201902	Green	Red	Amber	Green
HVORIV201903	Green	Green	Green	Green
HVORIV201904	Green	Green	Green	Green
HVORIV201905	Green	Green	Green	Green
HVORIV201906	Green	Green	Green	Green
HVORIV201910	Green	Green	Green	Green
HVOWES202003	Green	Green	Amber	Green
HVOWES202004	Green	Red	Amber	Green
HVOWES202005	Green	Red	Green	Green

8.7.2 LTM Pasture Results

The LTM pasture rehabilitation blocks exhibited a consistently higher ground cover percentage, along with improved pastured composition (54.3% – 94.3%) and lower cover of priority weed species (0.1 – 17.9%). These improved scores are a natural result of the rehabilitation maturing over time and are expected to continue to improve with ongoing management and monitoring. Additionally, pasture biomass results scored well, ranging from 1490 – 3000 kgDM/ha. Only minor rilling or sheet erosion was observed in these blocks, similar to the IEM sites.

An assessment of LTM pasture rehabilitation blocks against the MOP TARP triggers is presented in **Table 65** below.

Table 65 Assessment of LTM Pasture Monitoring Blocks against MOP TARP

Block Code	Erosion Control	Surface Cover	Species Composition	Weeds
HVOCHE200103	Green	Green	Green	Green
HVOCHE201502	Green	Green	Green	Green
HVORIV200001	Green	Green	Green	Green
HVOWES200103	Green	Green	Amber	Green
HVOWES200801	Green	Green	Green	Green

8.7.3 IEM Woodland Results

Observations from the LTM non-specific native vegetation rehabilitation blocks include:

- Erosion was relatively low across all sites, with most sites recording only minor rills or sheeting (<10 cm). Four sites recorded active erosion, two of these had a maximum depth of 10 to 30 cm and two were under 10 cm. Two additional sites recorded a maximum depth of 10 to 30 cm but were stable;
- Percentage of bare ground ranged from 0 to 45%;
- The total priority weed cover ranged from 6 to 100%;
- Native species richness ranged from 9.1 to 88.6%; and
- Tree stem density ranged from 0 to 1125.

An assessment of IEM non-specific native vegetation rehabilitation blocks against the MOP TARP triggers is presented in **Table 66** below.

Table 66 Assessment of IEM Non-specific native vegetation Monitoring Blocks against MOP TARP

Block Code	Erosion Control	Surface Cover	Species Composition	Weeds
HVOCHE201801	Green	Amber	Green	Red
HVOCHE201802	Green	Green	Amber	Red
HVOCHES202001	Green	Red	Green	Red
HVOCHES202002	Red	Amber	Green	Red
HVORIV201802	Green	Green	Green	Red
HVORIV201804	Green	Green	Amber	Red
HVORIV201907	Green	Green	Amber	Red
HVORIV201908	Green	Green	Amber	Red
HVORIV201911	Amber	Green	Green	Red
HVORIV201912	Green	Green	Amber	Red
HVORIV202001	Green	Amber	Green	Green
HVORIV202003	Amber	Green	Green	Red
HVOWES202001	Amber	Green	Green	Green
HVOWES202002	Green	Green	Green	Amber

8.7.4 LTM Woodland Results

Observations from the LTM non-specific native vegetation rehabilitation blocks include:

- Erosion was relatively low across all sites, with most sites recording only minor rills or sheeting (<10 cm). However, three sites recorded active erosion with various maximum depths recorded (10-<30cm, 30-<50cm and ≥1m). Two additional sites recorded erosion at a maximum depth of 10 to 30 cm but were stable.
- Percent bare ground was low, ranging from 0 to 25%;
- The total priority weed cover ranged from 0.3 to 91.8%;
- Native species richness ranged from 16.67 to 94.44%;
- The proportion of native trees and shrubs with flowering and fruiting structures present ranged from 0 to 8%;
- Tree stem density ranged from 0 to 1300; and
- Canopy cover ranged from 0 to 60%.

With regard to habitat features at the LTM Non-specific Native Vegetation sites in 2021, none of the sites contained trees with hollows or nest boxes, however five contained rock piles and 13 contained fallen logs.

An assessment of LTM non-specific native vegetation rehabilitation blocks against the MOP TARP triggers is presented in **Table 67** below.

Table 67 Assessment of LTM Non-specific native vegetation Monitoring Blocks against MOP TARP

Block Code	Erosion Control	Surface Cover	Species Composition	Weeds	Habitat Corridors
HVOCHE200302	Red	Green	Green	Red	Red
HVOCHE201302	Green	Green	Red	Red	Red
CHE201501	Green	Green	Green	Amber	Red
HVOCHE201602	Amber	Green	Green	Green	Red
HVOLEM200201	Red	Green	Amber	Red	Red
HVORIV200301	Green	Green	Green	Red	Red
HVOWES200008	Amber	Green	Green	Amber	Red
HVOWES201605	Amber	Green	Green	Red	Red
HVOWES201702	Green	Green	Green	Amber	Red
HVOWES201703	Green	Green	Green	Red	Red

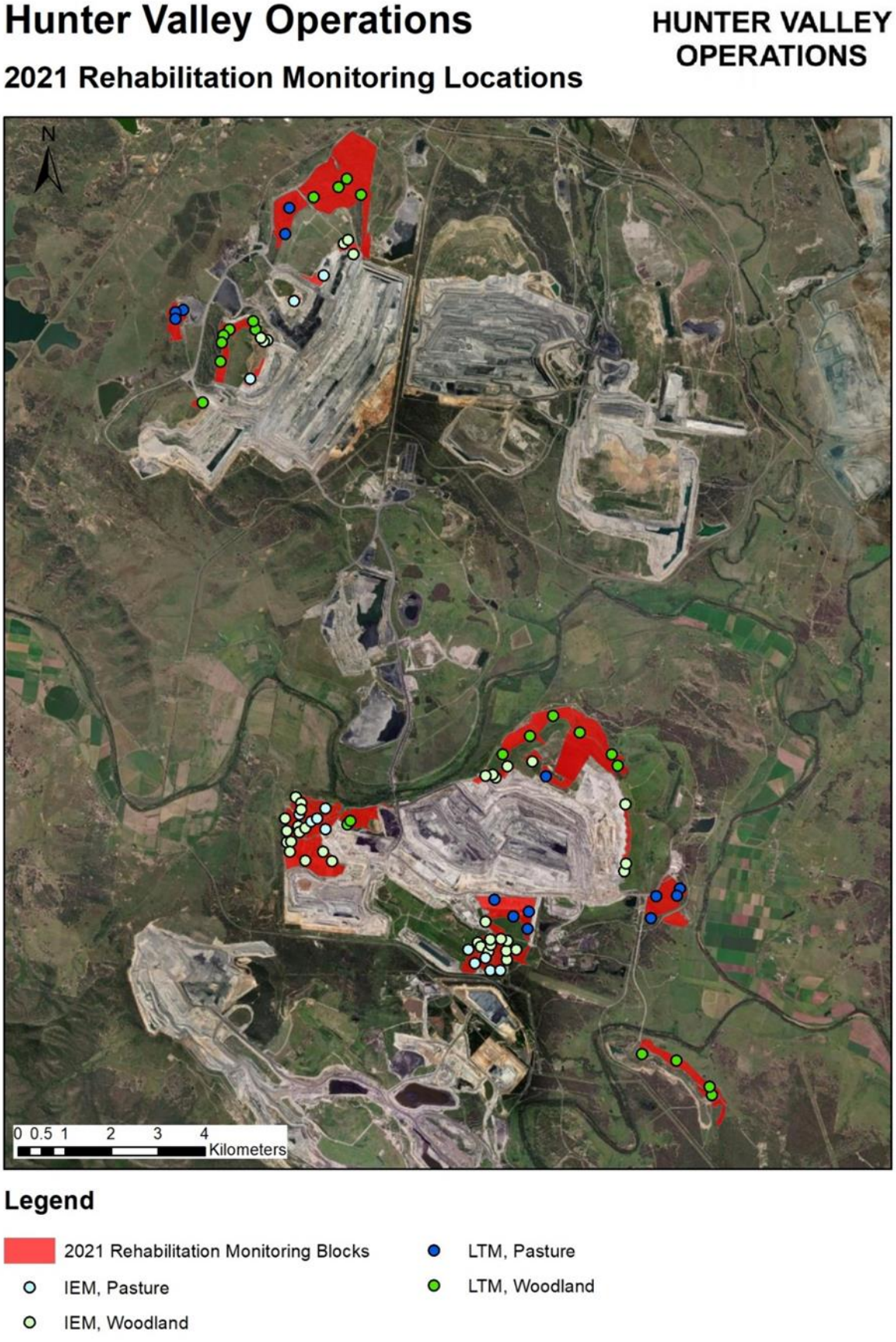


Figure 99 Overview of 2021 Rehabilitation Monitoring Locations

8.8 Overview of Rehabilitation Trajectory

As part of the rehabilitation monitoring program, an assessment was made against the rehabilitation completion criteria in the MOP for all LTM blocks (both pasture and woodland). IEM sites were not included in this assessment due to their young age. It should be noted that the current rehabilitation completion criteria in the 2020 HVO MOP are being updated to reflect both the new GCAA rehabilitation monitoring methodology and the guidelines released as part of the Resource Regulator Rehabilitation Reforms.

Table 68 Assessment of LTM Pasture Monitoring Blocks against Rehabilitation Completion Criteria

Block Code	2a Significant Weeds	2b Priority Weeds	4a Weed Cover	4b Erosion	4c Ground Protection	4d Non-weed Cover
HVOCHE200103	☒	☒	☒	☑	☒	☒
HVOCHE201502	☒	☒	☑	☑	☒	☒
HVORIV200001	☒	☒	☑	☑	☑	☑
HVOWES200103	☒	☒	☒	☑	☑	☒
HVOWES200801	☒	☒	☒	☑	☑	☑

Table 69 Assessment of LTM Woodland Monitoring Blocks against Ecosystem and Land Use Establishment Rehabilitation Completion Criteria

Block Code	3a Woodland Presence	3b Woodland Presence	3c Native Tree Species Diversity	3d Native Grass Species Diversity	3e Tree Stem Density
HVOCHE200302	☑	☑	☑	☒	☒
HVOCHE201302	☒	☒	☒	☒	☒
CHE201501	☑	☑	☒	☒	☒
HVOCHE201602	☒	☒	☒	☒	☒
HVOLEM200201	☒	☒	☒	☒	☒
HVORIV200301	☑	☑	☑	☒	☒
HVOWES200008	☑	☑	☑	☒	☑
HVOWES201605	☒	☒	☒	☒	☒
HVOWES201702	☑	☑	☒	☒	☒
HVOWES201703	☑	☑	☒	☒	☒

Table 70 Assessment of LTM Woodland Monitoring Blocks against Ecosystem and Land Use Sustainability Rehabilitation Completion Criteria

Block Code	5a Weed Cover	5b Erosion	5c Connect-ivity	5d Woodland Presence	5e Woodland Presence	5f Habitat Features	5g Ground Protection	5h Native Species Cover	5i Tree/ Shrub Diversity	5j Reproduction
HVOCHE200302	☒	☒	☑	☑	☑	☑	☒	☒	☒	☑
HVOCHE201302	☒	☑	☑	☒	☒	☒	☒	☒	☒	☒
CHE201501	☒	☑	☑	☑	☑	☒	☒	☒	☒	☒
HVOCHE201602	☒	☑	☑	☒	☒	☒	☒	☒	☒	☒
HVOLEM200201	☒	☒	☑	☒	☒	☑	☒	☒	☒	☑
HVORIV200301	☒	☑	☑	☑	☑	☑	☒	☒	☒	☑
HVOWES200008	☒	☑	☑	☑	☑	☑	☒	☒	☒	☒
HVOWES201605	☒	☑	☒	☒	☒	☒	☒	☒	☒	☑
HVOWES201702	☒	☑	☑	☑	☑	☒	☑	☒	☒	☑
HVOWES201703	☒	☑	☒	☑	☑	☒	☑	☒	☒	☑

8.9 Rehabilitation Maintenance

Management of rehabilitated areas is undertaken proactively to assist in initial establishment and when issues are identified through monitoring, auditing or inspections. Actions identified are risk ranked and prioritised as part of an annual work programme.

Section 240 Maintenance Program

In July 2019 the DP&E – Resources Regulator issued HVO with Notice 3259 under Section 240(1)(c) of the Mining Act (1992) (Section 240 Improvement Notice) requiring HVO to outline measures or actions to improve progressive rehabilitation performance across the site. This follows an earlier similar notice received during 2018 which was limited to 12 initial sites of concern. In response to these notices HVO has developed and committed to a rehabilitation maintenance and improvement program across the site as detailed in Appendix C (the s240 Maintenance Plan). This plan integrates and prioritises rehabilitation maintenance activities across the site to progress areas of rehabilitation initially sown to cover crop, manage weed competition, and encourage vegetation establishment. An overview of work from the plan undertaken during 2021 is presented in Figure 100, in addition to being detailed further below.

Weed Control

Broadacre weed treatment within rehabilitation areas is undertaken using agricultural methods comprising boom sprays, wick wipers and slasher/mulchers. In existing rehabilitation areas boom spraying is primarily used to manage cover crop and fallow areas prior to sowing to final native seed mixes. Pre-emergent application of herbicide is used when appropriate and necessary to control emerging weeds in the period between sowing and germination of the desired species. Wick wiping targets rapidly growing exotic grasses and other erect growing weeds in the period following native germination while desirable species remain below the wiper target zone. Slashing and mulching is also used to remove rank pasture grasses and stimulate fresh growth.

Hand spraying and manual removal of weeds is undertaken in rehabilitation areas with early stage and establishing native vegetation that would be likely to be damaged or destroyed should broadacre methods be used.

During 2021 rehabilitation blocks totalling 750 ha were boom sprayed, wick wiped, slashed/mulched or spot sprayed. The key weed species targeted in 2021 maintenance works were galenia (*Galenia pubescens*), Saligna (*Acacia saligna*), green panic (*Panicum maximum*), Rhodes grass (*Chloris gayana*) and mustard weed (*Brassica juncea*).

Erosion Repairs

Drainage structures such as contour banks, drop structures and sediment dams are largely functioning as designed and require little to no maintenance, particularly in more recently established rehabilitation areas. The 2021 Annual Walkover and Ecological monitoring reports identified some tunnelling and contour failures in historical areas, along with some minor rilling and gullying in newer rehabilitation areas. These have been prioritised and incorporated into HVO's detailed rehabilitation maintenance plan.

During 2021 rehabilitation blocks totalling 139 ha were subject to erosion repairs, being mostly repair and regrading of contour banks, and ripping and seeding of rilling areas.

Additionally on 9 November 2021, HVO was issued with a S240 notice from the Resource Regulator after conducting an inspection and observing evidence of contour bank failure, tunnelling and gullying on HVO's Western Out of Pit (WOOP) emplacement which is not covered by an HVO tenement. The notice required HVO to conduct an investigation that identified the scale and extent of impacts, the cause of the impacts, and proposed remedial actions to address long term erosion risks. The investigation was completed in December 2021, and a report submitted to the Regulator in January 2022.

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Grazing of Rehabilitation Areas

Grazing of rehabilitation areas is utilised to encourage and maintain pasture diversity, encourage nutrient cycling, and assist in fuel load management. A licence agreement is in place for grazing 666 ha of HVO North rehabilitation area, with temporary fuel load licences across a further 394 ha of rehabilitated land around HVO North and 210 ha around HVO South. Opportunities to integrate grazing to assist rehabilitation progression continues to be assessed.

Vegetation Enhancement

In addition to the progression of GMD areas throughout the year, HVO undertakes maintenance and re-seeding in rehabilitation areas that have been identified as failing or requiring additional species diversity. The need for these interventions, and the most appropriate method, are identified during the Annual Walkover and the Ecological monitoring. During 2021, 92 ha was re-seeded and an 8 ha area in the West Pit Central area had supplemental tube stock planting undertaken.

Topsoil Stockpiles

Regular inspections of topsoil stockpiles are completed to identify required maintenance activities. Maintenance works include weed control and re-seeding (if weed species have dominated). During 2021, 24 topsoil stockpiles were sprayed and re-seeded to improve their long term viability and reduce the spread of weeds onto new rehabilitation areas.

An overview of key rehabilitation maintenance activities is shown in **Figure 100**.

Figure 100 2021 Rehabilitation Maintenance Work

8.10 Vertebrate Pest Management

A number of baiting programs are carried out on a seasonal basis as part of the HVO Vertebrate Pest Action Plan. These programs are conducted at a level of frequency designed to disrupt pest species breeding/colonisation cycles and employ a variety of methodologies including baiting, trapping and ground based shooting

Wild Dog and Fox Baiting Programs

Three 1080 ground baiting programs targeting wild dogs and foxes were implemented across operational and biodiversity areas. These were undertaken during summer, winter, and spring. Each program consisted of approximately 60 bait sites utilising meat baits and ejector baits. Baits were checked over a three week period and replaced each week when taken. The winter and spring baiting programs are synchronised to coincide with neighbouring mine operations programs, with the timing of these events coordinated with and by Hunter Local Land Services

Hunter Local Land Services Wild Dog Trapping Program

Hunter Local Land Services implemented a wild dog control program on Hunter Valley Operations buffer farm properties utilising their professional dog trapper for several weeks over April 2021. During the course of this program 5 dogs, 3 foxes and 3 pigs were controlled.

Pig Trapping

Two pig baiting trials of the Sodium Nitrite 'Hoggone' baiting system were conducted at HVO during 2021. The first trial, conducted in August 2021 coincided with a conventional trapping program, resulting in 55 pigs controlled but none of these outcomes were attributed to the 'Hoggone' system. The second trial was conducted in November utilising the 'Hoggone' system on a standalone basis. This trail was run in conjunction with a wild dog program and resulted in an estimated 28 pigs destroyed across 18 bait stations.

Ground Based Shooting

HVO has two shooters attending the site on a regular basis opportunistically controlling feral pest species. Feral species controlled include pigs, wild dogs, foxes, hares/ rabbits, deer, and cats.

Table 71 summarises the results from the programmes carried out at HVO during 2021 with wild dog and fox baiting locations and results for the programs illustrated in **Figure 103** to **Figure 105**.

Table 71 Summary of Vertebrate Pest Management 2021

Season	1080 Baiting				Hoggo-ne Baiting	Trapping		Shooting			
	Total Lethal Baits Laid	Takes by Wild Dog	Takes by Fox	Takes by Feral Pig	Takes by Feral Pig	Wild Dog	Feral Pig	Feral Pig	Wild Dog/ Fox	Feral Cat	Hares & Rabbits
Summer	113	51	16	0	0	0	0	0	0	0	7
Autumn-Winter	119	65	16	0	0	5	55	17	0	1	13
Spring	119	47	15	0	28	10	0	0	0	0	0
Total	**351**	**163**	**47**	**0**	**28**	**15**	**55**	**17**	**0**	**1**	**20**

Table 72 provides a comparison of results from the last 19 baiting programmes undertaken at HVO. In 2021, as for previous programs undertaken at HVO, the vast majority of baits showed evidence of being consumed by wild dogs at 66% with foxes taking 19%, and 15% of baits being consumed by non-target species.

Results reported indicate the majority of takes by dogs or foxes, and photographic evidence taken in previous programs indicate a high population of wild dogs in the area. The number of takes by dogs in spring has decreased (47 takes currently compared to 56 in the last program); and by foxes has increased (fifteen in the current program compared to four in the last). The changes may reflect an increase in pressure on the dog population by increasing the frequency of trapping events between baiting programs. Trapping programs may be intercepting new dogs entering territory vacated by dogs removed after baiting programs. The resulting increase in the fox population/bait take may be from reduced competition for territory and / or prey.

Motion sensor camera photographic data has confirmed the trend of previous years with bait stations continuing to attract attention from non-target species including Australian ravens and lace monitor lizards that are digging up and extracting meat baits.

Figure 101 A Lace Monitor captured on motion sensor camera at bait site 19 11/2/2021

When assessing bait sites in the field, it is often difficult to determine if wild dogs, ravens or goannas have taken the meat baits as dogs and goannas have been photographed sniffing and investigating bait sites (**Figure 101** A Lace Monitor captured on motion sensor camera at bait site 19 11/2/2021 and **Figure 102**) within days of each other.

Figure 102 Wild Dog at Bait Site 19 8/2/2021

Table 72 Comparison of Results Between Baiting Programmes at HVO

Baiting Program	No. of Baiting Sites	Baiting Opportunities	Baits taken by Dogs	Dog (%)	Baits taken by Foxes	Fox (%)	Baits taken by non-target species	Other (%)	Total No. of Baits Taken	No. Sites where baits taken at least once	Represented as Percentage (%)	No. sites with baits taken on all occasions	No. sites with no baits taken	No. baits Disturbed Not Taken	No. baits taken alternatively by Dog or Fox	Baiting Efficiency %	Baiting efficiency excluding 'other'
1506 HVO	40	120	55	98%	0	0%	1	2%	56	31	76%	5	9	1	0	47%	46%
1510 HVO	60	180	71	89%	8	10%	1	1%	80	43	72%	10	17	4	5	44%	44%
1602 HVO	60	120	49	92%	3	6%	1	2%	53	42	70%	13	18	0	2	44%	43%
1606 HVO	60	180	94	96%	4	4%	0	0	98	54	90%	10	6	6	4	54%	54%
1609 HVO	60	180	83	94%	5	6%	0	0%	88	49	82%	11	11	12	3	49%	49%
1702 HVO	59	117	58	84%	10	14.5%	1	1.5%	69	49	87%	20	11	7	5	59%	58%
1705 HVO	60	120	70	95%	4	5%	0	0%	74	51	85%	23	9	3	0	62%	62%
1709 HVO	60	120	67	96%	3	4%	0	0	70	48	80%	22	12	5	2	58%	58%
1803 HVO	60	120	69	90%	6	8%	2	2%	77	49	82%	31	11	7	0	64%	63%
1806 HVO	60	120	77	94%	5	6%	0	0%	82	50	83%	32	10	8	4	68%	68%
1809 HVO	61	122	73	87%	10	12%	1	1%	84	50	82%	34	11	2	6	69%	68%
1905 HVO	64	124	61	85%	10	14%	1	1%	72	50	78%	22	17	8	8	64%	63%
1910 HVO	60	120	66	93%	4	6%	1	1%	71	48	80%	23	12	9	2	59%	58%

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Baiting Program	No. of Baiting Sites	Baiting Opportunities	Baits taken by Dogs	Dog (%)	Baits taken by Foxes	Fox (%)	Baits taken by non-target species	Other (%)	Total No. of Baits Taken	No. Sites where baits taken at least once	Represented as Percentage (%)	No. sites with baits taken on all occasions	No. sites with no baits taken	No. baits Disturbed Not Taken	No. baits taken alternatively by Dog or Fox	Baiting Efficiency %	Baiting efficiency excluding 'other'
2002 HVO	60	140	72	94%	4	5%	1	1%	77	48	80%	2	12	9	2	55%	54%
2005 HVO	60	118	44	71%	15	24%	3	5%	62	41	68%	21	19	12	6	53%	50%
2010 HVO	60	120	56	89%	4	6%	3	5%	63	43	72%	20	17	7	2	53%	50%
2102 HVO	60	113	51	65%	16	21%	11	14%	78	53	80%	26	7	12	5	69%	59
2105 HVO	60	119	65	72%	16	18%	11	12%	90	55	92%	37	5	8	7	76%	66%
2110 HVO	63	119	47	61%	15	19%	15	19%	77	51	81%	26	12	4	5	65%	52%
												Average Baiting Efficiency				**59%**	**56%**

The pattern of an increase in bait takes by non-target animals, first reported in 2020 has continued in 2021.

The 2021 spring bait program was carried out in October as in previous years. The similarity of results in terms of non-target species bait take, underpins advice from consultants to move the spring baiting programs back to September so that the program is completed before the lace monitors reach peak feeding in their breeding season. This is done to maximise the availability of baits for target animals and reduce behavioural changes to non-target species feeding patterns.

The impact of 1080 Wild Dog bait programs on non-target species is additionally mitigated by the following features inherent to the active constituent sodium fluoroacetate.

- 1080 is a naturally occurring toxin found in more than 30 species of native Australian plants. Australia's native wildlife have evolved tolerance to 1080, unlike the introduced dog and fox.
- Scientific studies have investigated risks of 1080 to native wildlife populations, including 29 species of native birds, 7 species of native reptiles and amphibians and 44 species of native mammals (including carnivorous marsupials). All studies found there to be no threat from 1080 to populations of these wildlife species. The standard toxic dose of 3-5 mg of 1080 for a dog or fox will not poison a goanna, quoll or wedge tailed eagle.
- 1080 is water soluble and readily broken down in the environment by naturally occurring bacteria and fungi
- Baits are sized and bait locations spaced to limit the quantity of 1080 a non-target species can feasibly ingest.

Dates for Wild dog baiting programs are synchronised with programs run by the Hunter Local Land Services and neighbouring mining/corporate entities. Moving the timing back for these programs will be a discussion item at future regional vertebrate pest management meetings.

Vertebrate pest management programmes will continue to be carried out during 2022 to limit feral pest impacts on landholdings and surrounding neighbours.

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Figure 103 HVO Vertebrate Pest Management Bait Locations – Summer 2021

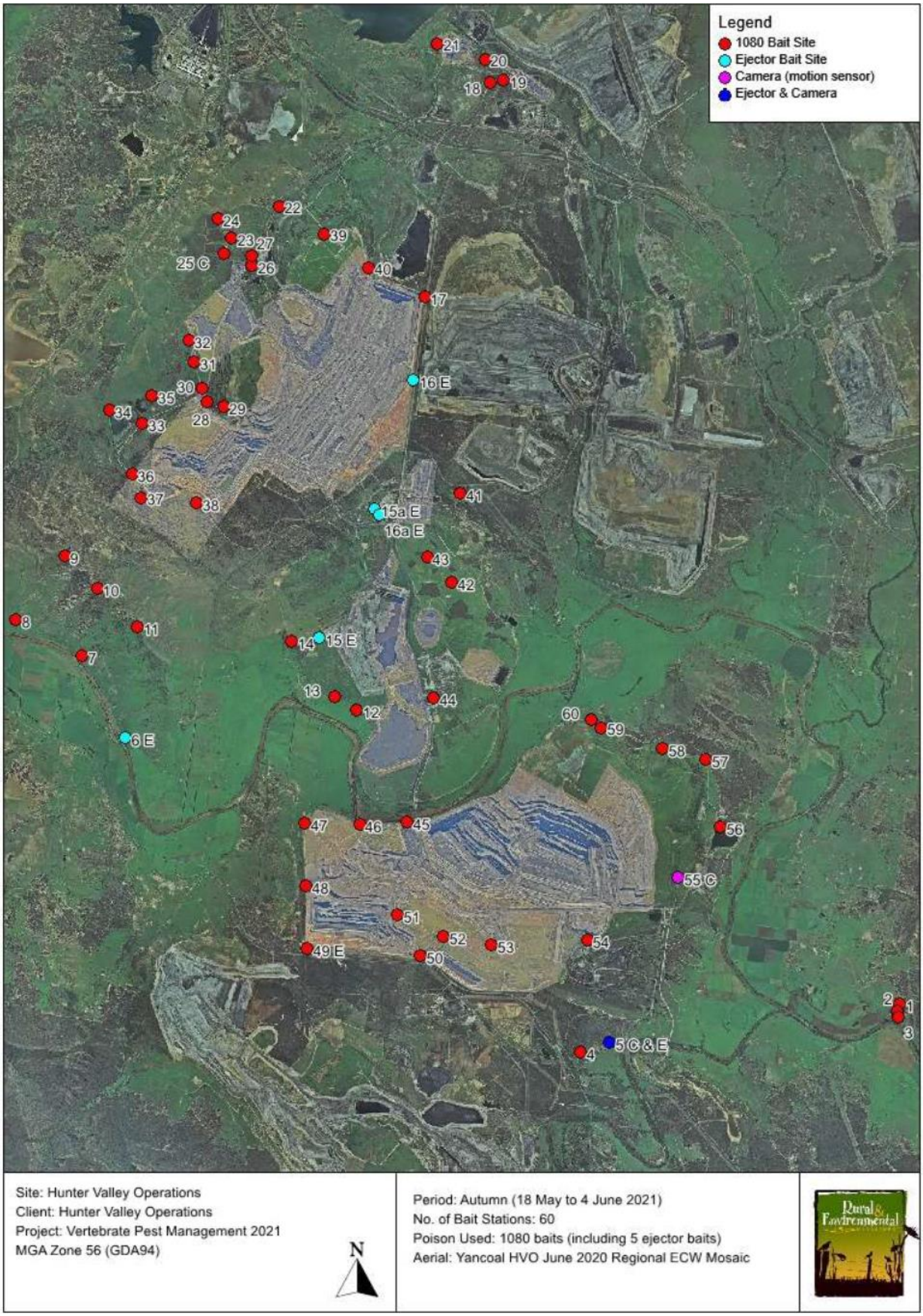

Figure 104 HVO Vertebrate Pest Management Bait Locations – Autumn 2021

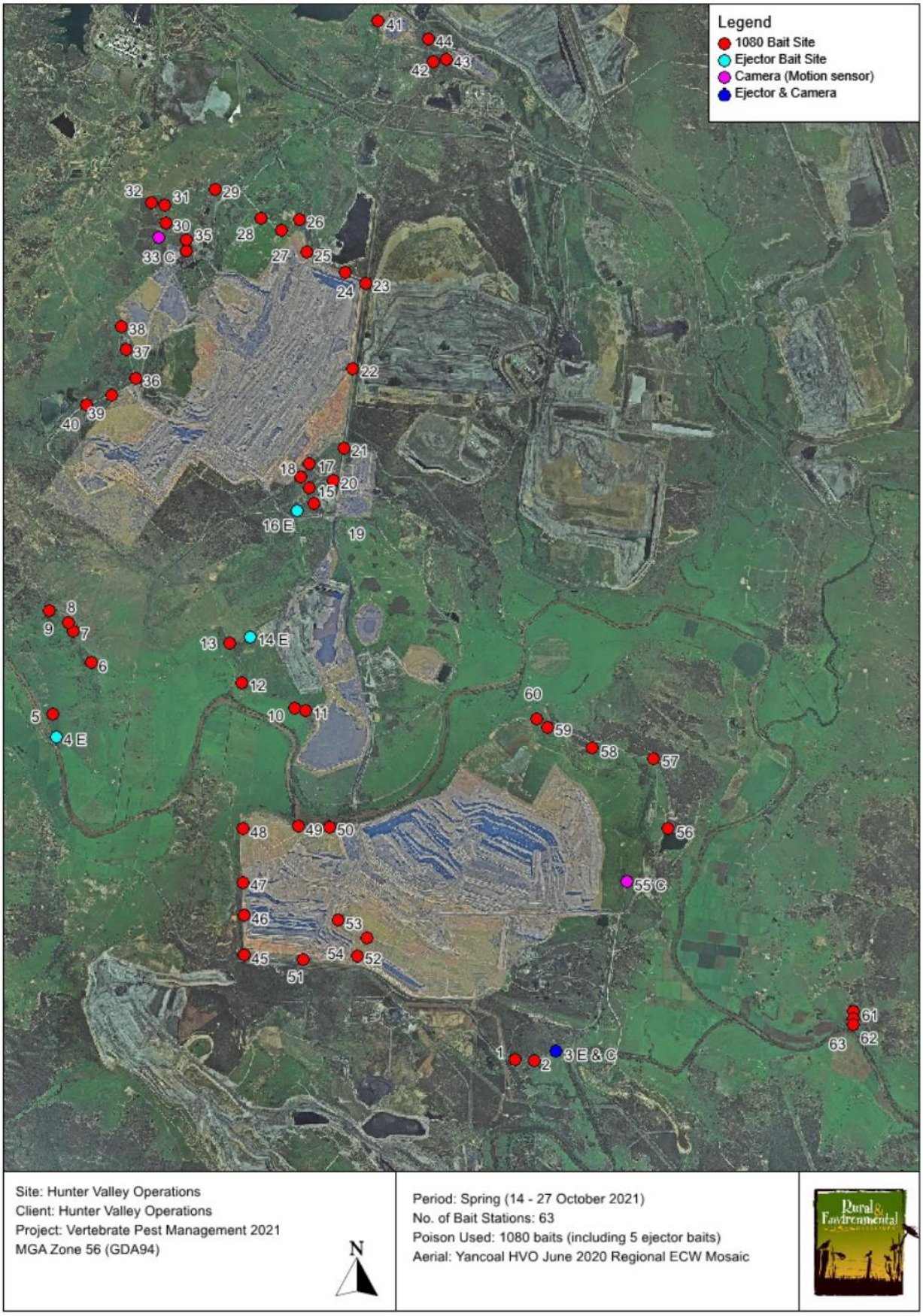

Figure 105 HVO Vertebrate Pest Management Bait Locations – Spring 2021

8.11 Renovations

Work commenced in 2021 renovating a shed for the purposes of establishing an Ammonium Nitrate Emulsion manufacturing facility and an Explosives Reloading facility. This is expected to be completed in 2022.

8.11.1 Derelict Rural Buildings

HVO scaled back demolition of derelict rural buildings located within its rural property portfolio in 2021. One derelict building, the abandoned Clay Target club house was demolished. Works included the decommissioning of septic systems, asbestos removal, the salvage/recycling of building materials (where feasible) and restoration of vegetation cover. Demolition of derelict rural buildings will recommence in 2022.

8.12 Tailings Management

Key Tailings Management Activities in 2021, included:

- Capping of the Southeast TSF remained ongoing.
- Adjustment of Secondary Flocculent dosage into Carrington In Pit TSF was made, to improve beaching;
- Temporary cessation of deposition into Dam 6W TSF has been extended, allowing time for consolidation prior to final top up deposition.
- Ongoing implementation of the North Void TSF Management Plan to manage and mitigate any potential impacts from an identified seepage pathway. Provision of quarterly and annual analysis reports to EPA; and
- Design of the first capping stages of Bob's Dump completed; ready for implementation in 2022.

Table 73 below outlines the current state of Tailings Storage Facilities across HVO that are still active or pending decommissioning.

Table 73 HVO Tailings Storage Facilities

Facility	Status	Decant System
North Void	Inactive	Decant pumps in place, regular pumping.
Dam 6W	Inactive	Decant pumps in place, regular pumping.
Cumnock Void	Active	Decant pump in place, regular pumping when deposition occurring.
Bob's Dump	Inactive; preparation for decommissioning	Solar pump in place, pumping as required.
Southeast TSF	Inactive - capping ongoing	Solar pump in place, pumping as required.
Central TSF	Inactive	No pumps required due to drying after rainfall (small catchment reporting to TSF).
Carrington In-pit TSF	Active	Decant pumps in place, regular pumping.

8.13 River Red Gum Restoration and Rehabilitation

8.13.1 River Red Gum Overview

Eucalyptus camaldulensis (River Red Gum) populations have become increasingly rare in the Hunter Valley, and the entire population occurring within the Hunter catchment is now listed as an Endangered Population under the NSW *Biodiversity Conservation Act 2016*. There are a number of River Red Gum sites across HVO North and South. HVO manages the River Red Gum stands on lands that it owns in accordance with the HVO River Red Gum Restoration and Rehabilitation Strategy (Strategy) (HVO 2020) which is a compliance requirement under Sch 3, Condition 31 of DA 450-10-2003.

The sites at HVO have been categorised into a high level of management at the Carrington Billabong, intermediate level at the priority sites and low level at the low priority sites. Each level has been allocated varying amount of monitoring and maintenance as outlined in the Strategy.

As the site with the highest priority, the objectives of the monitoring program at Carrington Billabong are to:

- determine if there is any improvement or deterioration in RRG within Carrington Billabong
- determine if there is any improvement or deterioration of the natural habitat at Carrington Billabong
- provide management recommendations to achieve further improvements in the ecological management of the site to assist in the recovery of RRG and their habitat.
- remove any potential influence that mining activities at HVO may have on the population. The monitoring results are compared to a reference site to the north of HVO that is not within a mining area.

The locations of the River Red Gum stands at HVO are shown in **Figure 106.**

The Strategy has an established monitoring programme of the river red gum subpopulations and vegetation communities in Carrington Billabong and priority sites on the Hunter River and Wollombi Brook in HVO North and South. The Reference Site is located between Scone and Aberdeen (NSW).

The ecological monitoring undertaken in 2021 included floristic survey, seedling survey and a remnant ecological heath assessment. The locations of the sampling points are shown in **Figure 107** to **Figure 109** and the results of these activities are summarised below.

Across 2021, the management activities undertaken within the HVO River Red Gum areas included tubestock planting of 200 river red gums within the Carrington Billabong and increasing the fenced area that is being managed for the Billabong to permit additional plantings in the coming year.

Additional activities undertaken during 2021 included condition monitoring across all known sites, the removal of redundant fence posts from the billabong, and implementing weed and vertebrate pest management activities. These activities are discussed further in the following sections.

The intent of the planting programme is to reduce the linear influence of the billabong on the existing mature *E. camaldulensis*. Over time, the new plantings should offer some protection to the mature individuals from storm events and assist to reduce the competitive advantages of the annual weeds on recruiting native species. In addition, dense or prickly mid-storey species that characterise the community are being planted in small clumps along the Billabong and adjacent plain areas to provide nesting habitat for insectivorous birds. The intention is to increase the resident population of small insectivorous birds to control the lerp population in the Billabong and assist with the health of the trees in the community. Future plantings are intended to form a vegetative link between the Billabong and the adjacent high priority site along the Hunter River, encouraging native fauna movement between these areas.

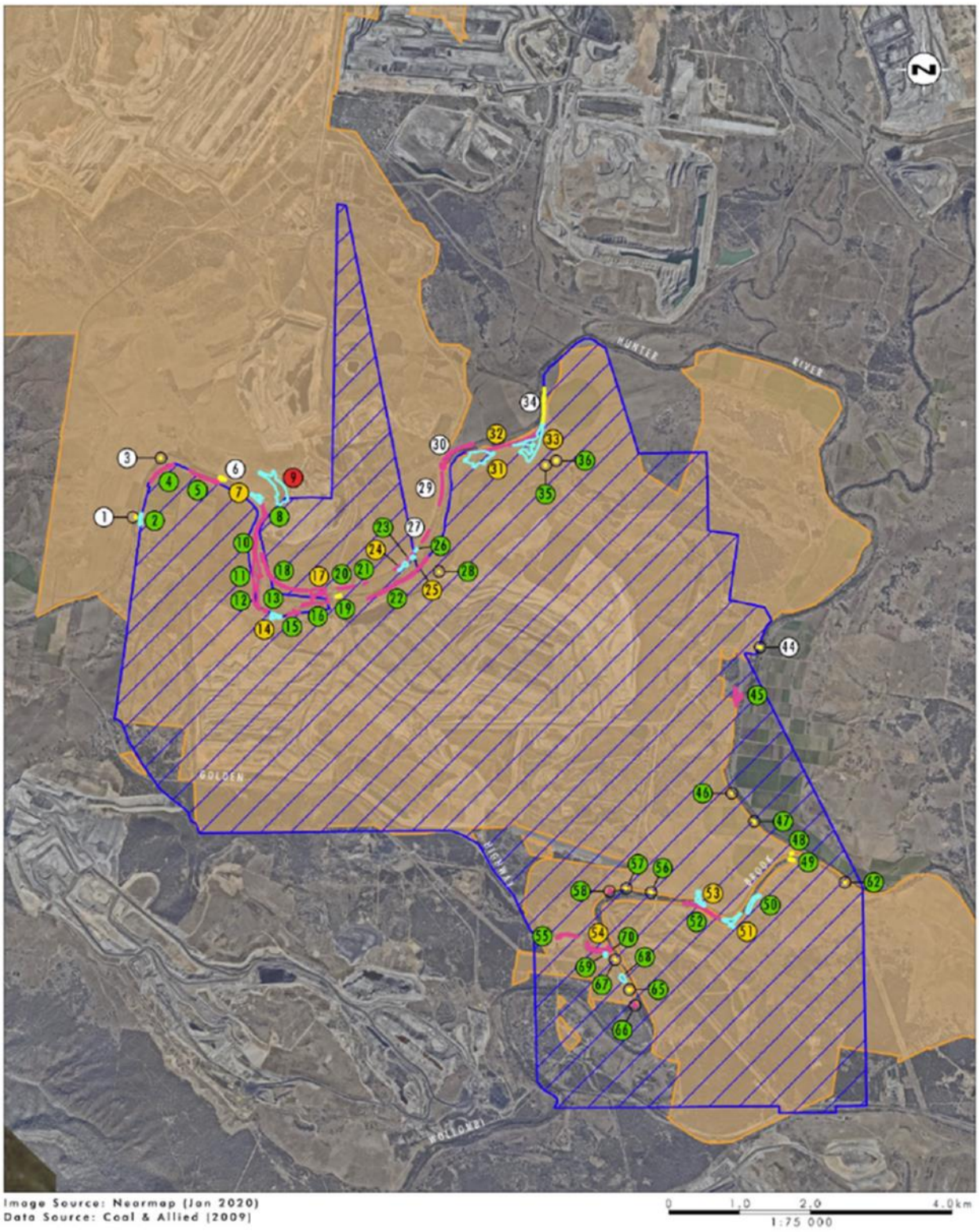

Figure 106 Eucalyptus camaldulensis stands being managed at HVO.

Figure 107 Eucalyptus camaldulensis monitoring sites at Carrington billabong.

Figure 108 Eucalyptus camaldulensis priority site monitoring locations

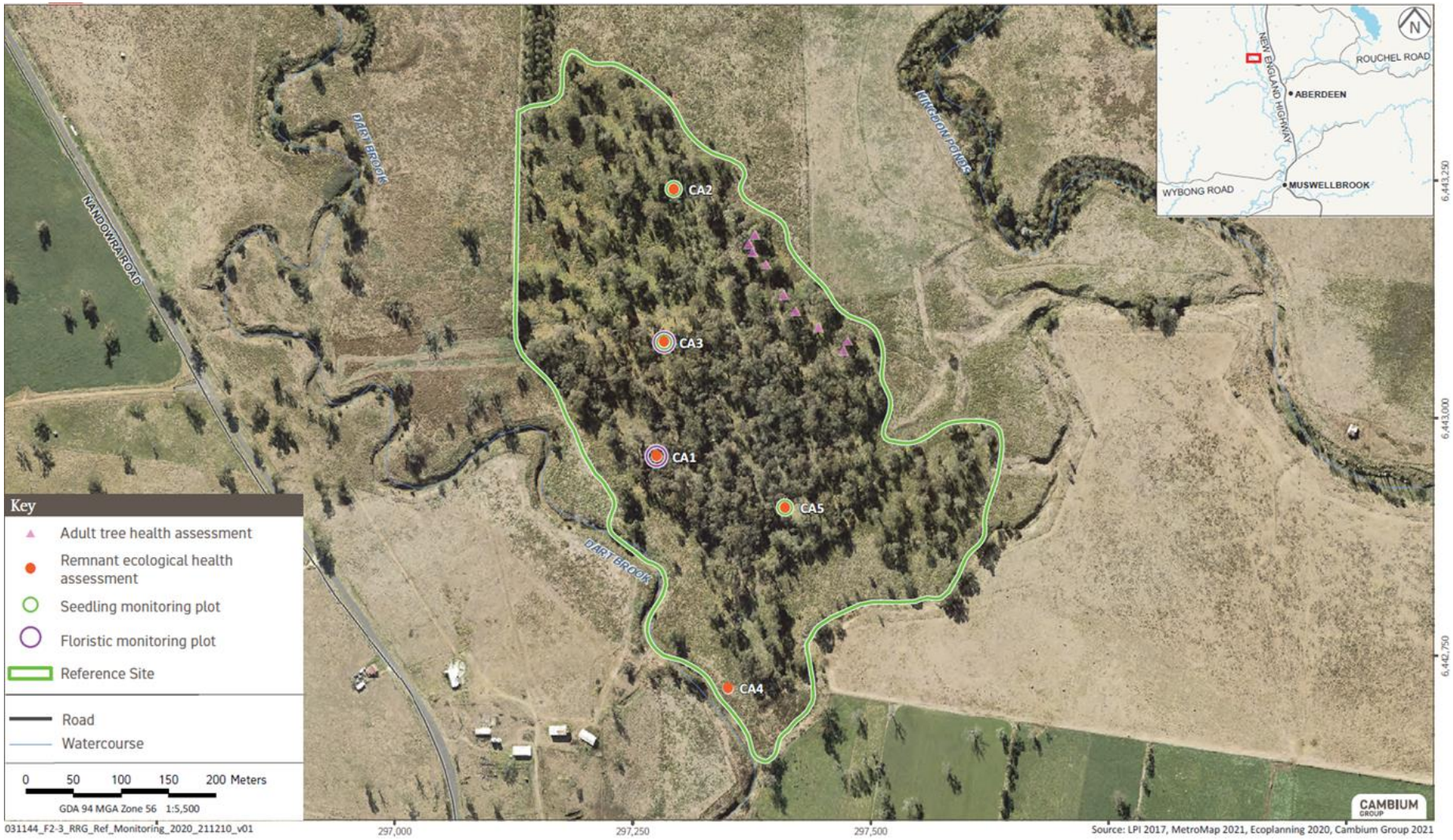

Figure 109 Eucalyptus camaldulensis monitoring locations at the Reference Sites.

8.13.2 RRG Monitoring Activities

Rainfall and recruitment

Above average rainfall occurred during 2021, which repeated the La Nina rainfall pattern from 2020. Above average rainfall occurred across all months with the exception of January, April, July, and September, with a total rainfall for the year 279.03 mm above the historical average.

A result of the additional rainfall over the summer period has been a noticeable increase in vegetation growth in the understorey, particularly of grasses and annual weeds within the Poaceae and Asteraceae families. Flooding of the Carrington Billabong occurred during November 2021 and, as of February 2022, is still in flood within the lower areas of the Billabong **(Figure 110).**

Figure 110 Receded flood waters within the Carrington billabong

Floristic Survey

A full floristic survey was conducted within set quadrats in the Carrington Billabong and the Reference Site. The 2021 monitoring period showed a noticeable increase in weed species diversity within floristic plots at Carrington billabong with a slight decrease in native species diversity. Within the floristic plots at Carrington Billabong 25 (35%) native species and 47 (65%) exotic species were recorded, while within the two plots from the Reference Site 26 (43%) native species and 35 (57%) exotic species were recorded.

In comparison with the 2020 data, in 2021 the proportion of weed species diversity to native species diversity was lower at the Reference Site compared to Carrington Billabong. In particular, the weed species diversity at CB5 was much greater than the previous 2020 survey. At the Reference Site, native species diversity increased at both sites whilst exotic species diversity decreased at both sites.

Similar to the 2020 survey, meanders through Carrington Billabong and the Reference Site did not identify any significant recruitment of native vegetation.

It is difficult to identify a single factor that may have increased the diversity of weed species when total rainfall has been above average. Nevertheless, an increase in weed diversity warrants continued weed control at Carrington Billabong, in accordance with the Implementation Plan (HVO 2020), to help reduce the diversity and cover of exotics and promote the recovery of native species.

The patterns in the density of seedlings and juvenile recruits were mapped in the field and reviewed against contour data. At the Carrington Billabong, recruitment was most evident within the lower parts of the site,

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predominately below the 68m contour. As with the 2020 survey, there were few naturally occurring recruits outside this area.

At the Reference site, recruitment was also greater in the lower parts of the landscape with less recruitment occurring on higher ground.

The majority of the recruits noted were greater than 2m tall, indicating that there has not been a significant germination event for some time. Given the lack of flooding events in recent years, despite the increased rainfall in 2020, this result is not unexpected given the literature states that recruitment of E. camaldulensis is most likely following a flood.

With the flood waters occurring within the Billabong from November 2021, it is hoped that recruitment will be triggered as the flood recedes. Should this occur, additional methods to estimate and map the recruits will be examined. Careful management of these areas will occur, and assisted regeneration may be employed where passive regeneration is not working or not likely to succeed.

Throughout 2021, HVO reduced the herbicide use within the Billabong and priority areas HR11 and HR13 (Figure 108) in preference for selective slashing of the annual weeds that have proliferated to reduce the production of weed seeds in these areas. This decision was to see if native recruitment was being impacted by the use of the herbicide. The results of the floristic survey would suggest that it was not necessarily the use of the herbicide that resulted in poor native vegetation regrowth and establishment, but likely the extent of the weed seed bank within the river red gum areas that have resulted from the extensive agricultural history of these areas and their renewal and germination following flood events.

Further investigations will occur in 2022 with annual herbs and grasses being slashed within the open areas and potentially reintroducing the selective use of herbicide within the billabong fringes to manage weedy regrowth. Active planting of species consistent with this community will be examined.

Remnant Ecological Health Monitoring

The health of adult trees was assessed using a representative sampling method. At Carrington Billabong, 63 adult trees were sampled from across the site. These trees had retained tags from previous monitoring (refer to Umwelt 2018) enabling comparison with prior datasets. At the Reference Site, nine trees were sampled along a transect that runs parallel to the north-eastern boundary. This replicates the sampling effort (9 trees) of previous monitoring undertaken during 2020 to allow for direct comparison of each tree.

Each tree sampled was surveyed for the thirteen attributes that were used in past monitoring, and this data was used to score and monitor the overall condition of each tree. Sixteen survey locations were assessed; five are located along the Hunter River, one on the Wollombi Brook, five within the Carrington Billabong and five at the Reference Site.

The results of the ecological health monitoring are presented in **Table 74**. Sites with higher scores are in better condition (the maximum potential score is 39). Factors such as weed invasion, low native diversity in the mid and ground layers, and limited connectivity often scored values of 1, reducing overall scores for each site. For the 2021 survey the summed scores provided in **Table 72** indicate that for Carrington Billabong ecological health has declined for four of the five sites (CB1, CB3, CB4, CB5) and one is unchanged (CB2). Four of the Priority Sites have declined in condition (HR1, HR8, HR13, WB1) and two have increased in condition (HR2 and HR11), whilst for the Reference Site, four of the five sites have improved in ecological health (CA1, CA2, CA3, CA5) and one declining in health (CA4).

A decline in ecological health was mainly attributed to time since flooding, native species diversity and cover. High cover of weeds may have masked the presence of native species at some sites. Based on advice in 2020, the time since flooding at some sites was believed to be recent (<5 years – score of 3), when advice in 2021 indicates that it is likely that the monitoring points at Carrington Billabong, along the Hunter River (except HR1) and Wollombi Brook were most recently flooded in 2007 (over 10 years – 1 point).

Note that the monitoring point HR1 was flooded in 2020. This affects the 2020 ecological health scores and has decreased the ecological health scores at these sites by 2 points. Taking this into consideration, a reduction in ecological health is not likely to exceed more than 10% at all sites. The adjusted 2020 scores means that sites CB1 and CB2 improved in condition in 2021.

The average canopy health score of the sites monitored increased from 2.4 in 2017 to 3.8 in 2020. This subsequently decreased to 3.5 in 2021. While there was only a slight decrease in in overall condition, canopy density generally remained stable or decreased.

New data was collected in 2021 regarding canopy extent, crown tip growth, leaf die off and the presence of cracked bark. Trees at Carrington Billabong had more reduced canopies, low levels of new growth and moderate to minimal levels of leaf die off. Cracked bark was uncommon. However, the trees monitored at the reference site had extensive canopies, moderate levels of new growth and minimal leaf die off. Cracked bark was also absent. Canopy extent and leaf die off will provide a better assessment of dieback in future years.

Tree health at Carrington Billabong is generally lower than would be expected given the volume of rain that the area has received during 2020 and 2021. While some months have received below average monthly rainfall during the monitoring period, a general decrease in condition at Carrington Billabong (particularly healthy trees) as opposed to a general increase in condition at the Reference Site is noted and investigations will continue.

It is possible that observer variation and bias is the cause of variation in the data from the previous year of monitoring. Observer bias cannot be completely eliminated from the monitoring program given the qualitative data collected, however, visual guides have been used to ensure greater consistency when recording some qualitative data such as canopy and tree health scores and should continue to be used as part of the next monitoring event.

Table 74 A comparison of the remnant ecological health assessment scores between monitoring events

Site	Remnant Ecological Health Assessment Score*						
	2007	2008	2010	2012	2017	2020	2021
CB1	21	25	27	24	28	28 (26)	27
CB2						28 (26)	28
CB3						31 (29)	28
CB4						30 (28)	26
CB5						27 (26)	25
HR1	25	21	25	26	26	27	25
HR2	32	32	28	25	25	25 (23)	25
HR8	23	23	2	25	24	28 (26)	24
HR11	26	28	25	25	26	26 (24)	27
HR13	24	26	26	24	24	26 (24)	22
WB1	28	28	27	29	26	29 (27)	25
CA1	29	27		31	31	31	32
CA2	26	25		26	28	30	32
CA3						30	31
CA4						30	29
CA5						30	33

* Out of a maximum of 39.

Note for 2020 scores, an adjusted score based on flood information provided in 2021 is in brackets.

Note: CB = Carrington billabong, HR = Hunter River sites, WB = Wollombi Brook sites, CA = Reference Site (Camyr Allen)

The change in remnant ecological health assessment scores from 2020 data is shaded to indicate a decrease in condition (red), stable condition (blue) and improved condition (green).

The monitoring observations from the Carrington Billabong that relate to the goals and objectives of the Strategy are presented in **Table 75** below.

Table 75 Observations that relate to the monitoring objectives outlined in the strategy

Goals	Objectives	2021 Observations
To reduce the impacts of threatening processes on the stands	To supress or eradicate the *in situ* environmental factors that are acting to reduce the viability of the remnant population	Weeds continue to dominate the species assemblage at Carrington Billabong and priority sites. This data does not mirror the trends observed at the Reference Site where a decrease in weed diversity and an increase in native diversity was recorded. However, the previous 10 years of data suggests that active management and restoration should continue in order to "suppress and eradicate" this threat. Flooding is required for germination of RRG. There have not been any significant flooding events since 2007, and excessive rainfall is likely to be the cause of isolated/patchy areas of inundation.
	To improve the conditions within this population such that it can withstand reasonable periods of stress, predation and shortage of water supply	Average tree health and canopy condition data showed a slight decline in health for 2021 within Carrington Billabong.
To aid the establishment of the appropriate conditions to promote the health of the River Red Gum populations	To identify the likely *ex situ* factors that are contributing to the reduction in viability of this population and the health of the billabong and act, where possible, to control those factors or to take account of those factors in management approaches if they are not able to be directly controlled	The ERA outlines the groundwater exceedance issues around Carrington Billabong and ecological monitoring and triggers.
	To ensure that the results of ongoing monitoring are appropriately used to modify the management regime in response to new or unexpected information	This report is provided to HVO to inform ongoing management decisions. Tubestock plantings occurred in 2021 and are planned for 2022 to buffer the Billabong from wind events, and encourage bird diversity, over time.
Increase the understanding of the	Develop an understanding of water requirements through the	The Strategy requires additional monitoring to be undertaken when triggered by flooding. As the flooding

Goals	Objectives	2021 Observations
water requirements of the River Red Gums	timely monitoring of responses of River Red Gums to flood and storm events	occurred following the 2021 monitoring event, and was still inundated during early 2022, the additional monitoring was not required in 2021 Groundwater monitoring is undertaken at Carrington Billabong. Flood modelling and commence to flow models will identify the flood levels required to inundate Carrington Billabong.
To enhance the River Red Gum population to enable it to persist as a viable functioning population	To assist this population to continue to self-propagate to ensure ample replacement of senescing trees with juvenile recruits.	Weeds continue to dominate the RRG community and can limit natural regeneration of RRG. Active weed management will continue in order to assist the community to become a self-sustaining population. However, it is also likely that, given the predominance of weeds in the area, flooding, wind and other vectors will affect ongoing weed management efforts.
	To support the establishment of a self-sustaining, functional and viable ecosystem that resembles what is likely to have been present in Carrington Billabong prior to European settlement	Species diversity is similar between Carrington Billabong and the Reference Site. Recruitment is evident at both Carrington Billabong and the Reference Site but no (likely) recent recruitment was noted.
	To support the establishment of a self-sustaining, functional and viable ecosystem	Remnant Ecological Health Assessments improved at the Reference Site compared to Carrington Billabong, and the Priority Sites remain approximately 10-20% lower.
To increase biodiversity including residence habitat, foraging habitat and native flora and fauna species	To increase habitat for the identified and potential native flora and fauna species	The area of habitat has not increased for flora and fauna. Tubestock plantings that occurred in 2021, and are planned for 2022, will increase the habitat area and local linkages once the tubestock become established and develop with time.
To determine if there is any improvement or deterioration in RRG within Carrington Billabong	Data shows a slight decline in RRG condition. Average canopy health increased from 2.4 in 2017 to 3.8 in 2020, however, declined slightly to 3.5 in 2021.	

Goals	Objectives	2021 Observations
To determine if there is any improvement or deterioration of the natural habitat at Carrington Billabong	Data shows a slight decline in the condition of remnant vegetation at Carrington Billabong and Priority Sites.	
To provide management recommendations to achieve further improvements in the ecological management of the site to assist in the recovery of RRG and their habitat	• Continued weed management • Flood and/or flow modelling of Carrington Billabong to understand flood levels that initiate commence to flow into the billabong. • Record the boundary and duration of inundation events within Carrington Billabong to identify potential areas for recruitment events/actions.	

8.13.3 Ecological Risk Assessment

As noted in the Groundwater section, HVO has a monitoring programme in place to monitor changes in groundwater quality due to seepage from the North Void TSF. Carrington Billabong is located adjacent to the North Void TSF.

As part of Condition 8, U1 of EPL 640, HVO has implemented a monitoring program that includes an Ecological Risk Assessment (ERA) (Umwelt 2020) that assesses the impact to the RRG community from the North Void TSF seepage. The annual monitoring is required to detect any notable decline in ecological condition of RRG at the Carrington Billabong. Should ecological monitoring identify any of the following factors, additional investigations will be implemented to determine the cause:

- An increase in tree dieback of 10% or greater compared to the previous year.
- Adult tree death of 10% compared to the previous year.
- Remnant ecological health scores decline of 10% compared to the previous year.
- Unforeseen event that indicates a relatively rapid decline in ecological health or function that can't be linked to catchment wide causes (such as drought).

The results of the 2021 monitoring relative to these ERA trigger values is presented in **Table 76**.

0Table 76 Factors to be considered to detect a notable decline in ecological condition of the RRG community in accordance with the ERA (Umwelt 2020)

Trigger	Monitoring outcome - 2020
Groundwater quality indicates an increase in seepage from NV TSF	All bores observed an increasing water level in response to increased natural recharge with above average rainfall and streamflow across 2021. As a result of the increased surface water recharge and rainfall, groundwater quality has improved. Sulphate concentrations reduced in most bores consistent with the modelling predictions. Only one bore (CFW55R) recorded water quality exceedances for the SO4/Cl ration from May to October 2021. This bore is closest to the NV TSF seepage point
An increase in tree dieback of 10% or greater compared to the previous year	Data for 63 tagged RRG trees was collected. Canopy cover scores were compared to 2020 data for the same 63 RRG trees. Most trees had a stable canopy cover or canopy cover decreased. 29% of trees recorded a reduced overall condition, and 43% scored a reduced canopy density. However, canopy cover is not an accurate measure of dieback as it is a measure of the entire canopy. Dieback is typically a phenomenon that affects the extremities of the canopy. New data on canopy extent and leaf die off will provide a better assessment of dieback in future years. As more than 10% of trees had a reduced canopy density, based on the data available, this is viewed as a “redflag” to potential dieback. Ecological health data scores dieback as <10%, 10-30% and >30%. Dieback scores increased from <10% to 10-30% at CB3 and CB4. All other sites remained stable.
Adult tree death of 10% compared to the previous year	No trees have died since monitoring in 2020.
Remnant ecological health scores decline of 10% compared to the previous year	Remnant ecological health scores were generally lower from 2020 to 2021 for Carrington Billabong and the Priority Sites. Site CB4, HR8, HR13 and WB1 all had a greater than 10% reduction in health. However, these scores were influenced by incorrect flooding information upon which 2020 data was based. When 2020 was corrected, none of the sites had a reduction in ecological health scores of greater than 10%. A general increase in remnant ecological health was recorded at the Reference Site.
Unforeseen event that indicates a relatively rapid decline in ecological health or function that can’t be linked to catchment wide causes (such as drought)	Although a decline in general condition compared to the Reference Site has been noted, a rapid decline has not been observed in the ecological health or function of the HVO RRG population.

8.13.4 Management Actions

Weed Management

Weed management occurred throughout the River Red Gum stands at HVO in 2021, specifically within and adjacent to the Carrington Billabong, alluvial land River Red Gum populations and the stands occurring in the Barry's Pit area (**Figure 112**). This included targeted spraying of various species and broad slashing of predominately Indian Mustard (*Brassica x juncea*), Farmers Friends (*Bidens pilosa*) and various species that dominated the understorey following the extensive rainfall received throughout the year. In addition, the Billabong has established plots that were planted with understorey species and protected from herbivores by wire fencing. The removal of weeds occurring within these established plots occurred during 2021 and can be seen in **Figure 111**. It was noted in 2021 that small birds had created nests within these understorey plots, and hence these areas are being managed to reduce weeds and permit the native vegetative cover within the plots to increase, improving the habitat for resident species.

A targeted campaign to reduce the weed population within the riparian stand of *E.camaldulensis* along the Hunter River adjacent to the Billabong also occurred in 2021. These works removed weeds from a 2km reach of the Hunter River within, and upstream of, the priority RRG area next to the Billabong. The main weed species removed during the campaign were balloon vine (*Cardiospermum grandiflorum*), Castor oil (*Ricinus communis*) and fennel (*Foeniculum vulgare*) along the top of the bank. As the next rehabilitation planting programme in the Billabong is intended to link the Billabong with this priority area, these works will be repeated during 2022.

Weed removal teams reduced the African olives that occur within the *E.camaldulensis* populations that occur along the Hunter River west of the HVO bridge during 2021. This followed the successful efforts that occurred along the northern bank in 2020. The density of the olives along the southern bank meant that the 'cut and paint' method wasn't as effective as intended and focussed attention will be required to eradicate this species from this area during 2022.

Figure 111 Prior (left) and post (right) hand weeding carried out in native planting plots, Carrington billabong in June 2021.

Figure 112 Weed control undertaken in River Red Gum Areas 2021

Active Regeneration

As discussed previously, to assist to protect the existing stand at Carrington Billabong from future storm and wind damage, HVO planted an additional 200 *E.camaldulensis* tubestock within the Hunter River floodplain adjoining the billabong to broaden the population (Figure 113**).** These tubestock were watered and hand weeded as needed during 2021 to assist survival and establishment. A clear majority of these tubestock have survived and growth rate has exceeded expectations.

To facilitate access and monitoring of the River Red Gum Reference Site, HVO agreed to plant additional plants at a designated site specified by the landholder. During 2021, 200 *E.camaldulensis* tubestock were established within the landholders designated location.

To ensure genetic integrity of each population, seeds from each location was collected during 2020 for propagation and planting back within the location from which it came. Additional plantings are planned to occur in 2022 in both the Billabong and the Reference Site.

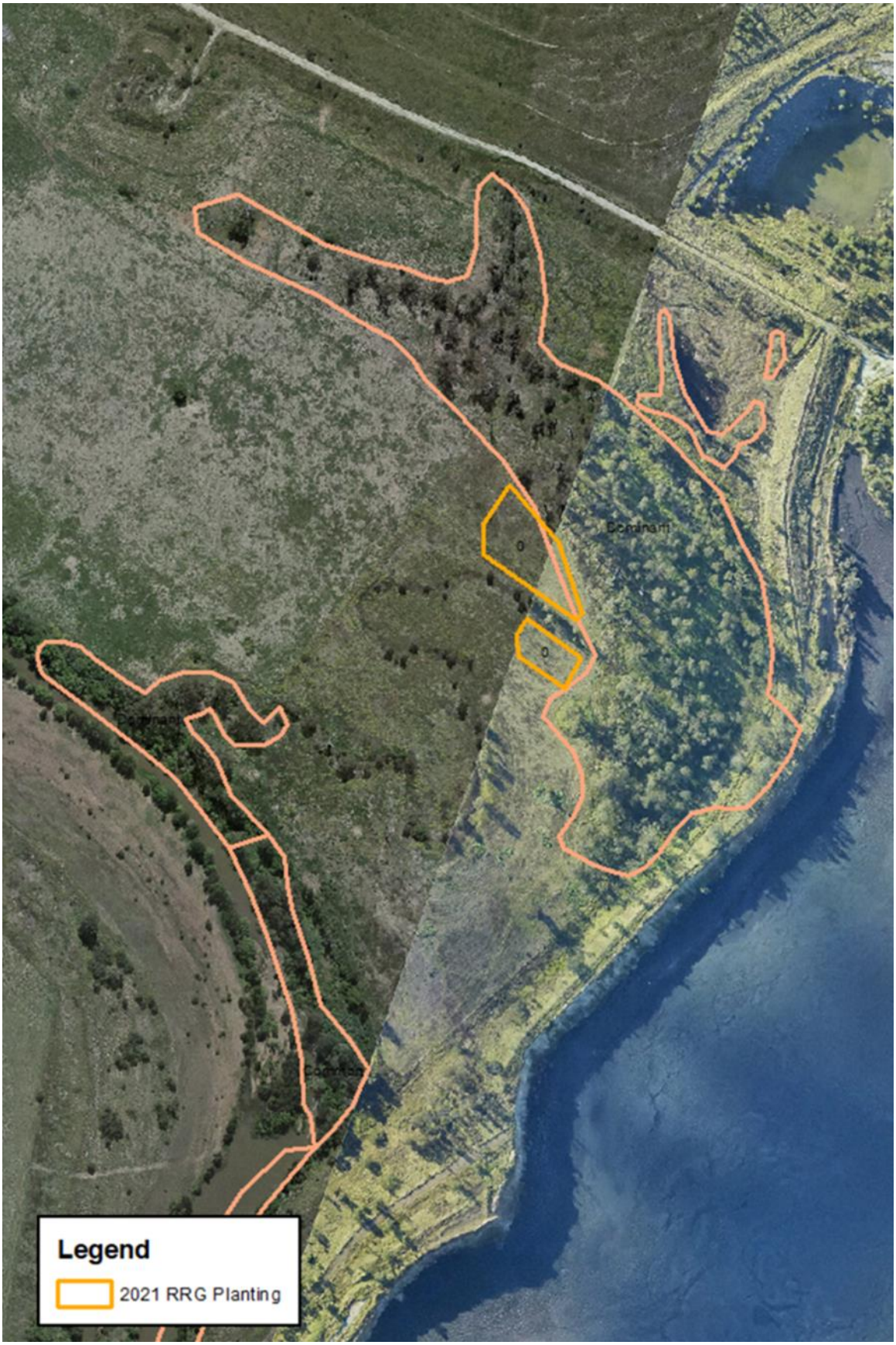

Figure 113 Location of the 2021 tubestock plantings at the Carrington billabong

Feral Bees

Two feral bee colonies were identified within the Carrington Billabong (**Figure 114** and **Figure 115**). Competition from feral honeybees *Apis mellifera L*. is listed as a key threatening process under the NSW *Biodiversity Conservation Act 2016* due to the potential for feral bees to colonise habitat hollows in trees to the detriment of native fauna utilising, or potentially utilising, the hollow.

Upon identification, an empty bee hive with starter strips and some honey to entice the bees into the hive was obtained to place next to each colony. One colony had moved on by the time the bee hives were obtained but the collection of the second colony was successful and the bees were removed from the Billabong.

Figure 114 Feral bee beard identified in the Billabong during September 2021

Figure 115 Feral bee population identified within a tree guard in Billabong in September 2021

Condition Assessments

To comply with the management actions outlined in the Strategy relating to the control of feral animals within the lower priority sites, a condition assessment was undertaken across the priority and low priority River Red Gum sites at HVO. The assessment documented any identifying features indicating the presence of feral animals residing in the locations, such as rabbit warrens, and summarised the weeds that need to be eradicated from each site. The results determined that a small number of sites attended contained burrows and these will be managed during the 2022 vertebrate pest control activities.

Importantly, the assessment provided valuable information regarding the required management actions relating to weed and grass management at the lower priority sites. Weed and grass management at these sites will also be implemented during 2022 to facilitate improved habitat for the regeneration of the River Red Gum populations.

Vertebrate Pest Control

As part of HVO's Vertebrate Pest Action Plan, programmes are carried out on a seasonal basis and include sites where the River Red Gum populations are found. These programmes are conducted at a level of frequency designed to disrupt pest species breeding/colonisation cycles and employ a variety of methodologies including baiting, trapping and ground based shooting. Further detail on vertebrate pest control undertaken in 2021 is included in the Vertebrate Pest Management section.

8.13.5 River Red Gum Condition Summary

Overall, the comparison of the monitoring data between 2021 and previous events have indicated that, weed management was a priority during the year due to the increased rainfall promoting weed germination, and the potential for weeds to inhibit and outcompete natural regeneration of the River Red Gum community.

The condition assessments determined that the Billabong did not respond as favourably to the improved environmental conditions as the Reference Site, and the Priority Sites at HVO were approximately 10-20% lower again. Despite the average canopy health in the Billabong increasing since 2017, additional works to encourage further improvement is required.

The control of feral pests and weeds within areas managed for the River Red Gums at HVO will continue and efforts to enlarge and protect the stands of River Red Gums both at HVO and within the reference site have will be repeated during 2022.

8.14 Biodiversity Offsets

8.14.1 Goulburn River Biodiversity Area Overview

In accordance with condition 29 of HVO's Project Approval, PA 06_0261, Hunter Valley Operations are accountable for managing a 140ha offset at the Goulburn River Biodiversity Area (BA).

HVO manage a number of other offsets including the Wandewoi, Condon View, Crescent Head and Mitchelhill biodiversity areas, however, these are managed under EPBC approval 2016/7640, are subject to compliance reporting under that approval and are not subject to further discussion in this document.

The Goulburn River BA is located near the town of Merriwa and, when considered in combination with the adjoining offset for the Warkworth Mine, forms an area of protected vegetation extending from the Goulburn River National Park (Figure 117). The Goulburn River BA is managed according to the Goulburn River Management Plan that is available on the HVO public website (www.hvo.com.au).

Given that the Goulburn River offsets for the Warkworth Mine and HVO are adjacent to each other and both parties have a common managing partner in Yancoal, HVO and the Warkworth Mine have a commercial agreement for the HVO BA to be managed by the Warkworth Mine on its behalf. The benefit of this agreement is a reduction in duplication related to the management and monitoring activities that are undertaken by consultants and contractors. As such, while the figures presented below may include information relating to the Warkworth Mine, the text will focus on the data and activities originating from the HVO BA.

8.14.2 Weather Records

Overall, the rainfall recorded at the closest weather station to the Goulburn River BA exceeded the average total rainfall in 2021 (**Figure 116**). In this period, the Merriwa (Roscommon gauge) received 908.2 mm, which is well above the mean average rainfall for the area (595.3 mm). Exceedances of the mean rainfall were typical of records occurring across the Hunter Valley during 2021.

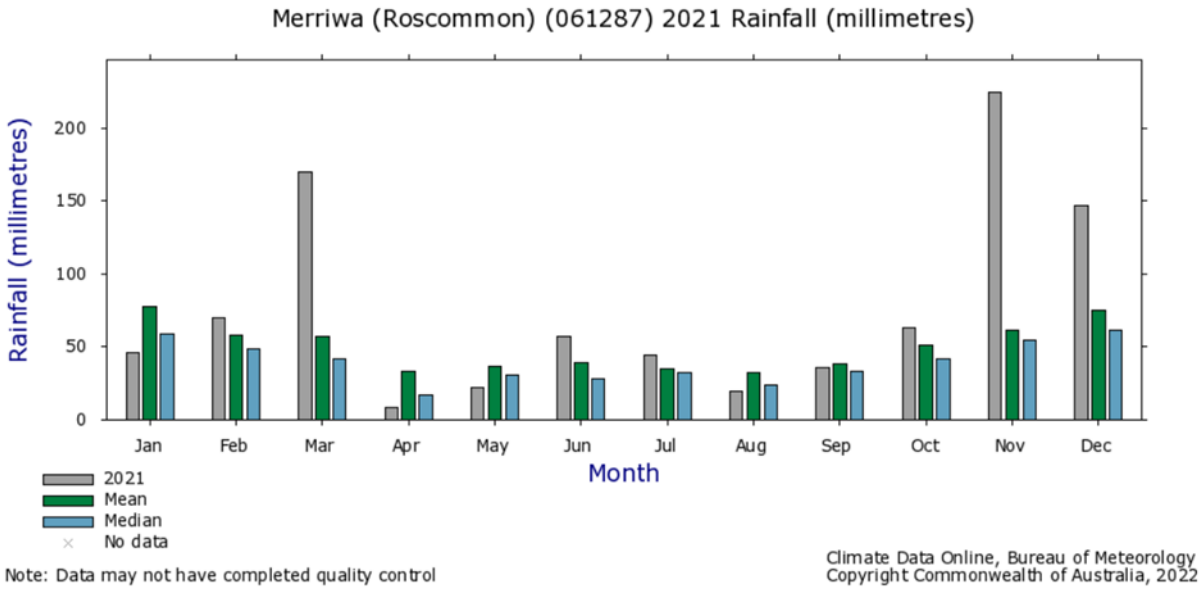

Figure 116 Rainfall records recorded at the Merriwa (Roscommon Gauge) - 2021

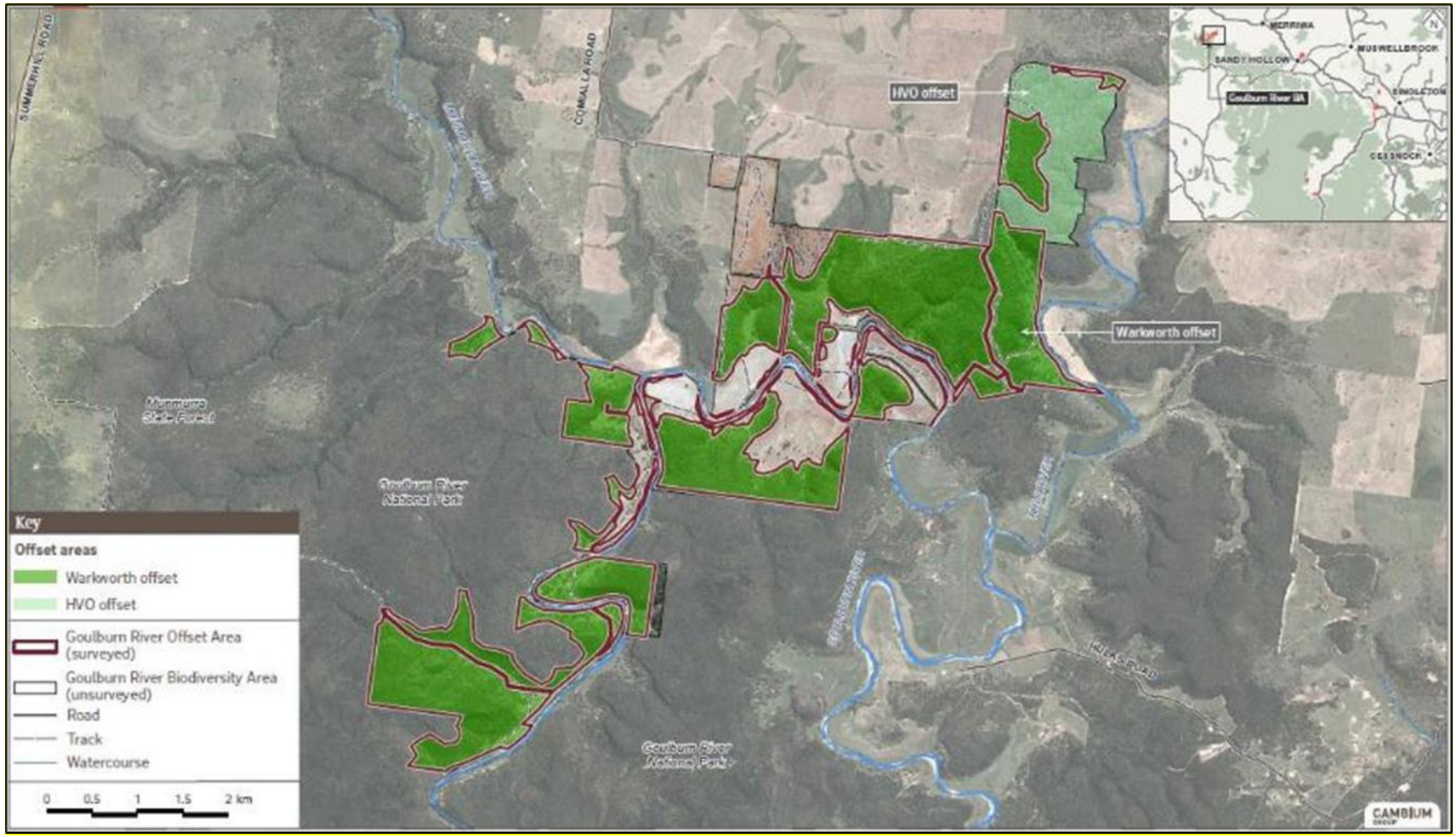

Figure 117 HVO's Goulburn River Offset and adjoining Warkworth Mine Offset

8.14.3 Biodiversity Area Management Activities

Access to the HVO portion of the Goulburn River offset is via the Warkworth Mine offset and requires two crossings across the Goulburn River. Due to the extensive rainfall experienced during 2021, flood waters in the Goulburn River was at a depth such that safe access was prevented and once the water had receded, one of the crossings had been damaged by the floodwaters.

The cost to repair the crossing was prohibitive and access via an upgrade to a walk trail was proposed. This activity involved rock breaking equipment and has been delayed during 2021 due to Covid 19 restrictions and inclement weather. The track upgrade is occurring in 2022.

As a result, any activities undertaken within the HVO portion, required an extensive walk up a vegetated escarpment. This requirement restricted the practical application of the various management activities planned to be undertaken at the Goulburn River BA throughout 2021.

HVO asked the adjoining landholder if access to the offset could occur via his property. Unfortunately, this request was denied on Covid 19 grounds and access to the HVO offset was only possible via the internal tracks. **Figure 118** indicates the current access across the Goulburn River (yellow track) and the alternate walking track (red track) that is currently being upgraded.

In accordance with the approved management plan, no monitoring other than property inspections were scheduled to be undertaken during 2021. A review of the bird assemblage monitoring locations identified that one monitoring location within the HVO offset was on the MTW side of the track. In addition, the previous monitoring recommendation suggested that an additional monitoring point be added to the HVO offset. As a result, a supplementary bird monitoring event was undertaken to assist to develop the baseline analysis for the HVO offset.

A summary of the key actions in the offset management plan is outlined in **Table 77** below.

Table 77 Biodiversity Area Management Activities 2021

Activity	Description
Weed Control	No access obtained to undertake this activity.
Bird Assemblage Monitoring	None scheduled in 2021, however, a supplementary bird assemblage monitoring event was undertaken.
Infrastructure Management and Improvement	No access obtained to undertake the property inspections in 2020. This included the Rapid Condition Assessment.
Strategic Grazing	Strategic grazing activities did not take place during the 2021 reporting period.
Vertebrate Pest Management	Access restricted due to the Goulburn River crossings being impassable during 2021. Two aerial shoots were undertaken to control vertebrate pests.

Figure 118 Access locations from the MTW offset to HVO's Goulbourn River Offset

Bird Assemblage Monitoring

As discussed above, no bird monitoring was scheduled for 2021. Despite this, a supplementary monitoring event was undertaken to develop the baseline data for the offset further.

The consultant reported that the conditions for bird assessments were good for bird watching, the shrub layer is thriving and lots of birds were observed.

The location of HVOGR1 occurred on the boundary of HVO and MTW offset. This site was relocated approximately 80 metres to the southeast within the same vegetation community. In addition, for statistical purposes, an extra monitoring point was included to be assessed in future monitoring events.

The species detected during the monitoring event are presented in **Table 78**.

No swift parrots or regent honeyeaters were detected occupying the HVO Goulburn River BA during the surveys.

Threatened species identified within the offset, but not necessarily within the survey areas, included Little lorikeets (*Glossopsitta pusilla*), Brown treecreeper (*Climacteris picumnus*) and the Speckled warbler (*Pyrrholaemus sagittatus*).

Overall bird activity was high and abundant eucalypt blossom attracted birds to the area.

Table 78 Summary of bird species identified during the supplementary assessment within the HVO Goulbourn River BA in 2021

	Site			
Species	**HVOGR1**	**HVOGR2**	**HVOGR3**	**HVOGR4**
Australian magpie	X			
Australian raven	X	X		
Black-faced cuckoo-shrike			X	
Brown thornbill	X		X	
Brown-headed honeyeater	X		X	X
Brown treecreeper*			X	
Buff-rumped thornbill		X		X
Eastern rosella	X			
Eastern yellow robin		X	X	
Galah	X			
Grey fantail			X	
Grey shrike-thrush			X	X
Jacky winter	X			
Leaden flycatcher				X
Little friarbird	X			
Magpie lark	X	X		
Mistletoebird	X		X	
Musk lorikeet	X	X	X	
Noisy friarbird	X	X	X	
Painted buttonquail			X	
Pallid cuckoo				X
Peaceful dove	X			
Red-winged parrot	X			
Rufous songlark		X		
Rufous whistler	X			X
Speckled warbler*			X	
Spotted pardalote	X			X
Striated pardalote	X	X	X	
Superb fairy-wren	X			
Varied sittella*				X
Variegated fairy-wren			X	
Weebill	X	X	X	X
White-eared honeyeater			X	X
White-naped honeyeater			X	
White-plumed honeyeater	X			
White-throated treecreeper		X	X	X
White-winged triller	X			
Willie wagtail	X	X		
Yellow thornbill		X	X	
Yellow-faced honeyeater	X	X	X	X
Yellow-rumped thornbill	X			

* Threatened species under NSW *Biodiversity Conservation Act 2016*

Property Inspections and Rapid Condition Assessment

Due to the restricted access associated with the high water levels, the property inspections were not undertaken during 2021.

Feral Animal Control

In October 2021, two aerial shoots were undertaken across the offset. The first by National Parks and Wildlife Service (NPWS) occurred in the adjacent Goulburn River National Park and included the MTW and HVO offset properties. No results were obtained from NPWS from this activity.

The second aerial shoot was undertaken by the Local Land Services (LLS). This activity was able to remove a number of feral pigs from areas along the Goulburn River and included one pig shot within the HVO offset. The results of this shoot is illustrated in **Figure 119.**

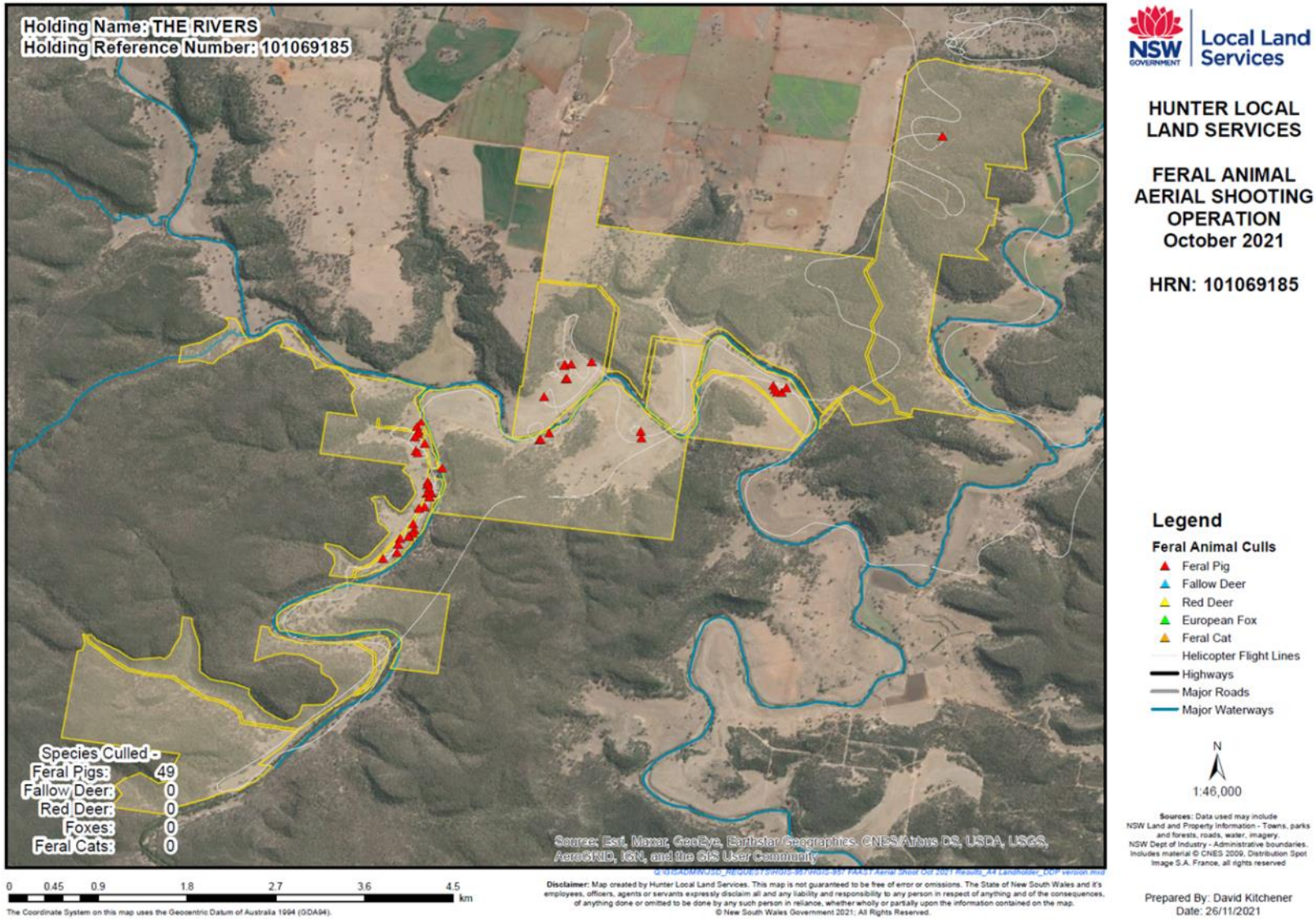

Figure 119 Aerial shooting of feral vertebrate pests at the Goulbourn River BA

9 Community

9.1 Complaints

HVO provides a 24-hour Community Complaints Hotline (via freecall number 1800 888 733) for community members to comment on concerns relating to its operations. All complaint details are recorded in a database in accordance with Condition M4.2 of Environmental Protection Licence 640 and made available on HVO's website (www.hvo.com.au).

A total of 25 complaints were received by HVO during 2021 (**Figure 120**) 11 of these complaints were received from one residence. This represents an increase of 9 community complaints from the previous year but a similar trend to the historical record (**Figure 122**). Complaints were predominantly received in blasting (overpressure and dust), noise and lighting. **Figure 121** provides further detail regarding the number of complaints per compliant type. Details of complaints received in 2021 are included in **Table 79**. In response to lighting complaints HVO commenced topographical assessments of mine working areas to inform location of lighting plants to reduce visibility of receptors. Further planning controls were also implemented to mitigate against dust blast plumes by applying a new blast plume model and integrating this with an internal checklist and escalation process for blasts identified with high dust or fume risk.

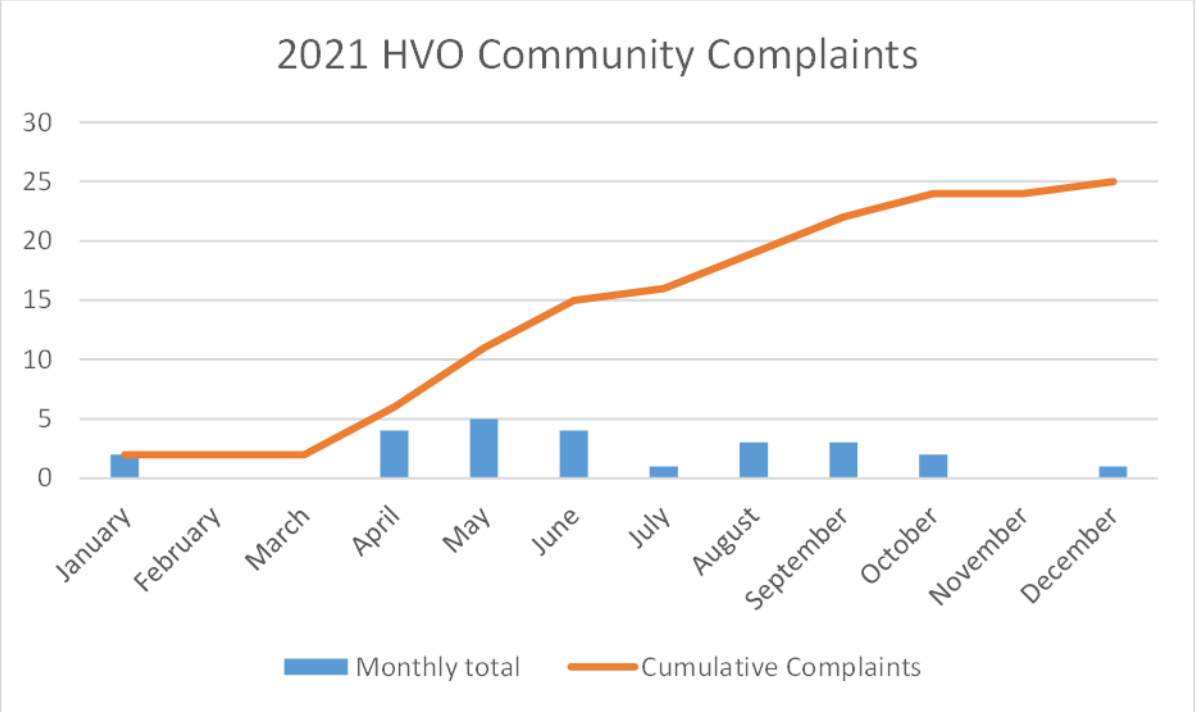

Figure 120 Summary of Community Complaints in 2021

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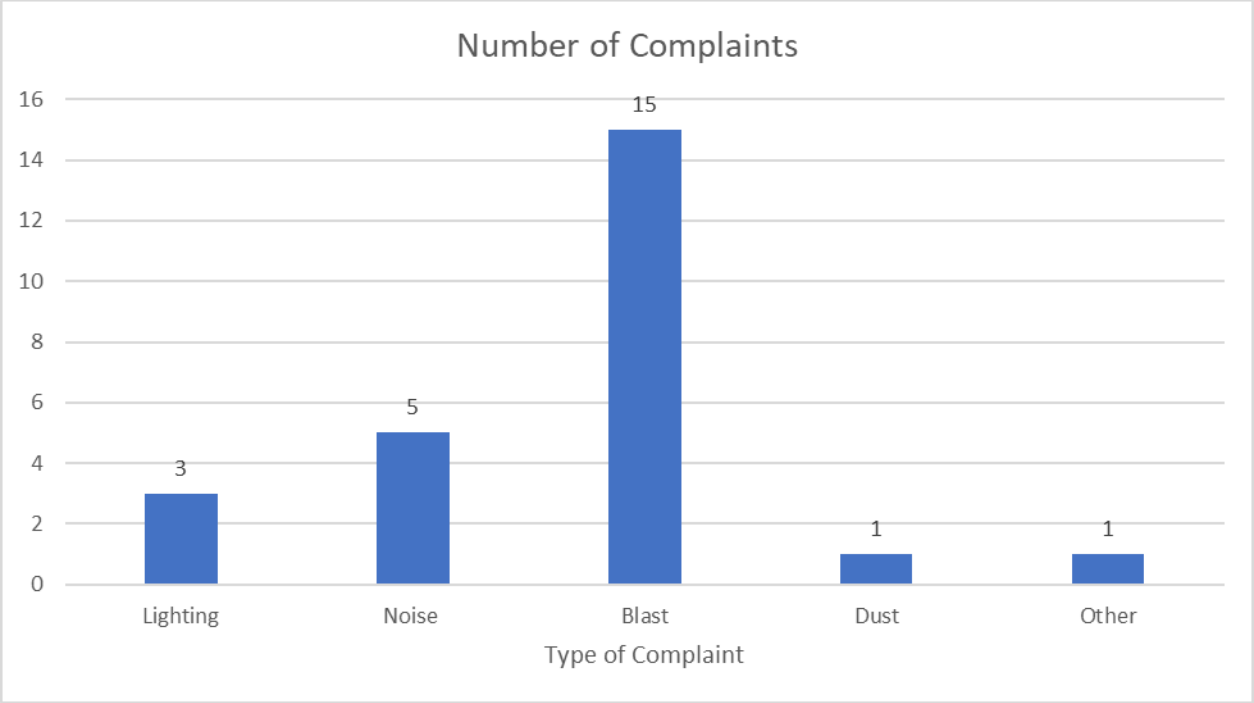

Figure 121 Number of Complaints per Type

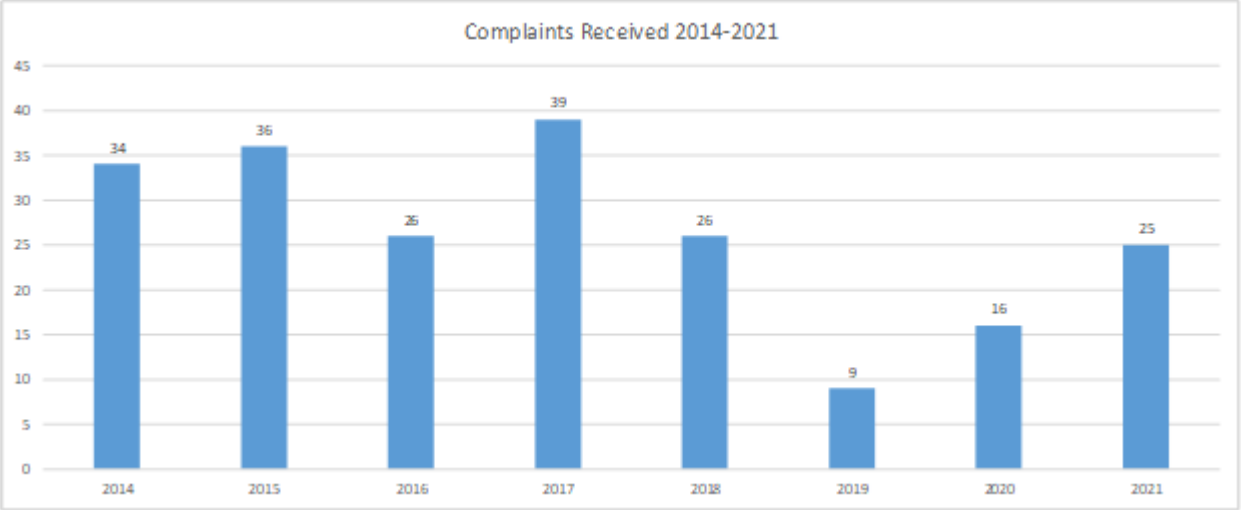

Figure 122 Community Complaints 2014 – 2021

Table 79 Details of Complaints Received in 2021

Date	Time	Nature of Complaint	Description	Follow Up Action
2 January 2021	10.12pm	Lighting	A resident from Long Point called the HVO Community Complaints Hotline to advise that two lighting plants from HVO operations had been shining directly into the window at the residence preventing the resident from sleeping.	The OCE shut down the Pit 2 RL125 dump activities and turned the lights off after which he called the resident back to see if there had been any changes to the offending lights. The resident confirmed that they could no longer see the lights and was happy with the action taken. The dump plan was modified to operate during daylight hours.
3 January 2021	11.48pm	Noise	A noise complaint was received from a resident in Long Point at 11.48 pm on 3 January 2021. The resident registered a further complaint at 12.12am on 4 January in regard to a loud whining sound coming from the pit resulting in sleep disturbance.	The OCE had reviewed noise levels and contacted the resident advising that the noise was below criteria however was in the process of undertaking an inspection of the area. The OCE travelled to Long Point Road and listened near the residence, where he advised that a low-level mining noise could be heard and an occasional whining sound that he believed to be the auto–retard on the haul trucks. The OCE did not consider the noise to be excessive. The Environment and Community Officer (E&C Officer) spoke with the complainant at 2.39pm on 4 January who confirmed that a whirring noise from the pit, in addition to dozer tracks and trucks revving could be heard at the time of the complaint. No noise alarms were received from the Long Point noise monitor. The highest 15-minute noise level recorded between 10 pm and 12:15 am was 19dB (low frequency) against a criterion of 35dB.
10 April 2021	1.27pm	Blast	A Maison Dieu resident sent a text message to the E&C Officer directly to confirm that the noise and vibration impact from shots fired in the Cheshunt Pit at 1.26pm and 1.27pm were felt at the resident's property.	Blasting data from the shots fired at 1.26pm indicate that the overpressure and vibration levels were below compliance levels being 113.6 dB and 0.47mms respectively. The complaint was recorded in the Community Complaints Register.
23 April 2021	3.40pm	Blast	A resident from Maison Dieu sent a text message to the E&C Officer at 3.41pm to advise that impacts from a blast fired at HVO at 3:40 pm were felt at the residence.	Blast levels were checked and deemed to be compliant. The Maison Dieu monitor measured overpressure of 100.06 dB(L) against a maximum criterion of 120 dB(L) and ground vibration of 0.47 mm/s against a maximum criteria of 10 mm/s.

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Date	Time	Nature of Complaint	Description	Follow Up Action
				The E&C Officer contacted the resident at 3.54pm to confirm the details of the complaint who advised they could feel the ground move and it rattled crockery in the house. They asked for the complaint to be recorded as a complaint rather than feedback. E&C Officer advised levels were compliant
30 April 2021	6.09pm	Blast	A resident in Maison Dieu sent a text message to the E&C Officer at 6.09pm to report that impacts from the blast fired in the Cheshunt Pit at 3.22pm were felt at the residence.	Blast levels were checked and deemed to be compliant. The Maison Dieu monitor measured overpressure of 96.74 dB(L) and ground vibration of 0.47 mm/s. The E&C Officer contacted the resident at 6.27pm to confirm the details of the complaint. The resident asked for the complaint to be recorded as a complaint rather than feedback.
30 April 2021	6:09pm	Lighting	A resident in Maison Dieu sent a text message to the E&C Officer at 6.09pm to request that the position of the lighting plant at the Cheshunt Dump be changed, as light from the lighting plant was shining directly into the resident's house.	The E&C Officer organised with the OCE to investigate the position of the lighting plant on the Cheshunt dump and move the plant. The E&C Officer called the resident at 7.04pm who confirmed that they could no longer see the lighting plant and that they were satisfied with the outcome.
1 May 2021	9.31pm	Noise	A resident in Jerrys Plains contacted the Complaints Line with the details 'noise complaint' and requesting a call back as soon as possible. The OCE phoned the resident at 9.31pm, who advised the noise sounded like a horn from a digger from the West Pit.	The OCE spoke with the operator of Ex313 at the Riverview Pit and asked to just keep the horn to one short sharp blow. In addition, he also called the Mining Supervisor in the West Pit and notified the operators of Ex 330 & Ex 310 about the complaint with the same instruction as given to the operator of Ex313. No further noise complaints were received for the remainder of the shift. Checks were subsequently undertaken on horn compressed air pressures and reduced to minimum where possible. The noise data from the Jerrys Plains ENC was checked with the noise reading for the period of the complaint under the compliance noise limit
10 May 2021	2.25pm	Blast	A resident of Maison Dieu sent a text message to the E&C Officer at 2.25pm to report that impacts from the blast fired in the Cheshunt Pit at 2.22pm were felt at the residence.	The E&C Officer contacted the resident at 2.36pm to confirm the details of the complaint. The resident asked for the matter to be recorded as a complaint.

Date	Time	Nature of Complaint	Description	Follow Up Action
				Blast levels were checked and deemed to be compliant. Maison Dieu monitor measured overpressure of 101.67 dB(L) and ground vibration of 0.17mm/s.
11 May 2021	10.01pm	Noise	A resident of Jerrys Plains contacted the Complaints Line at 10.01pm about noise which they believed was coming from the dragline at the Riverview pit.	The OCE phoned the resident at 10.06pm, who ascertained the resident could hear general mine noise from Wambo and a HVO Dragline was making a hum that they could hear whilst swinging/slewing. The OCE instructed the Dragline operator to slow down the slew. This was subsequently relayed to the resident and that if there were further noise disturbances to call back. No subsequent complaints were received for the remainder of the shift. The OCE checked the noise monitor, as well as any noise alarms received for the Moses Crossing area (nearest monitor to the complainant's house), which was below compliance levels prior to and at the time of the complaint.
18 May 2021	7.50pm	Lighting	A resident of Long Point Road called the Community Complaints Hotline at 7.50pm about a light from the HVO South operation shining into their bedroom.	The complainant was contacted by the OCE who through a process of elimination found that the lighting plant on the Auger RL170 South dump was the light causing the complaint. The lighting plant was moved and orientated to the south in response, with no further complaints received. In addition, the windrows on the eastern edge of the dump were also lifted to act as a screen.
27 May 2021	1.13pm	Blast Odour	A resident of Long Point called the Environment and Community Coordinator about an unrelated matter and mentioned that on 27 May 2021 a very strong sulphur smell at their property followed three blasts fired from the Cheshunt P2 area of HVO South on 26 May at 4.37pm, 4.41pm and 4.42pm.	Review of the blasting database confirmed that HVO did blast at the time specified by the resident. Wind direction was west-north-west and generally towards the resident location. No observations of offsite fume.
6 June 2021	1.14am	Noise	A noise complaint was received from a resident of Maison Dieu who reported that they were unable to sleep due to loud equipment noise from HVO which started about sunset	Noise alarms were reviewed for the period of the complaint which showed alarms were received at 9:30pm and 10:30pm from the nearest noise monitor (Maison Dieu). Alarms were responded to by operations, but no obvious source identified and at a time of

Date	Time	Nature of Complaint	Description	Follow Up Action
			and continued through to 3:30am. The resident noted hearing engine noise from a shovel and truck loading noise. The complaint was sent as a text message direct to the E&C Officer and not via the hotline, therefore the complaint could not be communicated to operations at the time.	existing equipment delays. Three 15-minute periods between 5pm and 3:30am exceeded the noise criteria of 41dB, however during these periods the wind speed exceeded 3m/s when noise criteria do not apply due to being adversely impacted by wind on microphones at the noise monitor.
21 June 2021	9.56am	Blast	A resident from Maison Dieu sent a text message to the E&C Officer at 9.56am on Monday 21 June 2021 to report that impacts from the blast fired in the Cheshunt Pit at 2.57pm on Saturday 19 June 2021 were felt at the residence.	Blast levels were checked and deemed to be compliant. The Maison Dieu blast monitor measured overpressure of 93.53 dB(L) and ground vibration of 0.15mm/s. This information was provided to the resident on Monday confirming that both ground vibration and overpressure were below respective compliance levels. It was requested that any future complaints are registered via the HVO Complaints Hotline to allow for more prompt and appropriate response.
23 June 2021	2.19pm	Blast	A resident of Dights Crossing, Maison Dieu left a voicemail message with the Environment and Community Manager at 2.19pm regarding the blast fired from Cheshunt Pit. The E&C Manager returned the resident's voicemail message at 2.48pm and advised him that based on the information provided this would align with the HVO blast fired at 1.13pm.	Blasting data for the blast that was fired from Cheshunt Pit at 1.13pm which registered overpressure of 113.30 dB(L) and ground vibration of 0.21mm/s from the Knodlers Lane blast monitor which is under compliance limits. The E&C Manager relayed to the resident that the blast monitors had recorded below compliance criteria and indications were that atmospheric reinforcement may have influenced the overpressure effect at distance.
23 June 2021	1.23pm	Blast	A resident of Long Point contacted the United Wambo Community Complaints hotline at 1.23pm reporting that the blast fired was really loud and shook their house. The United Wambo Environment and Community Manager spoke with the resident at approximately 2.20pm and then contacted surrounding mines to determine source, subsequently confirming it was HVO.	The blasting data for the blast that was fired from Cheshunt Pit at 1.13pm was checked which registered an overpressure of 113.30 dB(L) and ground vibration of 0.21mm/s from the Knodlers Lane blast monitor which is under compliance limits. The HVO E&C Community Coordinator returned a call to the resident and left a voice message to confirm that the blast that was the cause of the complaint was believed to have originated at HVO.

Date	Time	Nature of Complaint	Description	Follow Up Action
31 July 2021	1.21pm	Blast	A resident from Maison Dieu sent an SMS with photos to the E&C Officer and Environment and Community Manager at 1.21pm on Saturday 31 May regarding visible dust from the shots fired at 1.13pm and 1.14pm from Cheshunt P2 and Cheshunt P1 respectively.	The blast was fired according to internal blasting criteria for wind speed and direction. Wind direction prior to the blast at 1.10pm was at 294 degrees and 291 degrees at 1.20pm a minute prior to the SMS being sent. Wind speed was around 5.8m/s at 1.10pm and 5.5m/s at 1.20pm. The resident's property is at a bearing of ~ 270 degrees from the detonated blasts. Dust levels at both the Maison Dieu and Knodlers Lane monitors were both under the criteria of 50µg/m^3 following the shots being fired and were not observed to spike. The resident was contacted by email on Monday 2nd August at 4.09pm providing wind direction data as requested in addition to the TEOM readings from the Maison Dieu PM_{10} monitor.
13 August 2021	2.00pm	Other	A resident of Jerrys Plains rang the Environment and Community Manager to advise they had been sworn at and verbally threatened by a HVO contractor. The contractor was off duty at the time and had mistakenly entered the resident's yard to purchase firewood. Upon noticing Sydney dealership signs on the contractors' car, a discussion regarding the contractors residential and work details ensued and escalated to the alleged interaction.	The E&C Manager advised the resident that HVO would investigate the matter internally but that it was a civil matter and if they wanted to take further action, they should contact the Police.
20 August 2021	1.49pm	Blast dust	A resident of Long Point rang the Community Complaints Hotline at 1.49pm enquiring if HVO had fired a blast as a large amount of dust was produced. The resident thought that the blast had been fired at around 1.44pm.	It was confirmed that HVO fired a Cheshunt blast at 1.38pm. The 10-minute wind direction at 1:40pm (2 minutes after the blast was fired at 1:38pm) was 269 degrees and the wind speed was 5.9m/s which is within site blasting permissions. Dust levels at the Knodlers Lane monitor (in the path of any dust) were under the criteria of 50ug/m3 at the time of and following the blast. Dust levels at the Maison Dieu monitor reached 53ug/m3 at 1.50pm but then fell. In addition, the 24hr average was below criteria.

Date	Time	Nature of Complaint	Description	Follow Up Action
20 August 2021	1.54pm	Blast dust	A resident from Maison Dieu sent an SMS to the E&C Officer at 1.54pm stating they had concerns from dust from a blast.	See details above
10 September 2021	10.18pm	Noise	A complaint was received from resident at Gowrie (Singleton) regarding a low frequency rumbling noise from HVO while inside their house trying to sleep.	The Environment and Community Manager conducted an inspection which determined HVO truck engine noise was audible from the Gowrie location. The closest monitor (~3km away) at Long Point recorded 33 decibels at 10:15 pm against a criterion of 35 decibels. The monitor is the most representative of the resident's location.
27 September 2021	1.36pm	Blast	A resident from Maison Dieu sent an SMS to the E&C Officer at 1.36pm stating that impacts from the blast had been felt at the residence.	Monitoring data for the blast that was fired in Cheshunt Pit at 1.33pm was reviewed. A ground vibration level of 1.32 mm/s and overpressure level of 94.38 dB was recorded at the Maison Dieu blast monitor which are below compliance limits.
29 September 2021	4.07pm	Blast	A resident from Jerrys Plains sent an email to the HVO website "wanting to know if HVO south pit let a blast off just prior to 4pm causing a large amount of sound and movement at Jerry's plains". The E&C Officer rang the resident at 4.21pm to confirm that HVO had blasted in the West Pit at 3.54pm.	The blasting data for the shot fired at 3.54pm in West Pit was reviewed which showed that both ground vibration (0.13mm/s) and overpressure (101.46 dB) were under compliance limits.
25 October 2021	9.02am	Blast	A resident in Maison Dieu contacted the E&C Officer at 9.02am to report that there was excessive dust and vibration produced from a blast on 25 October at around 4pm.	HVO fired two blasts in Cheshunt Pit at 3:46pm and 3:48 pm. Overpressure and ground vibration levels were under compliance limits (100.14 dB(L)/0.10 mm/s and 101.59 dB(L)/0.20 mm/s respectively). The Knodlers Lane TEOM was checked and showed that dust levels were below compliance limits following the two shots. Camera footage was checked indicating limited offsite dust. Blast was fired in accordance with blasting permissions
26 October 2021	2:42 pm	Blast	A resident from Maison Dieu contacted HVO via the complaint's hotline at 2:42 pm to register a complaint about a blast noting that they felt the overpressure and vibration	The resident was contacted by the E&C Officer who confirmed that the complaint related to a Cheshunt blast fired at 2:24 pm. The blast was compliant registering overpressure of 92.89 dB(L) and vibration of 0.27 mm/s at the Maison Dieu blast monitor.

Date	Time	Nature of Complaint	Description	Follow Up Action
10 December 2021		Dust	The E&C Officer was speaking with a resident in Shearers Lane about an unrelated matter when they mentioned that there was dust coming off the hill (Cheshunt) which was affecting them. The E&C Officer asked the complainant if they wanted to record the complaint to which they said that they wanted the complaint recorded.	The E&C Officer was at Knodlers Lane at 10.48am (prior to the complaint) and observed dust coming from Cheshunt Pit 2, after which HVO Dispatch was called mitigate the cause of the dust. Following this, the E&C Officer notified the Environment and Community Manager and Environment and Community Coordinator. TEOM data for Maison Dieu (closest monitor to the complainant's address) was reviewed and found to be below compliance limits for the two hours preceding the complaint.

9.2 Review of Community Engagement

9.2.1 Communication

Two near neighbour newsletters were sent to HVO's near neighbours during 2021 providing an overview of:

- COVID19 management measures.
- Operational updates.
- Environmental activities such as aerial seeding activities, feral pest management programme.
- Community initiatives such as near neighbour amenity resource programme and community grants.
- Communication tools – InSite website, environmental monitoring public reporting website and the blast notification SMS alert system; and
- Continuation Project updates.

9.2.2 Consultation and Engagement Activities

Due to COVID19 restrictions, consultation and engagement activities were limited to Community Grants, the support of the Jerrys Plains Primary School pre-school programme and the Community Consultative Committee.

HVO continued to encourage the community to contact the company in a way that suits the individual community members.

9.2.3 Community Consultative Committee

The HVO CCC meetings were held in February, May, August, and November 2021. The HVO CCC meet to discuss operations, projects and mine activities. The Committee is comprised of HVO representatives, community members and other key external stakeholders, including Council. The HVO CCC minutes are available on the HVO website (www.hvo.com.au). The community is invited to visit the website(s) to learn more about the HVO CCC.

In 2021 CCC members were:

- Dr Colin Gellatly (Independent chairperson)
- Cr Hollee Jenkins
- Dr Neville Hodkinson
- Mrs Janelle Wenham
- Mr David Love
- Mr Brian Atfield
- Mrs Di Gee
- Mr Todd Mills
- Mr Michael Wellard
- Mrs Jeanie Hayes
- Mrs Sarah Purser (minute taker)
- HVO General Manager – Tony Galvin
- HVO Operations Manager – Michael Redman
- HVO Environment & Community Manager – Andrew Speechly
- HVO Environment & Community Officer – Merri Bartlett

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9.2.4 Community Grants

HVO supports applications for local donations and sponsorships that have a clear community benefit. In 2021, HVO provided $37,000 to 14 local projects and initiatives, including:

- Mental First Aid Course – Jerrys Plains
- Singleton PCYC School Holiday Activities – PCYC
- Colour Your Threads for Positive Education - Muswellbrook South Public School P&C
- Graded Triples Tournament - Singleton Bowling Club
- Healthy Soils, Sustainable Pastures Workshop – Singleton Beef and Land Management Association Incorporated
- Maison Dieu Mountain Bike Track - Erosion repairs and access improvements - Singleton Mountain Bike Club Incorporated
- Hunter Valley Campdraft Arena - Hunter Valley Campdraft Club Inc
- Singleton PCYC Book Fair - Singleton PCYC
- Video Conferencing Capability - Singleton Business Chamber
- Fingertip Pulse Oximeters - St John Ambulance Australia (NSW)
- Books in Homes - Toy Box Children's Mobile Outreach Service- Upper Hunter
- Eastern Branch ASHS Championships and Performance Weekend - Australian Stock Horse Society Eastern Branch
- Lolly Run – Singleton Fire Brigade
- Ovarian Cancer Australia

HVO also continued its partnership with Jerrys Plains Public School providing funding for their pre-school programme.

9.2.5 HVO Continuation Project

Face to face community consultation was limited in 2021 due to ongoing government restrictions and NSW Health advice related to the COVID 19 pandemic.

To keep the community informed of EIS progression, the project website was regularly updated. Newsletters were distributed to the community in December 2020, June 2021, and December 2021. These newsletters contained information on:

- the EIS development and assessment process
- proposed changes to the operations at HVO as part of the project
- types of technical studies being undertaken to inform the EIS
- how community members could have their say and stay informed

The December 2021 newsletter included specific articles on air quality and noise assessment processes in response to being identified in the EIS Scoping Report as key issues.

CCC meetings were held on a quarterly basis as per the existing requirements of HVO's planning approvals, with a project update being an agenda item for each meeting. In agreement with the CCC, it was decided in November 2021 that a monthly email update would be provided to the CCC to help keep the community representees informed with the latest information on the project.

As part of the EIS, various interviews and workshops were also held to inform the Social Impact Assessment and the Aboriginal Cultural Heritage Assessment. Details of this consultation will be documented in the EIS.

In 2022, community consultation effort will increase as further information becomes available from the progression and completion of technical studies and development of the EIS. A range of methods will be undertaken and offered to ensure consultation is completed, whilst complying with NSW Health advice and the concerns and needs of stakeholders with regards to the COVID 19 pandemic.

Consultation activities for the Project will continue throughout 2022.

10 Independent Audit

The last Independent Environmental Audit (IEA) was undertaken in December 2019. This audit was undertaken against the conditions of both Project Approval 06_0261 (as modified) and DA 450-10-2003 (as modified). The audit also assessed compliance with other licences and approvals including:

- HVO North – EPL 640 and associated WALs; and
- HVO South – EPL 640 and relevant mining/coal leases including ML 1634, ML 1465, ML 1734, ML 1753, ML 1682, CL 398, and CCL 714.

Hansen Bailey (now James Bailey & Associates) were engaged and endorsed by DPE as suitably qualified, independent experts to undertake the audit. The timeframe for the audit was from 1 November 2016 to 1 December 2019. The site inspection component of the audit was undertaken over four days between 2 and 5 December 2019.

The audit report and HVO's response to the auditor's recommendations were submitted to the DPE on 24 February 2020.

The audit identified 28 non-compliances:

- 1 was identified as a moderate risk
- 15 were administrative in nature
- 4 were considered to be low risk.

These findings, along with the auditor's recommendation and HVO's response to these recommendations, are summarized in **Table 80**. The next IEA is due in 2022.

During 2021, any remaining actions from the audit were completed.

Table 80 Independent Environmental Audit Findings and Recommendations – 2020

Reference	Audit Finding	Risk Rating	Auditors Recommendation	HVO Response	Timing
HVO South – PA 06_0261 Non-Compliance Recommendations					
Sch 2 Cond 2a	Some non-compliances were identified with the conditions of this approval	Administrative	Work with DPE to comply with conditions in Section of the IEA Report where practical.	Actions to address non compliances are committed to via HVO's response to recommendations.	N/A
Sch 2 Cond 15	Sch 3 Cond 60 no evidence of correspondence with Singleton Council or NSW RFS in relation to consultation on the Bush Fire Management Plan has been provided.	Administrative	Ensure consultation with Singleton Council and RFS over the Bushfire Management Plan as per Schedule 3 Condition 30.	Council and RFS have been consulted on the revised version since the audit and this will be included in the plan once finalised.	Completed
Sch 3 Cond 7	Measured overpressure levels exceeded the 120dbL criterion at two o locations (Moses Crossing, Jerrys Plains) on 17 January 2018.	Low	Bridges Acoustic recommends to avoid possible overpressure reflection from the control building and resultant uncertainty regarding overpressure levels, the second Maison Dieu monitor should be considered the primary monitor in this area.	This monitor has been relocated	Completed
Sch 3 Cond 10	One blast on Easter Saturday 2017 (which was officially considered a public holiday in 2017).	Administrative	No recommendation provided	N/A	N/A
Sch 3 Cond 19	The measurement on 29/07/17 at the Gliding Club was determined to be non-compliant at 58 µg/m^3 (with HVO contribution being 85% against the maximum contribution limit of 75% in accordance with the approved AQGHMP atthe time). Incident was reported to the HVGC and DPE.	Low	Dust deposition gauges at DL30 and Warkworth; and PM_{10} monitors at Knodlers Lane and Long Point be reconsidered as to their appropriateness as representative of private receivers (occur outside EA predictions of exceedance of criteria) as they are exceeding annual average results during the IEA period (however stated not due to HVO activities and not reported consistent with approved *AQGHMP*). As Knodlers Lane and Long Point monitoring sites occur within exceedance predictions for PM_{10} in the MOD5 assessment, it is likely that they will exceed on a continuous basis. HVO advises that DG will remain as internal management sites, not compliance as per Table 5 of the *AQGHMP*.	The current approved *AQGHMP* identifies which DDG are utilised as a measure of compliance, HVO considers this issue tonow be addressed in the current *AQGHMP*.	Completed

			Internal procedures and relevant training be updated for change to *AQGHMP* which changes reportable circumstances for PM_{10} 24 hr consistent with the updated *AQGHMP* Section 9.HVO advises this is proposed.		
Sch 3 Cond 28	No confirmation that CLWD (now Do Water) received the 2017 Annual Review	Administrative	No recommendation provided.	N/A	N/A
Sch 3 Cond 30 31	No evidence to confirm all River Red Gum sites (as shown in Appendix 8) have addressed management practices listed in the River Red Gum Strategy (2010).	Low	River Red Gum Strategy: • Add confirmation in the Annual Review over what areas of the Goulburn River Biodiversity areas have been addressed (in order to confirm HVO's 140 ha is compliant). • Recommend any revision to the Strategy include consultation with DoI Water and OEH. Recommend holistic review of actions in light of future mining in the immediate area and likely impacts, flooding potential, climate, groundwater and surface water monitoring, and ecological monitoring to determine a realistic way forward in relation to the management of the area which has been inconclusive to date. DPE should be consulted in relation to findings and way forward to ensure satisfaction secured.	Dot point one – HVO will address this in future Annual Review s Dot Point two and three – The strategy is currently under review and HVO will include evidence of relevant consultation in next revision.	Completed Completed
Sch 3 Cond 40	One compliance inspection per year has been completed rather than two as required within the approved ACHMP (2009) for 2018 and 2017.	Administrative	No recommendation provided.	N/A	N/A
Sch 3 Cond 48	Overburden emplacement area (OEA) in the Glider Pit was approximately 10m above the Obstacle Limitation Surface without obtaining prior approval from the HVGC. This w as reported and OEA reshaped to remediate issue.	Low	No recommendation provided.	N/A	N/A

Sch 3 Cond 53	Northstar advises that whilst a number of the actions undertaken by HVO may have some impact on the annualised GHG emission budget, these have not been presented in context of assessing all reasonable and feasible options.	Low	Northstar recommends that the *AQGHMP* Section 7 is updated to identify opportunities for emission reductions (in the reasonable and feasible areas of electricity use, diesel and other fuels, and Land Management. The Annual Review should include a summary of greenhouse gas emissions against commitments in *AQGHMP*.	The current *AQGHMP* discuss' Greenhouse Gas Management and as such no furthermodification to the *AQGHMP* is considered necessary. HVO will recommence reporting in the Annual Review greenhouse gas emission summary information against the *AQGHMP*.	Completed
Sch 3 Cond 60	No evidence available of consultation with Singleton Council or the RFS.	Administrative	Obtain correspondence from Council and Rural Fire Service confirming consultation and add to appendix at next review of the Bushfire Management Plan.	Council and RFS have been consulted on the revised version since the audit and this will be included in the plan once finalised.	Completed
Sch 4 Cond 2	Notification of relevant landholders regarding the blasting exceedance - measured overpressure levels exceeded the 120 dB(L) criterion at twolocations (Moses Crossing, Jerrys Plains) on 17 January 2018 (refer to Sch 3 Cond 7) was sent on 27/11/19, how ever was outside the required 2-week notification timeframe.	Administrative	Update process to notify affected landholders for exceedances of air and blasting.	HVO has developed a post incident (exceedance) checklist which is to ensure that landowners and/or tenants are notified as required.	Completed
Sch 5 Cond 1a	Management plans do not contain all required sections. Refer to Sch 5 Cond 1a for further detail.	Administrative	At the next required revision to relevant management plans (nonurgent) ensure all items within Sch 5 Cond 1a are addressed.	HVO does not consider this to be non-compliant in accordance with the footnote of the condition that the Secretary may waive some of the requirements required by the condition if they are unnecessary or unwarranted for particular management plans. HVO considers the Secretary's approval of the plans is Approval of these Waivers. Nonetheless,HVO will review this for adequacy in the next revision of each relevant management plan.	N/A
Sch 5 Cond 4a	No evidence available to confirm review s of strategies, plans and programs conducted on each occasion listed in this condition. However, all plans have been	Administrative	No recommendation provided	N/A	N/A

	updated in the audit period exceptfor the following: • HVO South Aboriginal Cultural Heritage Management Plan (May 2009); • Amenity Management Plan-Hunter Valley Gliding Club (October 2012); and River Red Gum Rehabilitation and Restoration Strategy (March 2010).				
App4 A.4	Bridges Acoustics notes the NMP, and noise monitoring reports do not assess and correct for (or do not report) tonal noise as required by the NSW Industrial Noise Policy and later Noise Policy for Industry.	Low	Tonal noise should be included in the noise monitoring reports and the NMP on its next revision.	HVO's noise monitoring consultant's monitoring reports indicate that intermittent or tonal features are not typically present in mining operational noise and the assessment is not undertaken on this basis. However, HVO will request this inclusion to noise monitoring reports developed by the noise monitoring consultant.	Completed
SOC Ref 11	No evidence exists that collection and storage of River Red Gum seed from existing stands is occurring.	Low	Collect seed from River Red Gum area or justify why not possible/required in revised BMP.	Seed collection will occur during 2020 if available.	Completed
HVO North - DA 450-10-2003 Non-Compliance Recommendations					
Sch 2 Cond 2a	Some non-compliances were identified with the conditions of this approval.	Administrative	Work with DPE to comply with non-compliancesin Section 5 of the IEA Report, where practical.	Actions to address non compliances are committed to via HVO's response to recommendations.	N/A
Sch 2 Cond 15	Sch 3 Cond 61 no evidence of correspondence with Singleton Councilor NSW RFS in relation to consultation on the Bushfire Management Plan was available.	Administrative	Ensure consultation with relevant regulators occurs for all management plans, or justify why not required in plan (e.g., administrative changes).	Noted.	N/A

Sch 3 Cond 4	As per PA 06_0261 Sch 3 Cond 53.	Low	As per PA 06_0261 Sch 3 Cond 53.	The current AQGHMP discuss' Greenhouse Gas Management and as such no furthermodification to the AQGHMP is considered necessary. HVO will recommence reporting in the Annual Review greenhouse gas emission summary information against the AQGHMP.	Completed
Sch 3 Cond 7	Exceedance of noise level criteria listed in Table 9. Refer to Appendix E DA 450-10-2003 Sch 3 Cond 7.	Administrative	No recommendation provided.	N/A	N/A
Sch 3 Cond 20	The following incidents relating to pollution of waters include: • Discharge from leaking pipework on Parnell's Dam to Parnell's Creek on 4 November 2016; and Discharge from the Hunter Valley Load Point Sump to Bayswater Creek on 30 March 2017.	Medium	No recommendation provided.	N/A	N/A
Sch 5 Cond 4	No evidence available to confirm reviews of strategies, plans and programs conducted on each occasion listed in this condition. However, all plans have been updated in the audit period. Action has sincebeen added to CMO with reminders.	Administrative	No recommendation provided	N/A	N/A
App4 A.4	The NMP and noise monitoring reports do not assess and correct for (or do not report) tonal noise as required by the NSW Industrial Noise Policy and later Noise Policy for Industry.	Low	Tonal noise should be included in the noise monitoring reports and the NMP on its next revision.	HVO's noise monitoring consultant's monitoring reports indicate that intermittent or tonal features are not typically present in mining operational noise and the assessment is not undertaken on this basis. However, HVO will request this inclusion to noise monitoring reports developed by the noise monitoring consultant.	Completed

SOC Ref 22	Annual visual assessments have not been completed. HVO has since purchased all properties that would have been considered to have been visually impacted by HVO North (particularly the Wandewoi Property on Lemington Road).	Administrative	A written justification should be provided to DPE for approval that annual visual assessments are no longer required.	As per previous IEA, HVO's response to the recommendations was to review current relevance of completing the assessments in respect to recent property purchases to determine if private receptors would still be impacted visually by HVO north since the 2010 SOC. HVO has since purchased all properties that would have been considered to have been visually impacted by HVO north particularly the Wandewoi Property on Lemington Road. Annual visual assessments are therefore no longer considered relevant. Agree with recommendation to have confirmation from DPE that these are no longer required.	Completed
EPL 640					
L1.1	The following incidents occurred relating to the pollution of waters: • Turbid water entered Farrells Creek from sediment dam overtop on 4-5/10/18 (See response to DA 450-10-2003 Sch 5 Cond 2); • Turbid water entered Farrells Creek from a rehabilitation area on the 18/3/19 (See response to DA 450-10-2003 Sch 5 Cond 2)	Low	No recommendation provided	N/A	N/A

	• Turbid water entered Farrells Creek from two sediment dams on 30/3/19 (See response to DA 450-10-2003 Sch 5 Cond 2); and Discharge of mine water to Bayswater Creek 11/5/18 (See response to (PA 06_0261 Sch 3 Cond 20).				
L4.1	One blast on Easter Saturday 2017 (which was officially considered a public holiday in 2017) as per PA 06_0261 Sch 3 Cond 10	Administrative	No recommendation provided	N/A	N/A
L4.3	Two blasting exceedances on one occasion in 2018 at point 9 &18: Measured overpressure levels exceeded the 120 dB(L) criterion at two locations (Moses Crossing, Jerrys Plains) on 17 January 2018. (See response to PA 06_0261 Sch 3 Cond 7)	Low	Refer to PA 06_0261 Sch 3 Cond 7.	Relocation of this monitor has been approved by the EPA as part of the EPL update in September 2020 and has since been completed.	Completed
O2.1	Minor discharge of saline water to Parnells Creek due to pinhole leak on 4/11/16. See response to DA 450-10-2003 Sch 3 Cond 20.	Low	No recommendation provided	N/A	N/A

11 Incidents and Non-Compliances

There were 5 incidents recorded at HVO in 2021 requiring reporting to DPE. These relate to air quality monitoring, water, and noise.

11.1 Air Quality

During 2021 there were 2 non-compliances related to air quality. These non-compliances are summarised below. Three Annual Average exceedances were also recorded and notified to DPE however the exceedances are not deemed to be attributable to HVO as discussed in Section 7.4.

PM10 Dust Exceedance Knodlers Lane TEOM – 28 July 2021

Review of monitoring data at the Knodlers Lane TEOM identified a 24-hour PM10 average of 70.8ug/m3, exceeding the Project Approval criteria of 50ug/m3. Initial investigation found site contribution to be below the Project Approval criteria, however the data was sent to an external consultant for investigation which found contribution from HVO South to be less than or equal to 55.8ug/m3, or 79% of the total level recorded at Knodlers Lane. Following receipt of consultant's report notification was made to the DPE. HVO received a Warning letter from DPE, requiring revision of the Air Quality Management Plan and reference to negotiated noise and air quality agreements with private landholders.

PM10 Dust Exceedance Cheshunt East HVAS – 28 July 2021

The Cheshunt East High Volume Air Sampler (HVAS) exceeded the HVO North PM10 24-hour air quality criteria on 12 September 2021 recording 63.4µg/m³ against a criteria of 50 µg/m³. The data was sent to an external consultant for investigation which found HVO's contribution was only 31.2 µg/m³ however the criteria is measured against HVO plus all other sources hence the exceedance was notified to DPE. DPE reviewed HVO's incident report and deemed it was operating in accordance with the approved Management Plan and no enforcement action was taken.

11.2 Water

During 2021 there were two incidents related to water summarised below,

Sediment Dam Discharge – 23 March 2021

Sediment Dam (2N) overtopped to Farrells Creek following continued heavy rainfall in the preceding week. HVO received 107.4mm of rainfall as recorded at the HVO Corporate MET station exceeding the approved dam design capacity. The dam was being pumped out at the time and continued to operate until the level reduced below the spillway. Notified to DPE and EPA with an incident report. Due to the fresh quality of the water from the dam and excessive rainfall in the local catchment there was not a potential for environmental harm.

HRSTS TSS exceedance – 23 March 2021

Parnells Dam exceeded discharge limits for Total Suspended Solids (TSS) during HRSTS discharge on 24 March. The sample returned a TSS of 266 mg/L vs EPL limit of 120mg/L. Due to Flood Flow in the Hunter River at the time there was no potential for environmental harm. An investigation was undertaken however a cause was not able to be confirmed. TSS samples taken up to and after the 24 March were well below the limit. Continuous Turbidity monitoring was occurring and did not indicate an increasing trend. Notified to DPE and EPA with an incident report.

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11.3 Noise

During 2021 there was one incident related to noise summarised below.

Noise Exceedance LA1 (1 minute) - 22 July 2021

On 22 July the monthly attended noise monitoring at the Jerrys Plains East monitoring location recorded a LA1(1 min) result of 55dB, above the compliance criteria of 45dB. The acoustic consultant contacted the Senior OCE to explain the monitoring result and that the source of the noise was coming from the dragline bucket in Riverview Pit. The dragline was shut down and progressively restarted while monitoring noise levels. Follow up monitoring was below criteria with five additional 1-minute measurements taken on the night and additional measurement taken the following week.

The EPA and DPE were notified of the incident and report provided. Constitutes non-compliance with EPL but not the HVO South Development Consent.

12 Activities to be completed in 2022

12.1 Noise

Noise management improvements identified for implementation in 2022 include:

- Sound Power Level testing of various heavy mining equipment.
- Investigate replacement technology for ageing Barnowl monitors
- Continuation of sound attenuation on other heavy mining equipment; and

12.2 Air Quality

Air quality management improvements identified for implementation in 2022 include:

- Aerial seeding of overburden that is temporarily unavailable for rehabilitation where available.
- Implementing recommendations from a review of the air quality monitoring program; and
- Commence a replacement programme for ageing HVAS monitors
- Implementation of real time monitoring for $PM_{2.5}$.

12.3 Blasting

Blasting management improvements identified for implementation in 2022 include:

- Commissioning of the new ANE manufacturing facility.

12.4 Historic Heritage

Improvements to historic heritage identified for implementation in 2022 include:

- Vegetation and asset protection zone maintenance around the Dog Leg Fence.
- Archerfield homestead stable stabilisation works
- Ongoing consultation with Liddell Coal operations on future mine activity that may interact with the Chain of Ponds Inn complex to ensure appropriate protective management measures are implemented as required.

12.5 Water

Improvements to mine water management in 2022 include:

- Complete automated dam level monitoring and pipeline burst detection on mine water pipelines.
- Commencing construction of water containment upgrades at the train load out facilities.
- Augmenting sediment dam capacity ahead of mining in West Pit.
- Install water management structures ahead of mining in Mitchell Pit.
- Commence detailed engineering of Dam15N enlargement project
- Commencing detailed engineering and scoping of water containment projects beyond 2022.
- Commence geotechnical investigations and engineering for barrier wall installation between the North Void TSF and Carrington Alluvium.
- Ongoing upgrade of internal water transfer pipelines, pumping infrastructure, and system controls and monitoring.
- Progress detailed engineering and construction pending approval of application to store water in Lemington Underground Workings.

12.6 Rehabilitation

During the next reporting period key focus areas for HVO will be:

- Completion of annual rehabilitation target of 65 ha of new rehabilitation.
- Continuation of Section 240 rehabilitation maintenance plan including progression of historic cover crop management areas to final target land use.
- Further development of rehabilitation completion criteria and monitoring programs to align with completion criteria.
- Commence detailed design for remediation and rehabilitation of the former Eastern TSF at HVO North.
- Undertake initial contour repair works on the WOOP dump and undertake detailed design for the remainder of the contours.
- Develop opportunities for incorporating, grazing as a management tool in suitable rehabilitation areas.

12.7 Tailings Storage Facilities

The following tailing storage facility activities are planned for 2022:

- Capping activities on Southeast TSF will continue during 2022 to progress rehabilitation of the remaining surface.
- Continuation of management activities for the North Void TSF, focusing on monitoring, dewatering and surface strength development.
- Revise the Life of Mine Fine Rejects Management Strategy.
- Review & Update of all tailings dam Operational and Maintenance Manuals; and
- Capping activities on Bob's Dump TSF to begin following completion of the Southeast TSF capping.

12.8 Stakeholder Engagement

The following stakeholder engagement activities are planned for 2022:

- Hosting four CCC meetings.
- Implementing two rounds of the HVO Community Grants Fund.
- Undertaking an improvement project in the community using HVO Apprentices.
- Developing and distributing two community newsletters.
- Conducting two Community Information sessions (at Jerrys Plains and Maison Dieu); and
- Hosting a UHMD School Site Tour

All stakeholder engagement activities will be subject to COVID-19 restrictions.

12.9 Timeline for Implementation of Improvement Projects

A proposed timeline for the improvement projects mentioned in **Section 13** is shown below in **Figure 122**.

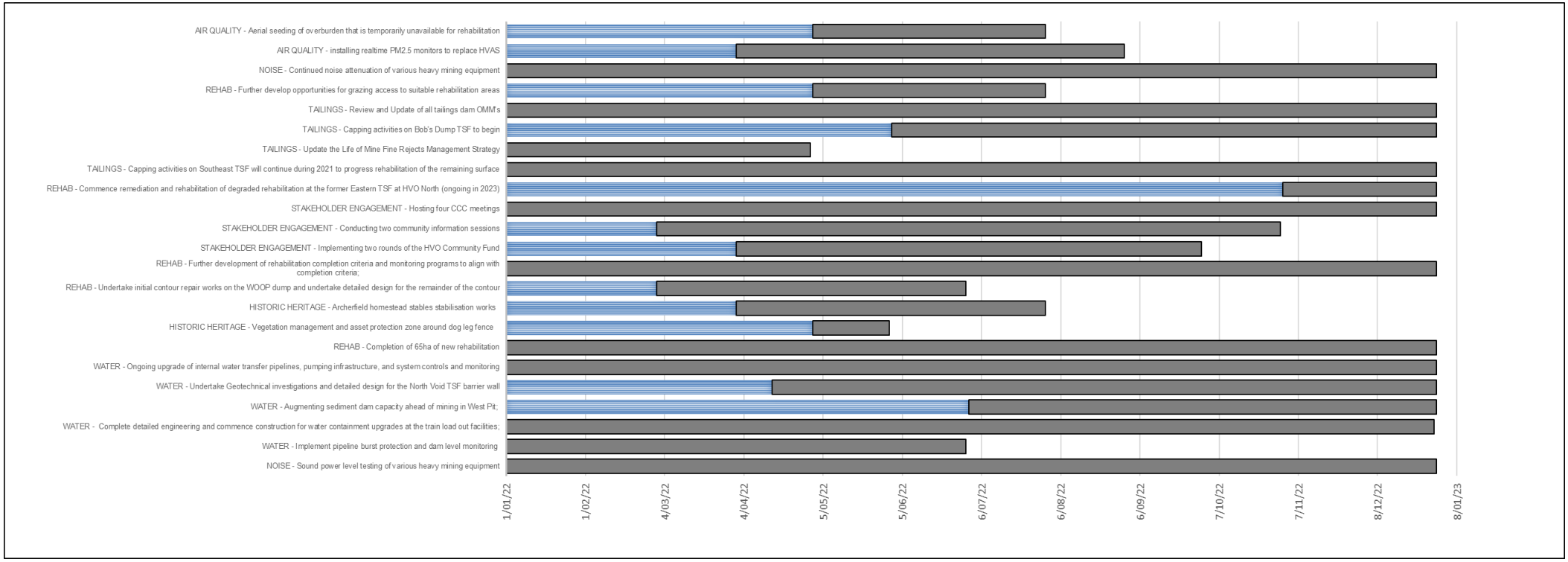

Figure 123 Proposed* Timeline *for* Implementation *of 2022* Improvement *Projects

Appendix A - Annual Air Quality Review

Appendix B - Annual Groundwater Review

Appendix C - HVO S240 Rehabilitation Maintenance Schedule

GMD Area	Wilton GMD Part HVOWIL201401	West North 230 GDM Part HVOWES201402	Cheshunt East Embankment GMD HOCHE201301, HVOCHE201202, part HVOCHE201203	Barrys Cheshunt GMD HVOCHE201703, HVOCHETBA, HVOCHE201603, HVOCHE201602	West North 230 Eastern Batter HVOWES201402, HVOWES201503
Area (ha)	6.258055 ha	11.0414 ha	25.88 ha	33.2 ha	15.85 ha
Month Reported	24/04/2021	30/04/2021	25/06/2021	15/10/2021	30/12/2021
HVO Pit	West Pit	West Pit	Cheshunt Pit	Cheshunt Pit	West Pit
MOP Domain	Final Landform Grassland	Final Landform Grassland	Final Landform Woodland	Final Landform Woodland	Final Landform Woodland
Polygon Centroid Easting	307118.9069	309384.5235	314913.61	313212.02	309745.442
Polygon Centroid Westing	6407359	6410584.097	6401251.966	6401508.61	6410690.202
Slope (minimum)	0	0	Refer Tech Services	Refer Tech Services	Refer Tech Services
Slope (maximum)	0	0	Refer Tech Services	Refer Tech Services	Refer Tech Services
Primary Aspect	North west	n/a	East	North	North
Secondary Aspect	n/a	n/a	North east	North east	East
Landform Surface Preparation	Boomspray Surface Vegetation Chisel Plough	Boomspray Surface Vegetation Chisel Plough	Boomspray Surface Vegetation Slash/Mulch Vegetation Repair Contours Soil Aeration	Boomspray Surface Vegetation Mulch Vegetation Repair Contours Desilt and re-distribute topsoil from drains Soil Aeration	Mulch Acacia Saligna Spot Spray Stems Repair Contour Soil Aeration Boomspray Surface Vegetation Mulch Vegetation

GMD Area	Wilton GMD Part HVOWIL201401	West North 230 GDM Part HVOWES201402	Cheshunt East Embankment GMD HOCHE201301, HVOCHE201202, part HVOCHE201203	Barrys Cheshunt GMD HVOCHE201703, HVOCHETBA, HVOCHE201603, HVOCHE201602	West North 230 Eastern Batter HVOWES201402, HVOWES201503
Growth Medium Surface Preparation	Chisel Plough (tractor)	Chisel Plough (tractor)	Rock Pile, Aerate (tractor)	Rock Pile, Aerate	Rock Pile, Aerate
Cover Crop Seed	n/a	n/a	n/a	Millet	Millet
Cover Crop Seeding Rate	n/a	n/a	n/a	5kg/ha	5kg/ha
Native Seed Mix	2021 Q1 Q2 PLW Seed Mix	2021 Q1 Q2 PLW Seed Mix	2021 Q1 Q2 Woodland Seed Mix	2021 Q3 Q4 Woodland Seed Mix	2021 Q3 Q4 Woodland Seed Mix
Native Seed Mix Rate	18.5kg/ha	18.5kg/ha	18.5kg/ha	9.5kg/ha	9.5kg/ha
Seeding Method	Seeding – Mechanical Cast	Seeding – Mechanical Cast	Seeding – Mechanical Drill	Seeding – Mechanical Drill	Seeding – Mechanical Drill
Primary Drainage	Overland Flow	Overland Flow	Contours directing flow to engineered drop structures	Contours directing flow to engineered drop structures	Contours directing flow to engineered drop structures
Secondary Drainage	Wilton Pit	Dam WP1	North Dam1	Dam 34S	Dam WP1, WP-2,& WP3 and then return to West Pit
Longitudinal Drainage Grade	n/a	n/a	Contour Standard = 2% grade	Contour Standard = 2% grade	Contour Standard = 2% grade
Fauna Habitat	None Placed	None Placed	None Placed	None Placed	None Placed

Appendix D - 2021 Heritage Compliance Inspection Audits

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