HUNTER VALLEY
OPERATIONS

2022 ANNUAL ENVIRONMENTAL REVIEW

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TITLE BLOCK

Name of Operations	Hunter Valley Operations
Name of Operator	HV Operations Pty Ltd
Development Consent / Project Approval	DA 450-10-2003 / PA 06_0261
Name of holder of development consent/project approval	HV Operations Pty Ltd
Mining Lease Number	Contained within Table 3-2 of this report
Name of Mining Lease Holder	Contained within Table 3-2 of this report
Water Licence Number	Contained within Table 3-4 of this report
Name of Water Licence Holder	Contained within Table 3-4 of this report
RMP Start Date	01/07/2022
RMP End Date	30/06/2023

I, David Foster, certify that this audit report is a true and accurate record of the compliance status of Hunter Valley Operations for the period 01/01/2022 to 31/12/2022 and that I am authorised to make this statement 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 that 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 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).

Name of Authorised Reporting Officer	David Foster
Title of Authorised Reporting Officer	General Manager
Signature of Authorised Reporting Officer	DocuSigned by: David Foster F5D6288380614F5...
Date	31-3-2023

TABLE OF CONTENTS

FIGURES

TABLES

Executive Summary

This Annual Environmental Review (Annual Review) reports on the environmental performance of Hunter Valley Operations (HVO) during the 2022 calendar year and satisfies the requirements of HVO's Development Consents. The structure of the 2022 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 11.94 million tonnes of run-of-mine (ROM) coal during 2022 against an approved ROM extraction rate of 42 million tonnes per annum (mtpa). The Coal Handling Preparation Plants (CHPPs) produced 9.63 million tonnes of saleable coal.

Noise

A total of 120 noise measurements were recorded in the attended noise compliance monitoring programme in 2022. No noise exceedances were recorded against HVO's criteria.

HVO continued to operate a real-time noise monitoring network which alerts operations to potential noise exceedances. A total of 1050[1] internal noise alarms were received and responded to and as a result 58 hours of equipment downtime was recorded for the management of noise during 2022.

Blasting

A total of 250 blast events were initiated, 140 from HVO South and 110 from HVO North. HVO complied with all blasting related overpressure and vibration development consent and licence criteria during 2022.

HVO employs a blast fume management protocol to mitigate generation of post blast fume emissions. During 2022, there were no incidents relating to blast fume. Manufacturing of Ammonium Nitrate Emulsion commenced on site following modification to the HVO South approval in 2021. A modification to the HVO South Approval was submitted in 2022 to allow for increased storage of Ammonium Nitrate Emulsion and associated precursor chemicals on site. This increased storage has been approved and will be implemented on site in 2023.

Air Quality

No non-compliances were recorded against HVO's air quality criteria in 2022.

HVO continued to implement operational controls to manage dust emissions in accordance with its Air Quality Management Plan during 2022 including response to internal air quality alerts. During the reporting period, HVO responded to 551 air quality alerts and recorded 1175 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 319 ha to reduce dust from wind erosion of mine stockpiles.

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

Heritage

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. Sites requiring maintenance and upgrades to site barricading, fencing and vegetative sediment controls were identified. Barricade upgrade and maintenance will be included as part of the works planning for 2023.

Under the provisions of both the HVO South and HVO North Aboriginal Cultural Heritage Management Plans (ACHMP), field based due diligence assessments were undertaken at four locations across HVO in 2022. No additional artefacts were identified through these assessments.

There were no incidents, nor any unauthorised disturbance caused to heritage sites at HVO during 2022.

Water

A total of 1047.2mm of rainfall was recorded at HVO Corporate Meteorological (MET) Station in 2022 producing an estimated 17,848ML of runoff. No water was pumped from the Hunter River during 2022. HVO discharged 6,622.8ML of water under the Hunter River Salinity Trading Scheme (HRSTS).

Surface and ground water monitoring activities continued in 2022 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 installation of a burst pipe detection system, automated dam level monitoring and augmentation of sediment dam 28W. Preliminary engineering was completed for all projects. Works commenced for the Load Point area upgrade and detailed design commenced for mine water dam 15N augmentation.

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 continued monitoring of groundwater. Groundwater monitoring results indicate that current management practices are effective in minimising seepage from the facility. A geotechnical investigation was undertaken to inform construction method for the barrier wall.

There were four reportable incidents related to water. These incidents relate to dams overtopping due to rainfall exceeding dam design criteria. For each of the events it was deemed that no environmental harm would have occurred. Application to modify the HVO South approval to permit storage of excess surface water in the Lemington Underground workings submitted in 2021 was granted approval in 2022.

Rehabilitation and Land Management

Rehabilitation at HVO was previously undertaken in accordance with commitments made in the Mining Operations Plan (MOP). During 2022, HVO replaced this with a Rehabilitation Management Plan (RMP) as required by new standard conditions for Mining Leases.

A total of 146 ha of rehabilitation was completed to “Ecosystem Establishment” phase during 2022 including 65 ha of new rehabilitation and 81 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 81.2 ha of historic

Growth Medium Development phase rehabilitation to native vegetation, weed control within areas of concern, and preparation works for ongoing progression of areas to final vegetation covers.

A number of baiting programmes were carried out on a seasonal basis and at a 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 135 baits were taken by dogs, 22 by foxes and 37 by feral pigs using the new 'Hoggonne' baiting method. 102 feral pigs were trapped, 10 feral pigs 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 7 community complaints were received related to blasting, dust, and one complaint related to unsafe driving on a public road. Four CCC meetings were held during the reporting period to discuss operations, projects and mine activities.

HVO provided $83,000 to 16 local projects and initiatives and continues its partnership with Jerrys Plains Public School providing funding for their pre-school program.

A range of methods were used to keep the community informed of operational and project activities. This included a community information session at Maison Dieu and Jerrys Plains, Community Newsletters and development and update of a new web page.

1 | STATEMENT OF COMPLIANCE

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

Table 1-1: Statement of Compliance

Were all conditions of the relevant approvals complied with?	
PA 06_0261 (HVO South)	Yes
DA 450-10-2003 (HVO North)	No

Table 1-2: Non-Compliances

Relevant Approval	Condition Number	Condition Description	Compliance Status	Where Addressed in Annual Review
DA 450-10-2003	Schedule 3 Condition 20	Overflow from Dam 15N – March 2022	Non-compliant (low)	**11**
DA 450-10-2003	Schedule 3 Condition 20	Overflow from Dam 32N – March 2022	Non-compliant (low)	**11**
DA 450-10-2003	Schedule 3 Condition 20	Overflow from Dam 15N – July 2022	Non-compliant (low)	**11**

Table 1-3: Compliance Status Key for Table 1-2

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 where 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 2022 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 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 2-1** and **Figure 2-2** respectively.

Figure 2-1: Regional Context

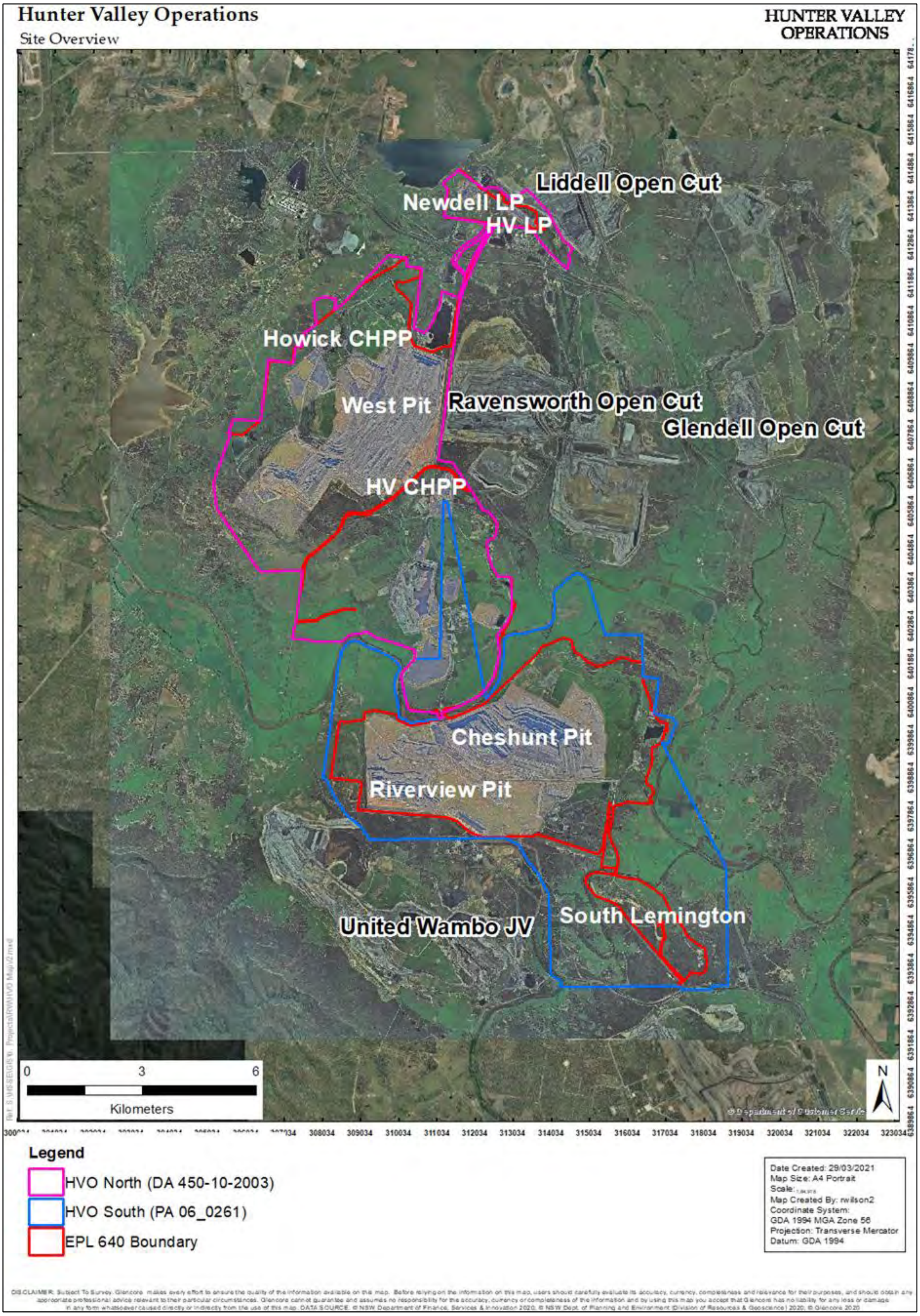

Figure 2-2: Hunter Valley Operations Site Overview

2.3 | MINE CONTACTS

Key mine contacts are listed in **Table 2-1**.

Table 2-1: Mine Contacts

Contact	Role	Phone	Email
David Foster	General Manager	1800 888 733	david.foster@hvo.com.au
Phillip Enderby	Operations Manager		phil.enderby@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 3-1: HVO Major Approvals

Table 3-2: Summary of Mining Tenements

Table 3-3: HVO Licences and Permits

Table 3-4: Water Related Approvals

Table 3-5: Surface Water Licences

Table 3-6: Groundwater Access Licences

Table 3-1: 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 8	Hunter Valley Operations – South Coal Project & associated modifications: MOD8 Approved 6 February 2023 Permits construction of an Ammonium Nitrate Storage Compound. MOD7 Approved 27 May 2022 Permits storage of water in Lemington Underground Workings. 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.	06/02/2023	24/03/2030

Approval Number	Description	Issue Date	Expiry Date
EPBC 2016/7640	Hunter Valley Operations – State approved mining Hunter Valley NSW	10/10/2016	31/12/2030

Table 3-2: 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	08/03/27	Granted
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	27/04/2028	Granted
EL 5417	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	23/12/1997	23/12/2024	Granted
EL 5418	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	23/12/1997	23/12/2028	Granted
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	Renewal pending
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
AL 32	Assessment Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	04/11/2020	03/11/2026	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	31/12/2044	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	14/04/2040	Granted
ML 1465	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	21/02/2000	21/02/2042	Granted
ML 1474	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	24/11/2000	23/11/2042	Granted
ML 1482	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	19/03/2001	19/03/2040	Granted

Title	Mining Tenement	Titleholder	Purpose	Grant Date	Expiry Date	Status
ML 1500	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	21/12/2001	20/12/2043	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	Ancillary Mining Activities	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	Ancillary Mining Activities	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
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	Ancillary Mining Activities	06/04/2016	06/04/2037	Granted
ML 1734	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities	06/04/2016	06/04/2037	Granted
ML 1748	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities	05/12/2016	04/12/2037	Granted
ML 1753	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities	19/04/2017	19/04/2038	Granted

Title	Mining Tenement	Titleholder	Purpose	Grant Date	Expiry Date	Status
ML 1810	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities	04/11/2020	04/11/2041	Granted
ML 1811	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities	04/11/2020	04/11/2041	Granted
ML 1840	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities	03/11/2022	03/11/2043	Granted
ML 1841	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities	03/11/2022	03/11/2043	Granted
MLA 495	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities	Mining Lease Application lodged 12th May 2015		Application Pending
MLA 496	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities	Mining Lease Application lodged 12th May 2015		Application Pending
MLA 520	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities	Mining Lease Application lodged 23rd December 2015		Application Pending
MLA 535	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities	Mining Lease Application lodged 28th October 2016		Application Pending
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 3-3: HVO Licences and Permits

Type	Licence Number	Description	Authority	Expiry Date
Environment Protection Licence	EPL640	Environment Protection Licence	EPA	N/A
Licence to Store Explosives	XSTR200117	Licence to Store	SafeWork	02/05/2026
Radiation Licence	RML5085293	Radiation Management Licence	EPA	14/11/2023
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 Licenses– Golden Highway	RMS	30/06/2023
	N/A	Road Closure Approval - Lemington Road	Singleton Council	30/06/2023

Table 3-4: Water Related Approvals

Licence Number	Type of Licence	Purpose	Legislation	Description	Expiry Date
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, AV50/56.5, AS50/62.5, AR55, Bunc 3, BZ25 (Bunc 12), BZ23 (Bunc 14), BZ24 (Bunc 13),	Perpetuity
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), Bunc 44D	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

Licence Number	Type of Licence	Purpose	Legislation	Description	Expiry Date
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
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: Bunc 45A, 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

Licence Number	Type of Licence	Purpose	Legislation	Description	Expiry Date
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	Monitoring Bore	Part 5 Water Act 1912	HVO North – Bores: HV6, HV3, DM6, HV2 (2), 4113P, 4114P. 4116P, 4117P	Perpetuity
20BL171857	Bore	Monitoring Bore	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 Act 2000	Associated with WAL965	Perpetuity
20CA212713	Works Approval	Pumping Plant	Water Management Act 2000	Associated with WAL36190	30/05/2025
20FW213280	Flood Work Approval	Levee	Water Management Act 2000	HVO North Carrington Levee 5	21/09/2027
20FW213281 Formerly 20CW802613	Flood Work Approval	Levee	Water Management Act 2000	HVO South – Barry Levee	21/09/2027

Licence Number	Type of Licence	Purpose	Legislation	Description	Expiry Date
20FW213277 Formerly 20CW802603	Flood Work Approval	Block Dam	Water Management Act 2000	HVO South – Hobden Gully Levee	21/09/2027
20FW213278 Formerly 20CW802604	Flood Work Approval	Levee	Water Management Act 2000	HVO North – North Pit Levee 3	21/09/2027
20WA210991 **(see WAL 18307)** Formerly 20SL050903	Stream Diversion	Stream Diversion	Water Management Act 2000	HVO West – Parnells Creek Dam	09/01/2033
20WA211427 **Formerly** 20SL061290	Stream Diversion	Cutting (Diversion Drain)	Section 10 Water Act 1912	Pikes Gully Creek Stream Diversion	07/09/2023
20WA210985 **(see WAL 18327)** 20SL042746	Diversion Works	Industrial	Water Management Act 2000	HV Loading Point Pump Bayswater Creek	08/09/2032
20WA211428 20SL061594	Stream Diversion	Cutting (Diversion Drain)	Water Management Act 2000	HVO North – Carrington Stream Diversion	31/07/2032
20WA201238 (see WAL 962)	Diversion Works	Pumping Plant	Water Management Act 2000	HVCPP River Pump	16/03/2028
20WA201257 (see WAL 970)	Diversion Works	Pumping Plant	Water Management Act 2000	HVO South – LCPP River Pump	Perpetuity
20WA201338 (see WAL 1006)	Diversion Works	Pumping Plant	Water Management Act 2000	HVO South – LCPP River Pump	Perpetuity
20WA201501 (see WAL 1070)	Diversion Works	Pumping Plant	Water Management Act 2000	HVO South – LCPP River Pump	Perpetuity
20WA201685 (see WAL 13387)	Diversion Works	Pumping Plant	Water Management Act 2000	HVO West – "Lake Liddell" Licence	Perpetuity
20FW213274	Flood Work Approval	Levee	Water Management Act 2000	Riverview	26/10/2028

Table 3-5: Surface Water Access Licences 2021/22 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 Regulated River WSP	Zone 2a (Hunter River From Glennies Creek Junction To Wollombi Brook Junction)	486	0	0	0
WAL962	HVO North – HVCPP River Pump – Water Access Licence	Hunter River	Hunter Regulated River WSP	Zone 1b (Hunter River From Goulburn River Junction To Glennies Creek Junction)	3,165	0	0	0
WAL969	HVO South – Former Riverview pump	Hunter River	Hunter Regulated River WSP	Zone 1b (Hunter River From Goulburn River Junction To Glennies Creek Junction)	39	0	0	0
WAL970	HVO South – LCPP River Pump – Water Access Licence	Hunter River	Hunter Regulated River WSP	Zone 2a (Hunter River From Glennies Creek Junction To Wollombi Brook Junction)	500	0	0	0
WAL1006	HVO South – LCPP River Pump – Water Access Licence	Hunter River	Hunter Regulated River WSP	Zone 2a (Hunter River From Glennies Creek Junction To Wollombi Brook Junction)	500	21	0	21
WAL1070	HVO South - LCPP River Pump – Water Access Licence	Hunter River	Hunter Regulated River WSP	Zone 2a (Hunter River From Glennies Creek Junction To Wollombi Brook Junction)	500	0	0	0
WAL13387	Macquarie Generation Hunter River Pump Station	Hunter River	Hunter Regulated River WSP	Zone 1b (Hunter River From Goulburn River Junction To Glennies Creek Junction)	20	0	0	0
WAL 13391	HVO North – Alluvial Rehabilitation Irrigation.	Hunter River	Hunter Regulated River WSP	Zone 1b (Hunter River From Goulburn River Junction To Glennies Creek Junction	420	0	0	0
WAL18127	Carrington BB1	Hunter River Alluvium	Hunter Unregulated and Alluvial Water Sources WSP	Hunter Regulated River Alluvial Water Source – Upstream Glennies Creek management zone	383	346	0	346

Licence Number	Description	Water Source	Water Sharing Plan	Water Source Management Zone	Entitlement (ML)	Passive Take / Inflows (ML)	Active Pumping (ML)	Total Take (ML)
WAL18158	Ollenberry	Hunter River Alluvium	Hunter Unregulated and Alluvial Water Sources WSP	Hunter Regulated River Alluvial Water Source – Upstream Glennies Creek management zone	65	0	0	0
WAL18307	HVO West – Parnells Creek Dam (Diversion Works Bywash)	Unregulated River	Hunter Unregulated and Alluvial Water Sources WSP	Jerrys Water Source; Jerrys Management Zone	500	352	0	352
WAL18327	HV Loading Point Pump Bayswater Creek (Diversion Works)	Unregulated River	Hunter Unregulated and Alluvial Water Sources WSP	Jerrys Water Source; Jerrys Management Zone	150	0	0	0
WAL 23889	Greenleek	Wollombi Brook	Hunter Unregulated and Alluvial Water Sources WSP	Lower Wollombi Brook Water Source	144	0	0	0
WAL 36190	HVO North, old farm bore	Hunter River Alluvium	Hunter Unregulated and Alluvial Water Sources WSP	Hunter Regulated River Alluvial Water Source – Jerrys Management Zone	120	0	0	0
WAL 41527	HVO North (Carrington Pit)	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16)	Permian Coal Seams	700	0	0	0
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

Table 3-6: Groundwater Access Licences 2021/22 Water Year

Licence Number	Description	Water Source	Water Sharping Plan (WSP)	Water Source – Management Zone	Entitlement (ML)	Passive Take / Inflows (ML)	Active Pumping (ML)	Total (ML)
WAL39798	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	41.5	41.5
WAL40462	HVO Pit Excavations / Alluvial Lands Bores (x4)	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16)	Permian Coal Seams	2,400	477	0	477
WAL40463	HVO Pit Excavations / Alluvial Lands Bores (x4)	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16)	Permian Coal Seams	180	180	0	180
WAL40466	HVO Pit Excavations / Alluvial Lands Bores (x4)	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16)	Permian Coal Seams	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 Coal Seams	700	700	0	700

3.1.2 | MANAGEMENT PLANS, PROGRAMS, STRATEGIES

HVO is required by the site 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 2022. Some plans remain under review and will be submitted to DPE in 2023. The status of management plans is shown in **Table 3-7** and **Table 3-8.**

Table 3-7: Management Plans Required for HVO North

Management Plan	Date Approved	Date Submitted to DPE
Agricultural Lands Reinstatement Management Plan*	20/06/2022	23/05/2022
Fine Reject Management Strategy	19/01/2023	4/11/2022
HVO Air Quality and Greenhouse Gas Management Plan	12/09/2019	24/08/2022
HVO Blast Management Plan	03/04/2019	07/04/2022
HVO Bushfire Management Plan	04/04/2020	N/A
HVO Environmental Management Strategy	08/01/2019	7/04/2022
HVO Greenhouse and Energy Efficiency Plan (Addressed in HVO Air Quality and Greenhouse Gas Management Plan)	12/09/2019	24/08/2022
HVO Noise Management Plan	16/12/2021	7/04/2022
HVO North Heritage Management Plan	19/12/2019	N/A
HVO River Red Gum Rehabilitation & Restoration Strategy	19/05/2022	N/A
HVO Water Management Plan	16/10/2018	23/11/2022
Final Void Management Plan	16/05/2022	Under revision
Rehabilitation Management Plan and Forward Program**	N/A	6/10/2022

*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.

**The Rehabilitation Management Plan and Forward Program is prepared in accordance with the provisions under the Mining Act 1992 and is not approved by DPE.

Table 3-8: Management Plans Required for HVO South

Management Plan	Date Approved	Date Submitted to DPE
HVGC Amenity Management Plan	22/01/2013 (revision submitted 28/12/2021)	9/09/2022
HVO Air Quality and Greenhouse Gas Management Plan	12/09/2019	24/08/2022
HVO Biodiversity Offset Strategy	23/10/2017	N/A
HVO Blast Management Plan	03/04/2019	07/04/2022
HVO Bushfire Management Plan	01/04/2020	N/A
HVO Environmental Management Strategy	08/01/2019	7/04/2022
HVO Integrated Biodiversity Management Plan	02/08/2018	5/10/2022
HVO Noise Management Plan	16/12/2021	7/04/2022
HVO River Red Gum Rehabilitation & Restoration Strategy	19/05/2022	N/A
HVO South Aboriginal Cultural Heritage Management Plan	19/12/2019	-
HVO Water Management Plan	16/10/2018	23/11/2022
Rehabilitation Management Plan and Forward Program*	N/A	6/10/2022
Biodiversity Management Plan (offsets component)	26/06/2017- Goulburn River Biodiversity Area Management Plan	-
HVGC Amenity Management Plan	22/01/2013 (revision submitted 28/12/2021)	9/09/2022

** The Rehabilitation Management Plan and Forward Program is prepared in accordance with the provisions under the Mining Act 1992 and is not approved by DPE.

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 4-1**. There are no active underground workings at HVO.

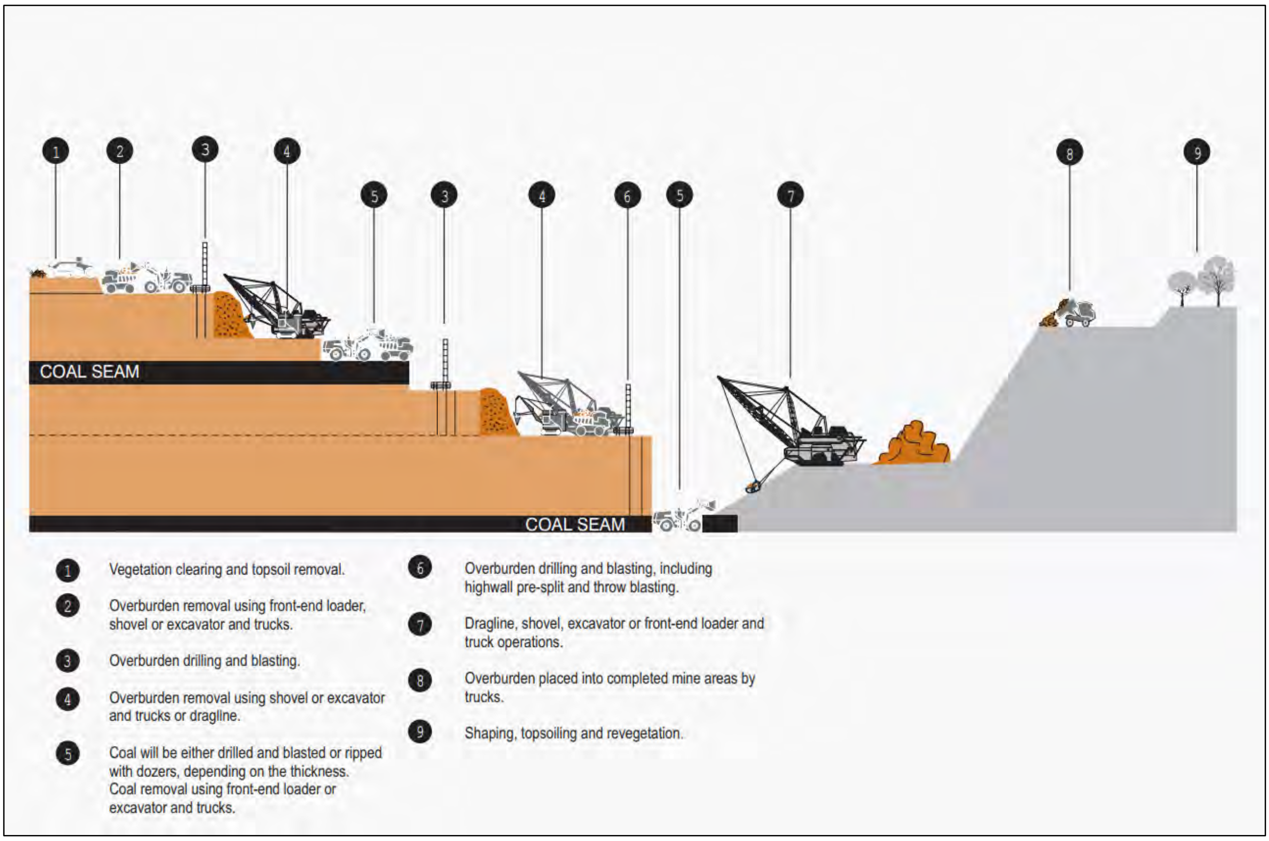

Figure 4-1: Open Cut Mining Schematic

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

The mining equipment fleet employed to carry out mining operations at HVO in 2021 and 2022 is detailed in **Table 4-1** along with the fleet forecast for 2023.

Table 4-1: HVO Equipment Used 2021-2022

Equipment Type	Number Used in 2021	Number Used in 2022	Forecast Numbers in 2023
Scrapers	2	2	2
Drills	7	8	9
Draglines	2	2	1
Shovels	3	3	2
Excavators	7	11	13
Trucks	73	86	95
Loaders	6	6	6
Service Trucks	5	4	4
Track Dozers	27	31	28
Rubber Tyre Dozers	4	4	4
Graders	11	11	12
Water Trucks	10	10	10
Floats	1	1	1
Cable Reeler	1	1	1
Cable Tractors	5	5	5
Total	**164**	**185**	**193**

4.1.1 | MINERAL PROCESSING

Coal is transported to one of two CHPPs 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 RMP. Each CHPP site has storage facilities for processed (saleable) and raw (unprocessed) coal. The capacity of each site is listed in **Table 4-2**.

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

Table 4-2: 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 4-3.** 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). After the coal has reached either HVLP or the NLP it is transported to the Port of Newcastle by rail.

Table 4-3: Methods of Coal Transportation

Transport Category	Quantity (Mt)
Coal transported from the site via trains	9.5
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	0.80
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)	133,350 (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 2022 in comparison to previous years and approval limits is provided in **Table 4-4**.

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

Table 4-4: Production Statistics and Correlating Project Approval Limits

	Approved Limit (PA 06_0261 and DA 450-10-2003)	Reporting Period 2021	Reporting Period 2022	Forecast for 2023
Prime Waste (Mbcm)	-	81.19	71.44	91.90
ROM Coal (Mtpa) (mined)	42	14.41	11.94	15.27
- *HVO South*	20	9.87	7.55	9.53
- *West Pit*	12	4.54	4.38	5.74
- *Carrington Pit*	10	0	0	0
Coarse Reject (Mt)	-	3.02	2.31	3.06
Fine Reject-Tailings (Mt)	-	1.43	1.38	1.09
Product (Mtpa)	-	10.57	9.63	10.39
ROM Coal Processed	26	14.86	13.68	14.53
- *Hunter Valley CHPP*	20	14.59	12.42	14.53
- *Howick CHPP*	6	0.25	1.26	0

4.1.3 | SUMMARY OF CHANGES

Production numbers throughout 2022 were reduced due to increased rain and flooding compared to previous years.

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 2023.

Tailings emplacement continued in the Carrington mining void in 2022.

4.2 | FORECAST OPERATIONS FOR NEXT REPORTING PERIOD

Table 4-5 outlines the forecast operations for the next reporting period.

Table 4-5: Production Operations Forecast

Material	Unit	2022 (Forecast)	2022 (Actual)	2023 Forecast	2024 Forecast
Stripped Topsoil	kbcm	217.16	113.3	176.0	370.8
Rock / Overburden	Mbcm	108.39	80.46	95.19	99.50
ROM Coal	Mt	18.90	11.94	15.27	18.35
Reject Material	Mt	5.11	3.69	3.06	3.41
Product	Mt	13.79	9.63	10.39	12.77

5 | ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

DPE responded to HVO on 14 June 2022 accepting the 2021 Annual Review. DPE did not require any changes to the 2021 Annual Review, however actions from the 2021 Annual Review for future reviews and HVO's response are detailed in **Table 5-1**. The NSW Resources Regulator did not provide any feedback in response to the 2021 Annual Review.

Table 5-1: Actions Recommended in 2021 Annual Review

Action Recommended in 2021 Annual Review	Action Taken By HVO
Investigations into elevated PM2.5 levels at the Maison Dieu monitor, and more broadly, the elevated PM2.5/PM10 ratios from the Maison Dieu and Kilburnie South monitors as detailed in the Annual Data Review 2021 produced by Todoroski Air Sciences (Appendix A of the 2021 Annual Review).	HVO have provided an update on these investigations in Appendix B and **Section 6.4.3**.
The implementation (or lack thereof) of the recommendations noted in Section 6.2 of the 2021 Annual Groundwater Monitoring Review produced by EMM (Appendix B of the 2021 Annual Review).	HVO have provided an update on progress against these recommendations in **Section 7.7**

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 6-2**. Daily average data is publicly available via the Monthly Environmental Monitoring Reports published on the HVO website.

Total annual rainfall for 2022 was 1047.2mm (recorded at the HVO Corporate Meteorological Station) compared to 910.2mm in 2021 and 793mm in 2020. (**Figure 6-1**).

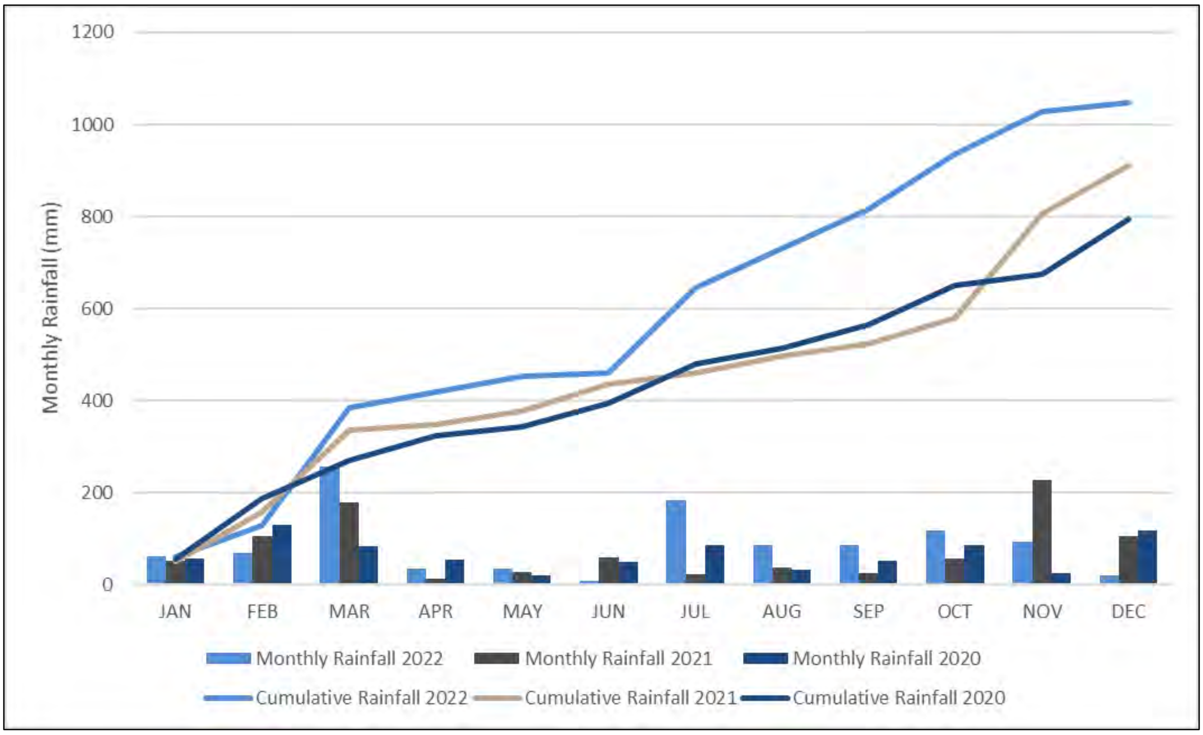

Figure 6-1: HVO Corporate Meteorological Station 2020 - 2022 Rainfall Data

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 existing haul trucks at HVO have been fitted with sound attenuation kits. New equipment brought to site arrives sound attenuated or is scheduled for retro-fitting.

Routine sound power level testing was completed according to the schedule and will continue throughout 2023. Sound power level testing was completed on 33 heavy vehicles on site in 2022. 10 of these vehicles required additional maintenance to meet relevant sound attenuation requirements which will be completed in 2023.

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 1050 noise alarms during 2022. Noise alarm triggers are based on internally set noise criteria. Alarms received include noise exceedances from other mines and non-mine sources. HVO recorded over 58 hours of equipment downtime for the management of noise during 2022. The location of real-time noise monitoring locations as per the approved NMP are shown in **Figure 6-2.**

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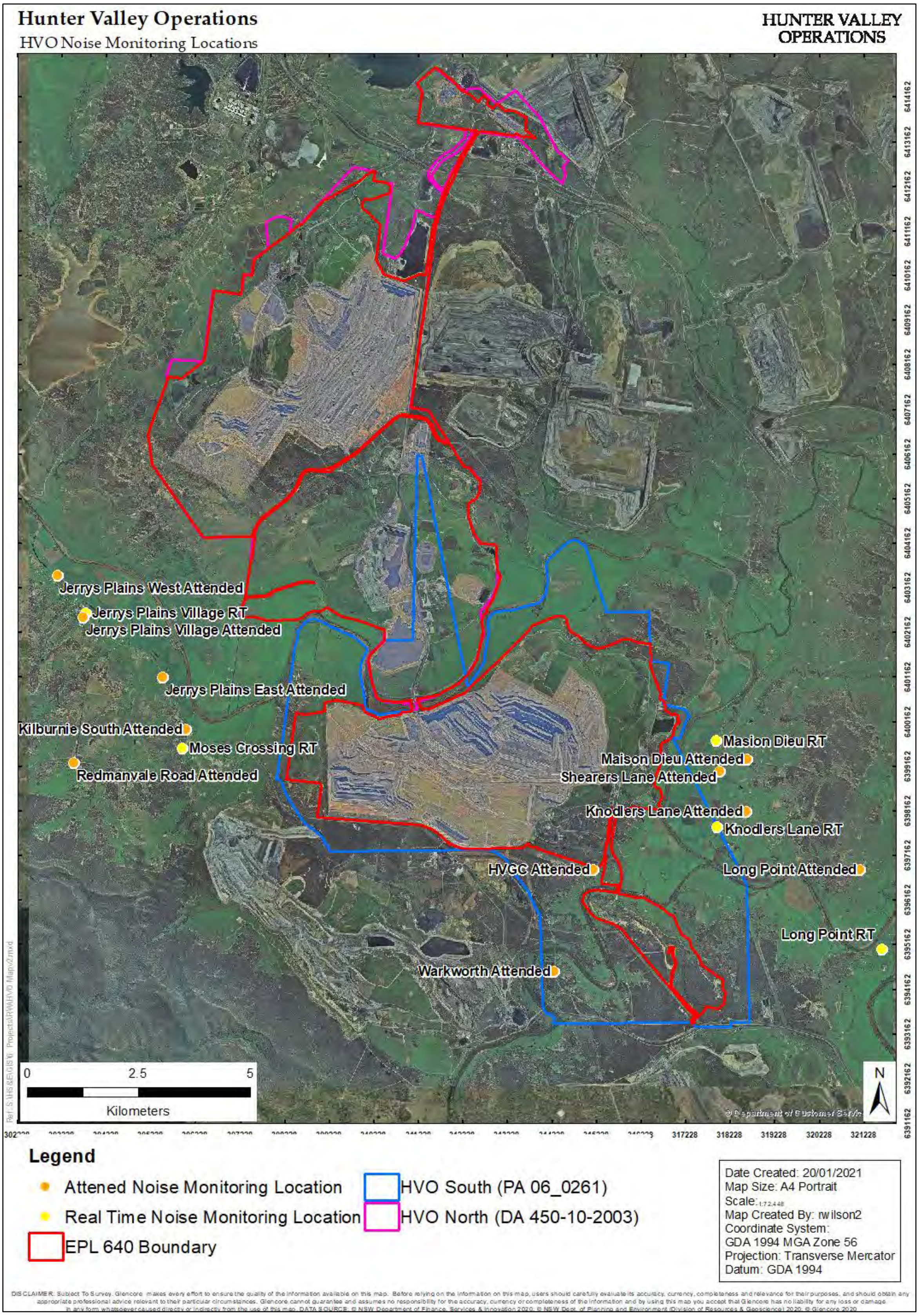

Figure 6-2: HVO Attended and Real Time Noise Monitoring Locations

Attended monitoring during 2022 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, there was even distribution between measurements being higher or lower than attended noise measurements. Comparisons were not able to be made for a majority of measurements due to low/inaudible noise from HVO than attended noise measurements.

Details of this assessment is provided in **Table 6-1**.

Table 6-1: Comparison of Attended and Real Time Noise Monitoring 2022

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
MaisonDieu	3	-	2	-	1	-	-	-
Knodlers Lane[3]	4	0	1	-	-	-	3	-
Long Point	-	-	-	-	-	-	-	-
Kilburnie South	3	3	1	-	2	2	-	1
Jerrys Plains Village[3]	-	3	-	2	-	-	-	1

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 contribution 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 experienced 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 120 measurements were recorded during 2022. 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 2022.

Comparison between the 2022 L_{Aeq} attended noise monitoring results (maximum HVO contribution levels measured under applicable meteorological conditions) and previous years are shown in **Table 6-2**.

Table 6-2: Comparison of 2022 Noise Monitoring Results Against Previous Years

Year	Number of Measurements	Number of measurements which exceeded allowable noise (under applicable	Number of non-compliances
2022	120	0	0
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 Noise Impact Assessment (NIA) for HVO North prepared in October 2010 to support Modification 3 of the HVO North DA (450-10-2003). Noise predictions contained within the NIA do not correspond with specific meteorological conditions. Attended noise monitoring results have been compared directly to Year 5, mitigated, total noise predictions in the NIA for Carrington & West Pit under all meteorological conditions where noise criteria were applicable. This comparison is shown in **Table 6-3**.

Table 6-3: Comparison of 2022 Attended Noise Monitoring Against EIS Predictions

Location	Units	EIS Prediction	2022 max measured LAeq 15 min (under applicable met conditions)
Shearers Lane	dB(A)	27	Inaudible
Kilburnie South	dB(A)	37	34
Jerrys Plains	dB(A)	41	39
Jerrys Plains East	dB(A)	39	38
Jerrys Plains West	dB(A)	41	34

Comparison of measured results against the modelled predictions demonstrates noise levels lower than predicted at all monitoring locations.

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 6-4**) indicates that noise during 2022 was equal to or lower than predicted levels for all receptors.

Table 6-4: Comparison of 2022 Monitoring Against HVO South (Stage 2 HVO South Modification 5 EA – 2017)

Location	Units	EIS Prediction (INP)	2022 max measured LAeq 15 min (under applicable met conditions)
Knodlers Lane	dB(A)	40	34
Maison Dieu	dB(A)	40	35
Shearers Lane	dB(A)	41	36
Kilburnie South	dB(A)	39	36
Jerrys Plains	dB(A)	34	<25
Jerrys Plains East	dB(A)	36	<35
Jerrys Plains West	dB(A)	32	Inaudible
Long Point	dB(A)	37	<30

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 2022.

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 6-3** for the blast monitoring locations.

6.3.2 | BLASTING PERFORMANCE

250 blast events were initiated at HVO during the reporting period. 140 blasts were fired at HVO South, and 110 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 6-4** to **Figure 6-8**.

There were 2 blasts that recorded overpressure greater than 115 dB(L) during the reporting period, and no exceedances of the 5 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 an 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 (9), which is less than the maximum weekly blasting frequencies as specified in both project approvals.

During the reporting period, HVO closed Lemington Road on 13 occasions for an average of 10 minutes, and the Golden Highway on 16 occasions for an average of 10 minutes. In addition, on three occasions the closure of Lemington Road 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 2022 there were no exceedances of 115 dB(L) air blast overpressure criteria.

See **Table 6-5** and **Table 6-6** for a review of long-term blasting data for both ground vibration and overpressure.

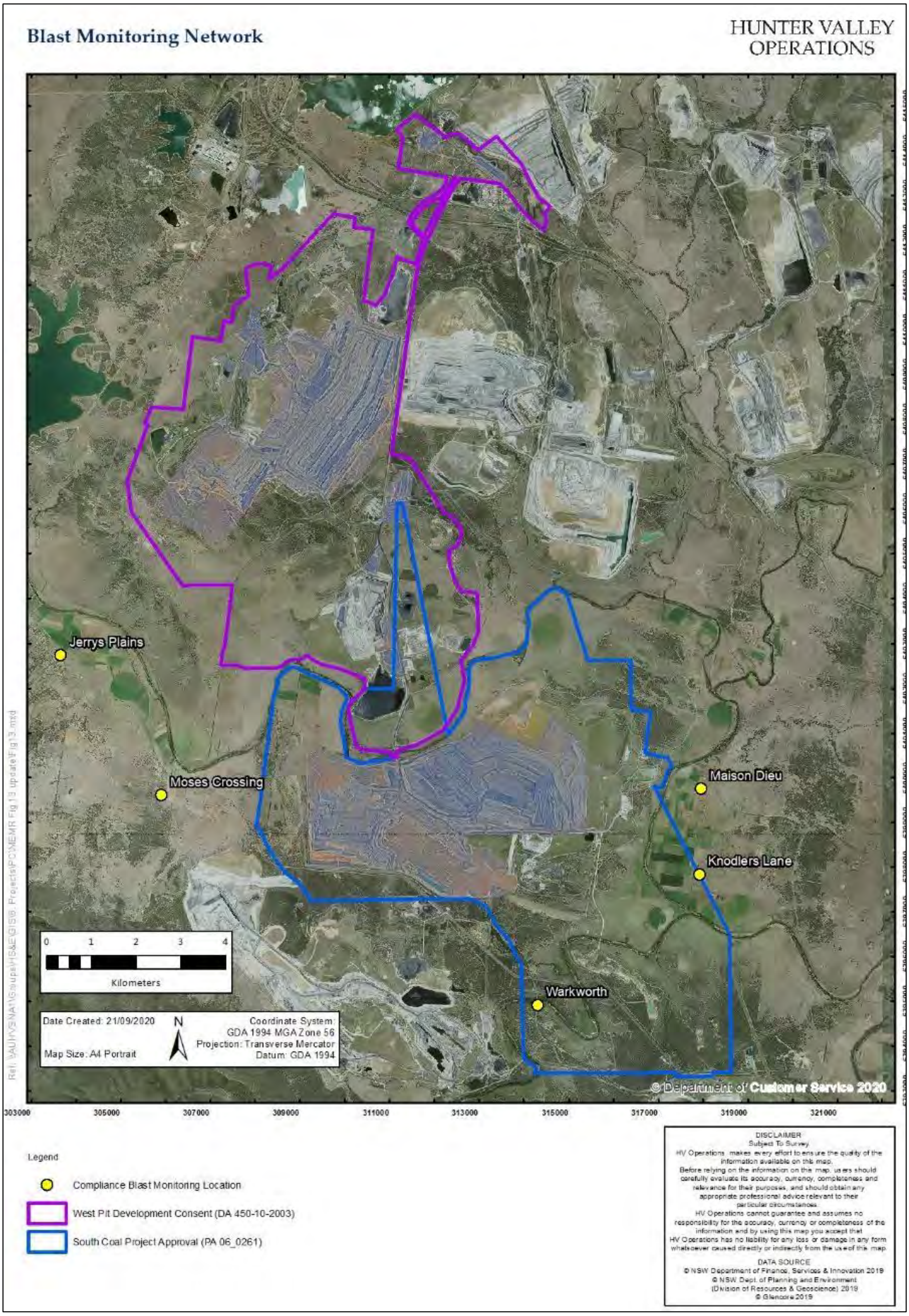

Figure 6-3: HVO Blast Monitoring Network

Table 6-5: Recent Blasting Data Trends for HVO North

Monitoring Location	2020		2021		2022	
	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	1.5	0	0	0	0	0
Knodlers Lane	0	0	0	0	0	0

Table 6-6: Recent Blasting Data Trends for HVO South

Monitoring Location	2020		2021		2022	
	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	0.8	0	0	0	0	0
Maison Dieu	2.5	0	0	0	0	0
Knodlers Lane	0.8	0	0	0	1.4	0

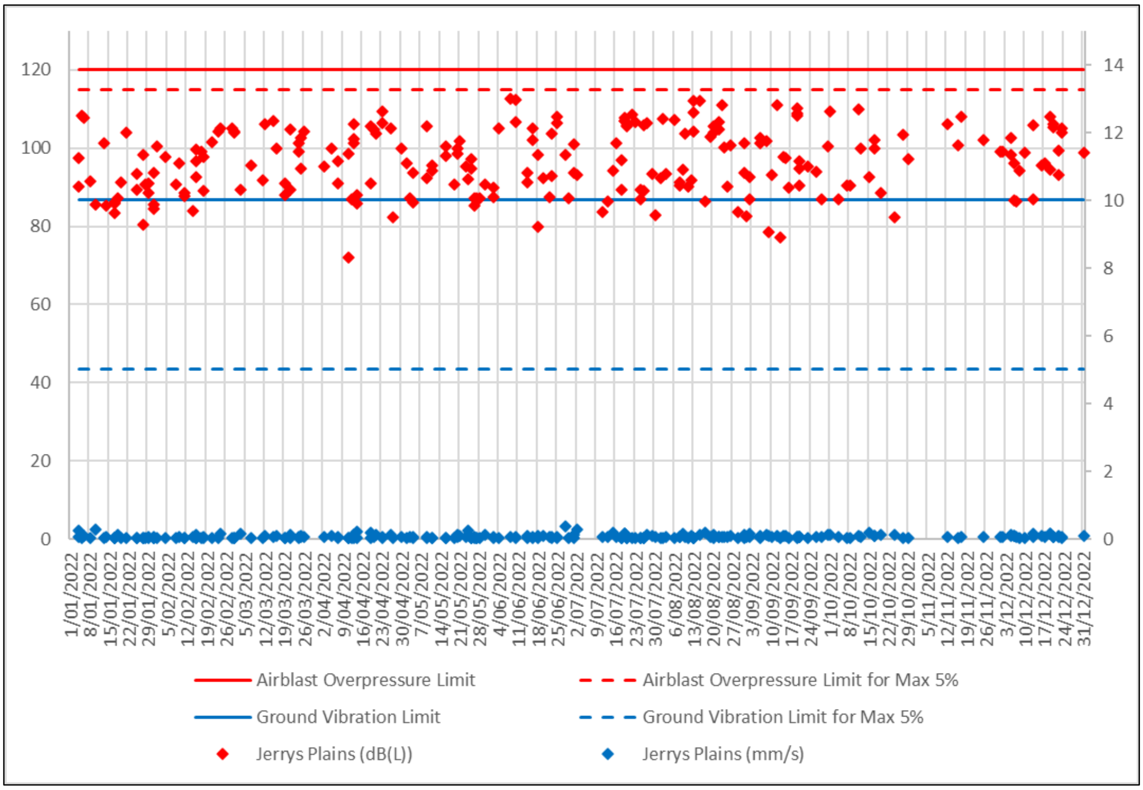

Figure 6-4: Jerrys Plains Blast *Monitoring Results 2022*

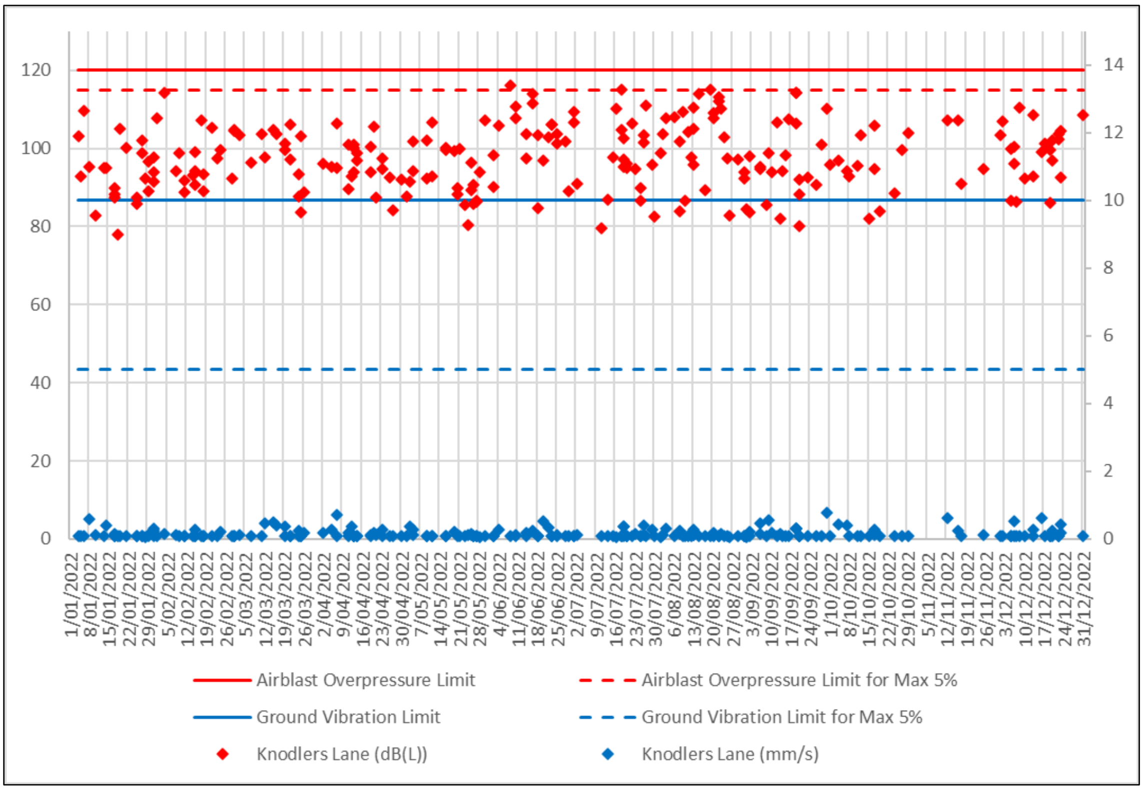

Figure 6-5: Knodlers Lane Blast Monitoring Results 2022

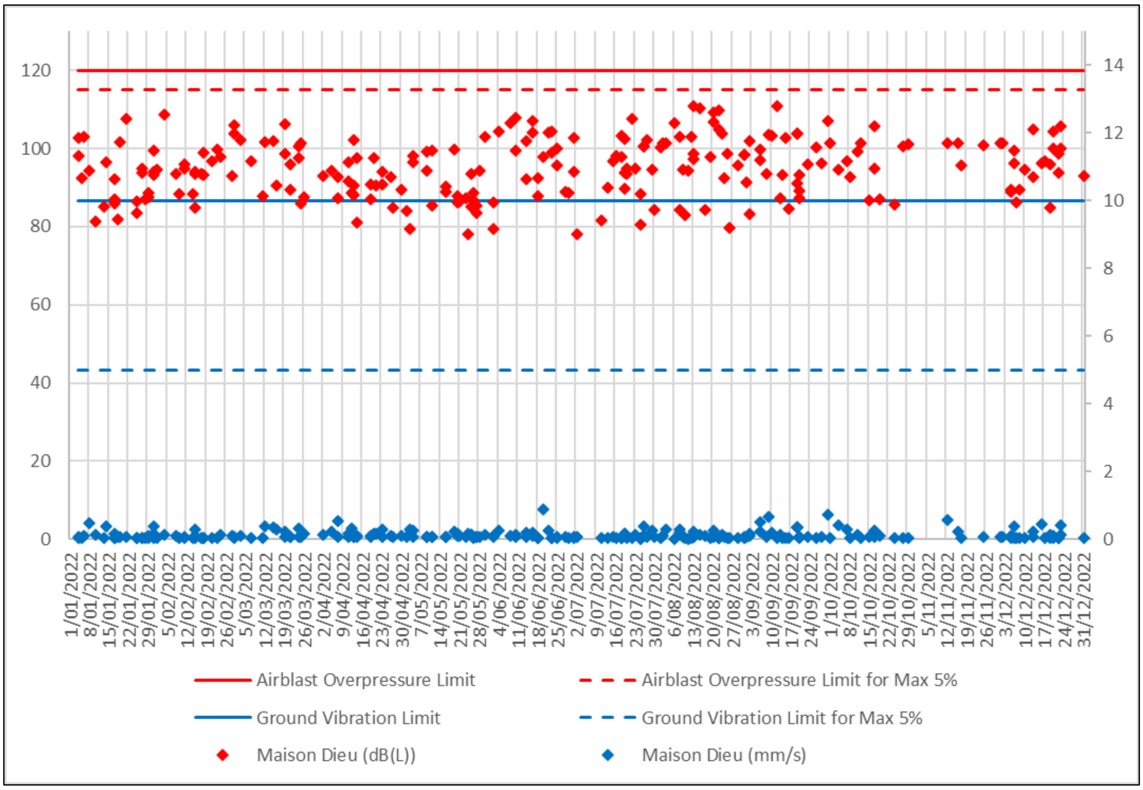

Figure 6-6: Maison Dieu Blast Monitoring Results 2022

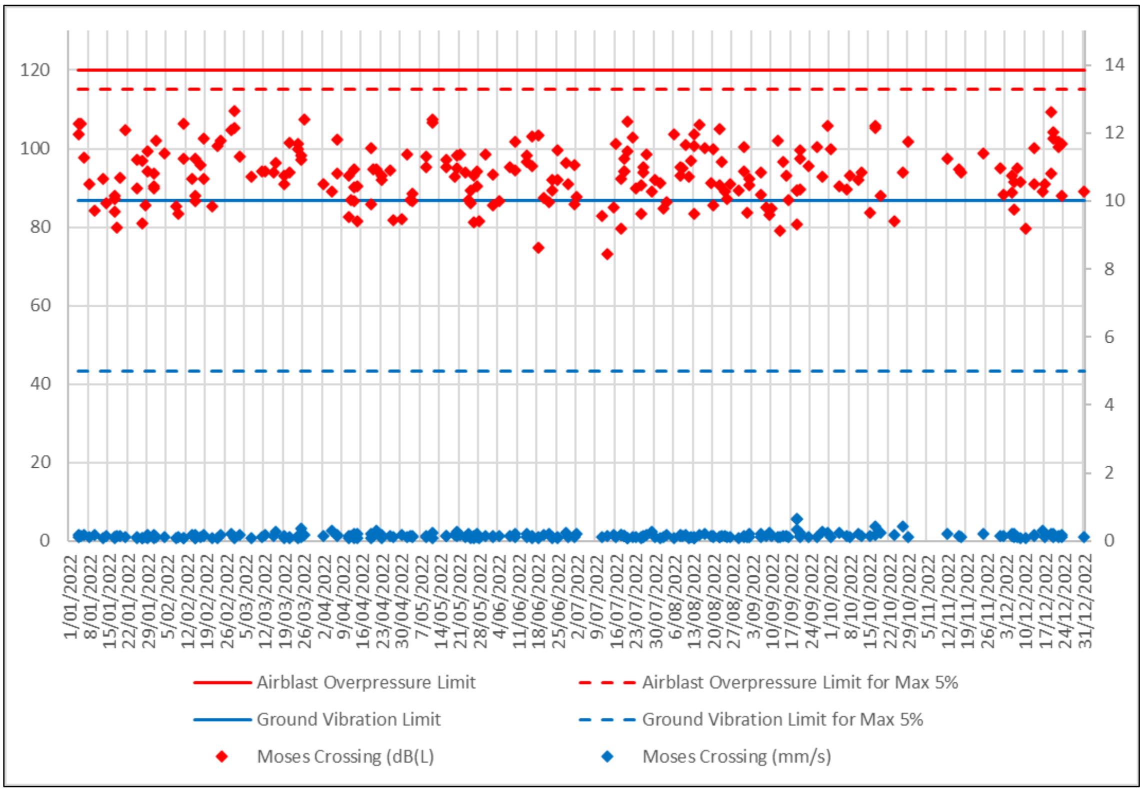

Figure 6-7: Moses Crossing Blast Monitoring Results 2022

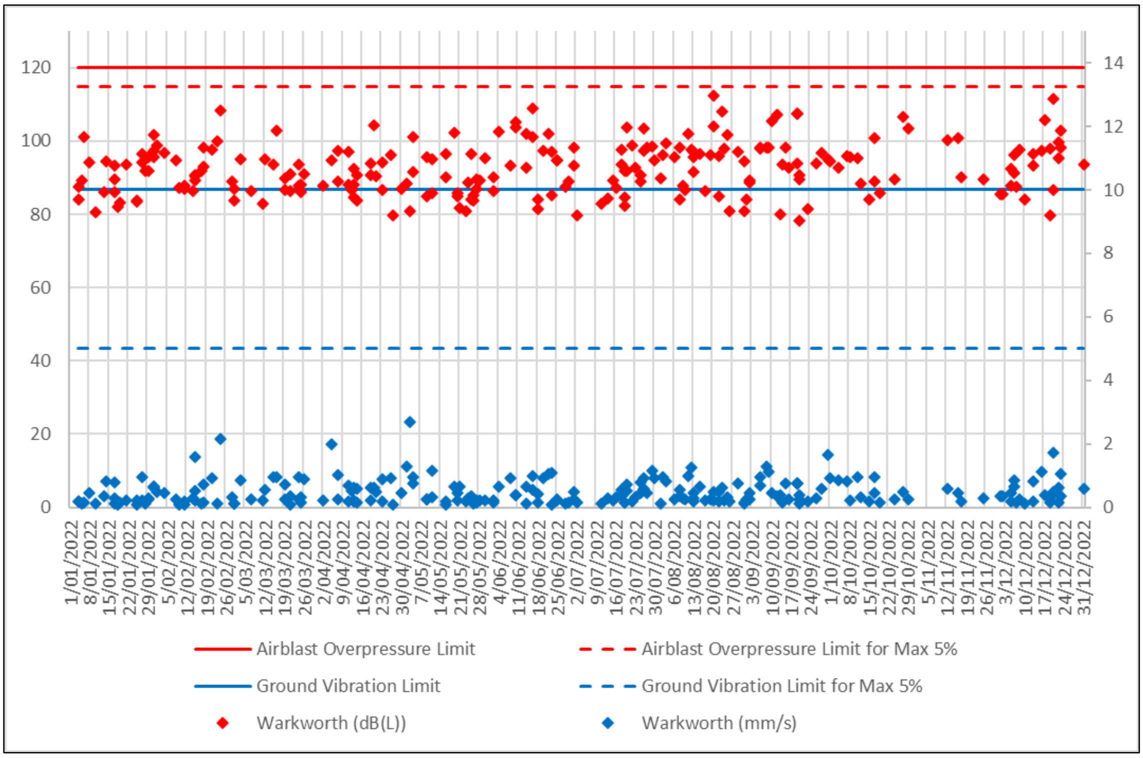

Figure 6-8: Warkworth Blast Monitoring Results 2022

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 2022 and comparison to previous years is provided in **Table 6-7**. No blast fume ranked as Category 4 or Category 5 was observed at HVO during the reporting period. Four blasts were ranked as Category 3 and no fume was observed to leave the site. There was an overall increase in category 1, 2 and 3 fume rankings compared to 2021 due to increase in the number of blasts, proportionally the number of fume events is consistent with 2021.

Table 6-7: Visible Blast Fume Rankings According to the AEISG Colour Scale

AEISG Ranking	2017	2018	2019	2020	2021	2022
0	272	214	202	160	170	212
1	39	19	39	22	45	52
2	11	16	15	27	27	30
3	2	4	4	0	3	4
4	0	0	0	0	1	0
5	0	0	0	0	0	0
Total*	324	253	260	209	246	298

* 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 6-9**. 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 551 real time alarms for air quality and meteorological conditions were received and acknowledged during 2022, which is a decrease from 797 alarms recorded during 2021. 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, 1175 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 6-10.** 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).

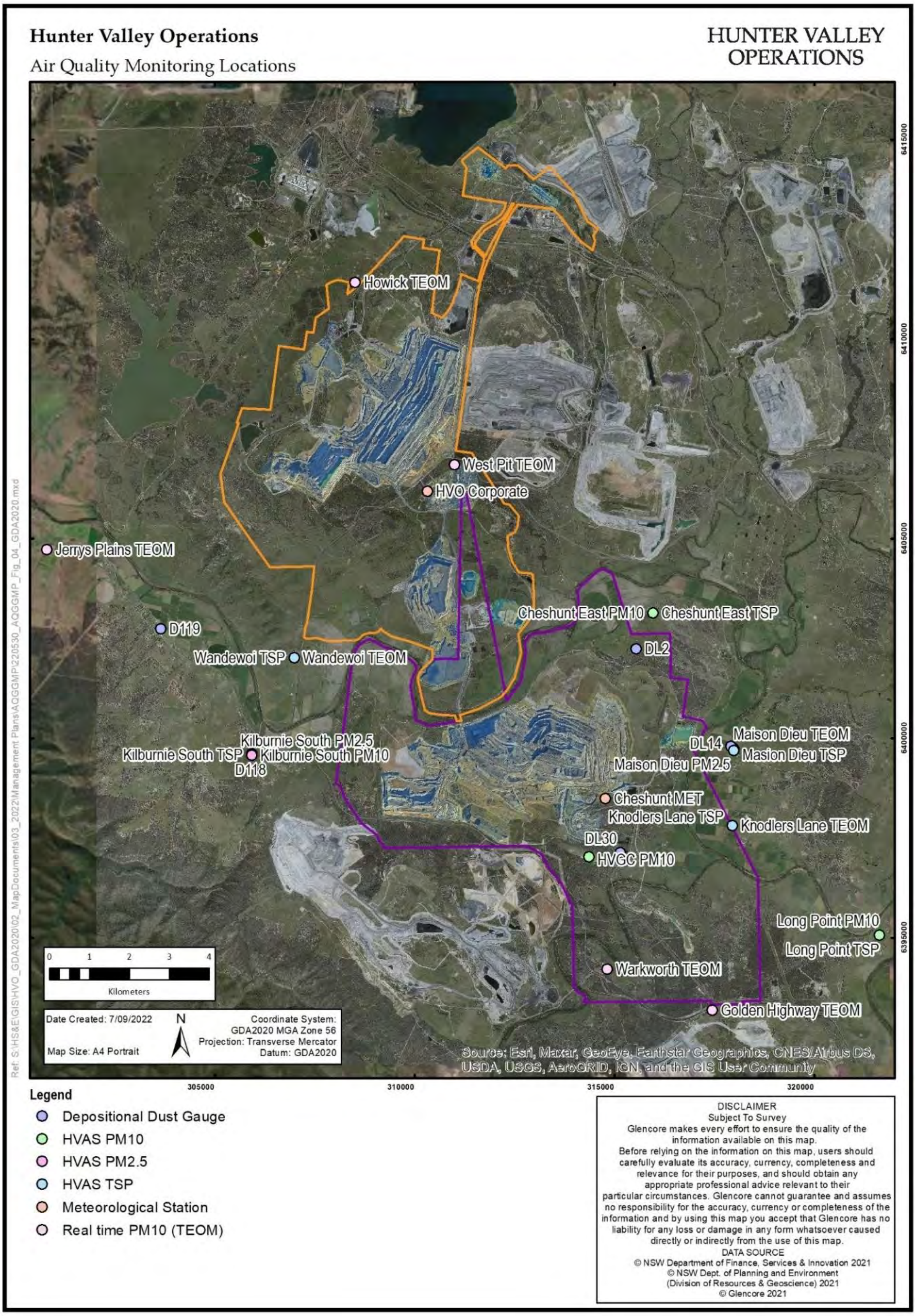

Figure 6-9: Air Quality Monitoring Locations

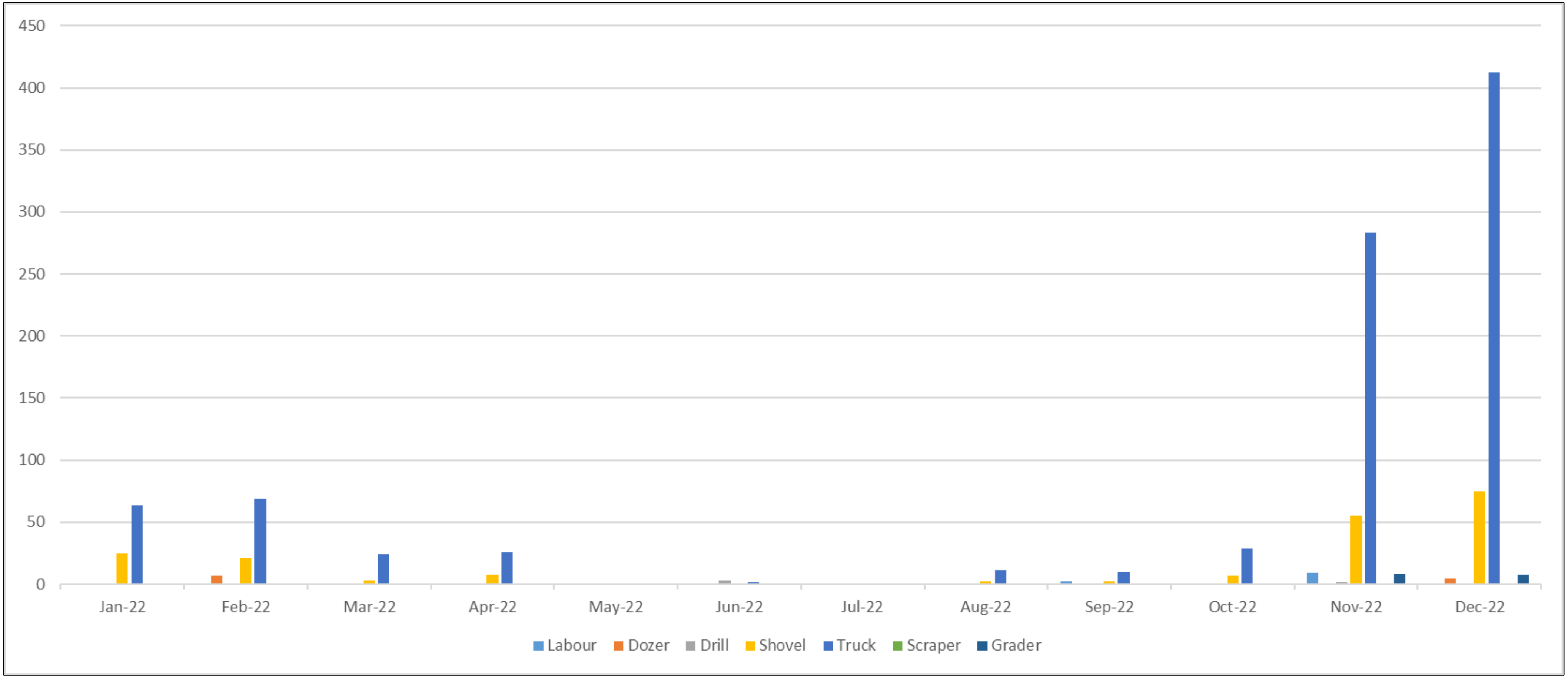

Figure 6-10: Equipment Downtime Hours for Air Quality Management 2022

Data availability from HVO's real time air quality monitoring stations is presented in **Table 6-8.** There was high data availability across the network with common reasons for data mis-captures being data-logger lockups, power failures and storms.

Table 6-8: Real Time PM_{10} Air Quality Monitoring Data Availability 2022

Monitoring Location	2022 Data Availability
Warkworth	95.6%
Knodlers Lane	98.4%
Maison Dieu	95.9%
Howick	97.0%
CHPP North	95.1%
Wandewoi	98.1%
Golden Highway	98.4%
Jerrys Plains	97.8%

Note: Data availability calculated across 2022 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 May 2022 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 319 ha was seeded which included waste dumps ahead of mining re-disturbance (**Figure 6-11**). 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.

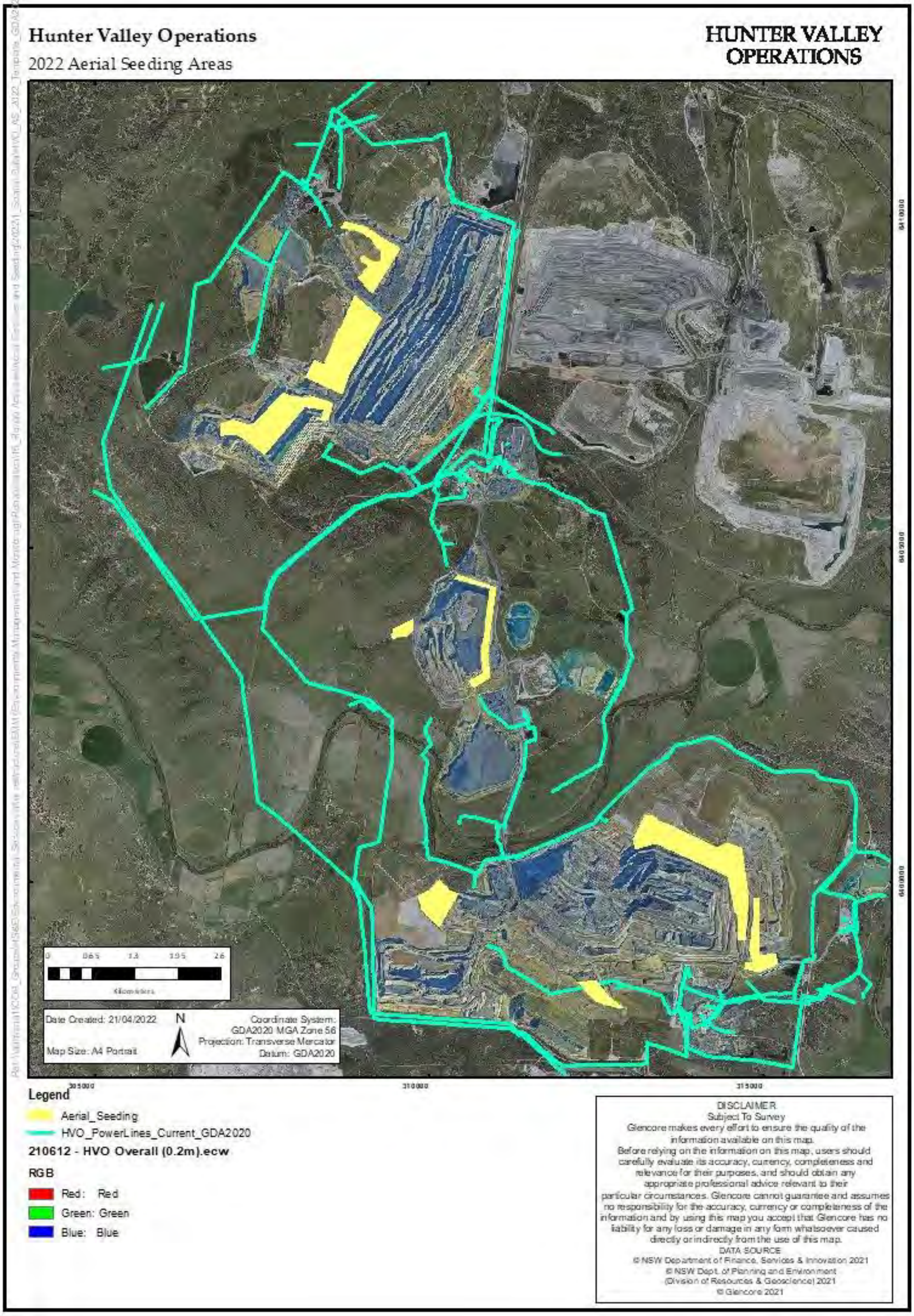

Figure 6-11: Areas Aerial Seeded in 2022 – NVO North (West Pit, Carrington Pit) and HVO South

Depositional Dust

Depositional dust is monitored at nine locations in accordance with the AQGHMP. The annual average insoluble matter deposition rates in 2022 compared with the depositional dust impact assessment criterion and previous years' data are shown in **Figure 6-12**.

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 2022. However, all results were below the maximum insoluble solids incremental increase criterion of 2 g/m^2/month (**Figure 6-13**).

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 0.1 g/m^2/month and was not deemed to have caused the exceedance (**Table 6-9**).

Table 6-9: Dust Deposition Annual Average Assessment

Date	Site	Measured Annual Average Dust Deposition (g/m^2/month)	Annual Average Dust Deposition Criteria (g/m2/month)	HVO's Contribution to Dust Deposition (g/m2/month)	Discussion
2022	Warkworth	6.9	4	0.1	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.

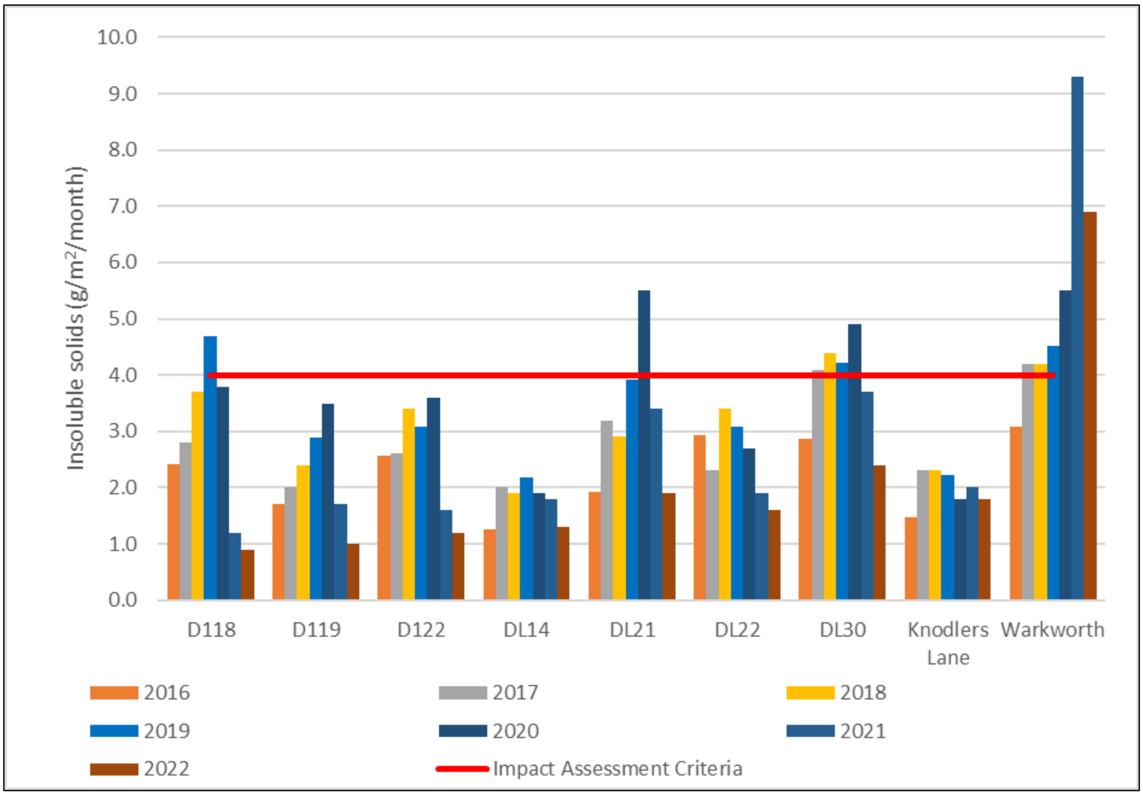

Figure 6-12: Annual Average Insoluble Matter Deposition Rates 2016-2022

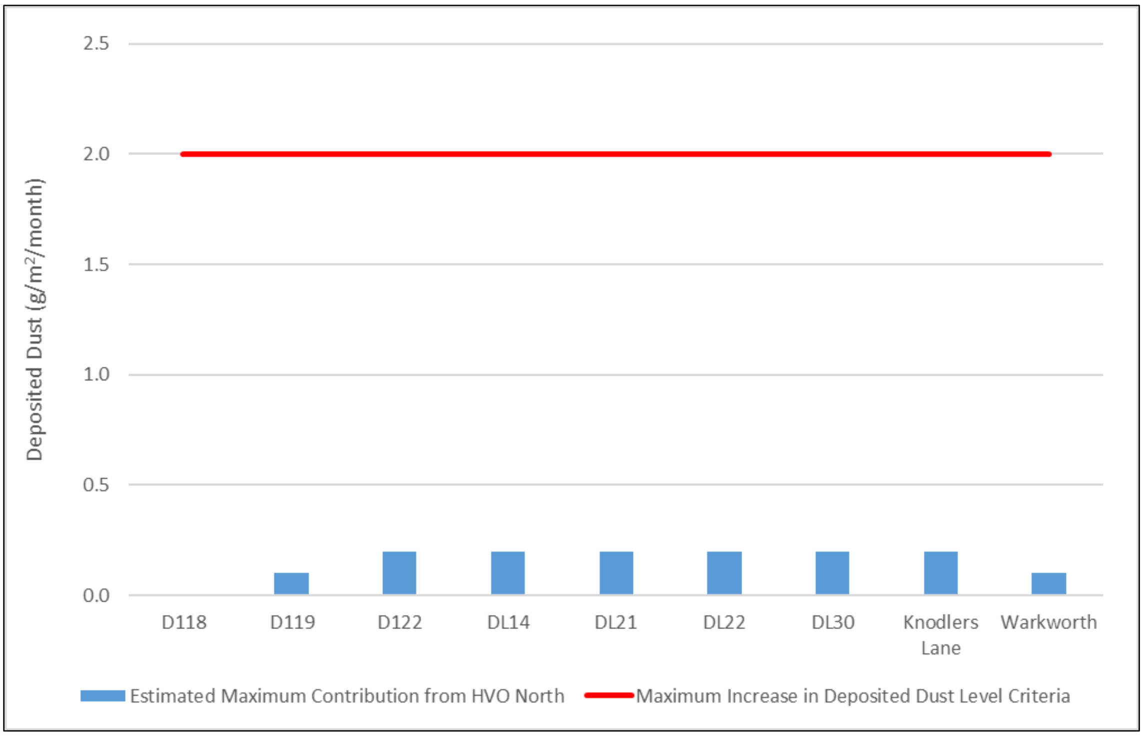

Figure 6-13: Maximum Allowable Increase in Deposited Dust Level 2022

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 2022 compared with the long-term impact assessment criterion and data from previous years are shown in **Figure 6-14**. TSP results in 2022 are considered to be generally lower than with those recorded in previous years, with the exception of Warkworth which showed similar levels to 2018 – 2020.

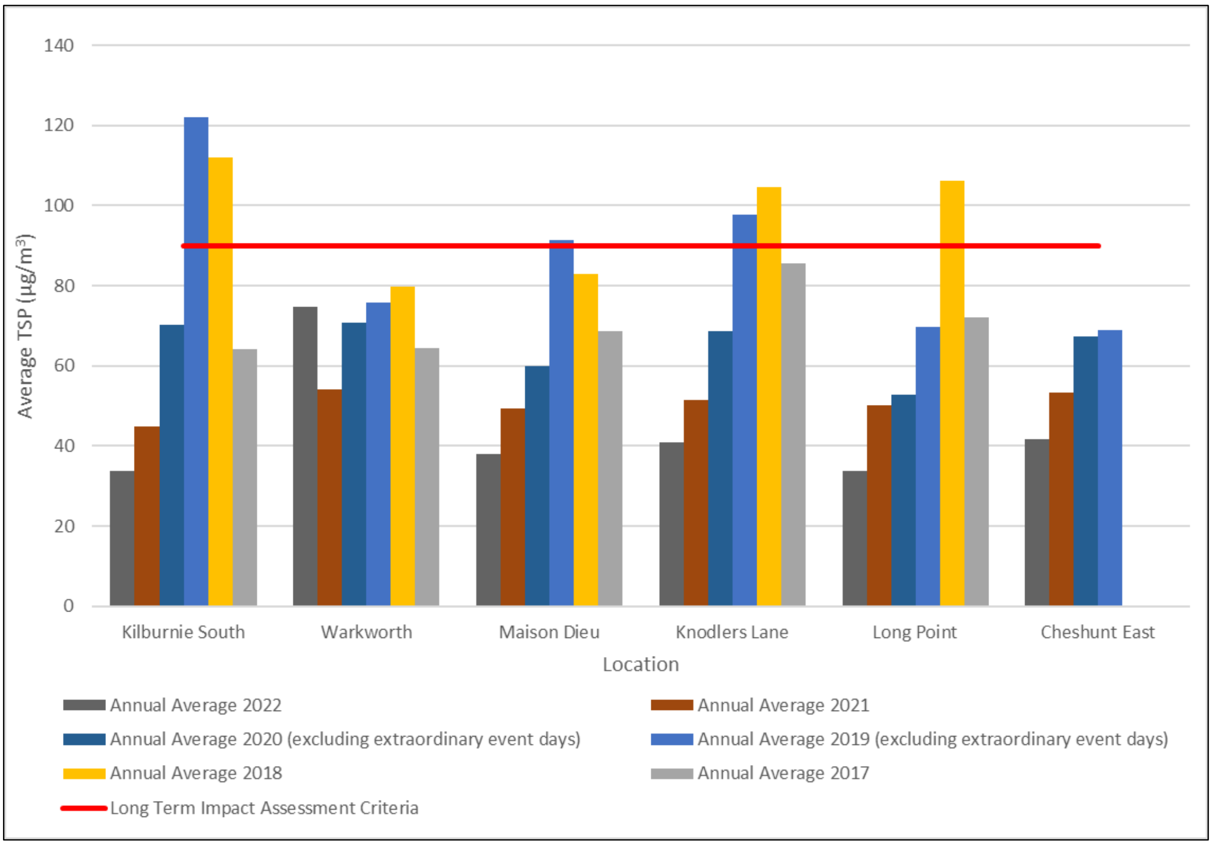

Figure 6-14: Annual Average TSP Concentrations 2017 to 2022 (Excludes Extraordinary Events)

Particulate Matter <10µm (PM_{10})

Particulate Matter <10 µm³ (PM10) 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 (PM10) – Short Term (24-hour average) Impact Assessment Criteria

Short Term (24-hour average) PM10 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 2022 is presented in **Figure 6-15**.

Two PM10 measurements at the Gliding Club HVAS and two PM10 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 miscaptures are provided in **Table 6-10**.

Table 6-10: PM_{10} HVAS 24hr Miscaptures

HVAS Location	Date	Reason for Miscapture
Long Point	03/06/2022	Cause identified as a localised power outage
Gliding Club PM10	13/09/2022	Filter was damaged when being changed out by monitoring contractor following sampling

The data presented includes total measured results including contribution from all particulate sources. There was one exceedance of PM10 criteria recorded during the reporting period. This exceedance was investigated to determine the level of contribution from either HVO North, HVO South or where relevant both. Outcomes of this assessment is provided in **Table 6-11.** The exceedance was assessed to have received incremental dust contributions below HVO criteria.

Table 6-11: 2022 PM_{10} HVAS 24hr Exceedance Investigation

Date	Site	Measured 24-Hour Average PM_{10} Level (µg/m^3)	HVO 24-Hour Average PM_{10} Criteria (µg/m^3)	Estimated HVO Maximum Incremental Contribution to PM_{10} Level (µg/m^3)	Discussion
31/10/2022	Gliding Club	53.2	50[2]	33.5[3]	Investigated based on wind direction, site increment below criteria.

[2] HVO South (PA 06_0261) – Incremental Air Quality Criterion (HVO increment only)

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

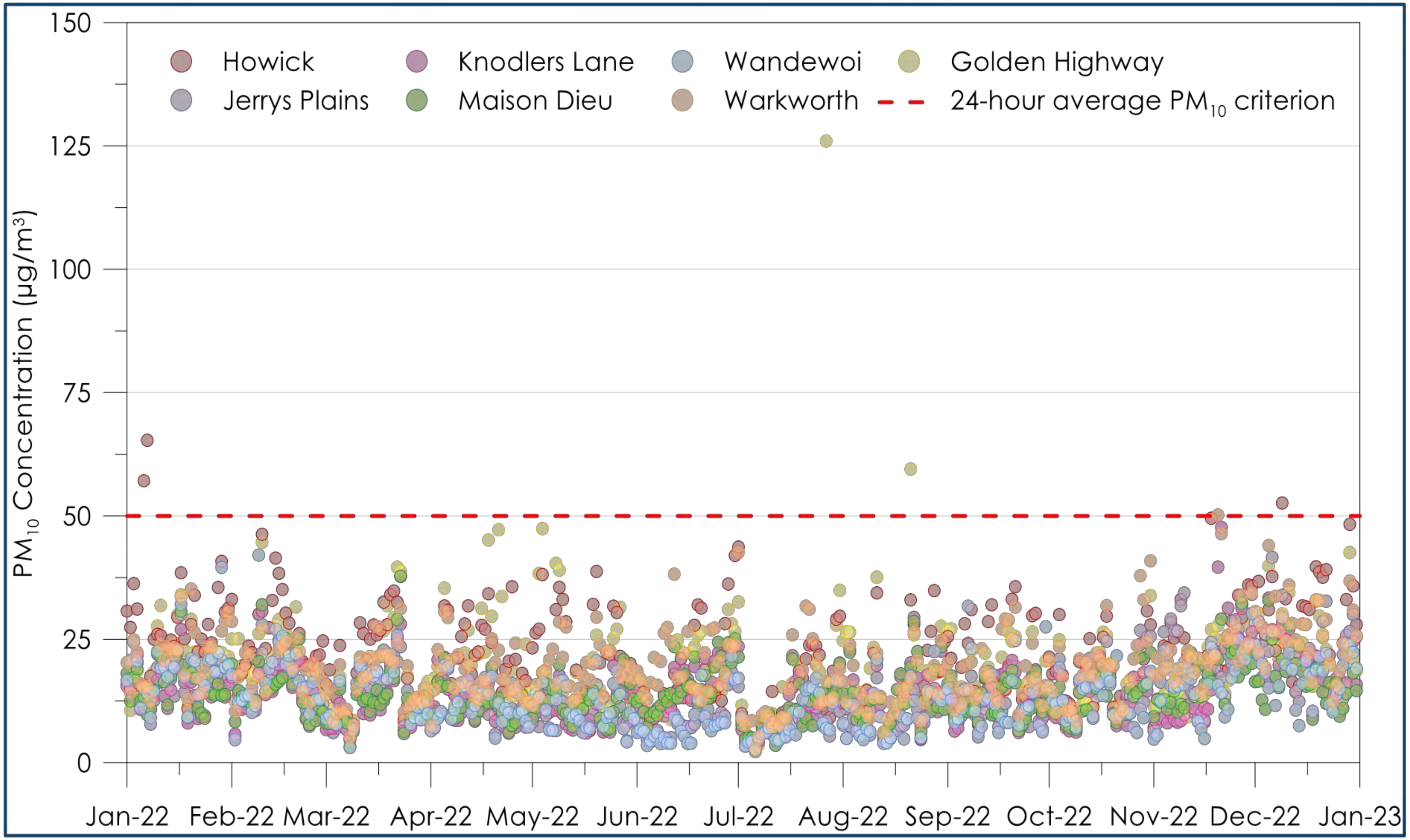

Figure 6-15: 24-hour Average Total PM_{10} results- 2022

Long Term PM_{10} Impact Assessment Criteria

Annual average PM10 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 PM10 levels were below the impact assessment criteria at all compliance monitoring locations during the reporting period.

A comparison of the long term PM10 impact assessment criterion and previous years' data are shown in **Figure 6-16**.

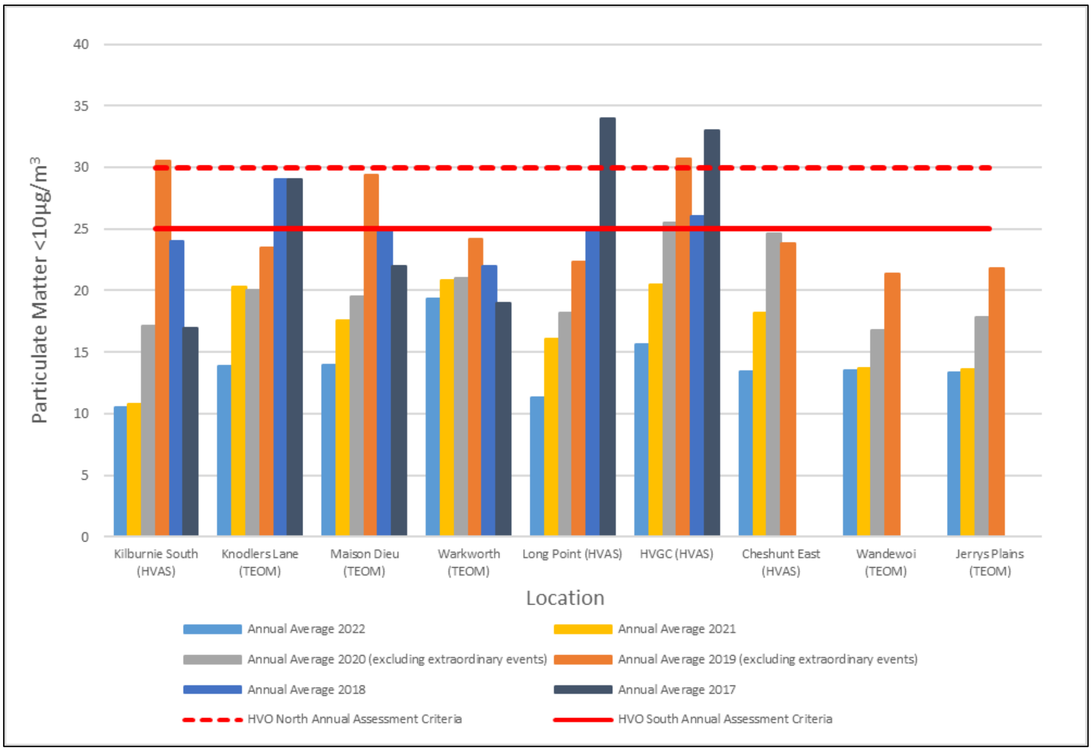

Figure 6-16: Annual Average HVAS PM_{10} results 2017 to 2022

$PM_{2.5}$ Impact Assessment Criteria

$PM_{2.5}$ samples were collected at Maison Dieu and Kilburnie South using HVAS, and these results are provided in **Table 6-12** and **Figure 6-17**.

There were 5 $PM_{2.5}$ measurements at the Maison Dieu HVAS that were not able to be collected on the scheduled sampling date (based on a sampling frequency of every six days). These miscaptures are detailed in **Table 6-13**. Following the run failures on 10 April and 10 May 2022 a new HVAS unit was installed at Maison Dieu.

2 results above criteria were recorded over 2 monitoring days during 2022. 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 PM10 monitor results.

Table 6-12: Short Term Impact Assessment Criteria – $PM_{2.5}$ Results 2022

Date	Site	Measured 24-Hour Average $PM_{2.5}$ Level (µg/m³)	HVO South 24-Hour Average $PM_{2.5}$ Incremental Criteria (µg/m³)	Estimated HVO South Incremental Contribution to $PM_{2.5}$ Level (µg/m³)	Discussion
06/12/2022	Kilburnie South	28.1	25	9.4	Investigated based on wind direction and background, site increment below criteria
12/12/2022	Maison Dieu	57.7	25	4.4	Investigated based on wind direction and background, site increment below criteria

Table 6-13: $PM_{2.5}$ HVAS Miscaptures - 2022

HVAS Location	Date	Reason for Miscapture
Maison Dieu	10/04/2022	Mains power trip. RCD was replaced as advised by technician.
Maison Dieu	10/05/2022	Caused by trip of RCD. Cause of trip unknown. Power cable was replaced as a precaution to isolate the source of the failure.
Maison Dieu	15/06/2022	No cause for failure could be fully determined. The unit was replaced with a new HVAS.
Maison Dieu	07/10/2022	Caused by a power supply failure.
Maison Dieu	19/10/2022	Caused by a suspected power supply failure.

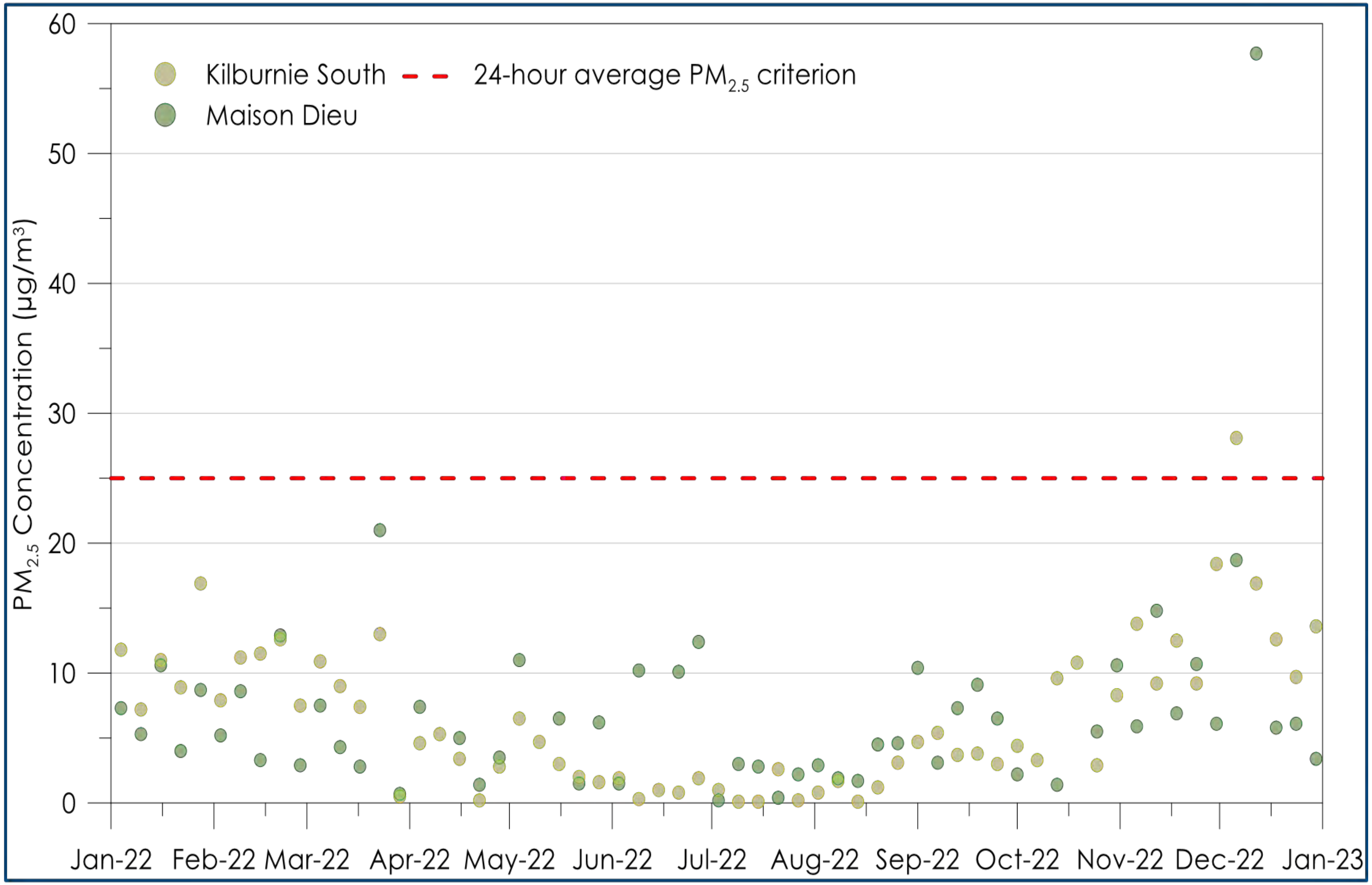

Figure 6-17: 24-hour Average $PM_{2.5}$ Results 2022

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

Annual average $PM_{2.5}$ was below the annual average criteria of 8 μg/m^3 at all locations for the reporting period, as presented in **Table 6-14**. 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.
- Calculation of PM10:PM2.5 ratios for monitoring equipment for co-located units (as shown in **Table 6-15**). 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.

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 engaged an air quality consultant to review the air quality monitoring network. This review recommended the implementation of real-time $PM_{2.5}$ monitoring at Maison Dieu and Kilburnie South. HVO installed two E-BAMs in these locations in Q1 2023.

Table 6-14: $PM_{2.5}$ Annual Average Monitoring Data 2022

Monitoring Location	HVO South Annual Average $PM_{2.5}$ Criteria (μg/m^3)	Measured Annual Average $PM_{2.5}$ Level (μg/m^3)	Estimated Contribution to Annual Average $PM_{2.5}$ Level (μg/m^3)
Maison Dieu	8	7.1	1.8
Kilburnie South	8	6.6	2.3

Table 6-15: Annual $PM_{2.5}$ / PM_{10} Ratios in Upper Hunter

Year	PM2.5 / PM10 Ratios					
	Muswellbrook	Singleton	Camberwell	Merriwa	Maison Dieu	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
2022	0.39	0.36	0.32	0.31	0.40	0.57

* 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 6-16**.

Table 6-16: UHAQMN Annual Average $PM_{2.5}$ Results for 2022

UHAQMN Monitor	Measured Annual Average 2022 PM2.5 Level (µg/m^3)
Muswellbrook	6.2
Singleton	5.1
Camberwell	4.8
Merriwa	3.4

6.4.4 | COMPARISON AGAINST EA PREDICTIONS

Table 6-17 and **Table 6-18** show a comparison between 2022 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 2022 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 2022 were below predicted levels for all monitoring locations.

*Table 6-17: HVO South PM10 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 (µg/m^3) Stage 2	2022 Maximum 24hr PM_{10} HVO Contribution (µg/m^3)	Predicted PM_{10} Annual Averages (µg/m^3) Stage 2	2022 PM_{10} Annual Average (µg/m^3)
Maison Dieu (256)	36	8.2	21	14.0
Warkworth (90)	95	8.6	46	19.3
Kilburnie South(307)	31	5.7	27	10.5
Knodlers Lane(117)	59	23.8	28	13.9
Long Point (137)	36	5.9	20	11.3
Hunter ValleyGliding Club***	>50	33.5	>30	15.6

^ 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 6-18: HVO South TSP Annual Average Results Compared Against Cumulative Predictions^*

Site (EA Receptor)	Long Term (Annual Average) TSP Criteria	
	Stage 2 Prediction (µg/m³)	2022 PM10 Annual Average (µg/m³)
Maison Dieu (256)	60	37.9
Warkworth (90)	106	74.7
Kilburnie South (307)	76	33.8
Knodlers Lane (117)	75	40.9
Long Point (137)	61	33.9

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

Table 6-19 and **Table 6-20** detail comparisons between 2022 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 6-19: HVO 2022 PM_{10} Annual Average Results Compared Against Cumulative Predictions^*

Site (EA Receptor	Long Term (Annual Average) Criteria			
	Predicted PM_{10} Annual Average (µg/m³)	2022 PM10 Annual Average (µg/m³)	HVO Estimated Contribution to 2022 PM_{10} Annual Average (µg/m³) (North)	HVO Estimated Contribution to 2022 PM_{10} Annual Average (µg/m³) (South)
Maison Dieu(6)	19.1	13.8	**	0.5
Warkworth(39)	20.8	18.6	**	1.2
KilburnieSouth (4)	19.7	10.1	0.2	0.7
Jerrys Plains (13)	16.6	13.0	0.3	1.2
CheshuntEast (7)	20.8	13.4	2.9	**

^ 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

** no relevant criteria under this consent

*Table 6-20: 2022 TSP Annual Average Results Compared Against Cumulative Predictions^*

Site (EA Receptor)	Long Term (Annual Average) Criteria	
	Predicted TSP Annual Average (µg/m^3)	2022 TSP Annual Average (µg/m^3)
Maison Dieu (6)	44.7	37.9
Warkworth (39)	46.6	72.2
Kilburnie South (4)	45.2	37.7
Cheshunt East (7)	46.5	41.6

^ 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 2022 were generally lower than or 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

6.5.1 | REPORTED GREENHOUSE GAS EMISSIONS

HVO reports greenhouse gas emissions (GHG) in accordance with National Energy and Greenhouse Gases (NGER) legislation. Each financial year HVO is required to submit to the Federal government the emissions from their NGERs registered facility into the Emissions and Energy Reporting System (EERS). Also, because HVO emits over 100kt of CO_2e- each year, HVO is registered as a Safeguard facility and therefore also had a Safeguard baseline. Emissions above the baseline for that year need to be offset by retiring Australian Carbon credit Units (ACCUs). The NGERs reporting year is based on a financial year, not a calendar year such as this Annual Review. In order to prevent incompatible public reporting, the values in this report also cover a financial year. **Table 6-21** contains the Scope 1 (direct emissions from the mining activities during the year), and Scope 2 emissions (electricity consumption by the mine during the year) compared to annual average emissions forecast for HVO South (PA 06_0261) in the *Air Quality and Greenhouse Gas Study HVO South Modification 5 (Todoroski Air Sciences, 2017*) (the EIS forecast). Greenhouse emission forecasts for HVO North are only suitable for comparison in the EIS for the Carrington West Wing modification, which has not commenced.

Table 6-21: Greenhouse Gas Emissions 2022

FY 2021/2022	Scope 1 (tCO_2e-)	Scope 2 (tCO_2e-)	Total Scope 1 & Scope 2 (tCO_2e-)
EERS Reported Value (HVO North and South)	577,874	93,865	671,739
EIS Forecast (HVO South only)	570,807	137,231	708,038

6.5.2 | COMPARISON AGAINST PREDICTIONS

The EIS forecast estimated that the annual average greenhouse gas emissions (Scope 1 and Scope 2) from HVO South would be 708,038 CO_2e-. As outlined in **Table 6-21**, total emissions during FY2022 were 671,739 CO_2e-. Total emissions reported are for the HVO Complex, which includes activities in both HVO South and HVO North.

Total emissions during FY2022 were below the HVO South EIS forecast of 708,038 CO_2e-. Scope 1 emissions were above the projected greenhouse gas emissions in the EIS Forecast.

While Scope 1 emissions were slightly (1.2%) above prediction, this prediction is for HVO South only. Considering that total emissions are below forecast and that the forecast does not include HVO North, HVO is operating below predictions.

6.5.3 | STEPS TAKEN TO IMPROVE ENERGY EFFICIENCY AND REDUCE GHG EMISSIONS

HVO is actively engaged in minimising greenhouse gas emissions associated with their coal operations and supporting the NSW Government objectives of net-zero emissions by 2050. In addition, HVO is governed by a range of climate change commitments made by Yancoal and Glencore, as the JV partners of HVO, including:

- Yancoal
  - Supporting innovation and investment in carbon capture, utilisation and storage through various industry and policy initiatives, to work towards the commitments outlined in the Paris Agreement;
  - Taking a constructive role in public policy development and participation in relevant industry associations, guided by recognition of the aims of the Paris Agreement; and
  - Supporting research into technologies that will reduce GHG emissions from the downstream consumption of products (Scope 3).
- Glencore
  - Announcing a 1.5°C pathway aligned target of 50% reduction of total emissions (Scope 1, 2 and 3) by 2035 on 2019 levels, consistent with the midpoint of the Intergovernmental Panel on Climate Change's 1.5°C scenarios and the 1.5°C pathways set out by the International Energy Agency; and
  - Setting an ambition to achieve, with a supportive policy environment, net zero total emissions by 2050. This will be done by managing the carbon footprint of Glencore's operations and contributing to global decarbonisation.

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, 11% of non-mineral waste material generated at HVO was disposed of in licensed offsite landfill facilities and 89% of waste was recycled. These results show an increase in recycling rates compared to 2021.

HVO will continue to maintain high recycling rates in 2023.

Details of waste and recyclables removed from demolition activities undertaken during the reporting period are included in **Section 7.6.7** and **Section 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 917kL 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 contractor include approximately 16 tonnes of waste grease.

6.6.4 | CONTAMINATED SOIL

HVO operates and maintains two 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 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.

6.6.5 | ACID ROCK DRAINAGE

There were no observed issues relating to Acid Rock Drainage during 2022. The Geochemical Monitoring Programme was reviewed during the reporting period, and this will be implemented from 2023.

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

HVO completed demolition of the Orica Reload Facility at HVO South (Cheshunt). A total of 84 tonnes of scrap metal, 536 tonnes of concrete, 47 tonnes of industrial waste and 203 tonnes of liquid waste material was removed to approved waste facilities. Works were performed safely and in accordance with AS 2601 The Demolition of Structures. Soil sampling was undertaken to determine potential for contaminants, none were identified. The site was left in a neat and safe condition, with the voids backfilled and levelled out.

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 the meeting held on 7 December 2022.

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

Arrow Heritage Solutions conducted due diligence assessments and surveys at four separate areas in 2022 which were the subject of internal Ground Disturbance Permits (GDPs). These assessments included an area adjacent to the Hunter River east of Archerfield Road on 9 April 2022, an area at the Newdell facility and Dam 32N on 11 June and 22 July 2022 and an area south of Riverview Pit on 9 November 2022. Proposed works in these areas include, respectively, vegetation slashing, drilling and water infrastructure maintenance. No artefacts were identified within the GDP areas covered by the assessments.

A separate due diligence assessment and survey was conducted by OzArk Environment and Heritage on 1 June 2022 for a GDP covering the decommissioning of six boreholes south west of HVO north near Lemington Road. No artefacts were identified within the GDP area.

At the December 2022 HVO Cultural Heritage Working Group (CHWG) meeting, the CHWG reached a consensus to recommend salvage of a remnant artefact scatter at HVO South that was located in an area that had been the subject of historical Aboriginal Heritage Impact Permits. The remnant artefacts were identified in 2020, inspected by the CHWG in 2021 and the subject of consultation with the CHWG at several meetings in 2021 and 2022.

During 2022 HVO has conducted consultation 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). Consultation with Registered Aboriginal Parties and preparation of the ACHA for the HVO Continuation Project progressed during the 2022 Annual Review period, with the project EIS and ACHA forming part of the development application submitted to the DPE in December 2022.

6.7.3 | HERITAGE AUDITS AND INCIDENTS

Under the provisions of the HVO South ACHMP, two compliance inspections were conducted in 2022 and under the provisions of the HVO North HMP, a single compliance inspection was conducted during 2022. 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 2022 HVO South compliance inspection was conducted on 11 April 2022 by 2 RAP representatives of the CHWG. A total of 43 aboriginal heritage sites were inspected focusing on buffer property areas south of Cheshunt Pit primarily used for livestock grazing. The findings and recommendations of these inspections are documented in the HVO South Aboriginal Heritage Management Plan April 2022 Compliance Audit Inspections report dated May 2022 and included as Appendix D.

The annual 2022 HVO South and HVO North compliance inspection was conducted over several days between 8 and 10 of November 2022 by three RAP representatives of the CHWG and a suitably qualified and experienced archaeologist. During the HVO South portion of the compliance inspection, a total of 67 Aboriginal heritage sites were inspected in the HVO South Area at Cheshunt, Nichols, Glider Strip North and the HVO Southern areas. These areas are not active mining areas with some utilised for grazing by third party rural licensees. During the HVO North portion of the compliance inspection, a total of 20 heritage sites were assessed including the key sites in proximity to the Newdell Loading Facility Area, Mitchell Pit South and the Carrington area. The findings and recommendations of these inspections are documented in the Hunter Valley Operations Aboriginal Heritage Management Plans November 2022 Compliance Audit Inspections report dated November 2022 and included as Appendix D.

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 vegetative sediment controls were identified. Barricade upgrade and maintenance will be included as part of the works planning for 2023. Inspections were hampered by high vegetation and ground cover resulting from recent rainfall. The CM CD1 site report included reference to the program of fencing upgrades proposed and endorsed by the CHWG 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 68 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 2022.

6.7.4 | HISTORIC HERITAGE – MANAGEMENT AND COMMUNITY CONSULTATION

Consultation was conducted at the Hunter Valley Operations Community Consultative Committee (CCC) Meetings held on 16 February, 18 May, 17 August, and 2 November 2022 as outlined in **Section 10.2.3**. Topics discussed included:

- Yard maintenance works and Termite Interception System inspections at LEP listed European heritage properties
- Arboreal works on trees around listed outbuildings and the Archerfield Stables. Structural works to the Archerfield Stables were also completed in July 2022. Works included removal of rotted posts and beams on the east and west stable verandahs and their replacement with species matched posts and beams.
- The Cockatoo Fence Asset Protection Zone maintenance works which were completed in August 2022 with the manual brushcutting of existing firebreaks on either side of the fence structure.
- HVO ‘s plan for an Historic Homestead Project, which will include the completion of detailed condition reports for the Archerfield, Wandewoi and Carrington Stud homesteads. In addition the project will prepare a long term maintenance and management plan for each homestead complex. An inspection of selected homesteads by the CCC is planned to take place in Q2 2023.

Figure 6-18: Cockatoo Fence Firebreak

Figure 6-19: Archerfield Homestead

6.8 | BUSHFIRE MANAGEMENT

The following bushfire management control and mitigation activities, outlined in the HVO Bushfire Management Plan were completed at the HVO site in 2022.

Operational Areas

Table 6-22: Bushfire Mitigation Measures Undertaken in Operational Areas

Task	Completion Note
Inspect and maintain operational area fire trails and breaks	Completed as per SAP maintenance strategy
Inspect, install and maintain signage for main intersections, and gates of firebreak trails	Completed as per SAP maintenance strategy
Inspect and maintain areas surrounding administration buildings, workshops, crib huts and external roads	Completed as per SAP maintenance strategy
Inspect and maintain areas around power poles, switch yards, transformers, air break switches, and substations	Completed as per SAP maintenance strategy
Inspect and maintain areas around powerlines	Completed as per SAP maintenance strategy
Inspect and maintain areas around CHPP and load points	Completed as per SAP maintenance strategy

Task	Completion Note
Inspect and maintain HC1 conveyor	Completed as per SAP maintenance strategy
Inspect and maintain workshops	Completed as per SAP maintenance strategy
Inspect and maintain water hydrant and pump function	Completed as per SAP maintenance strategy
Report any instances of bushfire outbreak to supervisor / manager, or raise emergency alarm	No instances of bushfire onsite during the reporting period
Review Bushfire Management Plan including currency of information including maps, access routes)	Plan reviewed, see section below for further details.
Bushfire reporting in the Annual Review	Completed – this report

Non-Operational Areas

Table 6-23: Bushfire Mitigation Measures Undertaken in Non-Operational Areas

Task	Completion Note
Report any instances of bushfire outbreak to supervisor / manager, or raise emergency alarm	No reportable bushfire events in non operational areas in 2022
Inspect and maintain non-operational fire trails and breaks	Inspection and maintenance of fire trails completed August 2022, with follow up slashing of fire trials completed in November.
Inspect, install and maintain signage for gates or firebreak trails	Fire trail signage installed October 2022
Review fuel loads and complete necessary reduction including areas adjacent to neighbouring properties	Fuel Load inspection and review completed August 2022

HVO did not conduct any fuel reduction burning activities during 2022.

HVO Bushfire Management Plan Review and Improvement

HVO conducted a review and update of the Bushfire Management Plan in 2022. The updated management plan has been approved by the Hunter Valley District RFS on the 31 October 2022. The RFS review of the plan was endorsed by Singleton Council on 9 March 2023.

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 7-1** to **Figure 7-3**. The HVO Water Management Plan contains further detail on management practices and is available on HVO website. Note that **Figure 7-1** to **Figure 7-3** are updated versions of plans presented in the currently approved *HVO Water Management Plan*, and have been included in the revised version of the plan provided to DPE for approval.

Figure 7-1: West Pit Water Management Infrastructure

Figure 7-2: North Pit Water Management Infrastructure

Figure 7-3: South Pit Water Management Infrastructure

7.1 | WATER BALANCE

The 2022 static water balance for HVO is presented in **Table 7-1.**

Table 7-1: 2022 HVO Water Balance

Water Stream	Volume (ML)
Inputs	
Fresh Water (potable)	38 (0.2%)
Fresh Water (Hunter River extraction)	0 (0%)
Groundwater	1,616 (8.3%)
Rainfall Runoff	17,848 (87.2%)
Recycled to CHPP from Tails & Storage (not included in total)	3,989 (19.5%)
Imported (Liddell/Ravensworth (via Cumnock))	0 (0%)
Water from ROM Coal	958 (4.7%)
Total Inputs	20,460
Outputs	
Dust Suppression	2,168 (13.8%)
Evaporation – Mine Water & Tailings Dams	2,733 (17.3%)
Entrained in Process Waste	2,148 (13.6%)
Discharged (HRSTS)	6,623 (42.0%)
Vehicle Wash-down	311 (2.0%)
Sent to Third Party	91 (0.6%)
Miscellaneous Industrial Use	351 (2.2%)
Water in Coarse Reject	477 (3.0%)
Water in Product Coal	866 (5.5%)
Total Outputs	**15,768**
Change in Pit Storage	**5,663 (increase)**

7.1.1 | WATER INPUTS

A total of 1,047.2 mm of rainfall was recorded at HVO in 2022 producing an estimated 17,848 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. These are given in **Table 7-1**.

Groundwater inflows were estimated to have contributed 1,616 ML to the site during 2022. No fresh water was extracted from the Hunter River during the reporting period.

7.1.2 | WATER OUTPUTS

The main outputs were water use for dust suppression (2,168 ML), evaporation from dams (2,733 ML), water entrained in process waste (2,148 ML) and water in product coal (1,338 ML).

HVO participates in the Hunter River Salinity Trading Scheme (HRSTS) allowing it to 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 2022 HVO discharged 6,623 ML under the Hunter River Salinity Trading Scheme and Environment Protection Licence 640.

7.2 | SURFACE WATER

Surface water monitoring activities continued in 2022 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 7-4**). 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 monitoring levels outside the trigger limits is detailed in the HVO Monthly Environmental Monitoring Reports that can be found on the HVO website.

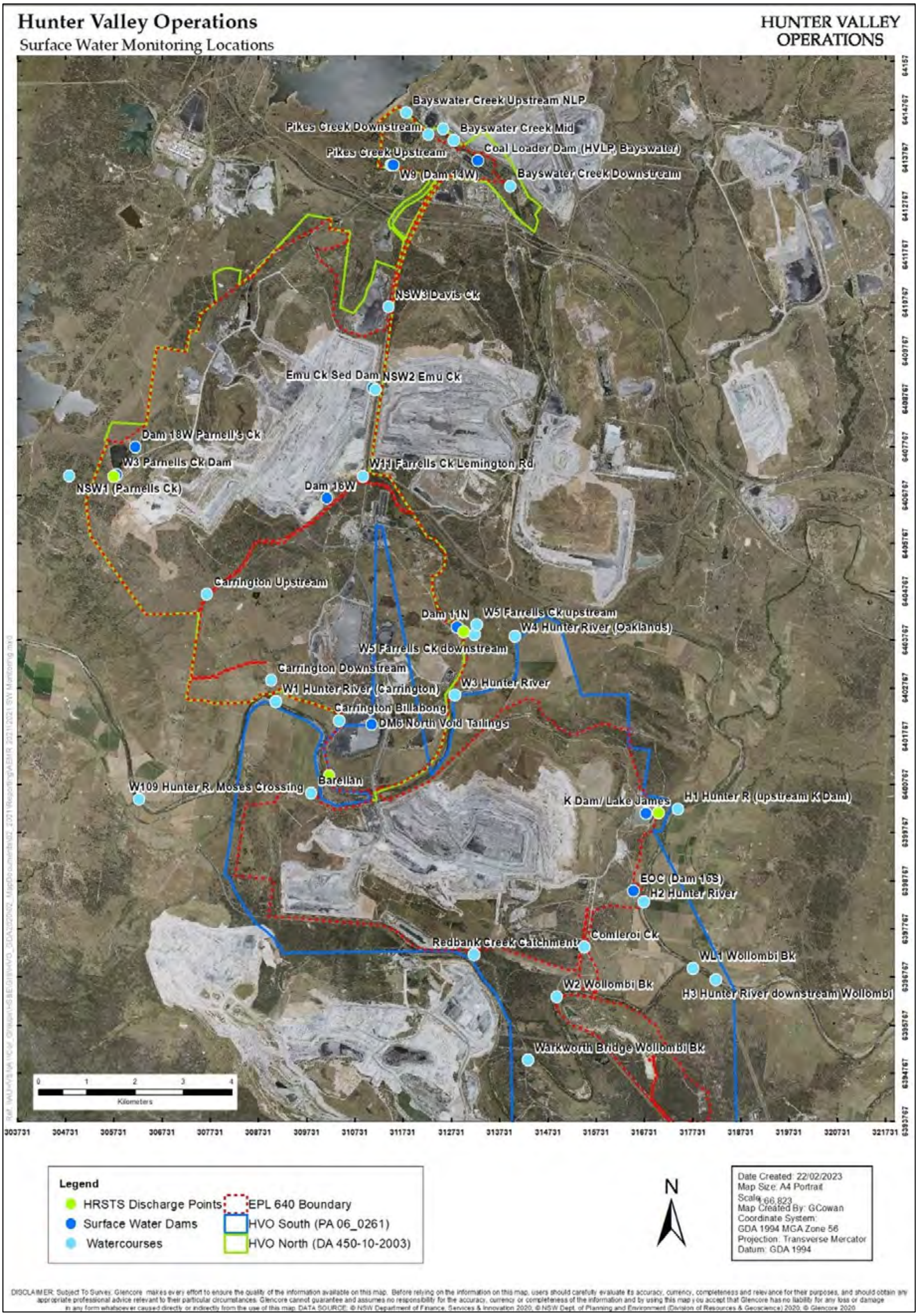

Figure 7-4: Surface Monitoring Locations

7.2.1 | SURFACE WATER MONITORING

Routine surface water monitoring was undertaken in 2022 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 7-2.** Australia and New Zealand Environment and Conservation Council (ANZECC) criteria are shown in the figures for comparative purposes.

Table 7-2: HVO Water Monitoring Data Recovery for 2022 (By Exception)

Location	Data Recovery (%)	Comments
Barellan	66%	No access for two events due to localised flooding
Carrington Billabong	33%	No access for four events due to localised flooding
DM6 North Void Tailings	92%	Unable to access for one event due to low water level in the dam.
EOC	75%	This monitoring location was unable to be sampled on one occasion due to localised flooding.
H3 – Hunter River	75%	This monitoring location was unable to be sampled on one sampling occasion due to localised flooding.
NSW1 (Parnell's Ck)	75%	This monitoring location was unable to be sampled on one sampling event due to localised flooding.
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 unable to be sampled on one sampling occasion due to localised flooding.
WL1	75%	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 2022. Long term trends for pH, EC and TSS are shown in **Figure 7-5** to **Figure 7-7**.

The elevated TSS levels recorded at multiple locations throughout 2022 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 7-3**.

Table 7-3: Hunter River Internal Trigger Tracking Results

Location	Date	Trigger Limit	Action Taken in Response
H2 – Hunter River	3/02/2022	TSS – 58	First exceedance of TSS trigger. Field observations indicated that the sample was light brown in colour and slightly turbid. TSS at W1 Hunter River (upstream of H2) also exceeded TSS trigger indicating elevated TSS in broader catchment rather than a localised impact near H2. Approximately 7 mm of rainfall in the two days prior to sampling. The result is consistent with TSS in Hunter River following rainfall. pH and EC results consistent with historical range of results at H2 and upstream in the Hunter River (i.e. W109) presented in WMP. There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact.
W1 – Hunter River	3/02/2022	TSS – 54	First exceedance of TSS trigger. Field observations indicated that the sample was light brown in colour and slightly turbid. Approximately 7 mm of rainfall in the two days prior to sampling. The result is consistent with TSS in Hunter River following rainfall. pH and EC results consistent with historical range of results at W1 and upstream in the Hunter River (i.e. W109) presented in HVO WMP. There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact.
W109 – Hunter River	30/03/2022	TSS – 117	First exceedance of TSS trigger. Field observations indicated that the sample was light brown in colour and slightly turbid. Approximately 75 mm of rainfall in the six days prior to sampling. The result is consistent with TSS in Hunter River following rainfall. pH and EC results are generally consistent with historical range of results at W109 presented in WMP, however, EC results are lower than the historical range which may be attributed to the high rainfall in the catchment. W109 because is an upstream reference monitoring location that cannot be impacted by HVO mining activities and the trigger exceedance is considered to be a consequence of high rainfall prior to sampling.
W1 – Hunter River	30/03/2022	TSS – 122	Second consecutive exceedance of TSS trigger. Field observations indicated that the sample was light brown in colour and slightly turbid. TSS at W109 Hunter River (upstream of W1) also exceeded TSS trigger indicating elevated TSS in broader catchment rather than a localised impact near W1. Approximately 75 mm of rainfall in the six days prior to sampling. The result is consistent with TSS in Hunter River following rainfall. pH and EC results are generally consistent with historical range of results at W1 and upstream in the Hunter River (i.e. W109) presented in WMP. HRSTS discharges that occurred on or two days prior to sampling had TSS concentrations of <25 mg/L. There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact.
W4 – Hunter River	30/03/2022	TSS – 135	First exceedance of TSS trigger. Field observations indicated that the sample was light brown in colour and slightly turbid. TSS at W109 Hunter River and W1 (upstream of W4) also exceeded TSS trigger indicating elevated TSS in broader catchment rather than a localised impact near W4. Approximately 75 mm of rainfall in the six days prior to sampling. The result is consistent with TSS in Hunter River following rainfall pH and EC results are generally consistent with historical range of results at W4 and upstream in the Hunter River (e.g. W1 and W109) presented in WMP, however, EC results are lower than the historical range which may be attributed to the high rainfall in the catchment. HRSTS discharges that occurred on or two days prior to sampling has TSS concentrations of <25 mg/L There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact.

Location	Date	Trigger Limit	Action Taken in Response
H1 – Hunter River	30/03/2022	TSS – 114	First exceedance of TSS trigger. Field observations indicated that the sample was light brown in colour and slightly turbid. TSS at W109 Hunter River, W1 and W4 (upstream of H1) also exceeded TSS trigger indicating elevated TSS in broader catchment rather than a localised impact near H1. Approximately 75 mm of rainfall in the six days prior to sampling. The result is consistent with TSS in Hunter River following rainfall. pH and EC results are generally consistent with historical range of results at H1 and upstream in the Hunter River (i.e. W1, W4 and W109) presented in WMP. HRSTS discharges that occurred on or two days prior to sampling had TSS concentrations of <25 mg/L. There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact.
W1 – Hunter River	5/04/2022	TSS – 62	Third consecutive exceedance of TSS trigger. Field observations indicated that the sample was light brown in colour and slightly turbid. TSS at W109 Hunter River (upstream of W1) also exceeded TSS trigger on 30/03/22 indicating elevated TSS in broader catchment rather than a localised impact near W1. Approximately 24.6 mm of rainfall in the seven days prior to sampling. The result is consistent with TSS in Hunter River following rainfall. pH and EC results are generally consistent with historical range of results at W1 and upstream in the Hunter River (i.e. W109) presented in WMP. Hunter River upstream Liddell Gauging station was in High Flow (1600ML/day) from rainfall received in weeks prior to sampling. There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact.
W1 – Hunter River	11/07/2022 13:50	TSS – 102	First exceedance of TSS. Field Observations indicated that the sample was brown in colour and turbid. Approximately 70 mm of rainfall in the seven days prior to sampling. HRSTS discharges that occurred on or 6 days prior to sampling have TSS concentrations of <40 mg/L There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact. The exceeded TSS value appears to be a result of high TSS within the broader catchment and high rainfall prior to sampling.
H2 – Hunter River	11/07/2022 9:35	TSS – 64	First exceedance of TSS. Field Observations indicated that the sample was brown in colour and turbid. Approximately 70 mm of rainfall in the seven days prior to sampling. HRSTS discharges that occurred on or 6 days prior to sampling have TSS concentrations of <40 mg/L There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact. The exceeded TSS value appears to be a result of high TSS within the broader catchment and high rainfall prior to sampling.
W1 – Hunter River	20/09/2022 10:20	TSS – 59	First exceedance of TSS. Field Observations indicate that the sample was brown in colour and turbid. Approximately 25mm of rainfall in the seven days prior to sampling. TSS at W109-Hunter River (upstream of W1) on 20/09/22 was 43mg/L indicating elevated TSS in broader catchment. No HRSTS discharges upstream of W1 on or prior to the 20/09/22. There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact. The exceeded TSS value appears to be a result of high TSS within the broader catchment.

Location	Date	Trigger Limit	Action Taken in Response
W4 – Hunter River	20/09/2022 9:20	TSS – 68	First exceedance of TSS. Field Observations indicate that the sample is brown in colour and turbid. Approximately 25mm of rainfall in the seven days prior to sampling. TSS at W109 Hunter River (upstream of W4) on 20/09/22 was 43mg/L, indicating elevated TSS in broader catchment. HRSTS discharges that occurred 1 day prior to sampling had a TSS concentration of <15 mg/L. There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact. The exceeded TSS value appears to be a result of high TSS within the broader catchment.
W3 – Hunter River	20/09/2022 12:00	TSS – 68	First exceedance of TSS. Field Observations indicate that the sample is brown in colour and turbid. Approximately 25mm of rainfall in the seven days prior to sampling. TSS at W109 Hunter River (upstream of W3) on 20/09/22 was 43mg/L, indicating elevated TSS in broader catchment. No HRSTS discharges upstream of W3 on or prior to the 20/09/22. There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact. The exceeded TSS value appears to be a result of high TSS within the broader catchment.
W1 – Hunter River	11/10/2022 9:30	TSS – 234	Second consecutive exceedance of TSS. Field Observations indicate that the sample was brown in colour and turbid. Approximately 60mm of rainfall in the seven days prior to sampling. No HRSTS discharges upstream of W1 on or prior to the 11/10/22. No sediment basins overtopped during rain event. There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact. The exceeded TSS exceedance appears to be a result of high rainfall prior to sampling leading to elevated suspended solids concentrations in broader catchment runoff.
H2 – Hunter River	11/10/2022 10:40	TSS – 231	First exceedance of TSS. Field Observations indicate that the sample was brown in colour and turbid. Approximately 60mm of rainfall in the seven days prior to sampling. HRSTS discharges at Lake James Discharge point, upstream of H2 on the 10/10/22 and the 11/10/22 (96.13ML). Discharge water quality records for both dates indicated TSS concentrations of 7mg/L and 6 mg/L. No sediment basins overtopped during rain event. There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact. The exceeded TSS exceedance appears to be a result of high rainfall prior to sampling leading to elevated suspended solids concentrations in broader catchment runoff.
W1 – Hunter River	3/11/2022 9:50	TSS – 345	Third consecutive exceedance of TSS. Field Observations indicate that the sample was brown in colour and turbid. Approximately 23mm of rainfall in the seven days prior to sampling. No HRSTS discharges upstream of W1 on or prior to the 3/11/22. No sediment basins overtopped during rain event. There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact. The exceeded TSS exceedance appears to be a result of rainfall prior to sampling leading to elevated suspended solids concentrations in broader catchment runoff.

Location	Date	Trigger Limit	Action Taken in Response
H2 – Hunter River	3/11/2022 10:40	TSS – 419	Second consecutive exceedance of TSS. Field Observations indicate that the sample was brown in colour and turbid. Approximately 23mm of rainfall in the seven days prior to sampling. No HRSTS discharges upstream of H2 on or prior to the 3/11/22. No sediment basins overtopped during rain event. There is no evidence to indicate that the TSS exceedance is associated with a HVO mining impact. The exceeded TSS exceedance appears to be a result of rainfall prior to sampling leading to elevated suspended solids concentrations in broader catchment runoff.

Figure 7-5: Hunter River pH Trends 2017 – 2022

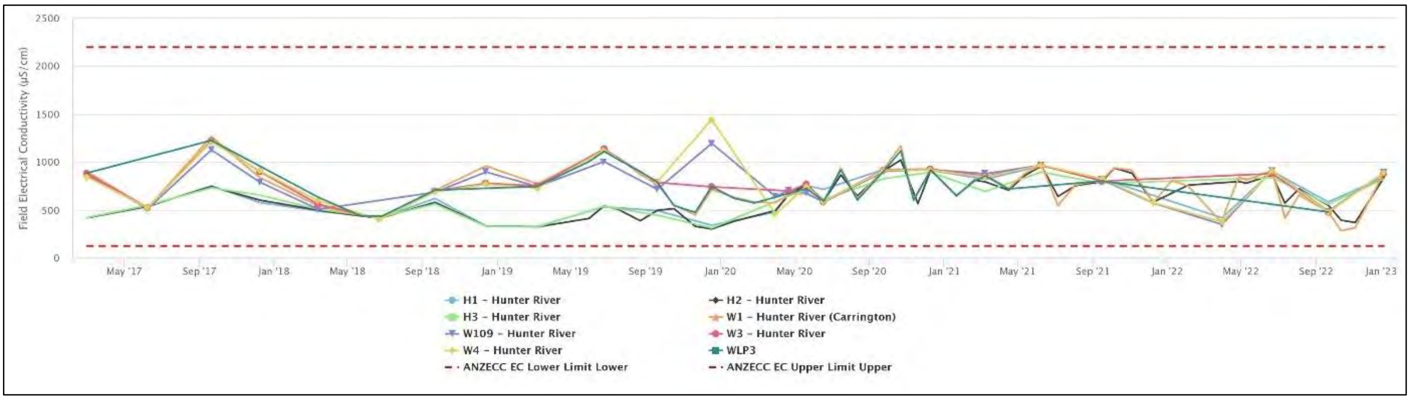

Figure 7-6: Hunter River EC Trends 2017- 2022

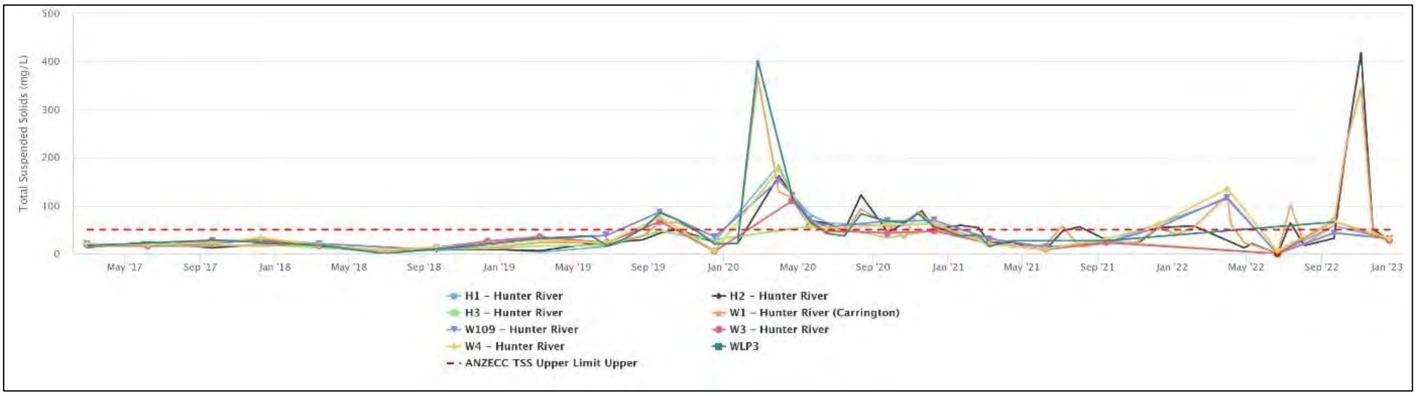

Figure 7-7: Hunter River TSS Trends 2017 – 2022

Wollombi Brook

Wollombi Brook was sampled on 15 occasions from three monitoring locations during 2022. Long term trends for pH, EC and TSS from Wollombi Brook are shown in **Figure 7-8** to **Figure 7-10**.

Results were generally consistent with historical trends and acceptable ranges.

There were no trigger exceedances in 2022.

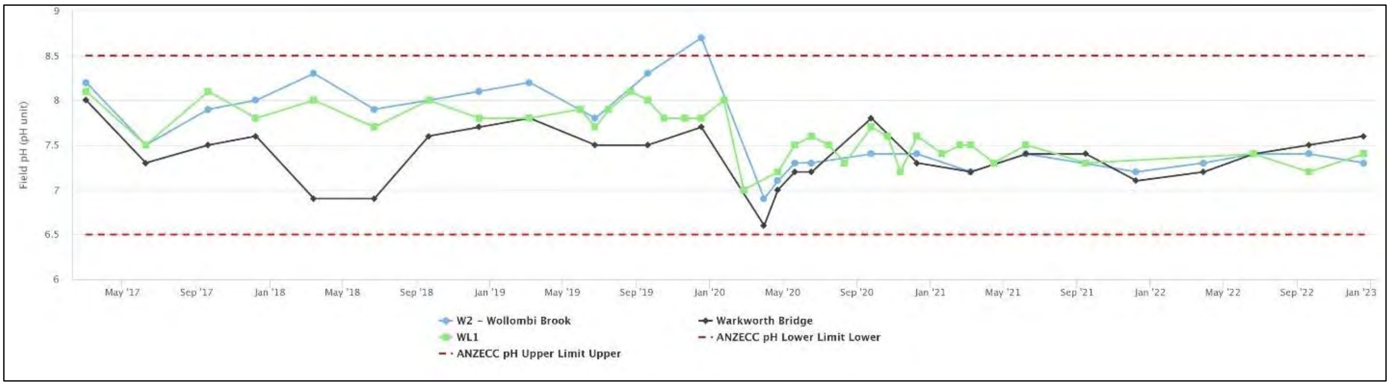

Figure 7-8: Wollombi Brook pH Trends 2017 – 2022

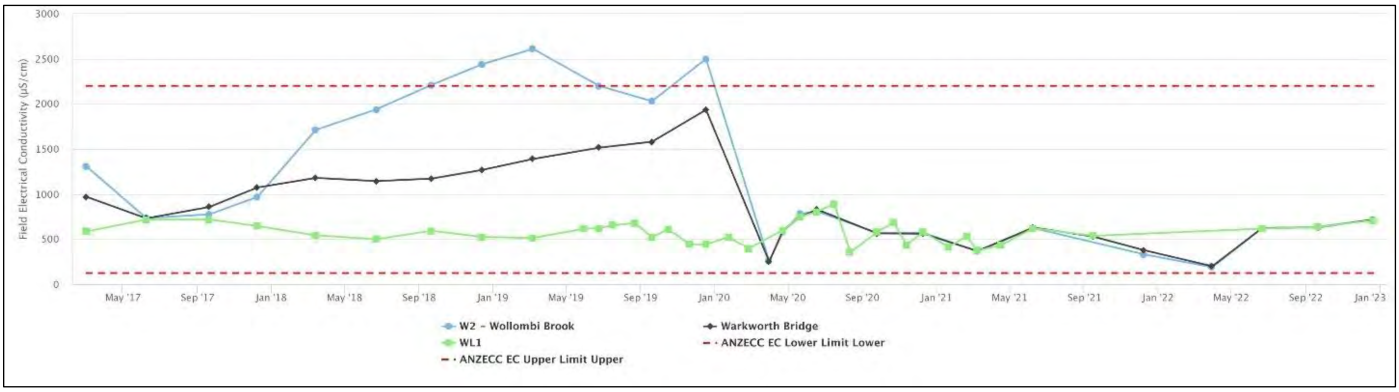

Figure 7-9: Wollombi Brook EC Trends 2017 – 2022

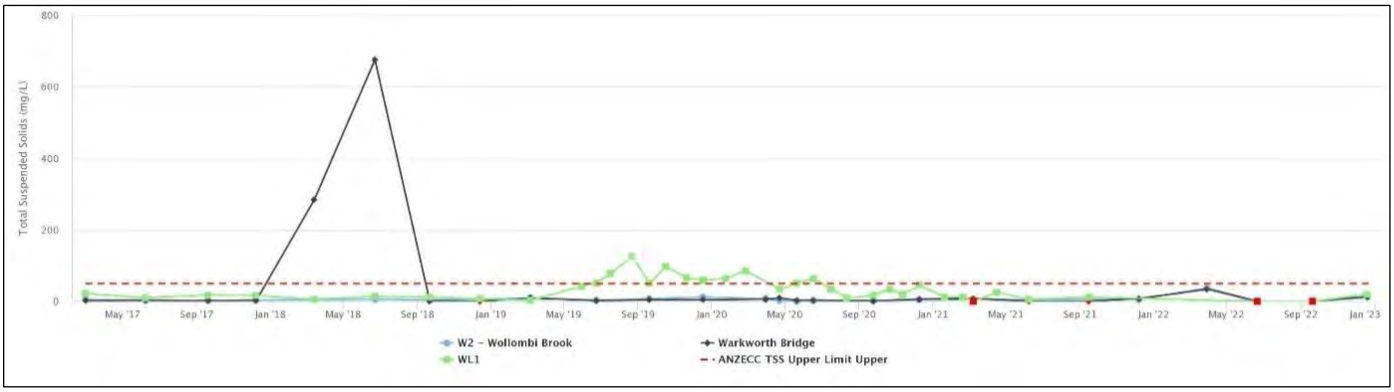

Figure 7-10: Wollombi Brook TSS Trends 2017 – 2022

Other Surrounding Tributaries

Rain event-based monitoring of natural tributaries surrounding HVO continued during 2022.

In accordance with the HVO WMP, four rain event sampling rounds were triggered during 2022. 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 7-11** to **Figure 7-14**. 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 7-4**.

Table 7-4: Other Tributaries Internal Trigger Exceedance Results

Location	Date	Trigger Limit	Action Taken in Response
Bayswater Creek Downstream	7/03/2022	TSS- 132	First exceedance of TSS trigger. Field observations indicated that the sample was light brown in colour and slightly turbid. Approximately 65 mm of rainfall in the seven days preceding the exceedance as well as over 30 mm on the day of the exceedance. Upstream result for TSS at Bayswater Creek Mid was 37 mg/L indicating an impact on TSS concentration between the two monitoring locations. pH and EC at Bayswater Creek Downstream was consistent with Bayswater Creek Mid results. pH and EC generally consistent with historical Bayswater Creek Downstream results presented in HVO WMP.
Bayswater Creek Mid	5/07/2022	pH – 8.4	Third consecutive exceedance of pH trigger. Field observations indicated that the sample was light brown in colour and slightly turbid. Approximately 137 mm of rainfall in the seven days prior to sampling. Approx 240ML/Day discharging from Bayswater power station who discharges upstream from sampling point. The result is consistent with pH in Bayswater Creek following rainfall. No evidence of scouring or mine influence from HVO.
Bayswater Creek Downstream	14/11/2022 11:45	pH – 8.3	Third consecutive exceedance of pH trigger. Field Observations indicate that the sample was brown in colour and turbid. Approximately 42mm of rainfall in the seven days prior to sampling. No sediment basins overtopped during rain event. HRSTS discharge from Bayswater Power station at time of sample. The Bayswater Power station November discharge monitoring results indicate a pH value of 8.1, therefore it is not likely to be the cause of the exceedance.
Pikes Creek Downstream	14/11/2022 11:10	TSS – 62	First exceedance of TSS. Field Observations indicate that the sample was brown in colour and turbid. Approximately 42mm of rainfall in the seven days prior to sampling. No dams overtopped during rain event.

Location	Date	Trigger Limit	Action Taken in Response
Bayswater Creek Mid	14/11/2022 11:20	TSS – 89	First exceedance of TSS. Field Observations indicate that the sample was brown in colour and turbid. Approximately 42.0mm of rainfall in the seven days prior to sampling. No dams overtopped during rain event.
Bayswater Creek Downstream	14/11/2022 11:45	TSS – 106	First exceedance of TSS. Field Observations indicate that the sample was brown in colour and turbid. Approximately 42.0mm of rainfall in the seven days prior to sampling. No dams overtopped during rain event.

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

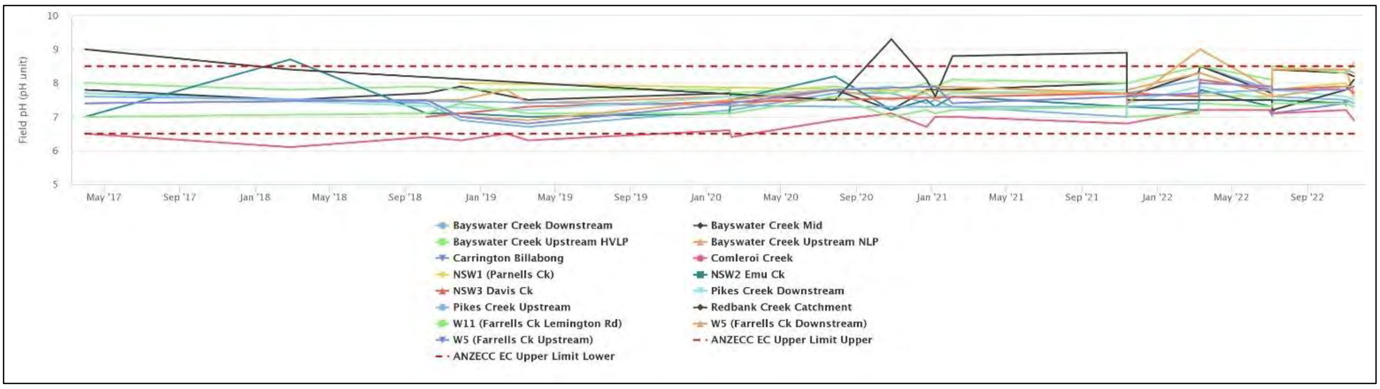

Figure 7-11: Other Tributaries pH Trends 2017 – 2022

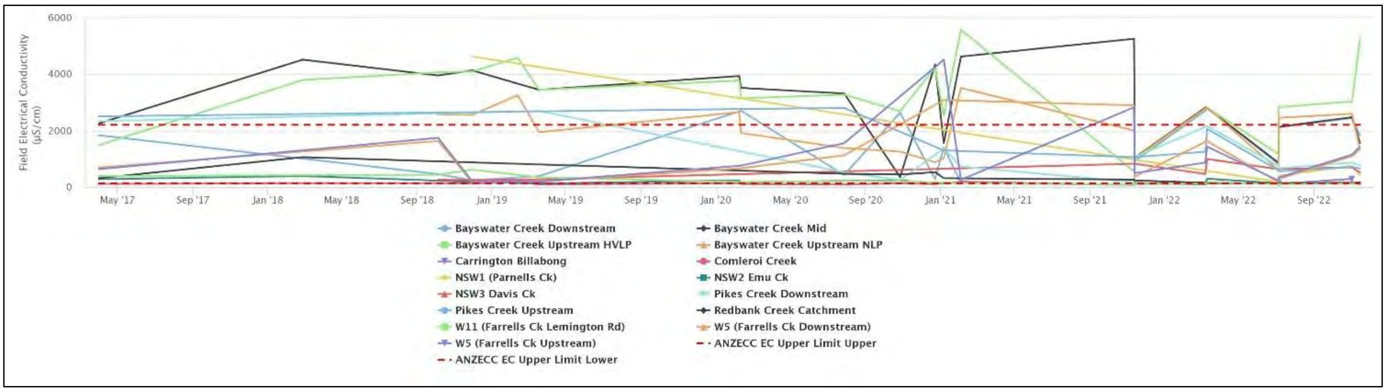

Figure 7-12: Other Tributaries EC Trends 2017 – 2022

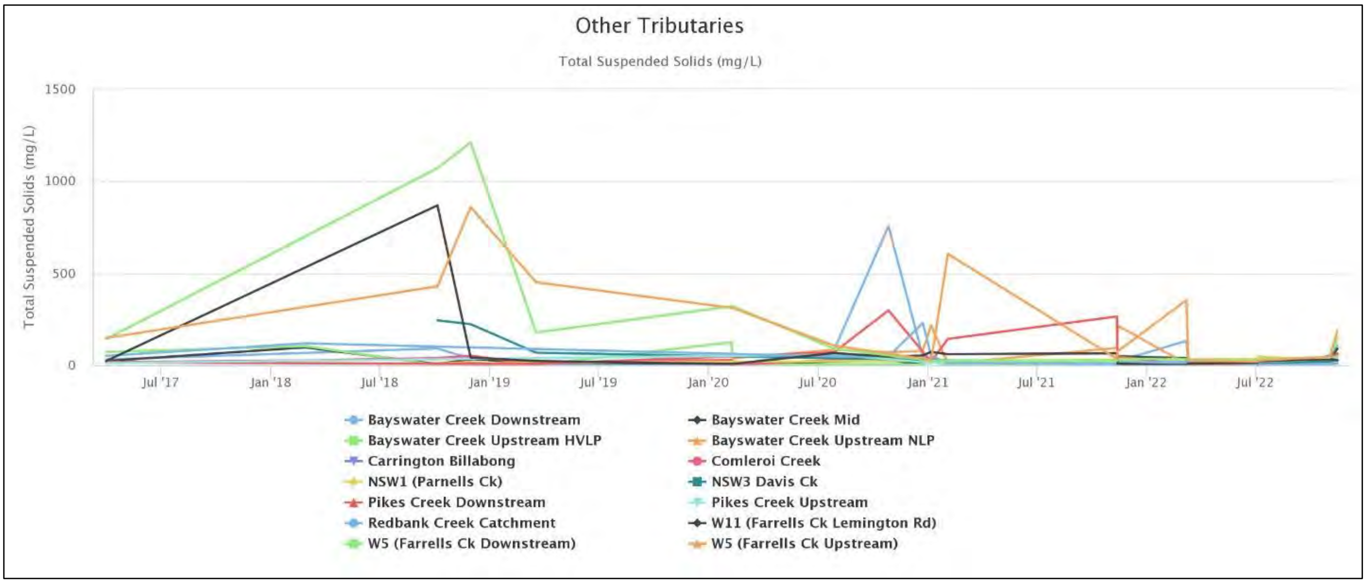

Figure 7-13: Other Tributaries TSS Trends 2017 – 2022

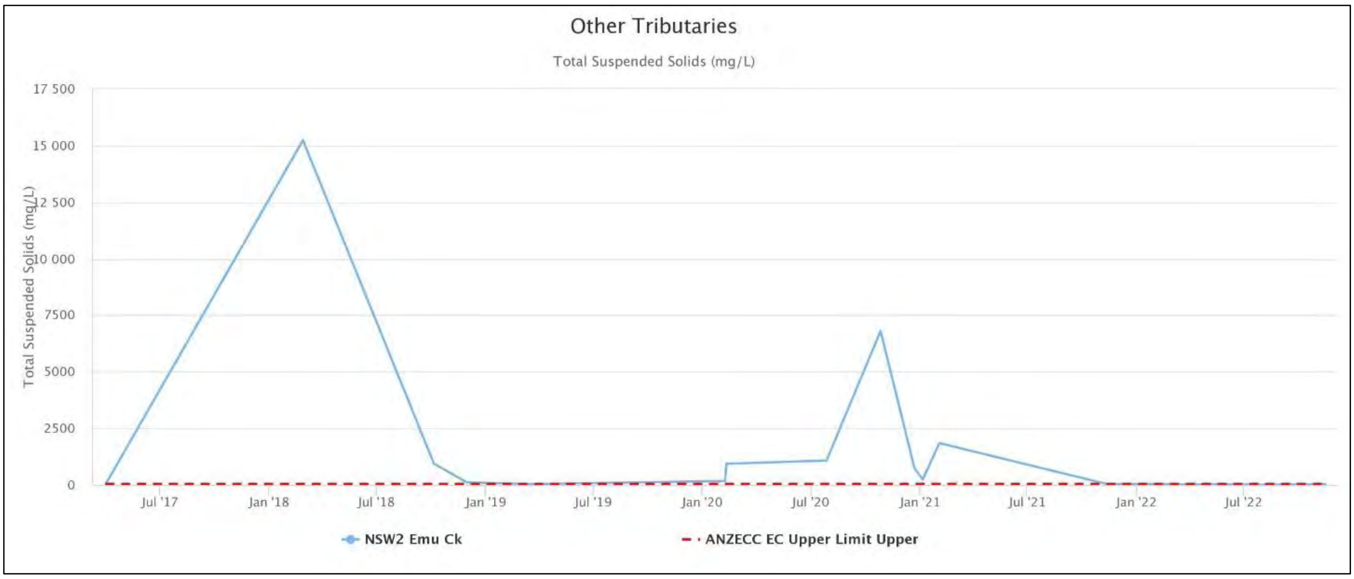

Figure 7-14: NSW2 Emu Creek TSS Trends 2017 – 2022

HVO Site Dams

During 2022, 62 samples were collected across 9 onsite dams. Long term trends for pH, EC and TSS are shown in **Figure 7-15** to **Figure 7-17**. HVO's onsite dams do not have impact assessment criteria. Results for water quality remained generally consistent with historical water quality trends.

Figure 7-15: HVO Site Dams pH Trends 2017 – 2022

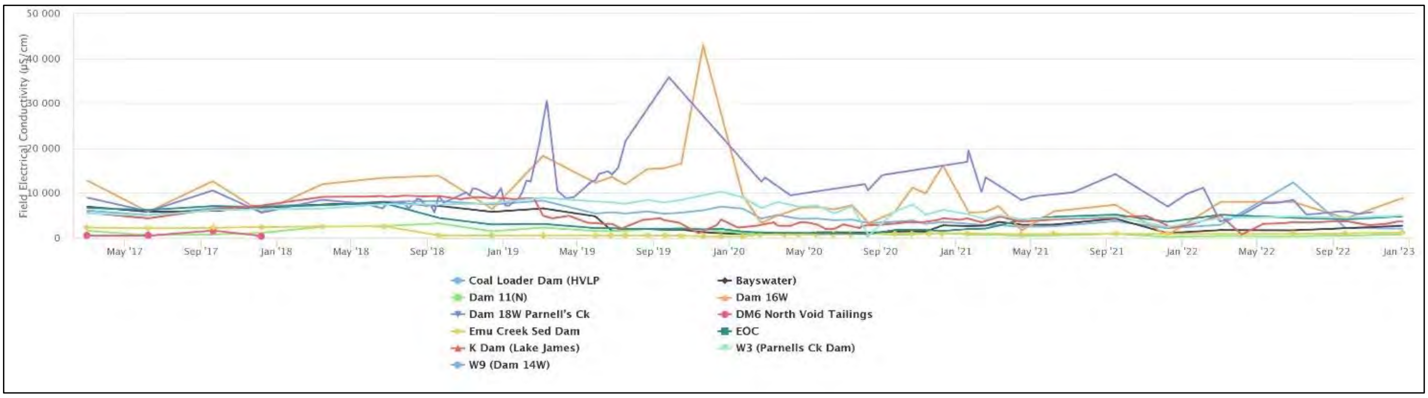

Figure 7-16: HVO Site Dams EC Trends 2017 – 2022

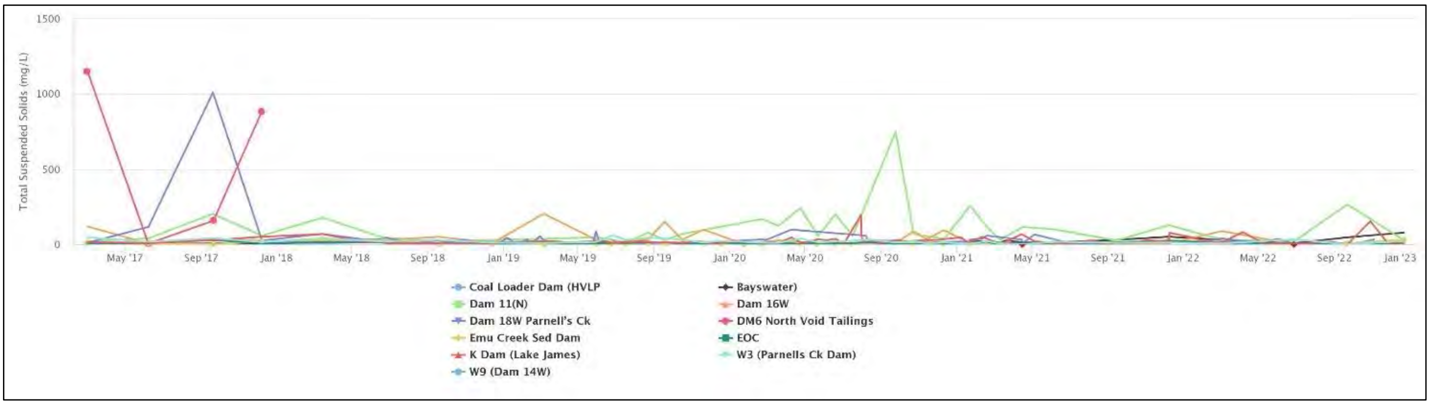

Figure 7-17: HVO Site Dams TSS Trends 2017 – 2022

7.3 | COMPARISON WITH EIS PREDICTIONS

7.3.1 | SOUTH PIT EIS PREDICTIONS

The South Pit EIS estimated an 'instantaneous' water quality for Electrical Conductivity 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 3,869 µS/cm during 2022, in line with predicted EC levels.

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 five times during rain events in 2022 resulting in an average TSS of 15 mg/L and EC of 125 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 | WEST PIT EIS PREDICTIONS

The West Pit EIS included the data in **Table 7-5** as representative of water quality in the local catchment area. During the review period Emu Creek (NSW2) recorded an average pH of 7.4 and an average EC of 149 µS/cm, both lower than the predicted results of **Table 7-5**. The pH and EC at Farrells Creek (combined upstream and downstream monitoring sites) averaged 7.9 and 903.1 µS/cm respectively during the review period, were also slightly lower than EIS predictions. The average pH and EC for Davis Creek (NSW3) were 7.8 and 653 µS/cm respectively during the review period, in the lower range and slightly lower than EIS predictions. Parnell's Dam (W3) measured an average EC of 3,374 µS/cm in 2022, within the prediction.

Table 7-5: 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.

As required by the EPL, HVO submitted a discharge report for the 2021/22 financial year. A total of 6623 ML of water was discharged during 2022 in accordance with the HRSTS.

7.5 | GROUNDWATER

7.5.1 | GROUNDWATER MANAGEMENT

Groundwater monitoring activities were undertaken in 2022 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 2018 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 7-18**.

Groundwater monitoring is conducted at HVO in accordance with the WMP (HVO, 2018), which includes details on the Groundwater Management Plan and Groundwater Monitoring Program. The monitoring results are used to monitor trends in physical and geochemical parameters of groundwaters that are potentially influenced by mining.

In 2019 SLR undertook a network review which identified some changes in target geology compared to the WMP. The network review also assessed the condition and purpose of each bore and made recommendations to remove bores from the monitoring network that were damaged or destroyed, not providing representative groundwater data, where duplicate monitoring locations existed and where site activities have ceased. It was recommended that these bores be removed from the next update of the WMP leaving 77 bores within the groundwater compliance monitoring network with triggers assigned. Groundwater quality triggers were reviewed, and the trigger levels were updated based on all historical data available and set based on geographical and target stratigraphy. The baseline data was used to update the 95th percentile for EC and 5th and 95th percentiles for pH. An updated groundwater monitoring program has been included in the draft WMP (version 3.4) which is currently with DPE awaiting approval. For the purposes of annual reporting, the results are presented in comparison to the details in the current WMP (HVO, 2018) and, if exceedances recorded, discussed with reference to the revised monitoring programme recommendations.

The Annual Groundwater Impacts Review conducted during 2022 is provided in **Appendix B.**

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 7-6**. Data recovery presented in **Table 7-6** 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 7-6: HVO Groundwater Monitoring Data Recovery for 2022 (By Exception)

Location	Data Recovery	Comments
4034P	75%	No access due to flooding in Q1
4036C	50%	No access due to flooding in Q1 and bore blocked in Q4
4051C	0%	Bore blocked
4116P	50%	No access due to flooding in Q1 and Q2
4119P	25%	No access due to flooding in Q1, Q2 and Q3
B425(WDH)	50%	Bore dry in Q2 and no access Q4 due to flooding
BZ3-1	25%	Bore blocked in Q2, Q3 and Q4
BZ4A(2)	50%	Insufficient water to sample in Q3 and Q4
BZ8-2	0%	No access due to flooding in Q1, Q2, Q3 and Q4
C122(BFS)	75%	Insufficient water to sample in Q4
C919(ALL)	25%	No access due to flooding in Q2
CGW32	75%	Not measured in Q2, reason unknown
CGW39	75%	Bore dry in Q1
CGW45	0%	Bore blocked
CGW46	75%	No access due to flooding in Q1
CGW47a	75%	No access due to flooding in Q1
CGW51a	75%	No access due to flooding in Q1
CGW52	75%	No access due to flooding in Q1
CGW52a	75%	No access due to flooding in Q1
CGW53	75%	No access due to flooding in Q1
CGW53a	75%	No access due to flooding in Q1
CGW55a	75%	No access due to flooding in Q1
D510(AFS)	50%	Bore blocked in Q2 and Q4
DM1	75%	No access due to flooding in Q1
DM3	50%	No access due to flooding in Q1 and blocked in Q4

Location	Data Recovery	Comments
DM4	75%	No access due to flooding in Q1
DM7	75%	No access due to flooding in Q1
GA3	50%	No access due to flooding in Q1 and Q3
GW-100	75%	No access due to flooding in Q1
GW-100a (VWP)	0%	Awaiting installation of new units
GW-101	50%	No access due to flooding in Q1, bore dry in Q2, Q3 and Q4
GW-101a (VWP)	0%	Awaiting installation of new units
GW-102 (VWP)	0%	Awaiting installation of new units
GW-103 (VWP)	0%	All sensors failed in 2020
GW-104 (VWP)	50%	Not downloaded in Q3 or Q4
GW-107	50%	No access due to flooding in Q1, insufficient water to sample in Q2 and Q3, bore dry in Q4
GW-108	50%	No access due to flooding in Q1 and Q3, insufficient water to sample in Q2, bore blocked in Q4
GW-114	75%	No access due to flooding in Q1
GW-115	75%	No access due to flooding in Q1
HV3(2)	50%	No access due to flooding in Q1 and Q3
MB14HVO01	50%	No access due to flooding in Q1 and Q2
MB14HVO02	50%	No access due to flooding in Q1 and Q2
MB14HVO03	75%	No access due to flooding in Q1
MB14HVO04	50%	No access due to flooding in Q1 and Q3
MB14HVO05	50%	No access due to flooding in Q1 and Q2
NPz2	75%	No access due to flooding in Q1
NPz3	75%	Bore blocked in Q4
NPz5	0%	No longer exists, mined through

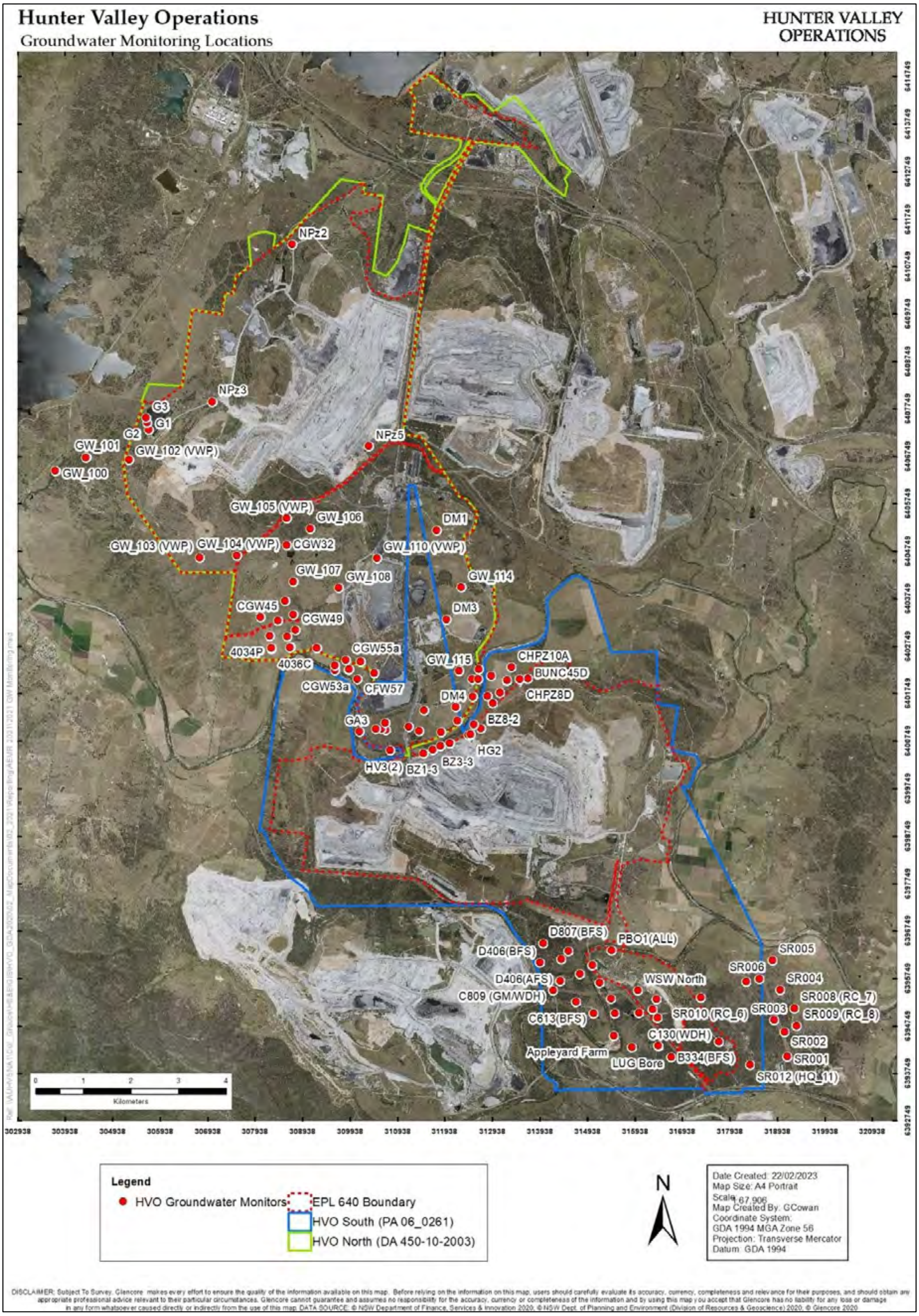

Figure 7-18: Groundwater Monitoring Network at HVO – 2022

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 2022 for Carrington Broonie Seam groundwater bores are shown in **Figure 7-19** to **Figure 7-21** 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 7-7**.

Table 7-7: Carrington Broonie Internal Trigger Tracking 2022

Location	Date	Trigger Limit	Action Taken in Response
CGW53	27/09/2022	pH – 5th Percentile	First consecutive trigger exceedance – monitor
CGW53	14/12/2022	pH – 5th Percentile	Second consecutive trigger exceedance – watching brief established

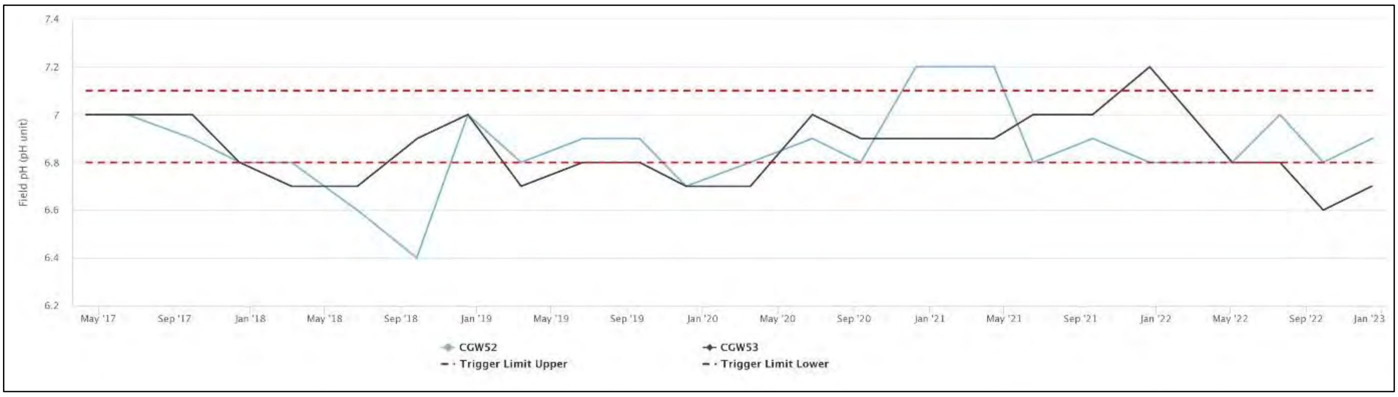

Figure 7-19: Carrington Broonie Groundwater pH Trends 2017 – 2022

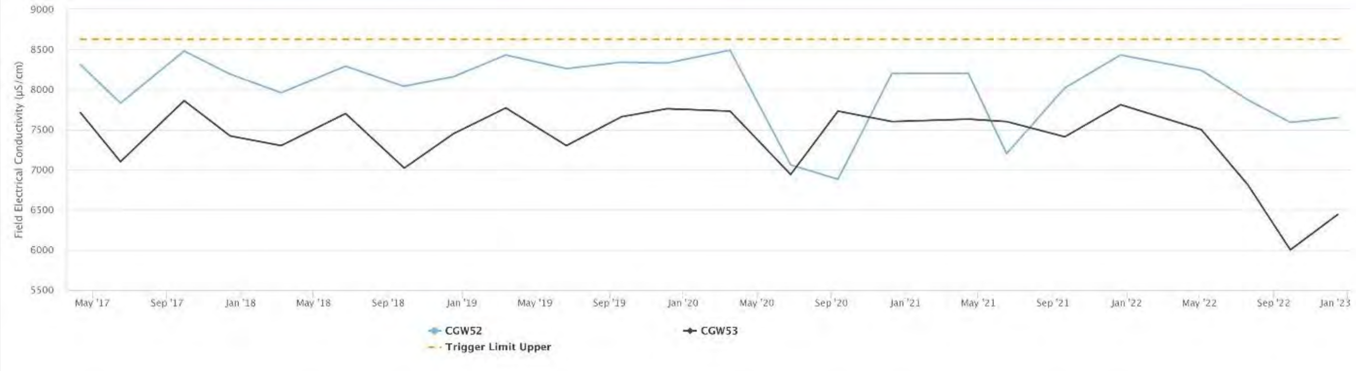

Figure 7-20: Carrington Broonie Groundwater EC Trends 2017 – 2022

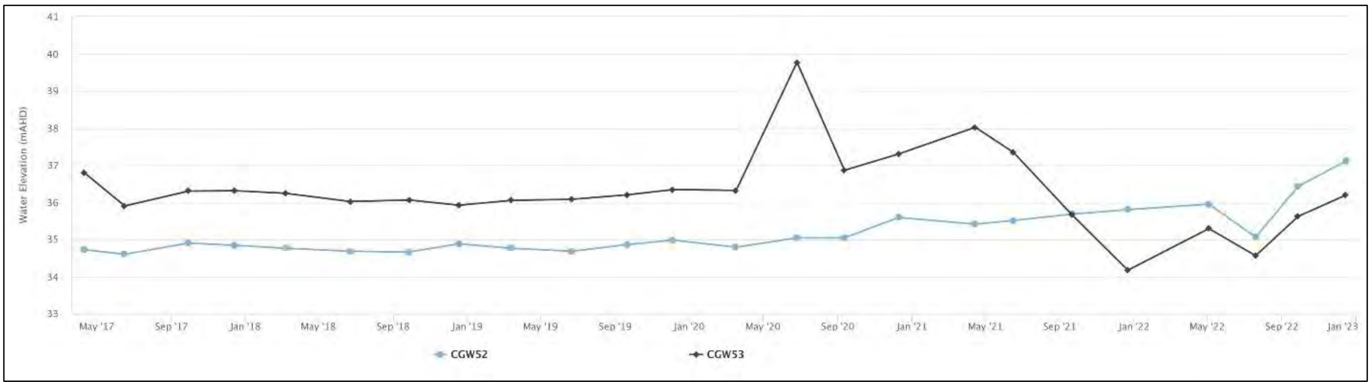

Figure 7-21: Carrington Broonie Groundwater SWL Trends 2017 – 2022

Carrington Alluvium

The EC, pH and SWL trends for 2017 to 2022 for Carrington Alluvium groundwater bores are shown in **Figure 7-22** to **Figure 7-24**. Water quality results were generally consistent with historical trends.

New triggers have been developed following an independent 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.

As part of a Pollution Reduction Programme, works in 2022 include a detailed engineering design for a permeability barrier wall to be constructed between the TSF and the alluvium.

Trigger exceedance results are listed in **Table 7-8**.

Table 7-8: HVO Carrington Alluvium Groundwater 2022 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
CFW55R	12/04/2022	EC	Fourth exceedance. Investigation Bore CFW55R recorded consecutive EC readings above the trigger level from January to April 2022 (Q1), declining from 8,960 µS/cm (Jan) to 6,880 µS/cm (Apr). The declining trend is corresponding to increased water levels which are a response to above average rainfall over the same period. EC levels have remained below the trigger level since May 2022.

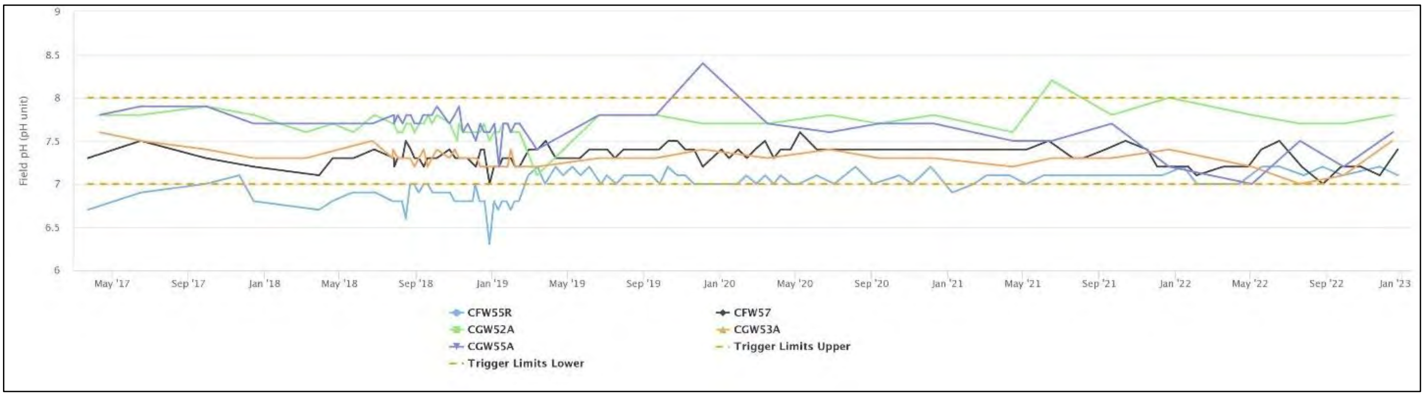

Figure 7-22: Carrington Alluvium Groundwater pH Trends 2017 – 2022

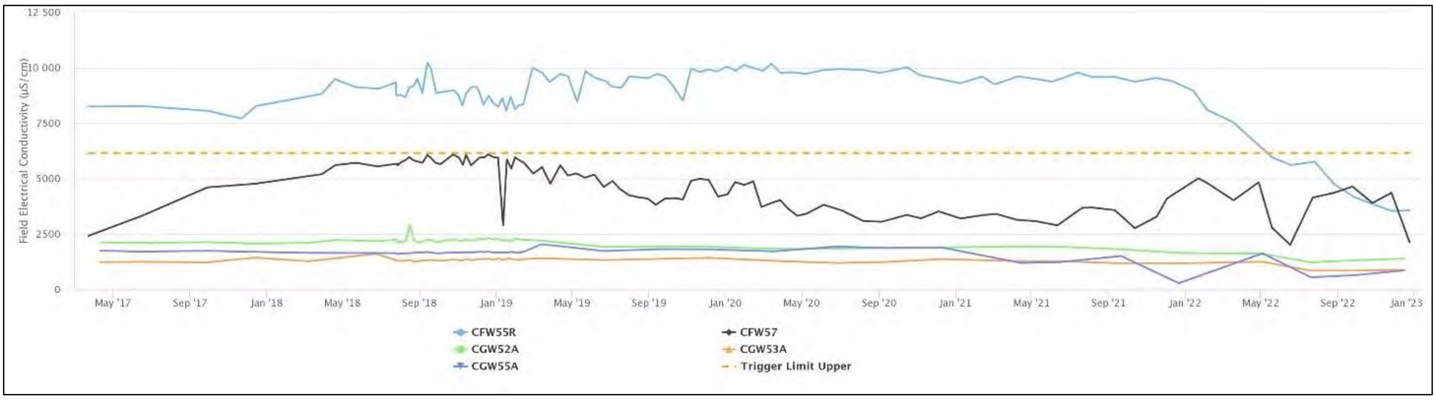

Figure 7-23: Carrington Alluvium Groundwater EC Trends 2017 – 2022

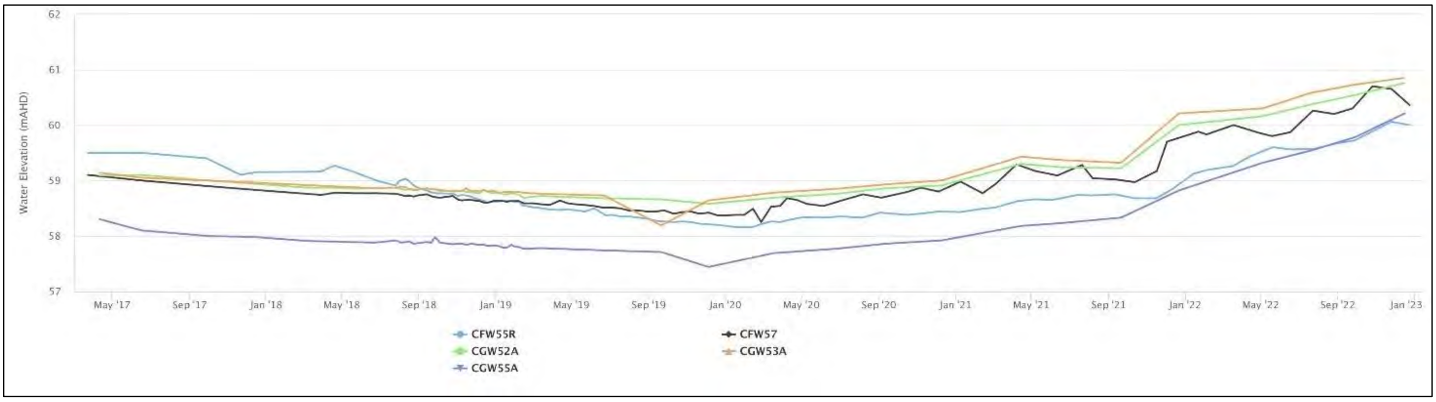

Figure 7-24: Carrington Alluvium Groundwater SWL Trends 2017 – 2022

Carrington Interburden

The EC, pH and SWL trends for 2017 to 2022 for groundwater bores in the Carrington Interburden are shown in **Figure 7-25** to **Figure 7-27** respectively. Water quality results were generally consistent with historical trends. Bore 4036C was dry and therefore samples were unable to be collected during 2022.

Trigger exceedance results are listed below in **Table 7-9.**

Table 7-9: HVO Carrington Interburden Groundwater 2022 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
CGW51A	27/09/2022	pH – 95th Percentile	First consecutive trigger exceedance – watching brief established
GCW51A	15/12/2022	pH – 95th Percentile	Second consecutive trigger exceedance – watching brief maintained

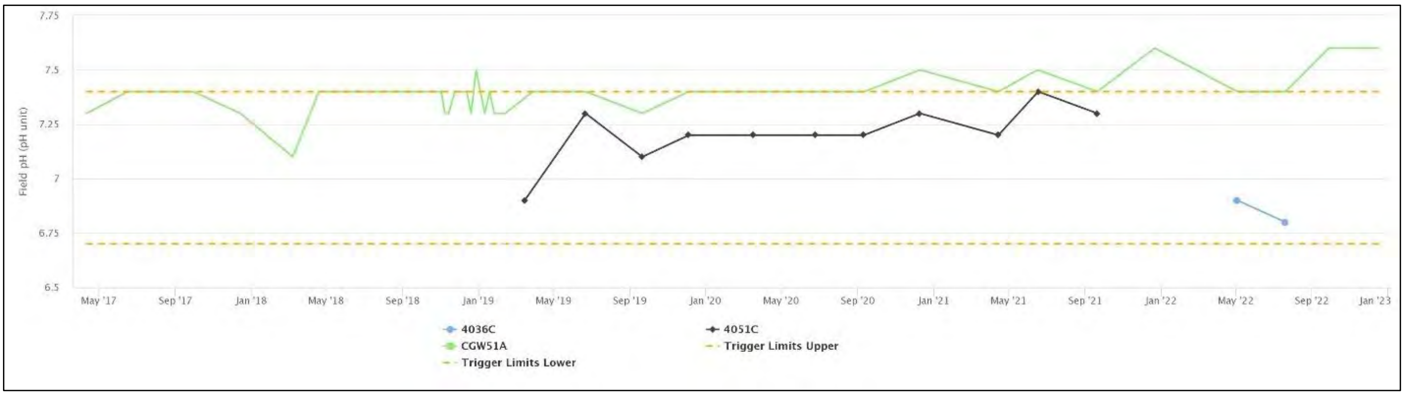

Figure 7-25: Carrington Interburden Groundwater pH Trends 2017 – 2022

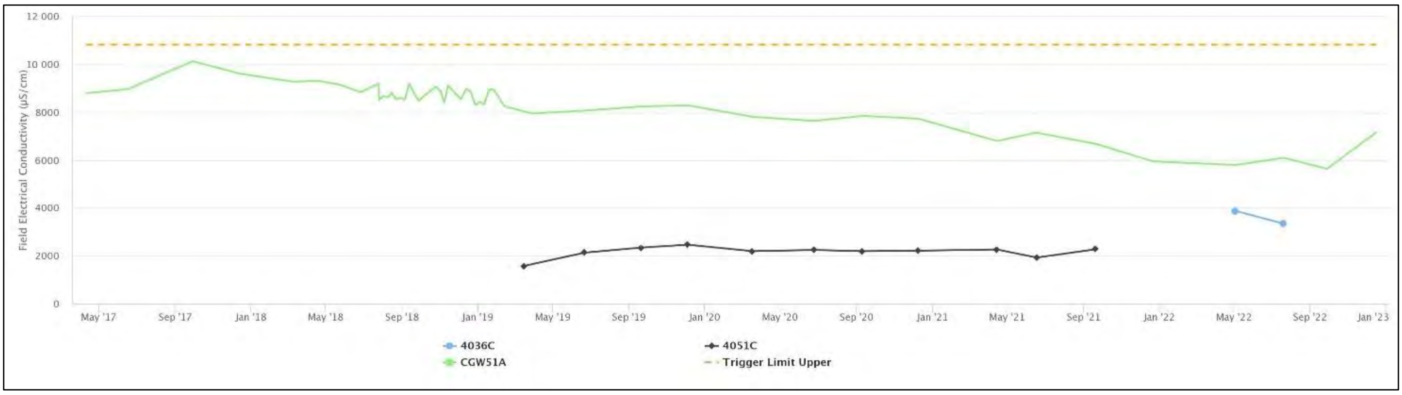

Figure 7-26: Carrington Interburden Groundwater EC Trends 2017 – 2022

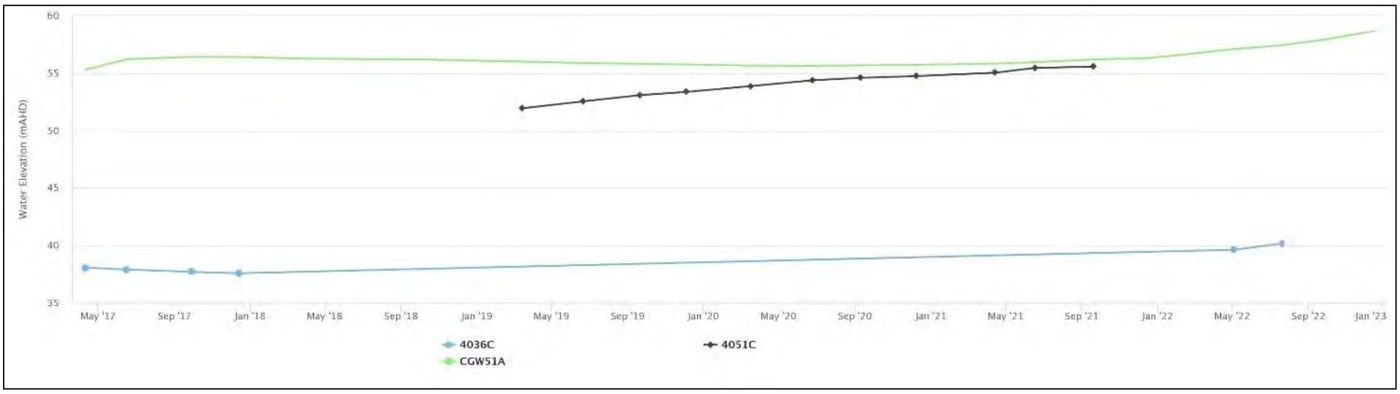

Figure 7-27: Carrington Interburden Groundwater SWL Trends 2017 – 2022

Carrington West Wing Alluvium

Results are shown in **Figure 7-28** to **Figure 7-30**. Water quality results were generally consistent with historical trends. Bore CGW49 intersects alluvium within the western limb of the paleochannel. Historical readings show that bore CGW49 has recorded pH ranging between 6.6 and 8.1. Review of pH readings remained fairly stable and within historical levels over 2022. The results show no adverse impacts due to mining.

Trigger exceedances in 2022 are shown in **Table 7-10**.

Table 7-10: HVO Carrington West Wing Alluvium Groundwater 2022 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
CGW49	14/12/2022	pH – 95th Percentile	First exceedance - monitor

Figure 7-28: Carrington West Wing Alluvium Groundwater pH Trends 2017 – 2022

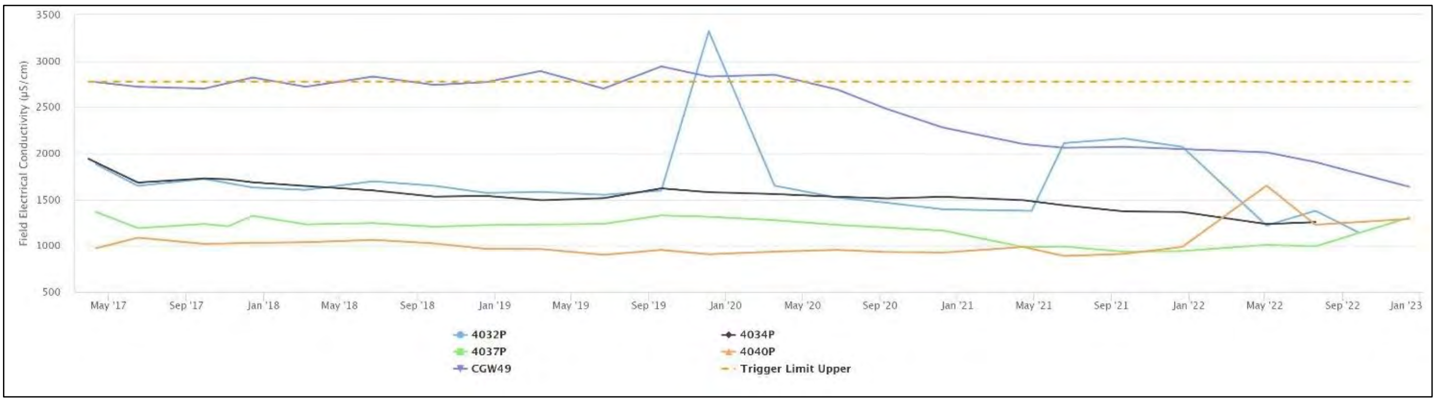

Figure 7-29: Carrington West Wing Alluvium Groundwater EC Trends 2017 – 2022

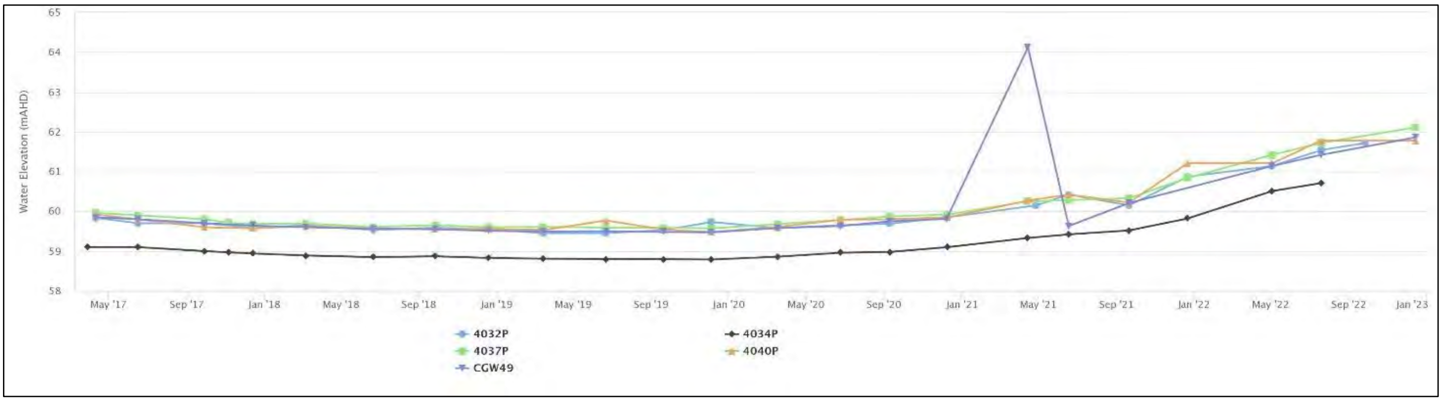

Figure 7-30: Carrington West Wing Alluvium Groundwater SWL Trends 2017 – 2022

Carrington West Wing Flood Plain

Results are shown in **Figure 7-31** to **Figure 7-33**. Water quality results were generally consistent with historical trends. pH levels for GW-106 were slightly below the lower pH trigger for Q1 to Q3 2022. This bore has been removed in the revised Version 3.4 of the Water Management Plan that has been submitted to DPE for approval.

Trigger tracking results are listed in **Table 7-11**

Table 7-11: HVO Carrington West Wing Flood Plain Groundwater 2022 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
GW-106	18/07/2022	pH – 5th Percentile	First exceedance - monitor

Figure 7-31: Carrington West Wing Flood Plain Groundwater pH Trends 2017 – 2022

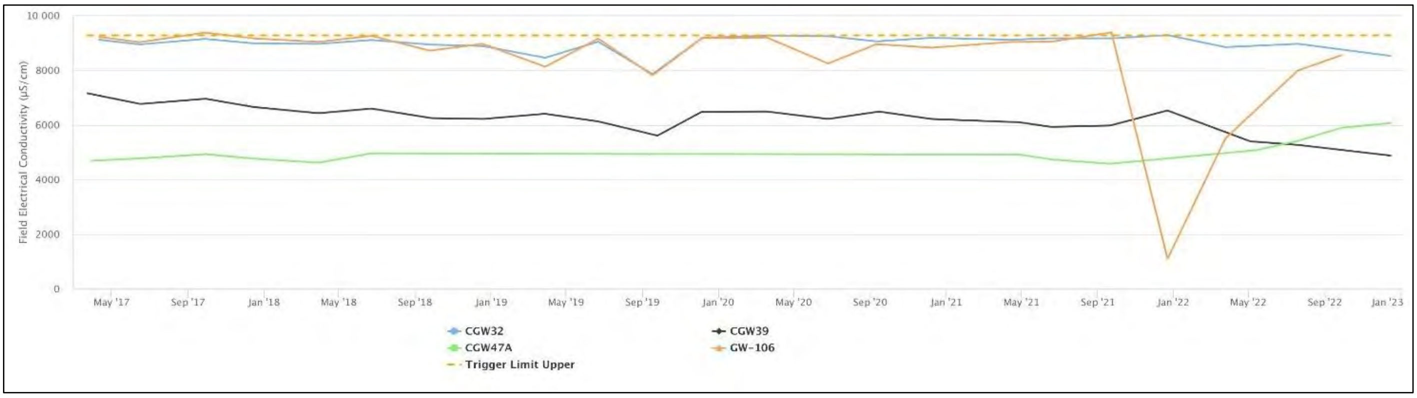

Figure 7-32: Carrington West Wing Flood Plain Groundwater EC Trends 2017 – 2022

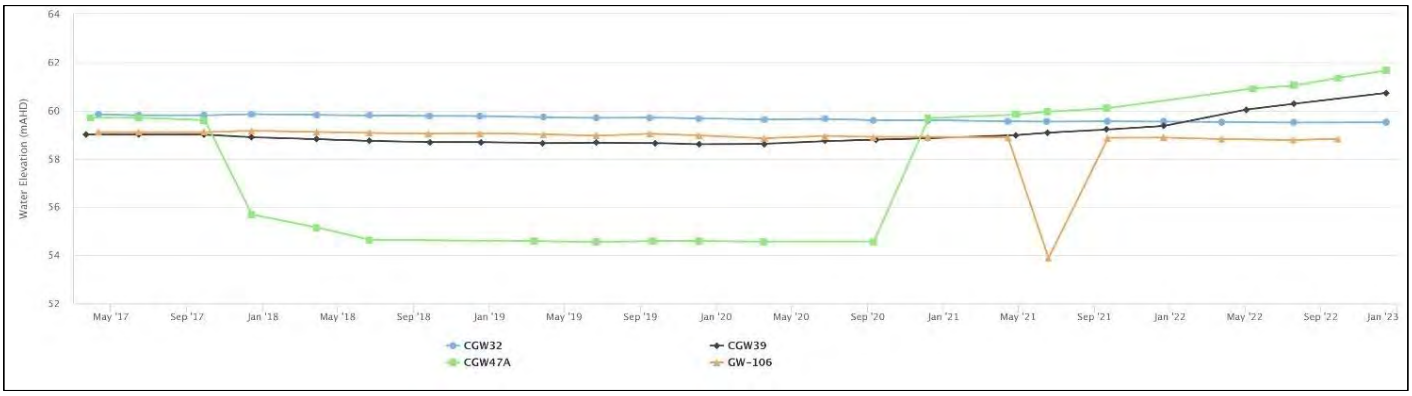

Figure 7-33: Carrington West Wing Flood Plain Groundwater SWL Trends 2017 – 2022

Cheshunt/North Pit Alluvium

Electrical Conductivity, pH and SWL trends for 2017 to 2022 are shown in **Figure 7-34** to **Figure 7-36**. Water quality results were generally consistent with historical trends. Hobdens Well is screened within alluvium, located between the Hunter River and Cheshunt Pit. Historical readings show that Hobdens Well has recorded pH ranging between 7.1 and 8.2. Review of pH readings indicated levels fluctuated slightly, but within historical levels over 2022. The results show no adverse impacts due to mining.

Trigger tracking results are listed in **Table 7-12**

Table 7-12: HVO Cheshunt/North Pit Alluvium Groundwater 2022 Monitoring Internal Trigger Exceedances

Location	Date	Trigger Limit	Action Taken in Response
Hobdens Well	23/08/2022	pH – 95th Percentile	First exceedance - monitor

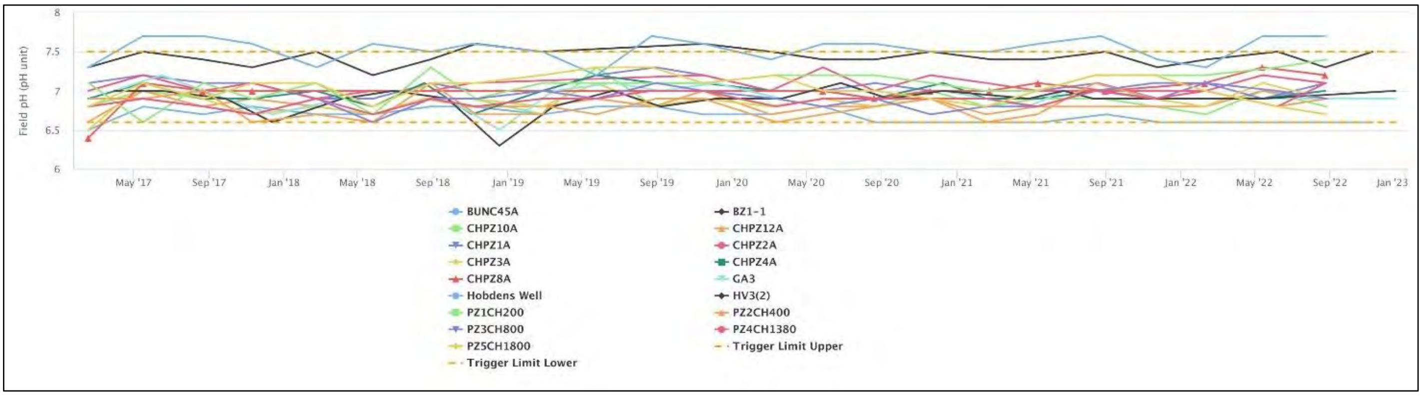

Figure 7-34: Cheshunt/North Pit Alluvium Groundwater pH Trends 2017 – 2022

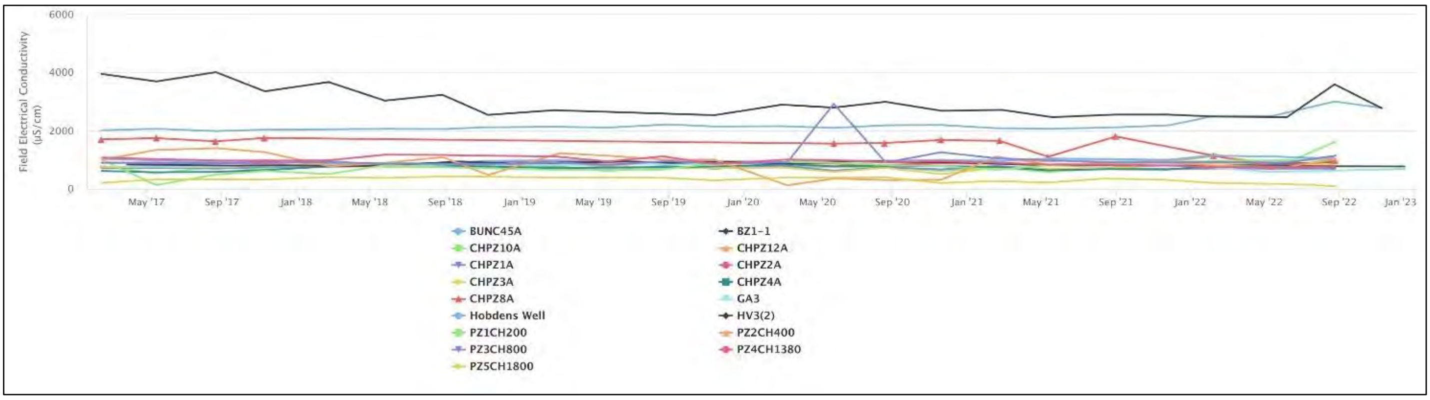

Figure 7-35: Cheshunt/North Pit Alluvium Groundwater EC Trends 2017 – 2022

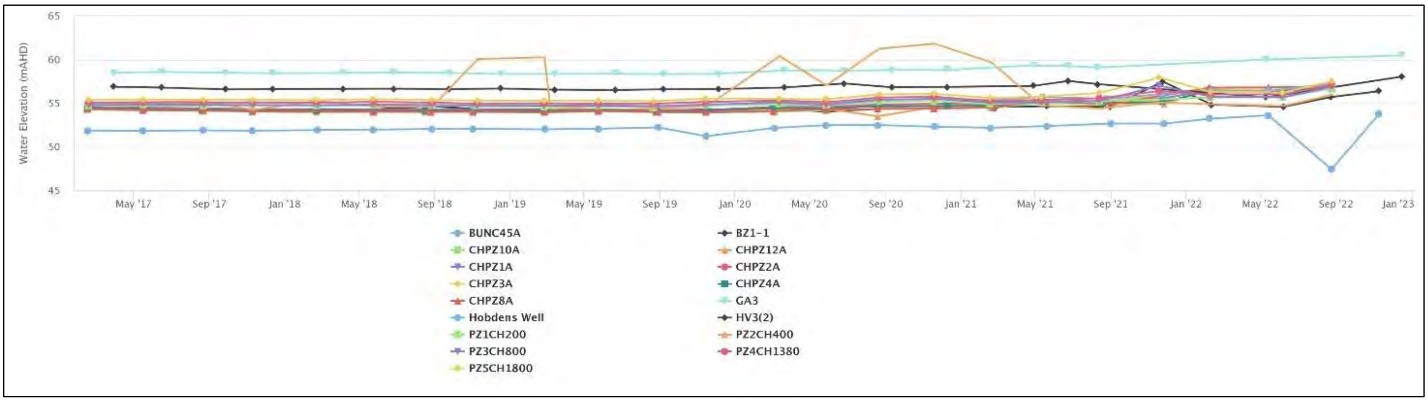

Figure 7-36: Cheshunt/North Pit Alluvium Groundwater SWL Trends 2017 – 2022

Cheshunt Interburden

The EC, pH and SWL trends for 2017 to 2022 are shown in **Figure 7-37** to **Figure 7-39**. Water quality results were generally consistent with historical trends.

There were no results outside of triggers in 2022.

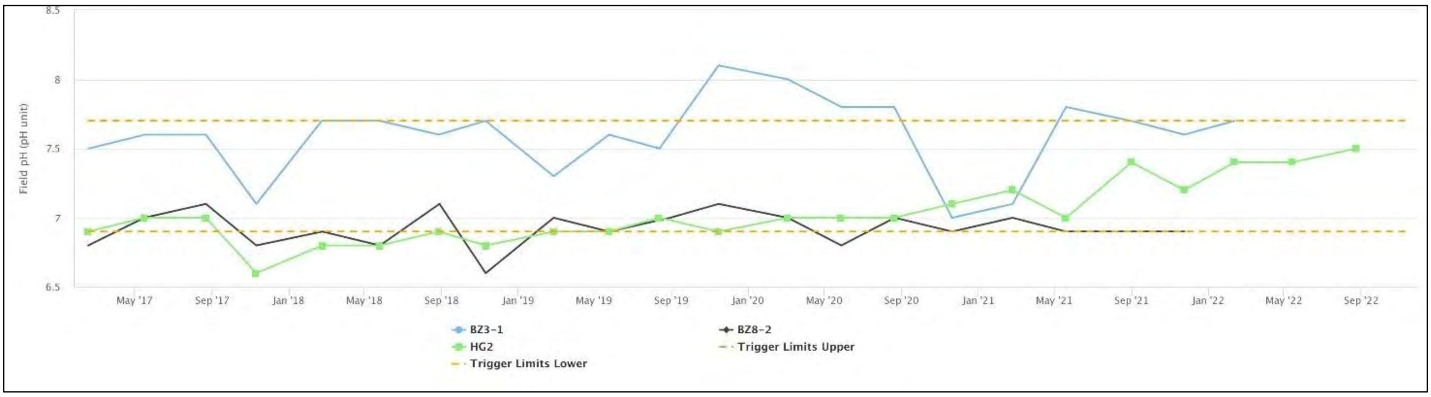

Figure 7-37: Cheshunt Interburden Groundwater pH Trends 2017 – 2022

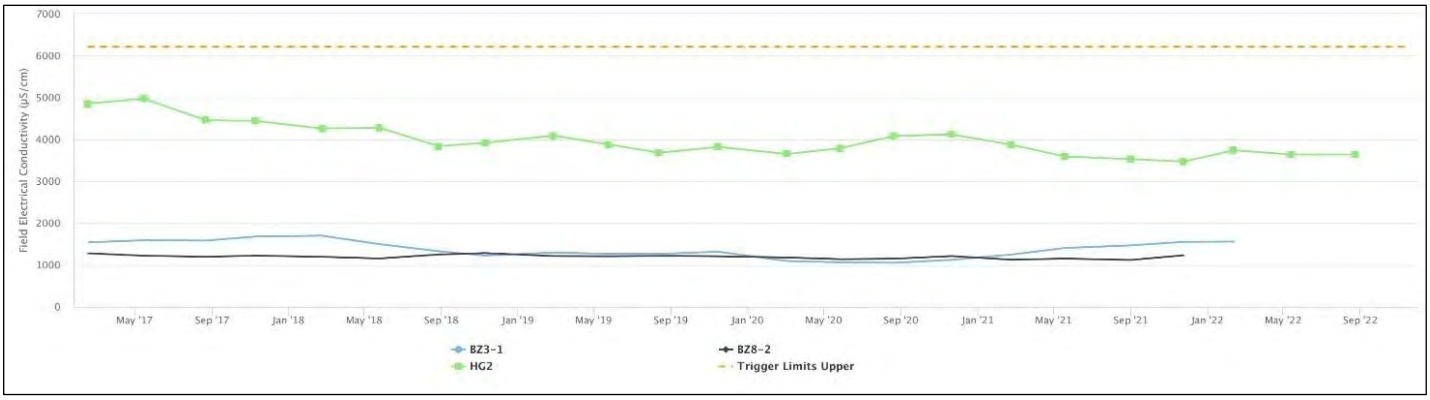

Figure 7-38: Cheshunt Interburden Groundwater EC Trends 2017 – 2022

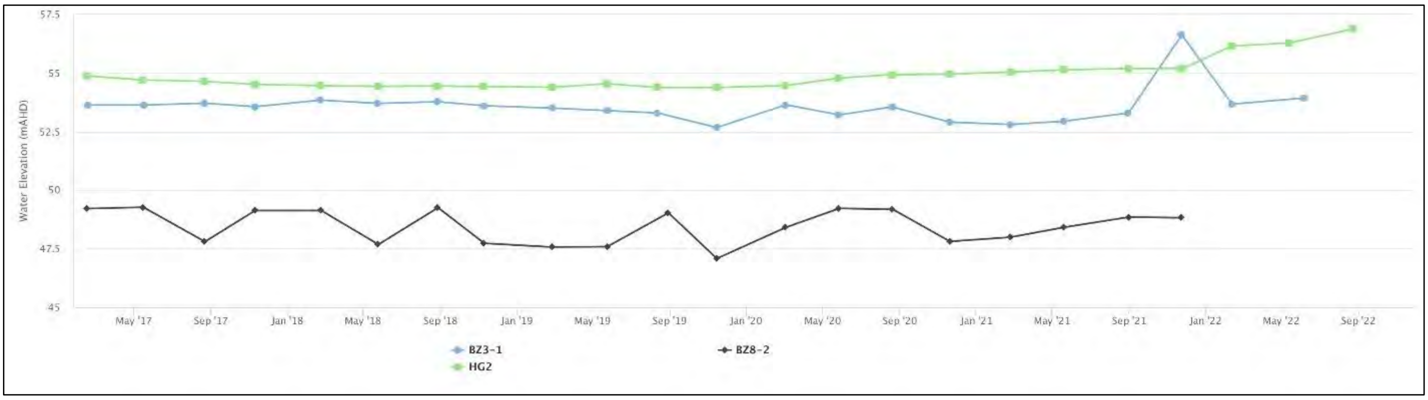

Figure 7-39 Cheshunt Interburden Groundwater SWL Trends 2017 – 2022

Cheshunt Mt Arthur

The pH, EC and SWL trends for 2017 to 2022 are shown in **Figure 7-40** to **Figure 7-42**. 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 (pH – 5th Percentile). 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.

Trigger tracking results are listed in **Table 7-13**.

Table 7-13: Cheshunt Mt Arthur Groundwater 2022 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
BZ2A(1)	10/02/2022	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established
BZ3-3	11/02/2022	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established
BZ4A(2)	10/02/2022	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established
BZ2A(1)	06/06/2022	pH – 5th Percentile	Second consecutive trigger exceedance - watching brief maintained
BZ3-3	06/06/2022	pH – 5th Percentile	Second consecutive trigger exceedance - watching brief maintained
BZ4A(2)	06/06/2022	pH – 5th Percentile	Second consecutive trigger exceedance - watching brief maintained
BZ2A(1)	23/08/2022	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established
BZ3-3	23/08/2022	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established

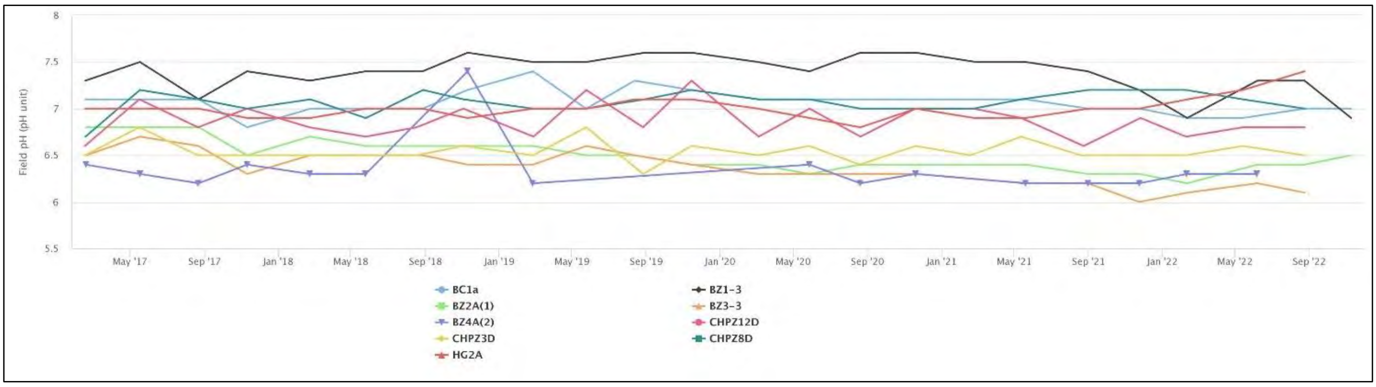

Figure 7-40: Cheshunt Mt Arthur Groundwater pH Trends 2017 – 2022

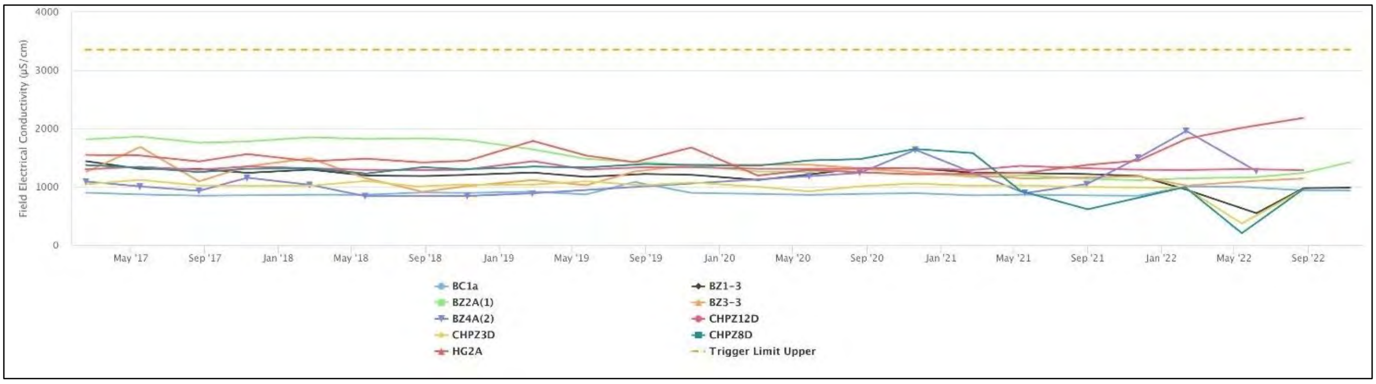

Figure 7-41: Cheshunt Mt Arthur Groundwater EC Trends 2017 – 2022

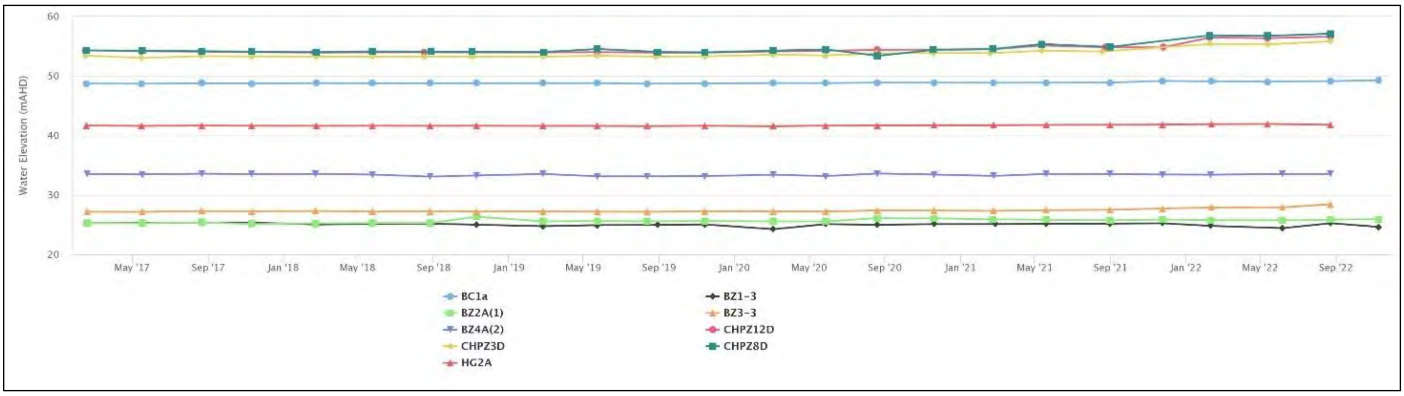

Figure 7-42: Cheshunt Mt Arthur Groundwater SWL Trends 2017 – 2022

Cheshunt Piercefield

The pH, EC and SWL trends for 2017 to 2022 are shown in **Figure 7-43** to **Figure 7-45**. Water quality results were generally consistent with historical trends.

There were no trigger exceedances recorded in 2022.

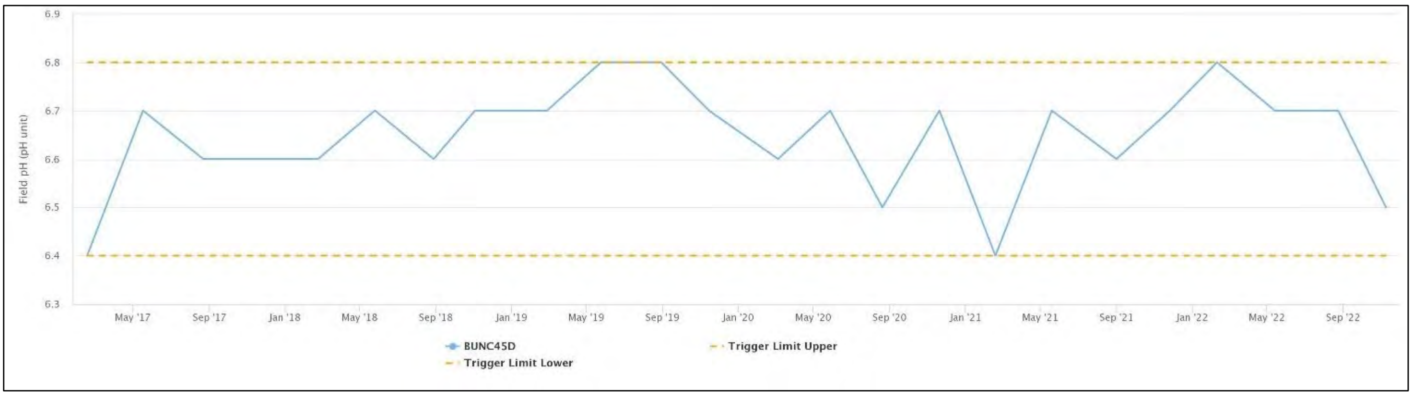

Figure 7-43: Cheshunt Piercefield Groundwater pH Trends 2017 – 2022

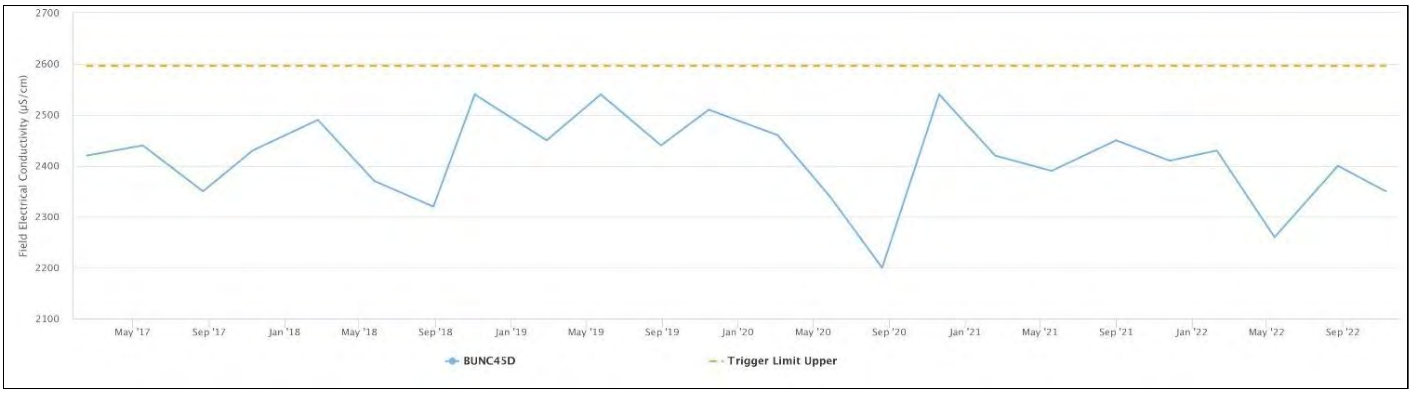

Figure 7-44: Cheshunt Piercefield Groundwater EC Trends 2017 – 2022

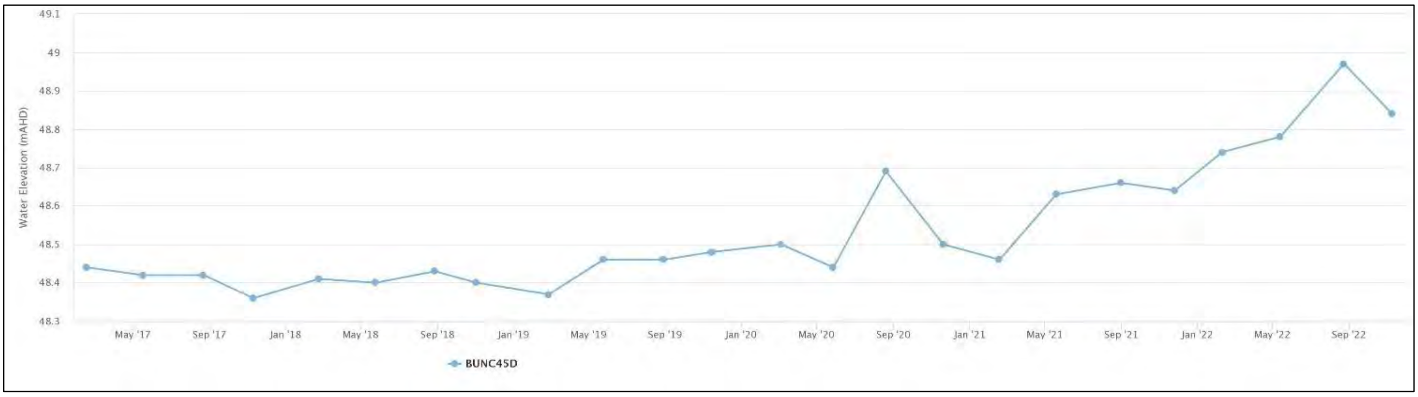

Figure 7-45: Cheshunt Piercefield Groundwater SWL Trends 2017 – 2022

Lemington South Alluvium

The pH, EC and SWL trends for 2017 to 2022 are shown in **Figure 7-46** to **Figure 7-48**. Water quality results were generally consistent with historical trends.

Trigger limits are listed in **Table 7-14.**

Table 7-14: Lemington South Alluvium Groundwater 2022 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
PB01(ALL)	02/08/2022	pH – lower	First consecutive trigger exceedance - watching brief established
PB01(ALL)	22/11/2022	pH – lower	Second consecutive trigger exceedance - watching brief maintained

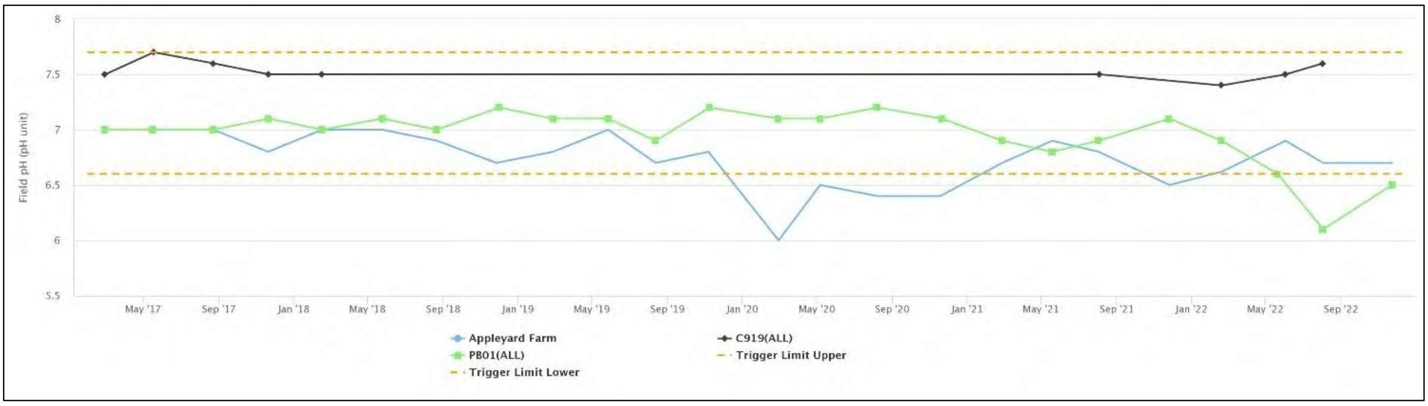

Figure 7-46: Lemington South Alluvium Groundwater pH Trends 2017 – 2022

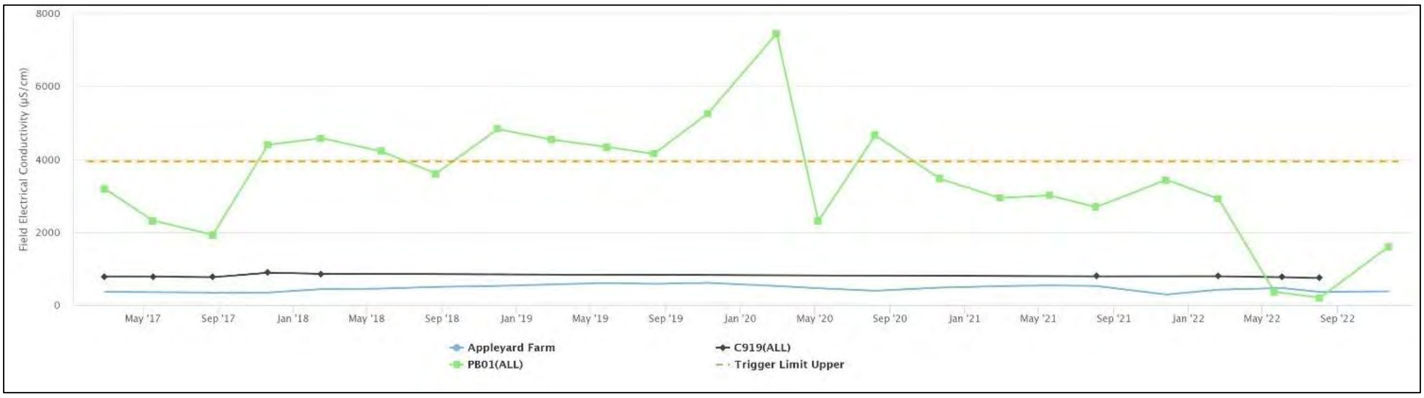

Figure 7-47: Lemington South Alluvium Groundwater EC Trends 2017 – 2022

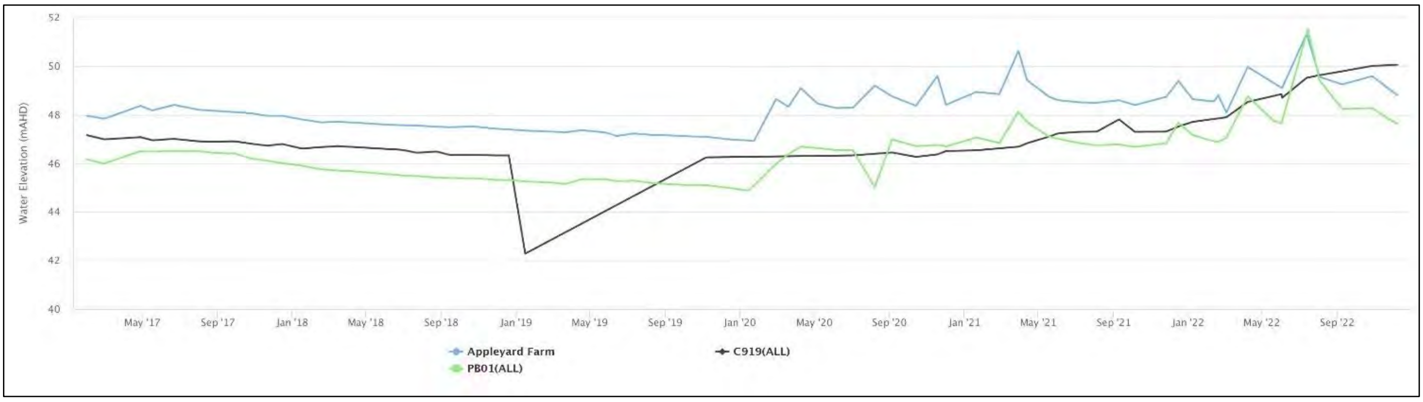

Figure 7-48: Lemington South Alluvium Groundwater SWL Trends 2017 – 2022

Lemington South Arrowfield

The pH, EC and SWL trends for 2017 to 2022 are shown in **Figure 7-49** to **Figure 7-51**. Water quality results were generally consistent with historical trends.

There were no trigger exceedances recorded in 2022.

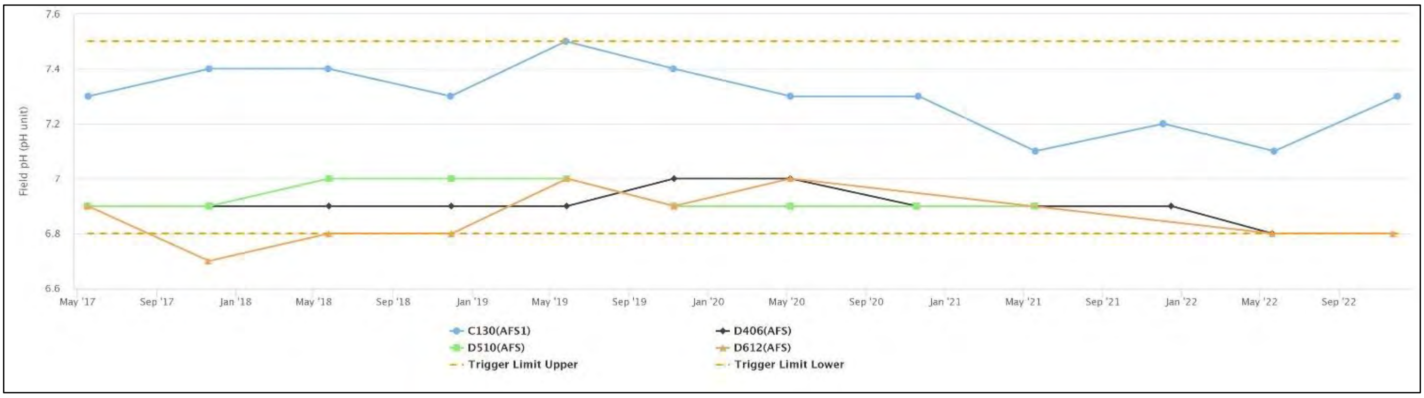

Figure 7-49: Lemington South Arrowfield Groundwater pH Trends 2017 – 2022

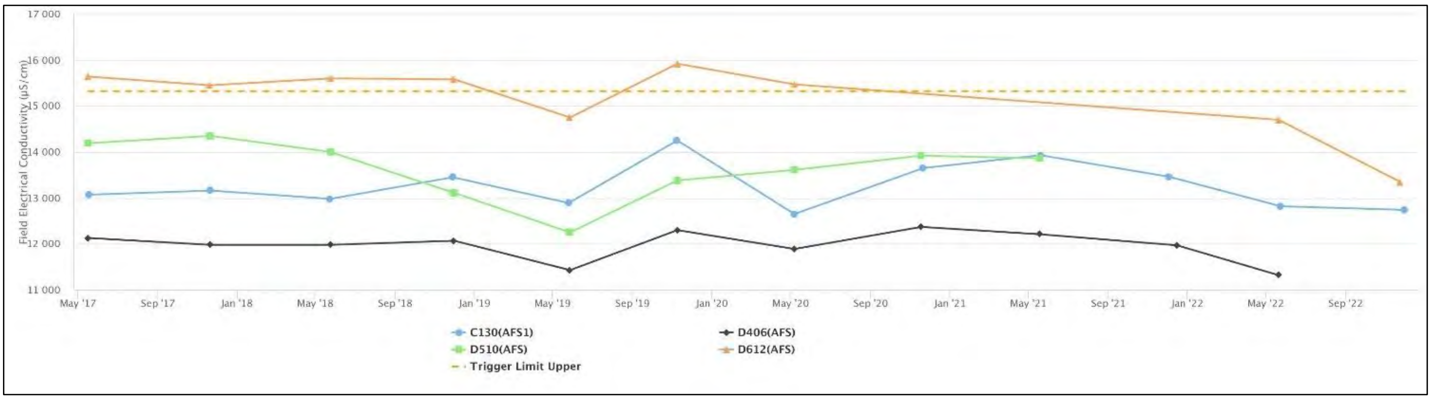

Figure 7-50: Lemington South Arrowfield Groundwater EC Trends 2017 – 2022

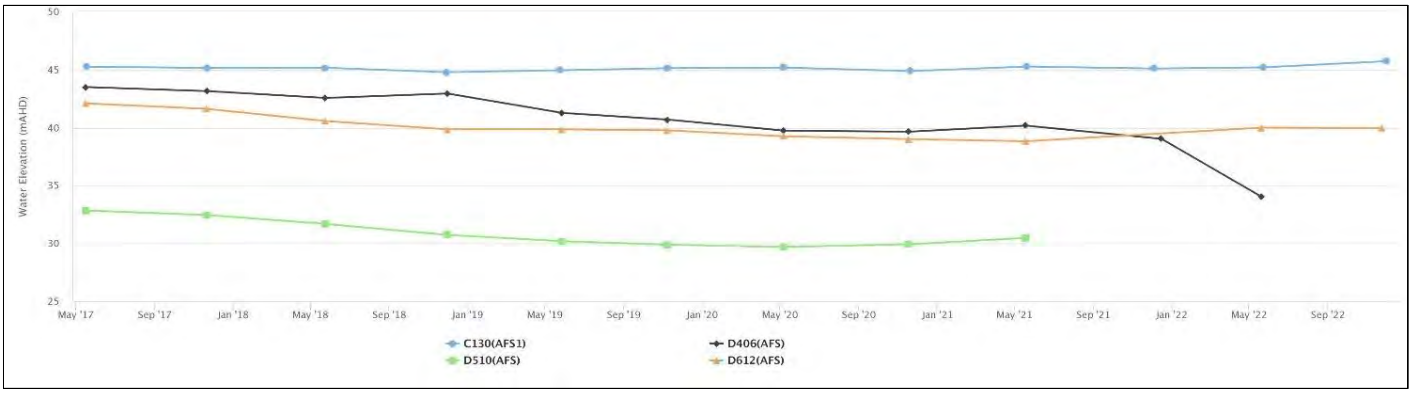

Figure 7-51: Lemington South Arrowfield Groundwater SWL Trends 2017 – 2022

Lemington South Bowfield

The pH, EC and SWL trends for 2017 to 2022 are shown in **Figure 7-52** to **Figure 7-54**. Water quality results were generally considered to be consistent with historical trends with the exception of triggers exceeded as listed in **Table 7-15**. The 2022 trigger value exceedances are not considered to reflect a mining related impact. Historical monitoring data from July 2011–December 2022 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.

Trigger limits tracking is listed in **Table 7-15**

Table 7-15: Lemington South Bowfield Groundwater 2022 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
C122(BFS)	02/06/2022	pH – 95th Percentile	Sample was likely below the base of the screen and not representative of the Bowfield seam.
D214(BFS)	23/11/2022	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established
D510(BFS)	23/11/2022	pH – 5th Percentile	First consecutive trigger exceedance - watching brief established
B631(BFS)	30/11/2022	pH – 95th Percentile	First consecutive trigger exceedance - watching brief established

Figure 7-52: Lemington South Bowfield Groundwater pH Trends 2017 – 2022

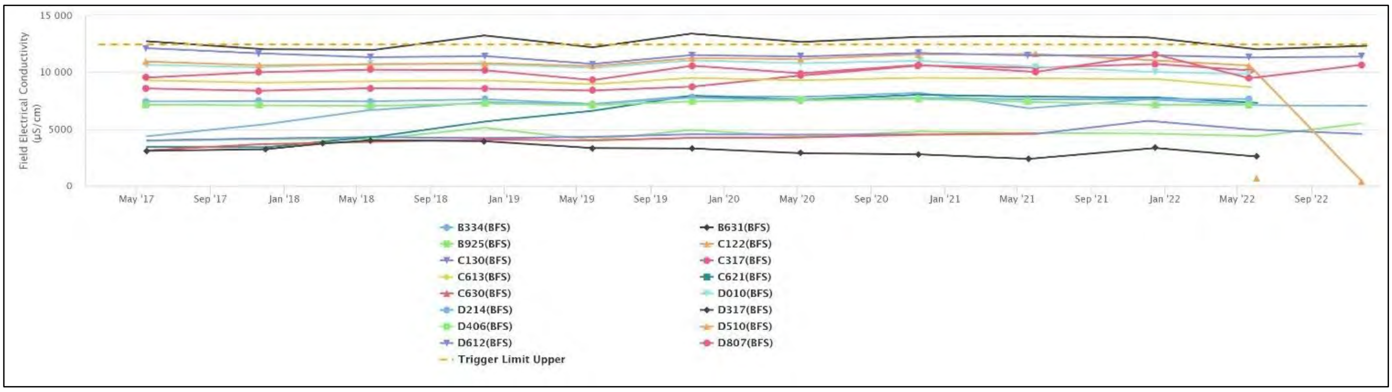

Figure 7-53: Lemington South Bowfield Groundwater EC Trends 2017 – 2022

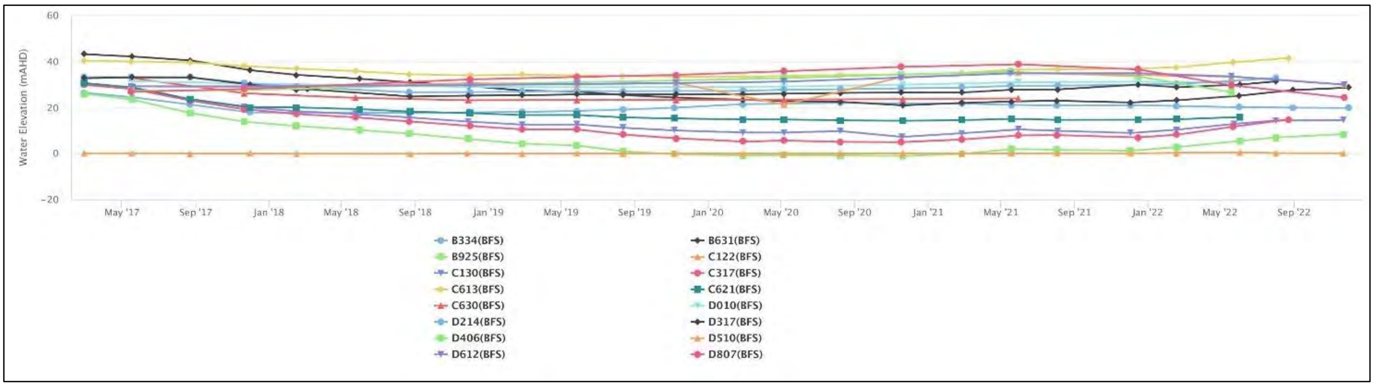

Figure 7-54: Lemington South Bowfield Groundwater SWL Trends 2017 – 2022

Lemington South Interburden

The pH, EC and SWL trends for 2017 to 2022 are shown in **Figure 7-55** to **Figure 7-57**. Historical readings of C130(ALL) show regular fluctuations of pH between 6.4 and 7.9 The 2022 readings for pH are considered consistent with historical concentrations. All of the EC measurements in the period 2011-2022 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 7-16**.

Table 7-16: Lemington South Interburden Groundwater 2022 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
C130 (All)	30/11/2022	EC – 95th Percentile	New trigger value recommended

Figure 7-55: Lemington South Interburden Groundwater pH Trends 2017 – 2022

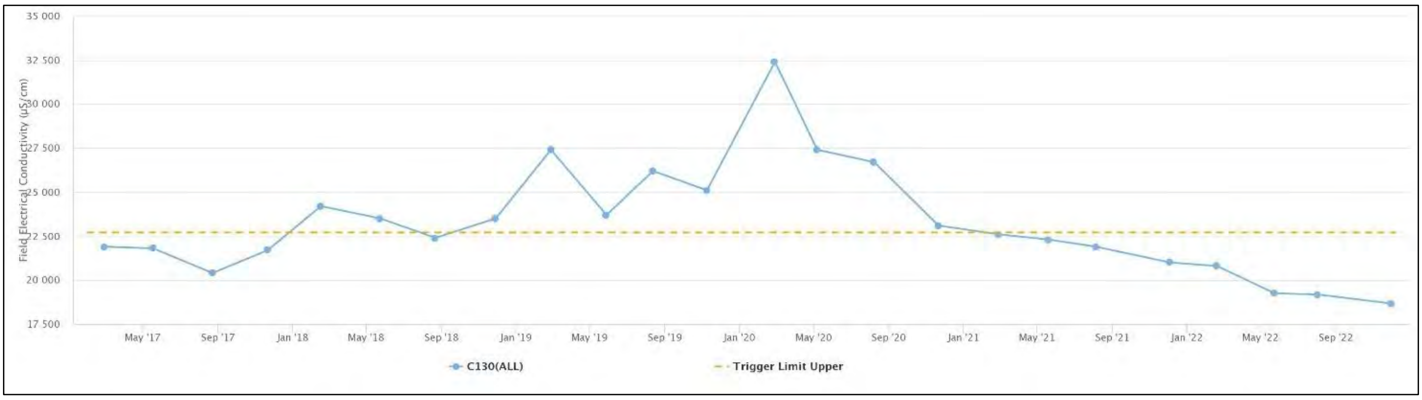

Figure 7-56: Lemington South Interburden Groundwater EC Trends 2017 – 2022

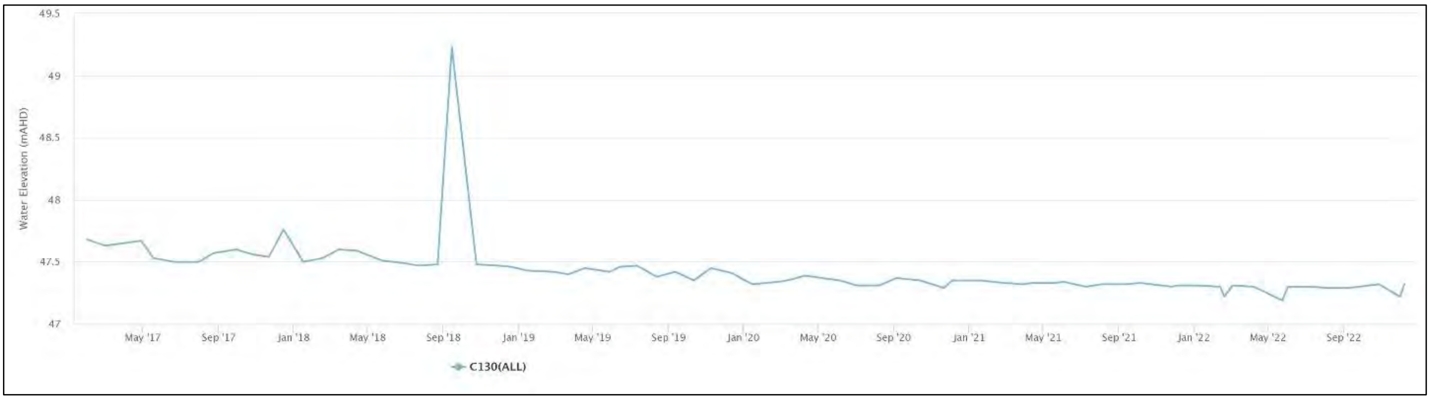

Figure 7-57: Lemington South Interburden Groundwater SWL Trends 2017 – 2022

Lemington South Woodlands Hill

The pH, EC and SWL trends for 2017 to 2022 are shown in **Figure 7-58** to **Figure 7-60**. Water quality results were generally consistent with historical trends.

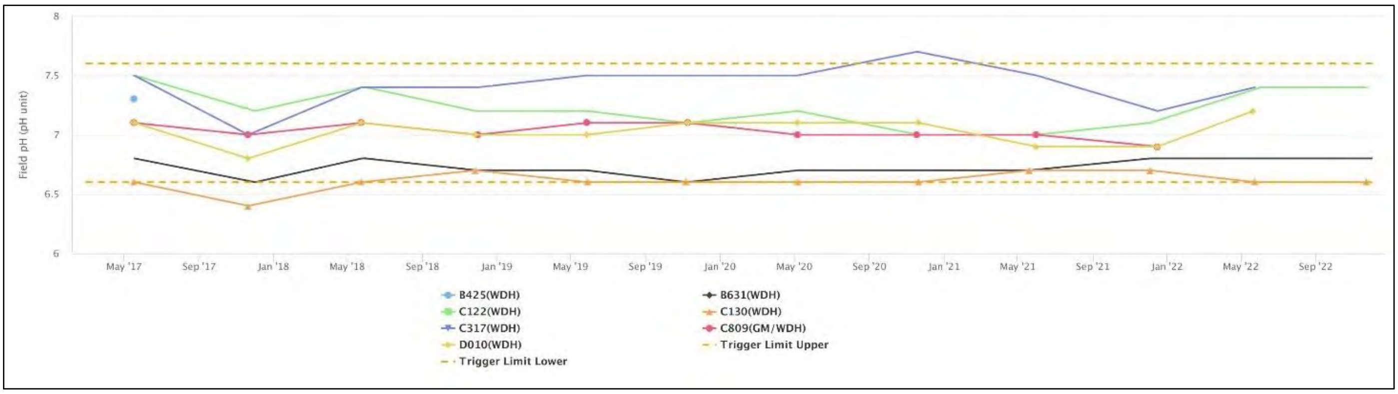

Figure 7-58: Lemington South Woodlands Hill Groundwater pH Trends 2017 – 2022

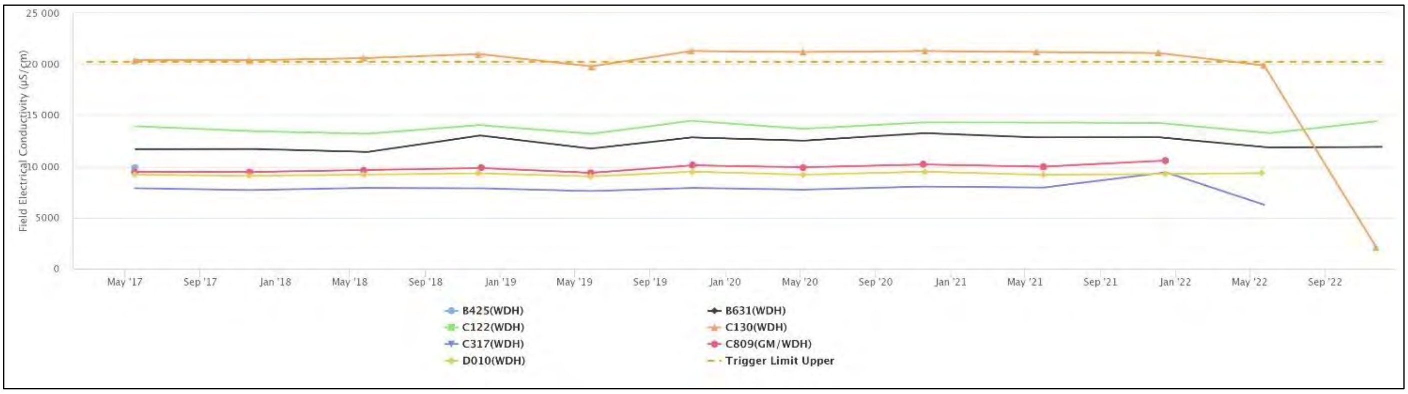

Figure 7-59: Lemington South Woodlands Hill Groundwater EC Trends 2017 – 2022

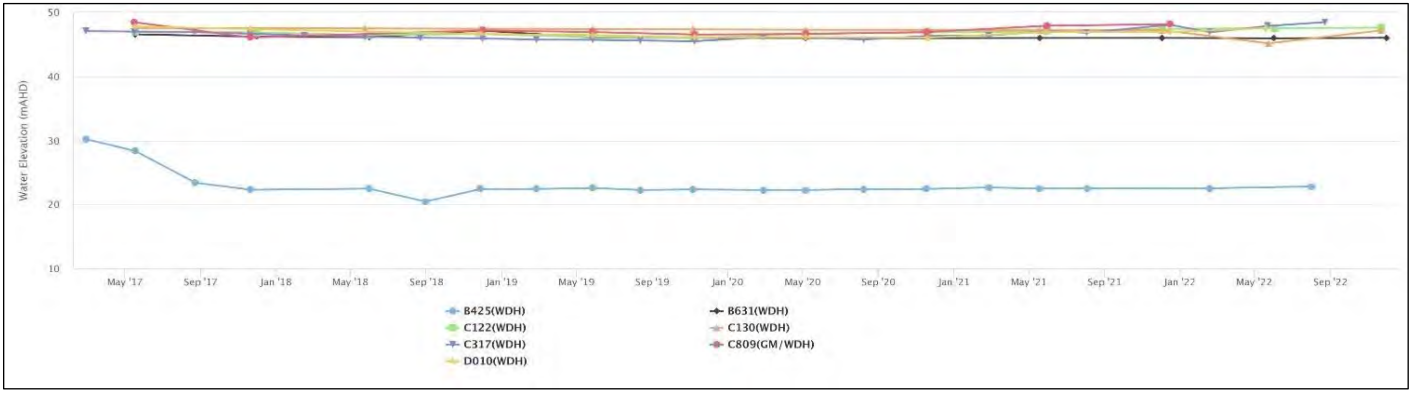

Figure 7-60: Lemington South Woodlands Hill Groundwater SWL Trends 2017 – 2022

Lemington South Glen Munro

Groundwater monitoring in the Lemington South Glen Munro seam was conducted twice in 2022 from one monitoring location. The pH, EC and SWL trends for 2017 to 2022 are shown in **Figure 7-61** to **Figure 7-63**. Water quality results were generally consistent with historical trends.

Internal triggers are listed in **Table 7-17**. As noted above the assignment of trigger values has been removed for bore D010(GM) in the draft WMP.

Table 7-17: Lemington South Glen Munro Groundwater 2022 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
D010 (GM)	Q4	EC – 95th Percentile	Recommendation to cease monitoring against trigger level.

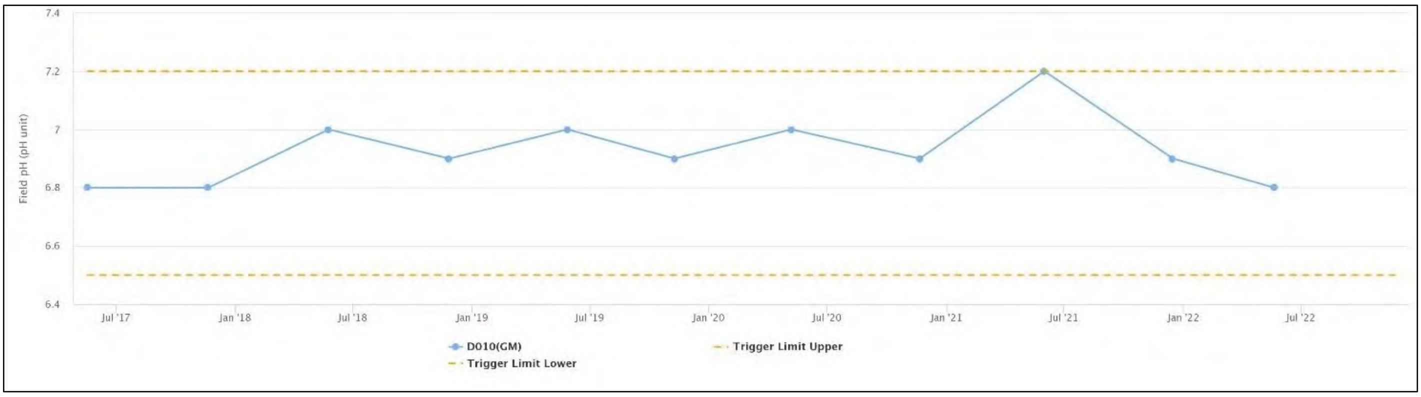

Figure 7-61: Lemington South Glen Munro Groundwater pH Trends 2017 – 2022

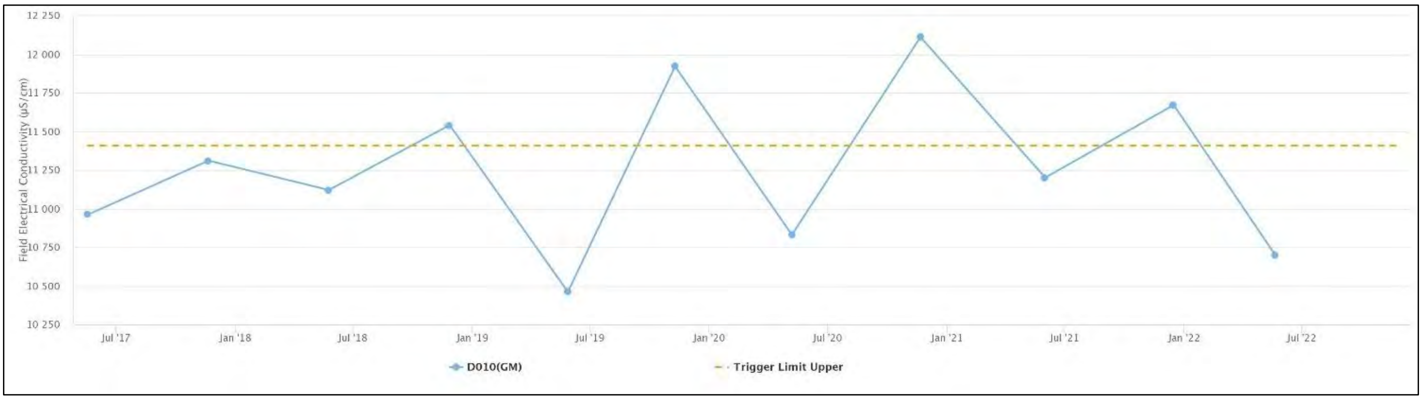

Figure 7-62: Lemington South Glen Munro Groundwater EC Trends 2017 – 2022

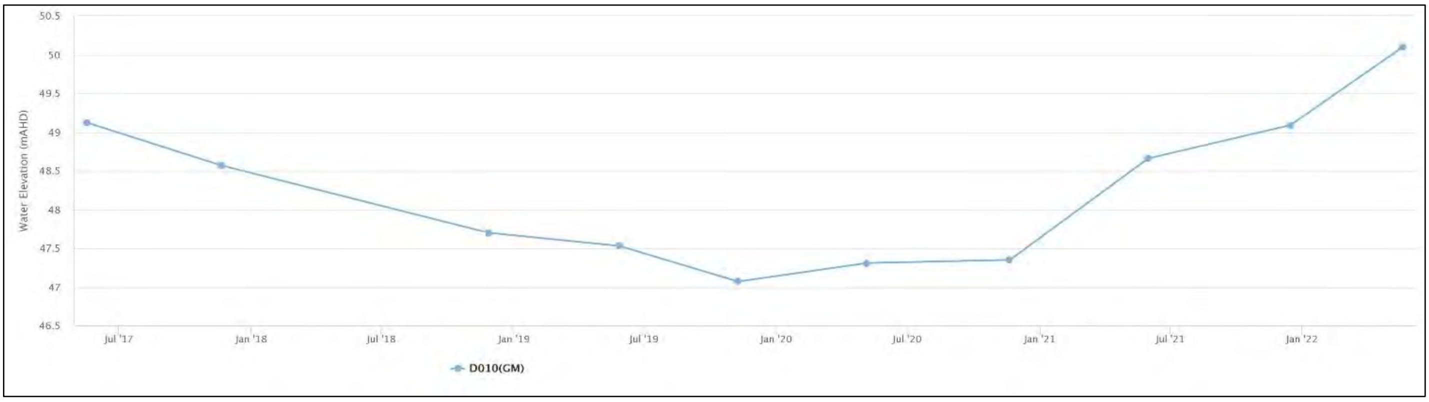

Figure 7-63: Lemington South Glen Munro Groundwater SWL Trends 2017 – 2022

North Pit Spoil

The pH, EC and SWL trends for 2017 to 2022 are shown in **Figure 7-64** to **Figure 7-66**. Groundwater levels increased by up to 2.5m (DM7) consistent with rainfall trends. Groundwater within the spoil flows from northern-most bore DM1 in a southerly direction towards the southern-most bore MB14HVO03. EC and pH was found to generally be within historical levels.

Internal triggers are listed in **Table 7-18**.

Table 7-18: North Pit Spoil Groundwater 2022 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
4116P	27/07/2022	EC – 95th Percentile	First consecutive trigger exceedance – watching brief established
DM3	27/09/2022	pH - 5th Percentile	First consecutive trigger exceedance – watching brief established

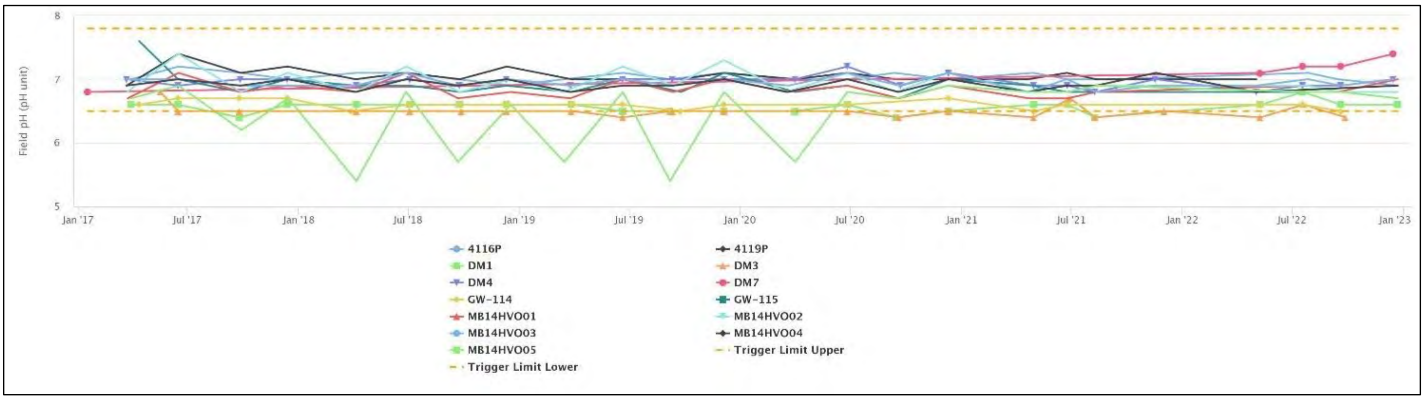

Figure 7-64: North Pit Spoil Groundwater pH Trends 2017 – 2022

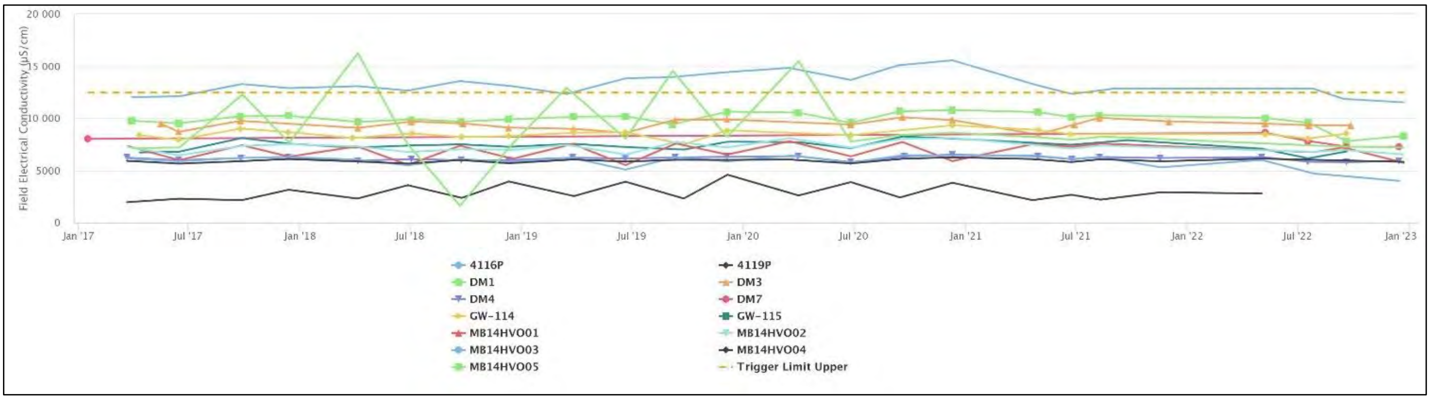

Figure 7-65: North Pit Spoil Groundwater EC Trends 2017 – 2022

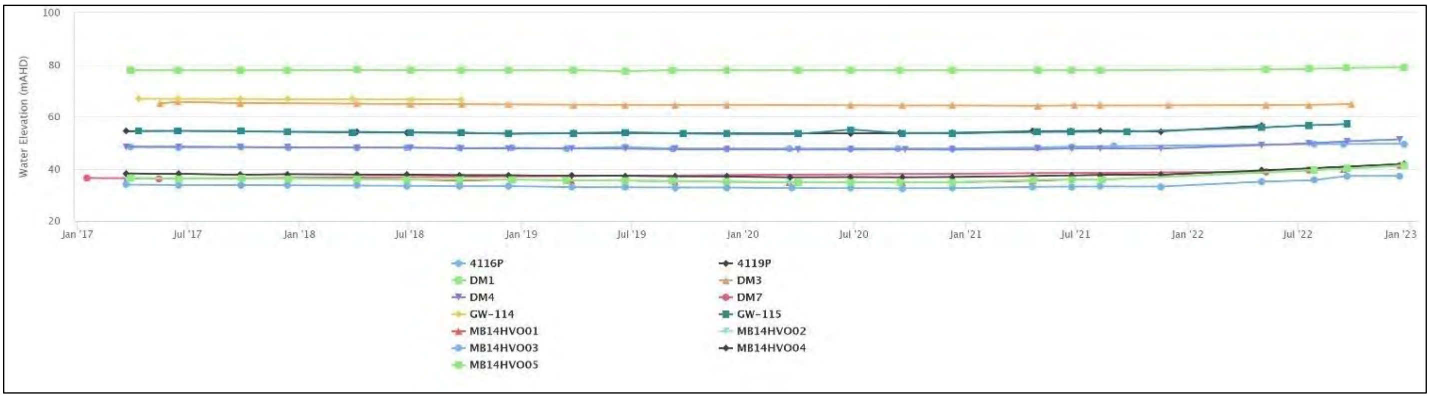

Figure 7-66: North Pit Spoil Groundwater SWL Trends 2017 – 2022

West Pit Alluvium

The pH, EC and SWL trends for 2017 to 2022 are shown in **Figure 7-67** to **Figure 7-69**. Bore GW-101 was unable to be sampled due to insufficient water and lack of access throughout 2022. 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 2022.

Figure 7-67: West Pit Alluvium Groundwater pH Trends 2017 – 2022

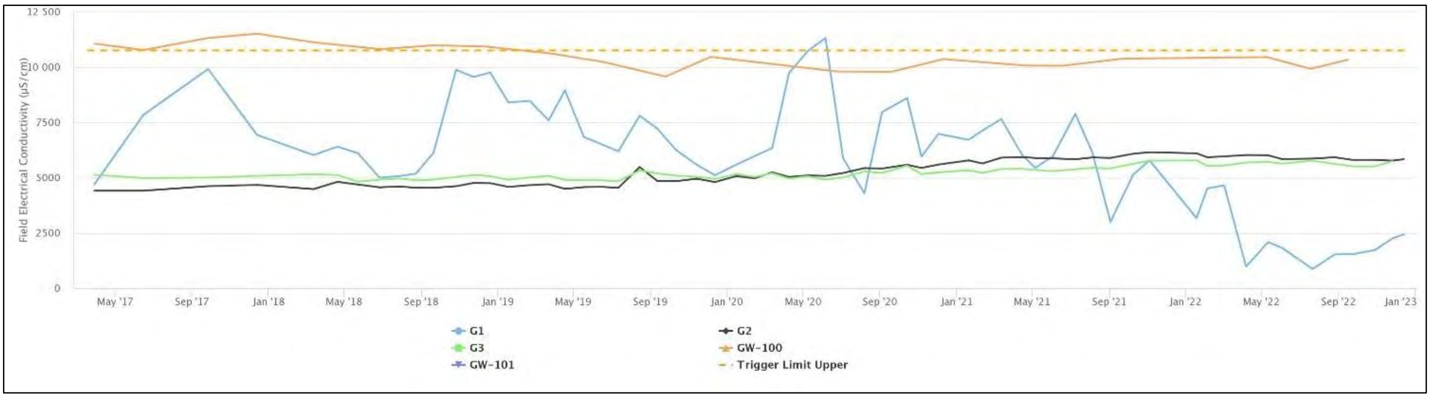

Figure 7-68: West Pit Alluvium Groundwater EC Trends 2017 – 2022

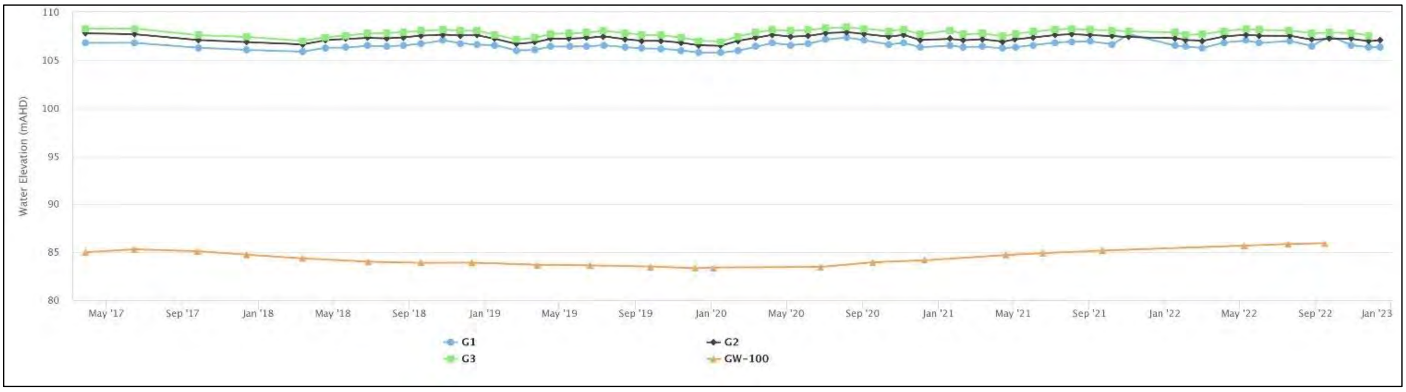

Figure 7-69: West Pit Alluvium Groundwater SWL Trends 2017 – 2022

West Pit Sandstone/Siltstone

The pH, EC and SWL trends for 2017 to 2022 are shown in **Figure 7-70** to **Figure 7-72**. Water quality results were generally consistent with historical trends. Bore NPZ2 is located northwest of West Pit beyond the outcrop of coal seams mined at West Pit and intersects Interburden sequences beneath the coal seams. EC readings range from 12,590 µS/cm (December 2014) and 19,400 µS/cm (December 2009). The 2022 readings are consistent with historical concentrations. The 2019 Groundwater Network Review (SLR, 2019a) noted that the bore is unlikely to detect relevant site impacts and recommended removal from the compliance monitoring network but kept in operational monitoring network for future work. The bore has already been removed from the compliance monitoring network in version 3.4 of the WMP which is currently with DPE for approval.

Internal triggers are listed in **Table 7-19**.

Table 7-19: West Pit Sandstone/Siltstone Groundwater 2022 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
NPZ2	09/05/2022	EC – 95th Percentile	Recommendation to remove from compliance monitoring
NPZ2	18/07/2022	EC – 95th Percentile	
NPZ2	15/09/2022	EC – 95th Percentile	
NPZ2	15/12/2022	EC – 95th Percentile	

Figure 7-70: West Pit Sandstone/Siltstone Groundwater pH Trends 2017 – 2022

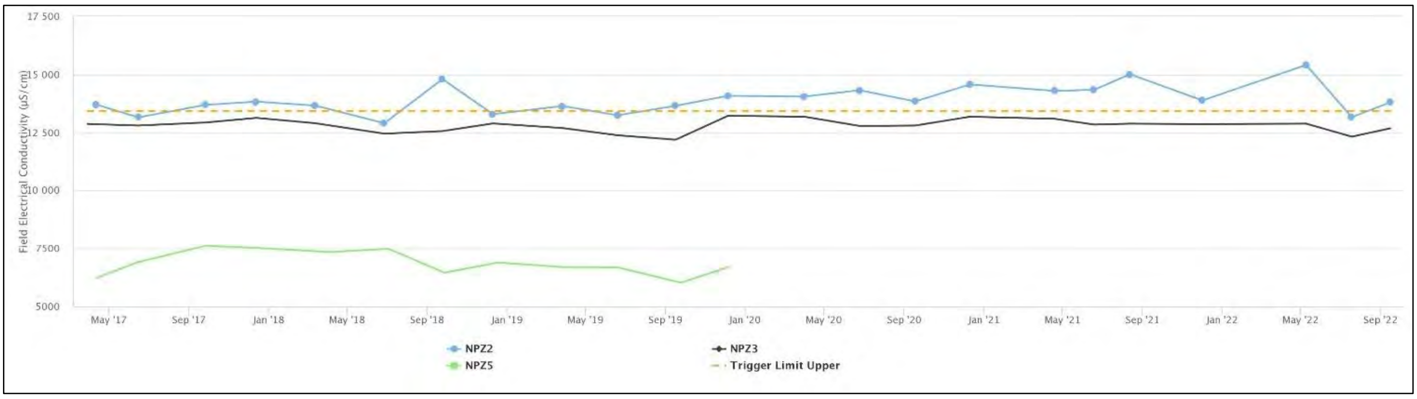

Figure 7-71: West Pit Sandstone/Siltstone Groundwater EC Trends 2017 – 2022

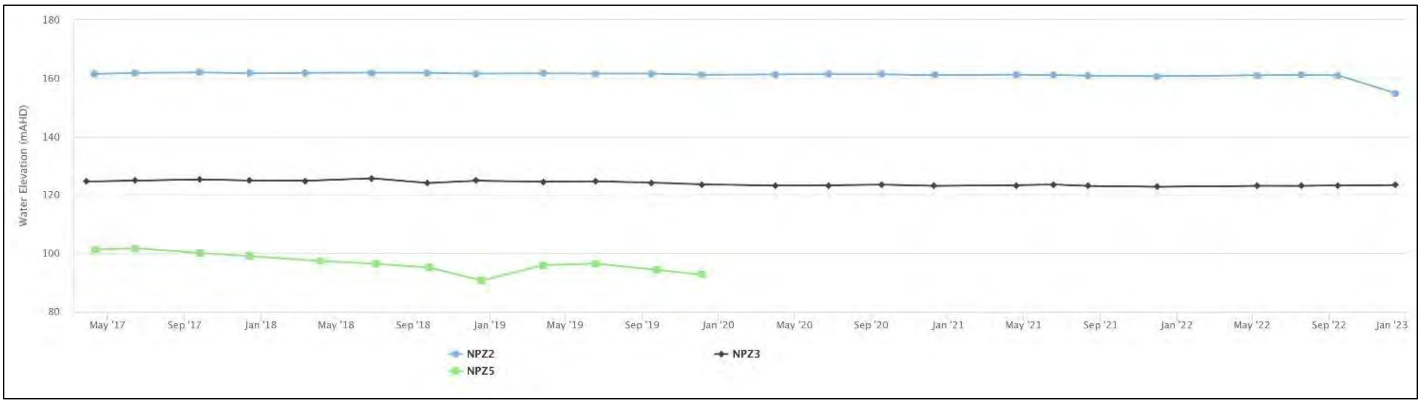

Figure 7-72: West Pit Sandstone/Siltstone Groundwater SWL Trends 2017 – 2022

Carrington West Wing Bayswater

The pH, EC and SWL trends for 2017 to 2022 are shown in **Figure 7-73** to **Figure 7-75**. Water quality results were generally consistent with historical trends although there was a drop in EC and SWL.

Internal triggers are listed in **Table 7-20**

Table 7-20: Carrington West Wing Bayswater Groundwater 2022 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken in Response
CGW46	27/07/2022	pH – 5th Percentile	First consecutive trigger exceedance – watching brief established

Figure 7-73: Carrington West Wing Bayswater Groundwater pH Trends 2017 to 2022

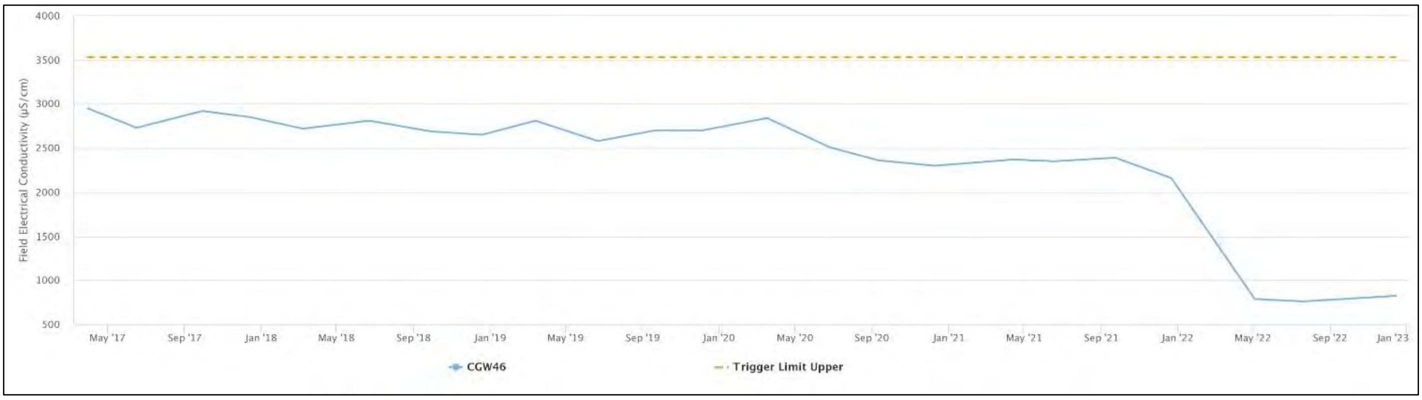

Figure 7-74: Carrington West Wing Bayswater Groundwater EC Trends 2017 to 2022

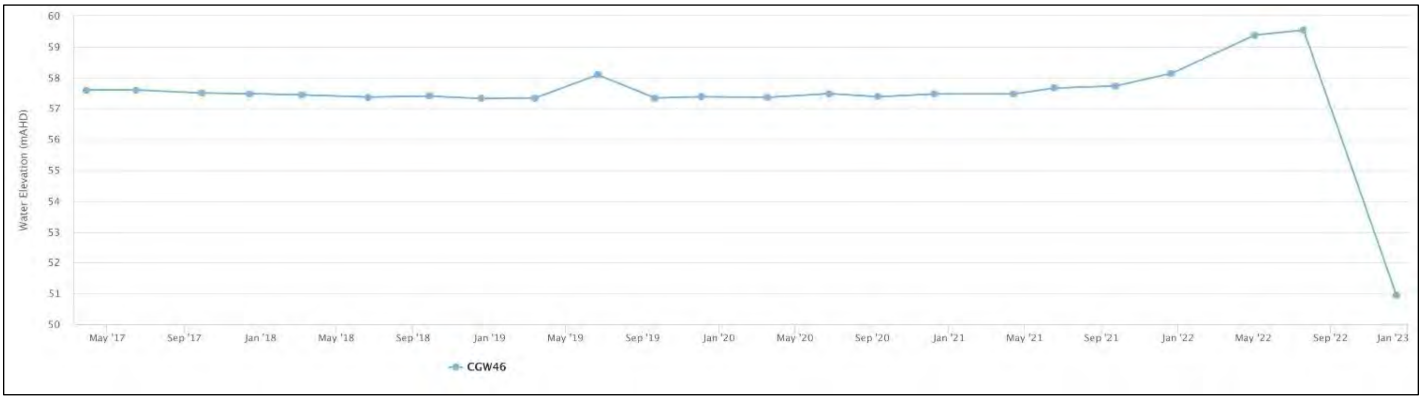

Figure 7-75: Carrington West Wing Bayswater Groundwater SWL Trends 2017 to 2022

7.6 | COMPENSATORY WATER SUPPLY

During 2022 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.

7.7 | PROGRESS AGAINST RECOMMENDATIONS IN 2021 ANNUAL GROUNDWATER REVIEW

A number of recommendations were made in the Annual Groundwater Monitoring Review produced by EMM (Appendix B of the 2021 Annual Review) in Section 6.2. Progress against these actions is shown in **Table 7-21.**

Table 7-21: Progress Against Recommendations in 2021 Annual Groundwater Review

Recommendation	Progress in 2022
The relevance of the lower pH trigger value assigned to the - Mt Arthur Cheshunt Seam bores should be validated, specifically: - It is recommended that pH trigger levels be removed for bores BZ2A(1) and BZ3-3 (consistent with the updated draft WMP).	Bores BZ2A and BZ3-3 have been removed from updated WMP as per additional advice from Umwelt. WMP awaiting DPE approval.
- As the groundwater levels measured in BZ4A(2) are at the base of the screen in this bore, with continuous pH/EC trigger value exceedance, BZ4A(2) is not considered representative of groundwater in the Mt Arthur seam. Further to this, the dry sampling events at BZ4A(2) are likely to continue. Hence it is recommended that bore BZ4A(2) be removed as a monitoring bore in the revised WMP.	Bore has been removed in revised WMP advice. WMP awaiting DPE approval.

Recommendation	Progress in 2022
- It is recommended that the pH trigger level value be lowered to 6.4 (from the current value of 6.5) for all of the remaining bores monitoring the Cheshunt - Mt Arthur Seam (consistent with the updated draft WMP).	Updated in revised WMP. WMP awaiting DPE approval
It is recommended the proposed EC and pH trigger values at bores C130(WDH) and C630(BFS) in the updated draft WMP be revised, as historical monitoring data suggest that trigger value exceedances may continue despite being revised in the draft WMP.	Umwelt engaged to undertake review. Still in progress.
It is recommended that the ground elevation and bore construction be reviewed for some monitoring bores (including D406(AFS), D612(AFS) and D612(BFS))	Monitoring bore ground elevations and construction data reviewed. Follow on action in CMO to confirm survey level of some bores.
The 95th percentile groundwater level trigger value for CGW53A should be reviewed as the bore has been showing an increasing trend since the drought ended in late 2019 / early 2020.	Groundwater level trigger no longer required to be reviewed as per additional advice from Umwelt - water level rise corresponds with level rises across other bores within area which can be attributed to higher than average rainfall.
Trigger values that were exceeded at the end of 2021, yet do not require action (Section 5.2) should be reviewed in the subsequent groundwater data review.	Groundwater trigger values addressed in referenced actions and also Qrtly GW impacts reports for 2022.
An assessment should be undertaken (potentially using a submersible inspection camera or similar) of bore CGW45 to determine the depth of blockage and assess options for re-instating the bore as an effective monitoring location. In addition, the monitoring records noted that this bore could not be located.	Bore was assessed and discovered to have animal faeces in it. Extension post put on bore, monitoring contractor working on clearing blockage and reinstating bore.
If monitoring continues at GW-114, survey data should be obtained and provided via the EMD	GW-114 site info updated in EMD - results uploaded to EMD.

8 | REHABILITATION AND LAND MANAGEMENT

8.1 | SUMMARY OF REHABILITATION

Rehabilitation at HVO is undertaken in accordance with commitments made in the 2020 to 2022 Mining Operations Plan (MOP) and 2022-2025 Forward Works Program (FWP) and Rehabilitation Management Plan (RMP). Although site had an approved MOP to 31 December 2022, a newly developed FWP was provided to the Resources Regulator to satisfy the requirements of the Mining Act 1992. The distinct difference being the MOP having calendar year targets whilst the FWP covers a financial year period for July 2022-July 2025. During December 2022, HVO gained approval from the Resources Regulator to re-align to a calendar year period from 2023 onward. The updated RMP was provided to the Department during August 2022 to satisfy the requirements of both development consents and remains pending approval.

A summary of the key rehabilitation performance indicators is shown in **Table 8-1**.

Table 8-1: Key Rehabilitation Performance Indicators

Mine Area Type	Previous Reporting Period (Actual) Year 2021 (ha)	This Reporting Period (Actual) Year 2022 (ha)	Next Reporting Period (Forecast) Year 2023 (ha)
A. Total mine footprint[2]	6666.7	6817.2	7028.2
B. Total Active Disturbance[3]	3695.7	3781.2	3957.2
C. Land being prepared for rehabilitation[4]	338.0	256.8	159.8
D. Land under active rehabilitation[5]	2631.2	2779.2	2911.2
E. Completed rehabilitation[6]	0	0	0

*Large land being prepared for rehabilitation figures is due to reclassification of areas previously reported as under active rehabilitation. These require remedial actions prior to being re-sown to final vegetation (i.e. reclassified to Growth Medium Development phase).

•

[2] **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

[3] **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).

[4] **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).

[5] **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).

[6] **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 2022 is shown in **Table 8-2**.

Table 8-2: Summary of New Rehabilitation Completed in 2022

Rehabilitation Site Name	Rehabilitation Type	Seed Mix	Area (ha)	Summary
West North 210 & 230	New Rehabilitation	Pasture / Woodland	15.5	Final landform sown with final cover
Cheshunt Pit 160-165	New Rehabilitation	Woodland	12.3	Final landform sown with final cover
Riverview RL138	New Rehabilitation	Pasture / Woodland	13.5	Final landform sown with final cover
Carrington RL80	New Rehabilitation	Pasture	6.4	Final landform sown with final cover
Carrington park-up	New Rehabilitation	Pasture	6.5	Final landform sown with final cover
South East TSF	New Rehabilitation	Pasture	10.8	Final landform sown with final cover
Riverview - Glider	GMD Progression	Woodland	7.1	Final landform sown with final cover
Cheshunt Pit 155	GMD Progression	Woodland	8.9	Final landform sown with final cover
Wilton Pit slopes	GMD Progression	Pasture	18.3	Final landform sown with final cover
West North slopes	GMD Progression	Pasture	34.1	Final landform sown with final cover
South East TSF	GMD Progression	Pasture	12.8	Final landform sown with final cover
TOTAL REHABILITATION			**146.2**	

8.3 | REHABILITATION PERFORMANCE

A total of 146.2 ha rehabilitation was undertaken during 2022, including 65 ha of new rehabilitation, and 81.2 ha of Growth Media Development (GMD) progression. Details of the rehabilitation areas completed during 2022, including vegetation types are provided in **Figure 8-1**.

Table 8-3 details the amount of rehabilitation and disturbance completed during the reporting period compared with proposed area in the respective MOP/FWP.

Table 8-3: Summary of Rehabilitation and Disturbance Completed in 2022

FWP	2022 Totals (ha)	
	Actual	Proposed FWP (22/23 FY)
Rehabilitation		
HVO North	39.2	-
HVO South	25.8	-
GMD North	65.2	-
GMD South	16.0	-
HVO Total	146.2	152.0
Rehabilitation Disturbance		
HVO North	6.9	-
HVO South	25.4	-
HVO Total	32.3	63.0
New Disturbance		
HVO North	81.0	-
HVO South	0.0	-
HVO Total	81.0	113.0
Net Rehabilitation (Rehabilitation minus Rehabilitation Disturbance)		
HVO Total (Rehab)	HVO Total (Rehab Disturbance)	HVO Total
146.2	32.3	+113.9

HVO previously had a single consolidated MOP for HVO North and HVO South which expired 31 December 2022. In July 2022, HVO submitted a single FWP for the complex for the 2022/23 – 2024/25 period in line with the Rehabilitation Reforms to meet the requirements of the Mining Act 1992.

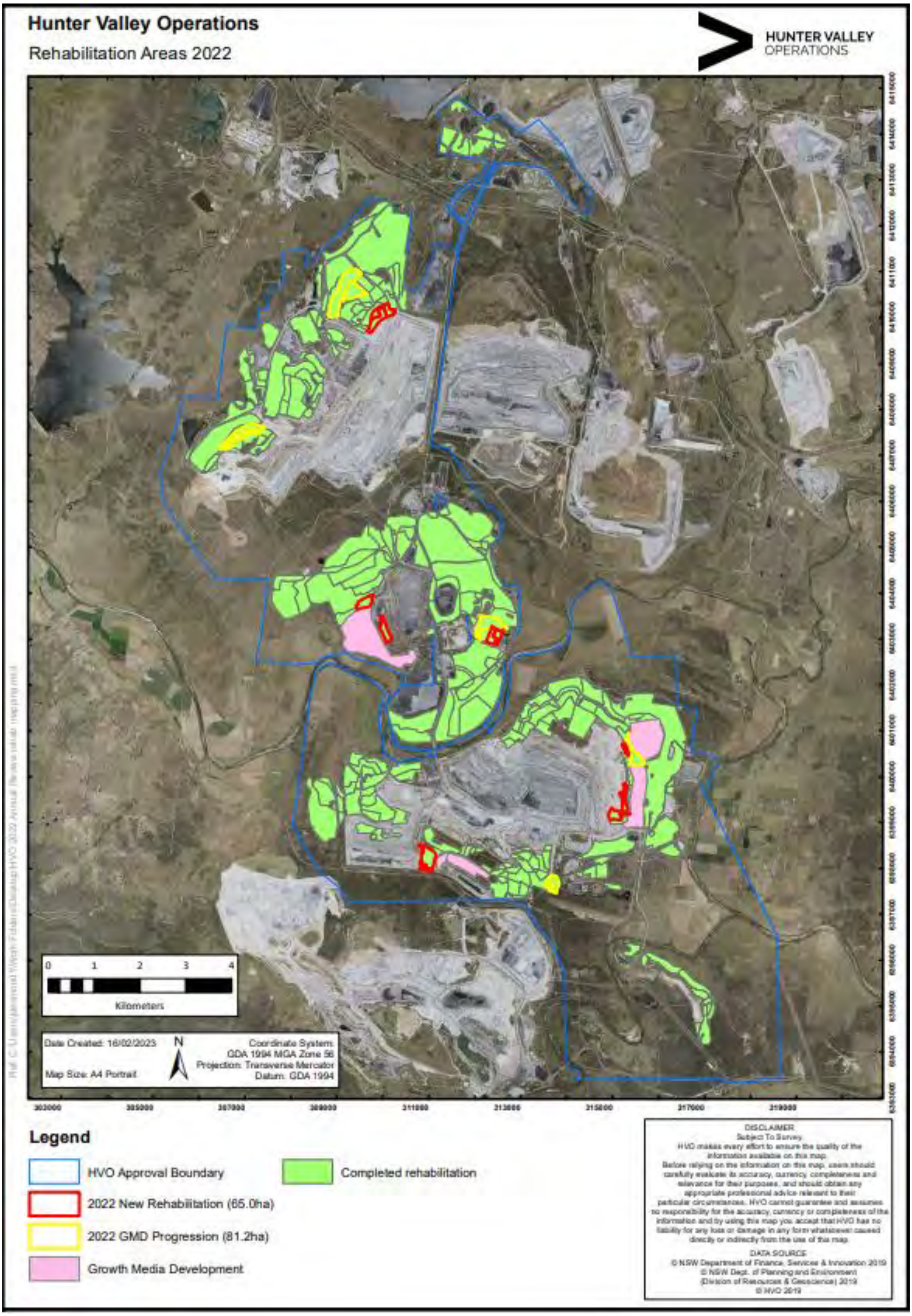

Figure 8-1: HVO Rehabilitation Areas

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 cumulative 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 2022 was 1871.7 hectares. Land under active rehabilitation at HVO North at the end of 2022 totalled 1798.2 hectares. A further 84.0 hectares are classified as within growth medium development phase representing a total rehabilitation management footprint at end of 2022 of 1882.2 hectares which is consistent with EIS projections.

As at the end of 2022, 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 2022 shows 1141 ha of rehabilitation completed. Land under active rehabilitation at the end of 2022 was 979.1 hectares in association with 141.2 hectares in growth medium development phase. Total rehabilitation management footprint at end 2022 is therefore 1120.3 hectares and consistent with progression to the end of Stage 1.

8.4 | REHABILITATION PROGRAMME VARIATIONS

The 2022 variations to the rehabilitation programme are summarised in **Table 8-4**.

Table 8-4: Variations to the Rehabilitation Program in 2022

FWP	Has rehabilitation work proceeded generally in accordance with the conditions of an accepted Mining Operations Plan?	Comment
HVO South	Yes	HVO South net rehabilitation (net rehabilitation = rehabilitation minus – rehabilitation disturbance) completed during period 2022 was 16.4 ha. HVO North net rehabilitation (net rehabilitation = rehabilitation minus – rehabilitation disturbance) completed during period 2022 was 97.5 ha. Both areas have progressed ahead of FWP/RMP forecasts due to works being completed ahead of financial year reporting, as well as some rehabilitation disturbance being delayed (32.3 ha against forecast of 63 ha). **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. HVO has since commenced a program of re-sowing these areas with its final cover. During 2022, 65.2 ha of GMD was progressed to final cover in HVO North, and 16.0 ha was progressed in HVO South.
HVO North	Yes	

8.5 | REHABILITATION TRIALS

No rehabilitation trials were conducted during 2022.

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;
- Having insufficient biological resources (topsoil, vegetation, seeds etc);
- Weather and climatic influences (high rainfall 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 RMP. 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 2022 rehabilitation monitoring results against the TARP is included in **Section 8.8**.

8.7 | REHABILITATION MONITORING

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.

Monitoring during 2022 represented a continuation of this ecological monitoring program adopted during 2020. During the 2022 monitoring, ninety five sites were monitored and these comprised:

a. 31 sites of Initial Establishment Monitoring for Grazing Pastures.
b. 7 sites of Long Term Monitoring for Grazing Pastures;
c. 37 sites of Initial Establishment Monitoring for Non-specific native vegetation.
d. 20 sites of Long-Term Monitoring Non-specific Native Vegetation.

The results of the annual rehabilitation monitoring, combined with the annual walkover, are utilised to assess rehabilitation performance against the sites closure criteria, the RMP TARP and GCAA's Rehabilitation Report Card. An overview of TARP triggers and closure criteria performance are presented in **Section 8.8**.

8.7.1 | IEM PASTURE RESULTS

The newly established pasture rehabilitation sites generally recorded a high ground cover percentage (average of 80.7%) with only minor rilling or sheet erosion being observed. Preferred pastures species averaged 36.6%, whilst priority weed cover ranged from 0.5 – 44% (averaged 12.5%). It was also noted that grazing by kangaroos and rabbits appeared to be impacting vegetation at some sites. The improved IEM sites results compared to previous years are a combination of favourable meteorological conditions (high rainfall) as well as early intervention (maintenance) of juvenile pasture rehabilitation areas.

An assessment of IEM pasture rehabilitation blocks against the RMP TARP triggers is presented in **Table 8-5**.

Table 8-5: Assessment of IEM Pasture Monitoring Blocks against RMP TARP

Block Code	Erosion Control	Surface Cover	Species Composition	Weeds
HVOWES20190101	Green	Green	Green	Green
HVOWES20190201	Green	Green	Green	Green
HVOWES20200301	Green	Green	Green	Green
HVOWES20200401	Green	Amber	Amber	Green
HVOWES20200501	Green	Green	Green	Green
HVOWES20210101	Green	Green	Green	Green
HVOWES20210102	Green	Green	Green	Green
HVOWES20210201	Green	Amber	Green	Green
HVOWES20210202	Green	Amber	Green	Green
HVOWES20210203	Green	Green	Green	Green
HVOWES20210301	Green	Green	Green	Green
HVOWES20210302	Green	Green	Green	Green
HVOWES20210303	Green	Green	Green	Green
HVOWIL20210101	Green	Green	Green	Amber
HVOWIL20210102	Green	Green	Green	Green
HVOWIL20210103	Green	Green	Green	Green
HVOCHE20210501	Green	Amber	Green	Green
HVOCHE20210502	Green	Green	Green	Green
HVOCHE20210503	Green	Amber	Green	Green
HVOCHE20210504	Green	Green	Green	Green
HVOCHE20210601	Green	Green	Green	Green
HVOCHE20210602	Green	Green	Green	Green
HVOCHE20210603	Green	Green	Green	Amber
HVOCHE20210604	Green	Green	Green	Amber

Block Code	Erosion Control	Surface Cover	Species Composition	Weeds
HVORIV20190701	Green	Green	Green	Amber
HVORIV20190801	Green	Green	Green	Amber
HVORIV20190802	Green	Green	Green	Green
HVORIV20190803	Green	Green	Green	Green
HVORIV20191101	Green	Green	Green	Green
HVORIV20191102	Green	Green	Green	Green
HVORIV20191103	Green	Green	Green	Green

8.7.2 | LTM PASTURE RESULTS

The LTM pasture rehabilitation blocks exhibited a higher ground cover percentage (81.6%), along with improved pastured composition (averaged 49.0%) and whilst priority weed species ranged from 4.0-35.1% (average 17.1%). These slightly 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 34.5 – 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 RMP TARP triggers is presented in **Table 8-6**.

Table 8-6: Assessment of LTM Pasture Monitoring Blocks against RMP TARP

Block Code	Erosion Control	Surface Cover	Species Composition	Weeds
HVOWES20160302	Green	Green	Green	Green
HVOWES201603	Green	Green	Green	Green
HVOWES201601	Green	Green	Green	Green
HVOWES20160301	Green	Green	Green	Amber
HVOWES20160303	Green	Green	Green	Green
HVOWES20170501	Green	Green	Amber	Amber
HVOWES20170502	Green	Green	Green	Amber

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 with a maximum depth of 10 to 30cm;
- Percentage of bare ground ranged from 0 to 45.5%;
- The total priority weed cover ranged from 6 to 93%;
- Native species richness ranged from 57.1 to 93.2%; and
- Tree stem density ranged from 0 to 1600.

An assessment of IEM non-specific native vegetation rehabilitation blocks against the RMP TARP triggers is presented in **Table 8-7** below.

Table 8-7: Assessment of IEM Non-specific native vegetation Monitoring Blocks against RMP TARP

Block Code	Erosion Control	Surface Cover	Species Composition	Weeds
HVOCAR20210101	Green	Green	Green	Green
HVOCAR20210102	Green	Green	Green	Green
HVOCAR20210103	Green	Green	Green	Green
HVOCHE20210101	Green	Green	Green	Green
HVOCHE20210102	Green	Green	Green	Green
HVOCHE20210103	Green	Green	Green	Green
HVOCHE20210201	Green	Green	Amber	Green
HVOCHE20210202	Amber	Green	Green	Green
HVOCHE20210301	Green	Green	Green	Green
HVOCHE20210302	Green	Green	Green	Green
HVOCHE20210303	Green	Green	Green	Green
HVOCHE20210401	Green	Green	Green	Green
HVOCHE20210402	Green	Green	Green	Amber
HVOCHES20200101	Green	Green	Green	Green
HVOCHES20200102	Green	Green	Green	Green
HVOCHES20200103	Green	Green	Amber	Green
HVOCHES20200201	Green	Green	Green	Green
HVOCHES20200202	Green	Green	Green	Green
HVOCHES20200203	Green	Green	Green	Green
HVORIV20200301	Green	Green	Green	Red
HVORIV20200302	Green	Green	Green	Green
HVORIV20200303	Green	Green	Green	Amber
HVORIV20200304	Green	Green	Green	Green
HVORIV20210101	Green	Green	Green	Red
HVORIV20210102	Green	Green	Green	Red
HVORIV20210103	Green	Green	Green	Red
HVORIV20210301	Green	Green	Green	Green
HVORIV20210302	Green	Green	Amber	Amber
HVORIV20210303	Green	Green	Green	Green
HVOWES20200101	Green	Green	Green	Green
HVOWES20200102	Green	Green	Green	Green
HVOWES20200103	Green	Green	Green	Green

Block Code	Erosion Control	Surface Cover	Species Composition	Weeds
HVOWES20200201	Green	Green	Green	Green
HVOWES20200202	Green	Green	Green	Green
HVOWES20200203	Green	Green	Green	Green
HVOWES20210401	Green	Green	Amber	Green
HVOWES20210402	Green	Green	Amber	Green
HVOWES20210403	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);
- Percent bare ground was low, ranging from 0 to 40%;
- The total priority weed cover ranged from 0.3 to 90.2%;
- Native species richness ranged from 58.3 to 95.5%;
- Tree stem density ranged from 50 to 3325; and
- Canopy cover ranged from 5 to 70%.

An assessment of LTM non-specific native vegetation rehabilitation blocks against the RMP TARP triggers is presented in **Table 8-8** below.

Table 8-8: Assessment of LTM Non-specific native vegetation Monitoring Blocks against RMP TARP

Block Code	Erosion Control	Surface Cover	Species Composition	Weeds	Habitat Corridors
HVOCHE20170401	Green	Green	Green	Green	Red
HVOCHE20170402	Green	Green	Amber	Green	Red
HVOCHE20170403	Green	Green	Green	Green	Red
HVOCHE20180101	Green	Green	Green	Green	Red
HVOCHE20180102	Green	Green	Green	Green	Red
HVOWES19990401	Green	Amber	Green	Amber	Green
HVOWES19990402	Green	Green	Green	Green	Green
HVOWES19990403	Green	Green	Amber	Green	Green
HVOWES19990404	Green	Green	Green	Green	Green
HVOWES19990405	Green	Green	Amber	Red	Amber
HVOWES20020101	Green	Green	Green	Amber	Green
HVOWES20020102	Green	Green	Green	Green	Green
HVOWES20020103	Green	Green	Amber	Red	Green
HVOWES20150201	Green	Green	Green	Green	Amber
HVOWES201602	Green	Green	Green	Green	Amber
HVOWOOP20000101	Green	Green	Green	Red	Amber
HVOWOOP20000102	Green	Green	Amber	Red	Amber
HVOWOOP20000103	Green	Green	Amber	Red	Amber
HVOWOOP20000104	Green	Green	Green	Red	Amber
HVOWOOP20000105	Green	Green	Green	Red	Amber

Figure 8-2: Overview of 2022 Rehabilitation Monitoring Locations

8.8 | OVERVIEW OF REHABILITATION TRAJECTORY

The objective of rehabilitation monitoring is to assess the progression of rehabilitation areas towards relevant criteria and commitments and to facilitate continuous improvements in rehabilitation practices.

In line with the GCAA's Rehabilitation Report Card, performance against key rehabilitation metrics was assessed for each rehabilitation polygon. Each polygon is assigned one of four performance rankings as per the criteria in **Table 8-9**.

Table 8-9: GCAA Rehabilitation Report Card Criteria

Category	Criteria
Rework	• Does not meet completion criteria. • Extensive rework required that would not typically form part of a rehabilitation maintenance program; e.g. slopes do not comply with approval requirements, large bare areas >0.1ha, very severe and widespread erosion, etc. • TARP condition red.
Maintenance	• Does not meet completion criteria. • Routine rehabilitation maintenance works required (e.g. weed control, infill seeding/plantings, repair of minor erosion, fertiliser application). • TARP Condition Amber.
Monitor	• Trending towards completion criteria but does not meet all criteria. • No intervention required other than ongoing routine land management, but continued monitoring required (e.g. ecologically young areas, variable results). • TARP condition Green.
Acceptable	• Rehabilitation objectives and completion criteria are generally met and the area is ready for sign off by regulators. • Routine management and monitoring should be continued to maintain status until relinquishment process is sought. • TARP Condition Green.

A summary of rehabilitation performance as determined through rehabilitation monitoring during 2022 is shown in **Figure 8-3**.

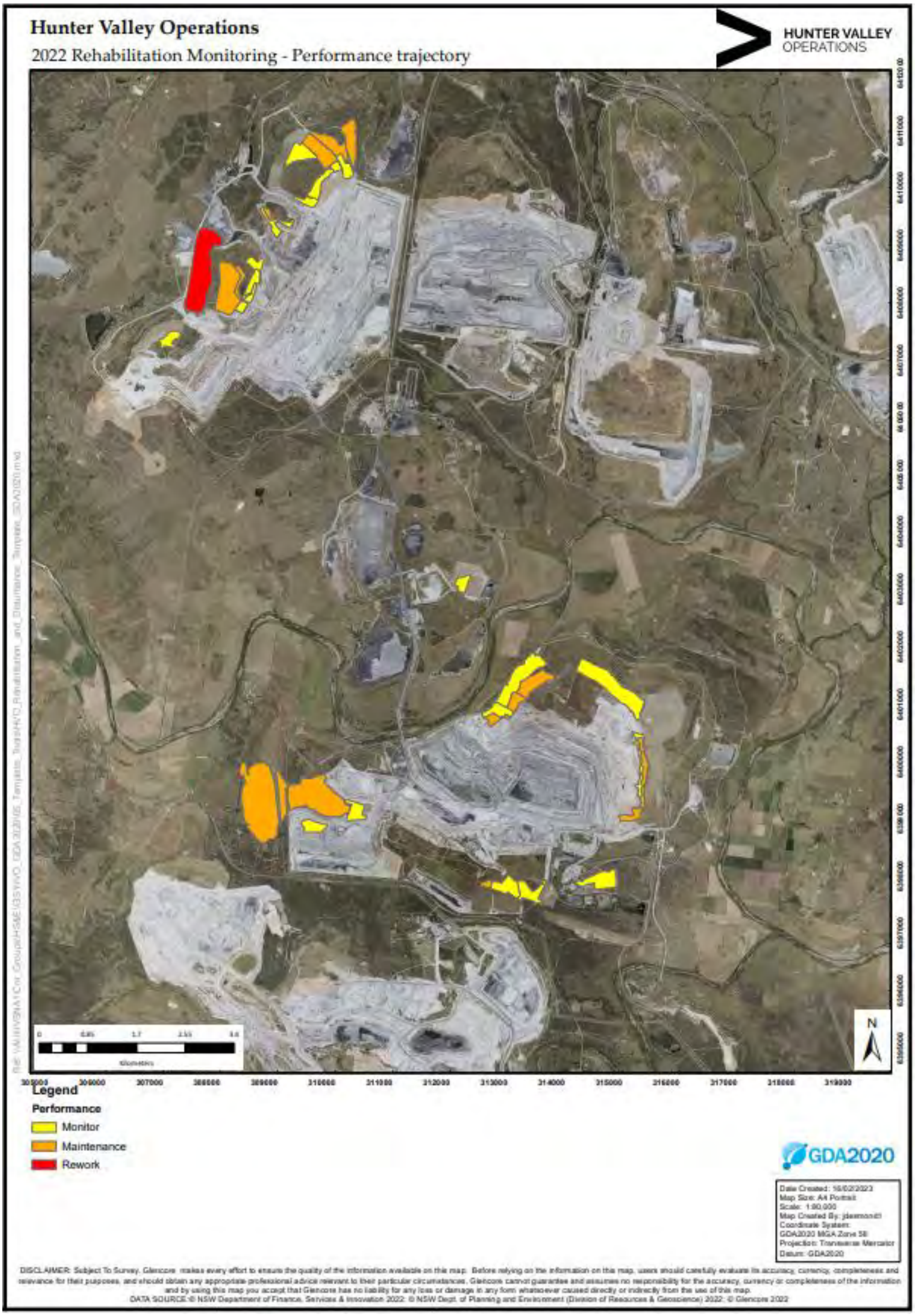

Figure 8-3: Overview of Rehabilitation Monitoring Performance Trajectory

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.

An overview of key rehabilitation maintenance activities is shown in **Figure 8-4** and detailed below.

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 2022 is presented in **Figure 8-4**, 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 2022 rehabilitation blocks totalling 476 ha were boom sprayed, wick wiped, slashed/mulched or spot sprayed. The key weed species targeted in 2022 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 2022 Annual Walkover and Ecological monitoring reports identified some contour failures in historical areas which had mainly stabilised, along with some minor rilling and gullying in newer rehabilitation areas. These have been prioritised and incorporated into HVO's detailed rehabilitation maintenance plan.

In response to S240 notices NTCE 0009902 and NTCE 0009942 covering contour bank failure, tunnelling and gullying on HVO's Western Out of Pit (WOOP) emplacement HVO have conducted the following works. In 2021 HVO engaged ERR to prepare an initial erosion assessment which was submitted to the to the regulator in January 2022. Following this HVO engaged SLR Consulting Australia Pty Ltd to prepare a detailed strategy /design for the remediation of existing erosion on the WOOP Dump. HVO conducted initial repairs to contours 1 and 2 in June 2022. These contours were reformed and reseeded and several gullies backfilled along with the installation of a dissipation dam. The repair works were inspected by the Hunter

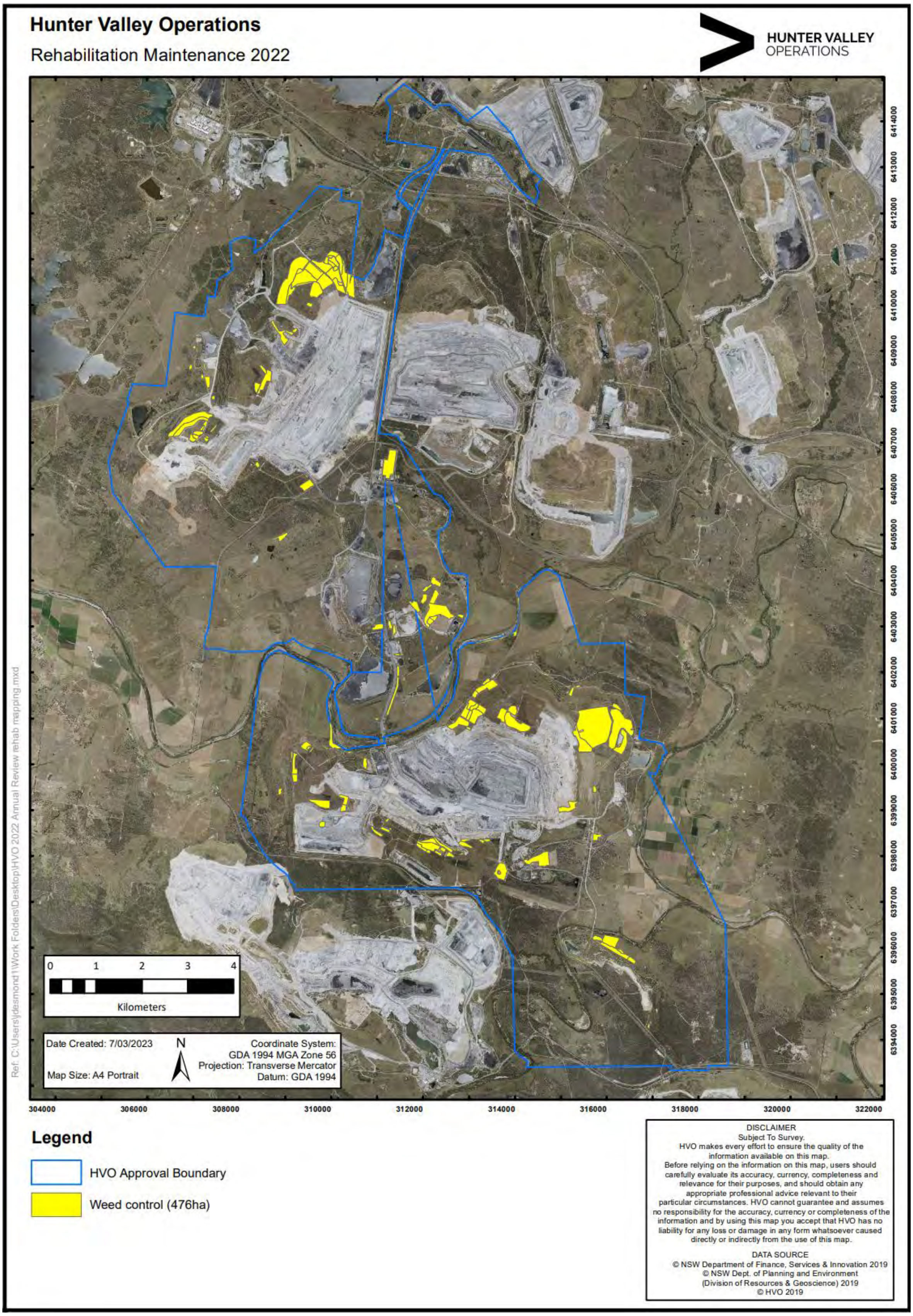

Figure 8-4: *Rehabilitation Maintenance – Post-Rehabilitation Weed Control*

local land Services in July and their feedback resulted in further revisions to the SLR HVO WOOP Dump Remediation Design with further works planned for implementation in 2023. Update reports were submitted to the Regulator in July 2022 and January 2023 as required in the s240 Notices.

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 regular re-seeding and planting of tube-stock 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 2022, erosion repairs were re-seeded and no tube-stock planting occurred.

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 2022, 94 topsoil stockpiles were inspected with follow up works including herbicide spraying and/or re-seeding to improve their long term viability and reduce the spread of weeds onto new rehabilitation areas.

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

Rural Licensee Wild Dog Trapping Program

Between the 1080 ground baiting programs, one of HVO's rural licensees implemented a wild dog control program on Hunter Valley Operations buffer farm properties utilising a professional dog trapper from February to May 2022. During the course of this program 9 wild dogs were controlled.

Pig Trapping and Baiting

Two pig baiting programmes using Sodium Nitrite 'Hoggone' baiting systems were implemented at HVO during winter and spring. The programmes resulted in 32 pigs being controlled across 5 bait stations. An additional 107 pigs were controlled by rural licensees using a combination of pig traps and 'Hoggone' baiting systems on buffer properties over the course of the year. An additional 10 pigs were controlled as part of opportunistic ground based shooting activities. The programs undertaken throughout the year resulted in 149 pigs being controlled.

Ground Based Shooting

HVO has three 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 8-10 summarises the results from the programmes carried out at HVO during 2022 with wild dog and fox baiting locations and results for the programs illustrated in **Figure 8-7** to **Figure 8-9.**

Table 8-10: Summary of Vertebrate Pest Management 2022

	1080 Baiting			Hoggone Baiting	Trapping		Shooting			
	Total Lethal Baits Laid	Takes by Wild Dog	Takes by Fox	Takes by Feral Pig	Wild Dog	Feral Pig	Feral Pig	Wild Dog/ Fox	Feral Cat	Hares & Rabbits
Summer	118	48	7	0	0	0	0	0	0	0
Autumn-Winter	119	48	9	37	9	102	10	0	0	0
Spring	117	39	6	0	0	0	0	0	0	0
Total	**354**	**135**	**22**	**37**	**9**	**102**	**10**	**0**	**0**	**0**

Table 8-11 provides a comparison of results from the last 22 baiting programmes undertaken at HVO. In 2022, as for previous programs undertaken at HVO, the vast majority of baits showed evidence of being consumed by wild dogs at 68% with foxes taking 11%, and 21% 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 increased slightly (49 takes currently compared to 47 in the last program); and by foxes has decreased (6 in the current program compared to 15 in the last). The results 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 decrease 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 and activating ejector baits.

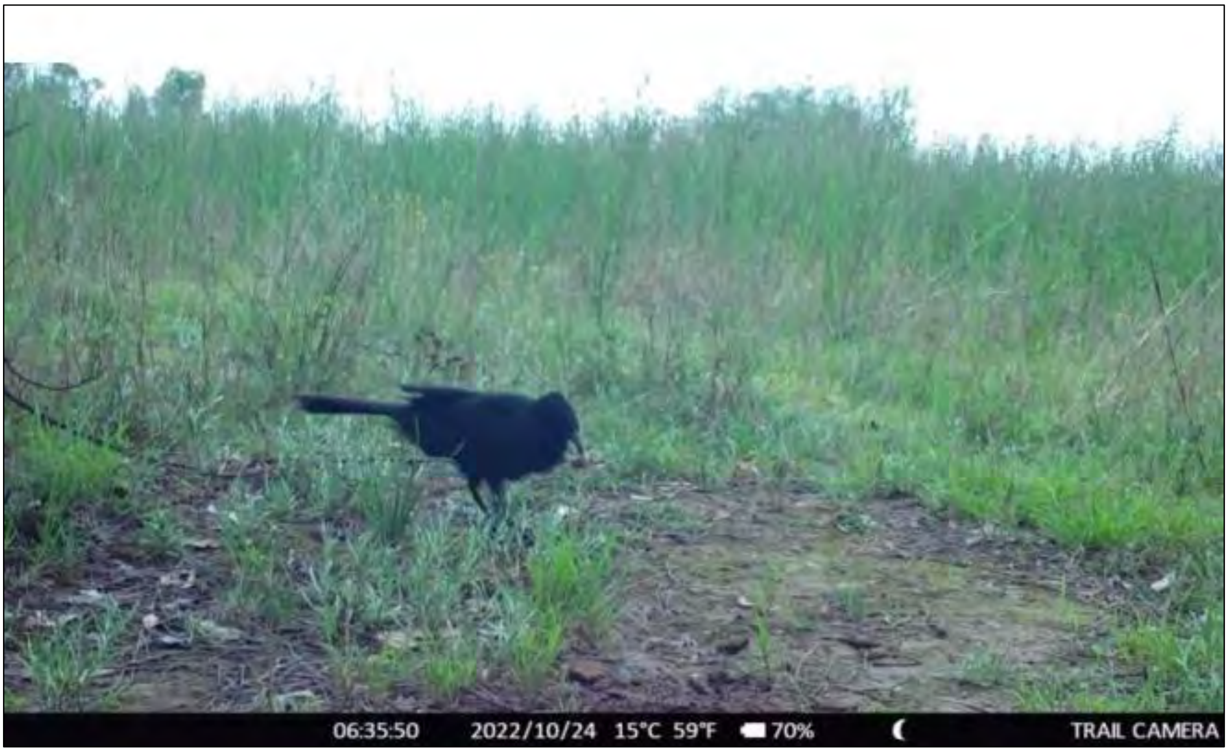

Figure 8-5: White-Winged Chough, Cocorax Melanorhamphos, captured on motion sensor camera pecking at kangaroo meat bait lure at Ejector Bait Site 3 24/10/2022

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, goannas and birds have been photographed investigating bait sites (**Figure 8-5** and **Figure 8-6**). A White-Winged Chough and Lace Monitor were captured on motion sensor camera at Ejector Site 3 within days of each other.

Figure 8-6: A Lace Monitor Captured on Motion Sensor Camera at Ejector Bait Site 3 27/10/2022

Table 8-11: 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%

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
1910 HVO	60	120	66	93%	4	6%	1	1%	71	48	80%	23	12	9	2	59%	58%
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%
2202 HVO	60	118	48	71%	7	10%	14	21%	68	46	77%	22	14	2	4	58%	46%
2205 HVO	60	119	48	74%	9	14%	8	12%	65	45	75%	20	15	2	6	55%	48%
2210 HVO	60	117	49	59%	6	9%	21	32%	66	45	75%	21	15	1	4	56%	38%
												Average Baiting Efficiency				**58%**	**54%**

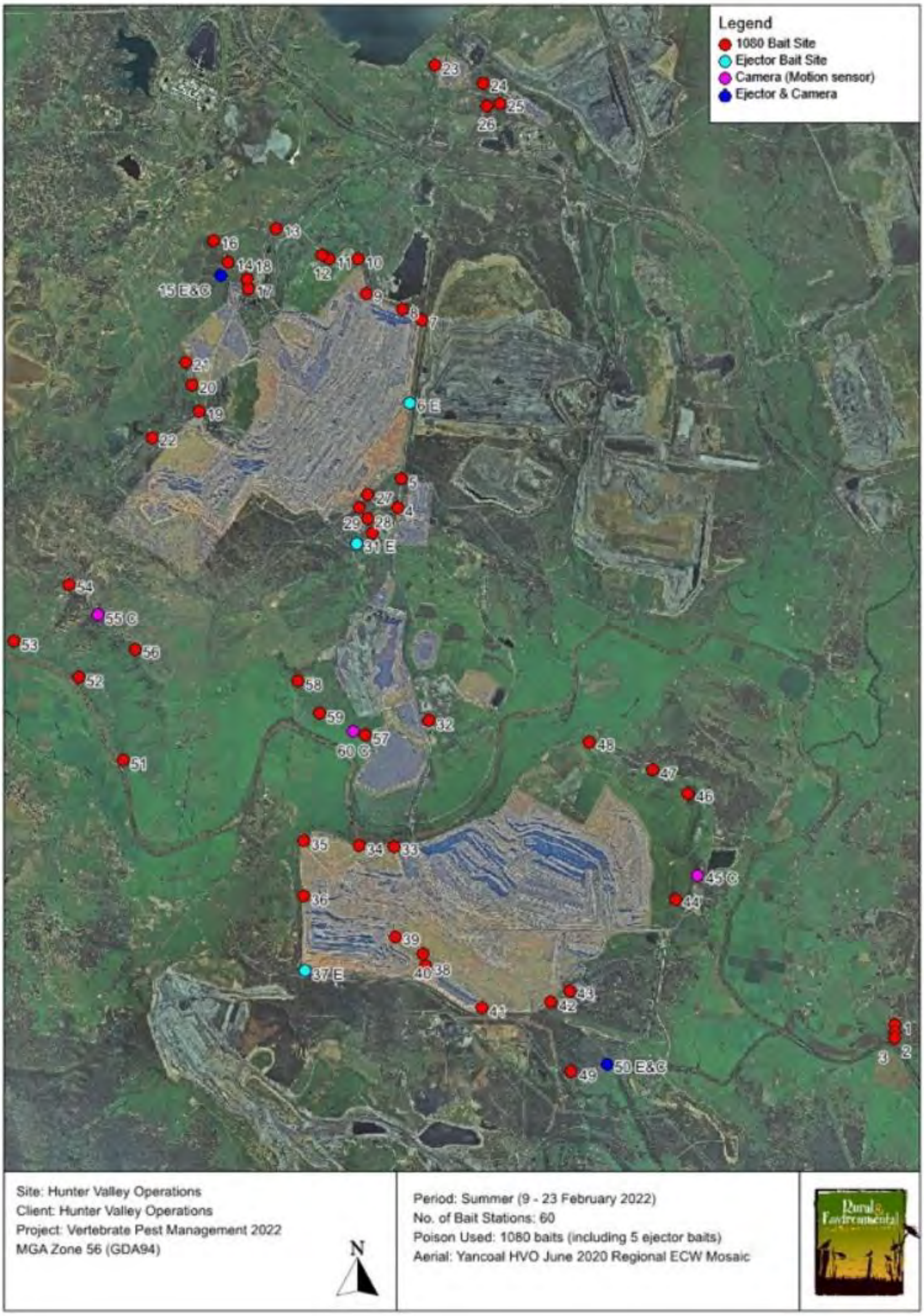

Figure 8-7: HVO Vertebrate Pest Management Bait Locations – Summer 2022

Figure 8-8: HVO Vertebrate Pest Management Bait Location – Autumn – Winter 2022

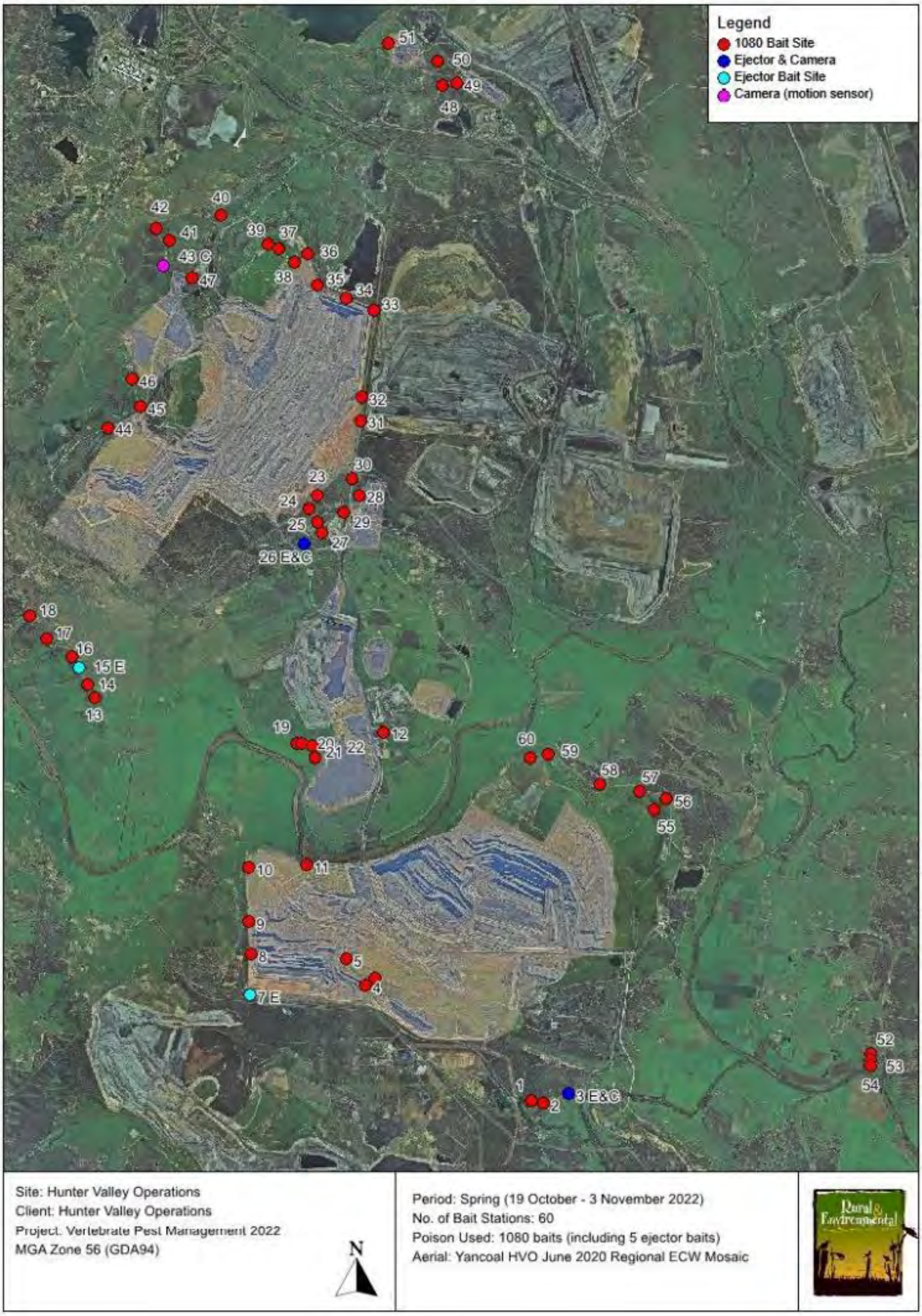

Figure 8-9: HVO Vertebrate Pest Management Bait Locations – Spring 2022

8.11 | RENOVATIONS

No renovations were completed in 2022.

8.11.1 | DERELICT RURAL BUILDINGS

HVO scaled back demolition of derelict rural buildings located within its rural property portfolio in 2022 due to unseasonal wet weather hampering the implementation of non-essential civil works.

8.12 | TAILINGS MANAGEMENT

Key tailings management activities in 2022 included:

- Capping of the Southeast TSF was completed;
- Continued secondary flocculant dosage into Carrington n-Pit TSF 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. This included provision of quarterly and annual analysis reports to the EPA; and
- Design of the first capping stages of Bob's Dump completed.

Table 8-12 below outlines the current state of Tailings Storage Facilities across HVO that are still active or pending decommissioning.

Table 8-12: 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	Pump in place, pumping as required.
Southeast TSF	Inactive - capping complete	Removed, Decant pumps in place, regular pumping.
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 8-10**.

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).

Ecological monitoring occurred in 2022. The locations of the sampling points are shown in **Figure 8-11** to **Figure 8-13**. Flooding within the Reference Site prevented monitoring from occurring and thus the monitoring results discussed below relate only to the HVO sites.

Across 2022, the management activities undertaken within the River Red Gum areas at HVO were restricted due to access issues related to flooding and boggy conditions. Despite this, activities undertaken during the year included tubestock planting of 200 river red gums within the Carrington Billabong, slashing weeds and grasses in the broader Billabong fenced area, weed removal (primarily balloon vine and castor oil plant) from along the Hunter River priority areas, replacement fencing along a priority area on the Wollombi Brook and slashing the floodplain riparian area inside this new fence.

The intent of the tubestock planting programme is to reduce the linear influence of the billabong on the existing mature *E. camaldulensis* (**Figure 8-14**). 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 discrete areas 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 lerps and other such insects, to 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.

Unfortunately, the tubestock planted in 2022 largely failed to establish due to factors such as grazing by herbivores soon after planting, and competition from weeds that arose from the inability to slash the site due to the restricted access. While some individuals still occur, replanting of these areas is occurring early in 2023 with stronger tubestock.

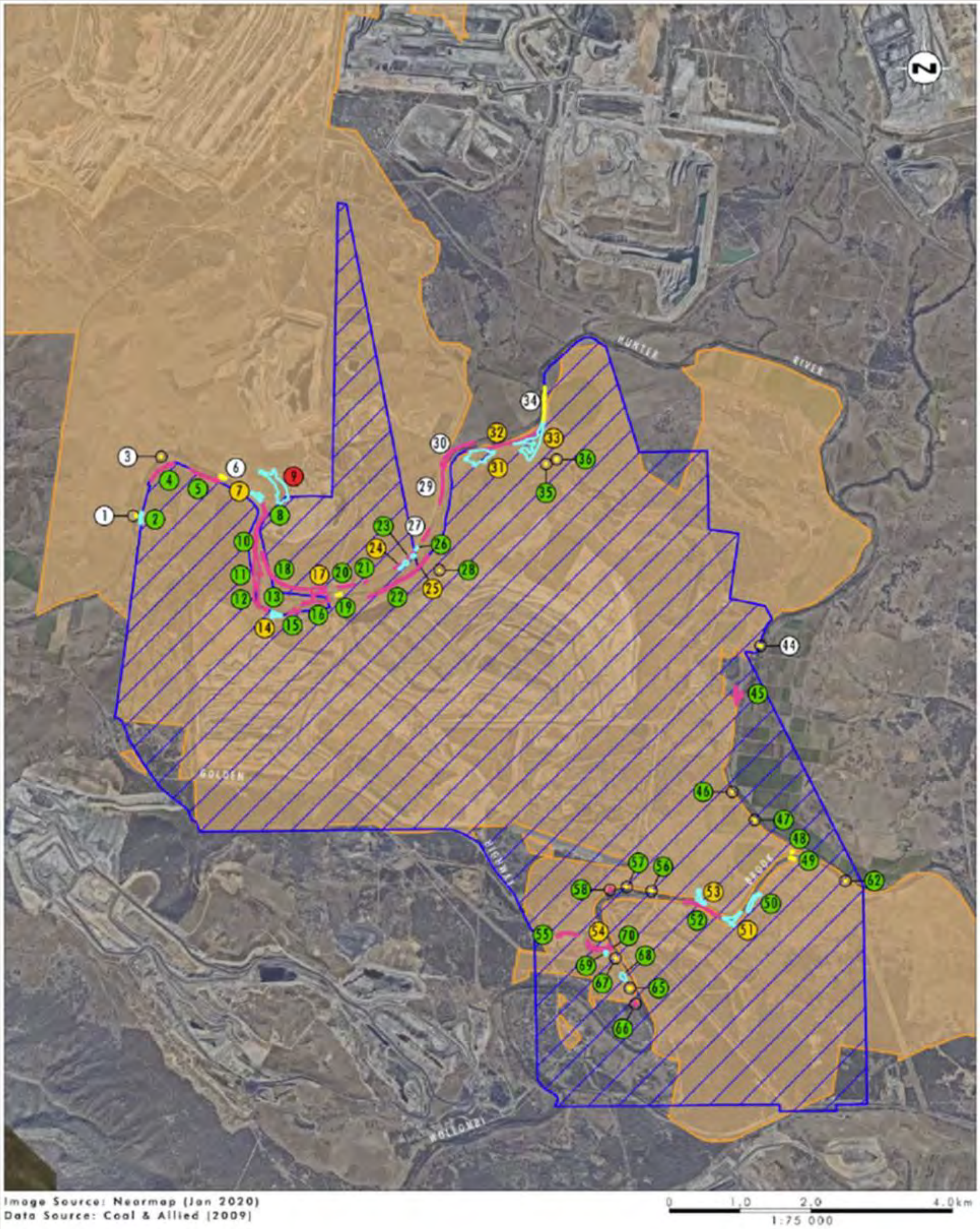

Figure 8-10: Eucalyptus camaldulensis stands being managed at HVO

Figure 8-11: Eucalyptus camaldulensis monitoring sites at Carrington billabong.

Figure 8-12: Eucalyptus camaldulensis priority site monitoring locations

Figure 8-13: Eucalyptus camaldulensis monitoring locations at the Reference Sites

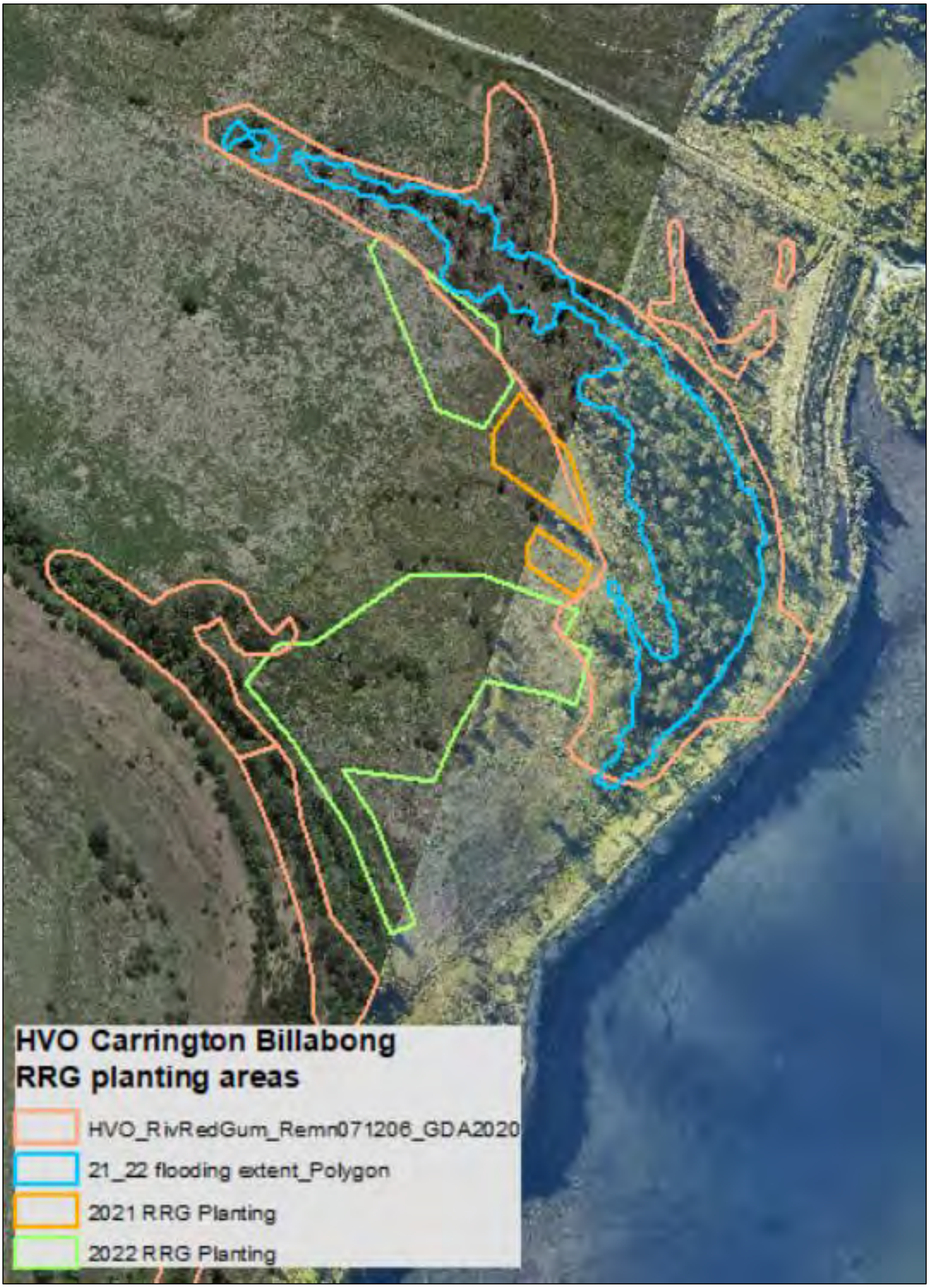

Figure 8-14: Tubestock planting locations of E.camaldulensis and extent of flooding within the Carrington Billabong during 2022

8.13.2 | RRG MONITORING ACTIVITIES

Rainfall and Recruitment

Above average rainfall occurred during 2022, which repeated the La Nina rainfall pattern from 2020 and 2021. The total rainfall for the year at HVO was 1047.2 mm which was 412.2 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 remained persistent through the majority of 2022 (**Figure 8-15**).

The recruitment that has occurred within the Billabong since 2007 can be readily seen in **Figure 8-16**. The image illustrates the canopy growth on a remnant RRG tree between 2007 and 2022. During that period the Billabong has been subject to flooding in 2007 followed by an extended drought, then the La Nina flood during 2021 and the majority of 2022. The flooding events provided the opportunity for recruitment to occur as can be seen within the Billabong in the background.

Figure 8-15: Flood Waters Within the Carrington Billabong 2022

Figure 8-16: Changes in Vegetation Density Over Time at Carrington Billabong Between 2007 (Left) and 2022 (Right)

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Figure 8-17: Flood Waters Within the Carrington Billabong 2022

Figure 8-18: Changes in Vegetation Density Over Time at Carrington Billabong Between 2007 (Left) and 2022 (Right)

Floristic Survey

A full floristic survey was conducted within set quadrats in the Carrington Billabong. Due to extensive flooding of the quadrat locations, the Reference Site was unable to be accessed for monitoring to occur. The 2022 monitoring identified 70 species across all sites comprising 41% native species and 59% exotic species. Within the floristic plots at Carrington Billabong, there was an increase in native species diversity with a slight decrease in weed species diversity in comparison to previous monitoring events (**Table 8-18**).

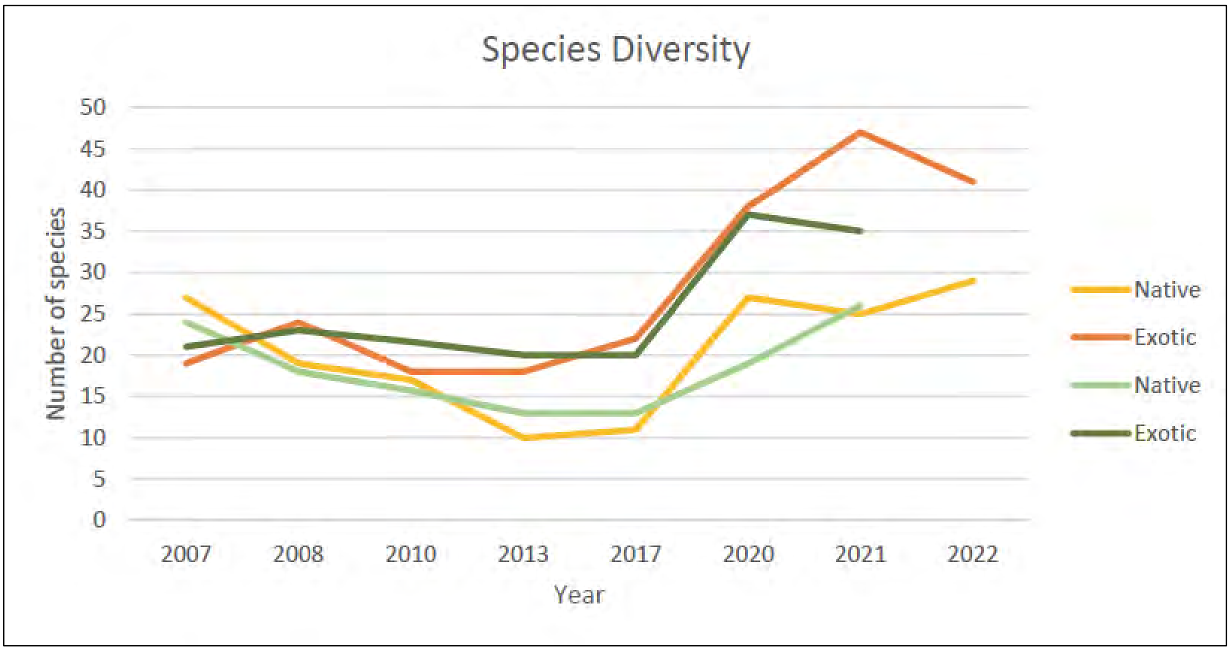

Figure 8-19: Change in Species Diversity Over Time at Carrington Billabong (Orange) and the Reference Site (Green) – Note that the Reference Site (CA) Was Not Sampled in 2022

It is difficult to identify a single management activity that resulted in the increase in diversity when the total rainfall has been above average. High rainfall has resulted in very high biomass in the ground layer. The main management activity for weeds and ground cover vegetation has been slashing prior to seed set within the Billabong and within adjacent open areas. Reducing the ground cover biomass is important to increase the establishment of seedlings. Recently inundated areas will leave exposed earth as water recedes, which will be a productive media for seedling recruitment.

It is expected that as water recedes in Carrington Billabong a new cohort of seedlings will establish. However, high soil moisture and warm weather may also be accompanied by a flush of weeds and colonising flora that may out compete the River Red Gum seedlings.

Weed management has been an ongoing activity within the Carrington Billabong during 2022. A focus for early 2023 will be managing the extent of exotic grasses on the periphery of the flood zones to enable any recruiting seedlings to establish and be identified before further management actions are imposed.

The Eucalyptus camaldulensis tubestock that were planted within the open areas adjacent to the Carrington Billabong in 2021 are growing with great vigour. Continued growth of these trees will provide harbour for small passerines and leaf gleaners that will prey on the insects and their larvae that are devouring the canopies of older remnant eucalypts on site. Most of the planted trees have reached a height above the ground layer providing some certainty that they have overcome potential competition from plants within this stratum.

Remnant Ecological Health Monitoring

The health of adult trees was assessed using a representative sampling method using thirteen attributes to score and monitor the overall condition of each tree. At Carrington Billabong, the health of 63 adult river red gum trees were assessed across the site from the original 140 trees that were tagged in 2007. These trees had retained tags from previous monitoring enabling comparison with prior datasets.

The results of the ecological health assessment are presented in Table 8-13. 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.

Tree health at Carrington Billabong is generally in good condition with 49.2% of trees given a ‘healthy’ score. A general increase in condition at Carrington Billabong (particularly healthy trees) from 2021 to 2022 was observed.

Trees given the “near dead” condition score went up by 7.8%. Many of the trees assessed as “near dead” or with a canopy with low cover had a high level of insect attack. While there were no signs or insects or their larvae during the survey, new growth and increased water availability is likely to have resulted in an ideal food supply for invertebrates. The warmer months may provide suitable conditions for the eucalypts to reshoot, and it is possible that there will be a flush of epicormic growth in these trees over this period.

While there was an increase in overall condition, canopy density generally increased or remained stable. Of the trees monitored, 22% of trees recorded a reduced overall condition, and 14% of trees scored a reduced canopy density.

The increased canopy density, new growth, and improvement in overall condition in trees and seedlings seems to be clearly linked to the increased rainfall and flooding of Carrington Billabong, Hunter River and its tributaries.

Table 8-13: 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	2022
CB1	21	25	27	24	28	28 (26)	27	30
CB2						28 (26)	28	27
CB3						31 (29)	28	NA
CB4						30 (28)	26	NA
CB5						27 (26)	25	28
HR1	25	21	25	26	26	27	25	26
HR2	32	32	28	25	25	25 (23)	25	29
HR8	23	23	2	25	24	28 (26)	24	25
HR11	26	28	25	25	26	26 (24)	27	25
HR13	24	26	26	24	24	26 (24)	22	27
WB1	28	28	27	29	26	29 (27)	25	31
CA1	29	27		31	31	31	32	NA
CA2	26	25		26	28	30	32	NA
CA3						30	31	NA
CA4						30	29	NA
CA5						30	33	NA

* 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 2021 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 8-14** below.

Table 8-14: Observations That Relate to the Monitoring Objectives Outlined in the Strategy

Goals	Objectives	2022 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. The previous 10 years of data suggests that active management and restoration should continue in order to "suppress and eradicate" this threat. The growth of planted RRG in cleared areas adjacent Carrington Billabong was noted in 2022. It is hoped that, while these trees may protect the remnant trees from climatic factors, that they may also provide habitat for birds and other species that may prey in the invertebrates that consume the eucalypt leaves.
	To improve the conditions within this population such that it can withstand reasonable periods of stress, predation and shortage of water supply	Flooding is required for germination of RRG. At the time of the monitoring a major flooding event occurred in March 2022, and excessive rainfall is likely to be the cause of isolated/patchy areas of inundation. Average tree health and canopy condition data showed an increase in health for 2022 within Carrington Billabong. Planted eucalypts (discussed above) also play a role in protecting the remnant from climatic and biotic threats.
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. Refer to **Table 8-17**.

Goals	Objectives	2022 Observations
	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 2022 to buffer the Billabong from wind events, and encourage bird diversity, over time. These plantings largely failed and will be repeated in early 2023.
Increase the understanding of the water requirements of the River Red Gums	Develop an understanding of water requirements through the timely monitoring of responses of River Red Gums to flood and storm events	The Strategy requires additional monitoring to be undertaken when triggered by flooding. As the flooding occurred following the 2021 monitoring event, and was still inundated during early 2022, the additional monitoring was not required in 2021 The volume of rain and persistence of flood waters, and the apparent response of remnant trees to these factors, provides some insight into the triggers required to see an improvement in overall tree health. Groundwater monitoring is undertaken at 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 has increased slightly at Carrington Billabong from 2021 to 2022. Recruitment is evident at Carrington Billabong but no (likely) recent

Goals	Objectives	2022 Observations
	To support the establishment of a self-sustaining, functional and viable ecosystem	recruitment of the canopy was noted. Remnant Ecological Health Assessments generally improved at Carrington Billabong and the Priority Sites.
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	Tubestock plantings that occurred in 2021 and 2022 will increase the habitat area and local linkages once the tubestock become established and develop with time. The trees are too small to provide effective habitat for small fauna. Further tubestock plantings are planned for 2023.
To determine if there is any improvement or deterioration in RRG within Carrington Billabong	Data shows a slight improvement in RRG condition. Average canopy health increased from 2.4 in 2017 to 3.8 in 2020, declined slightly to 3.5 in 2021, and have increased to 3.8 in 2022.	
To determine if there is any improvement or deterioration of the natural habitat at Carrington Billabong	Data shows a slight improvement in the overall 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 and reduce ground cover biomass. • Record the extent and duration of flood events within Carrington Billabong to identify potential areas for recruitment events/actions. • Plant additional canopy and midstorey species in open areas.	

8.13.3 | ECOLOGICAL RISK ASSESSMENT

As noted in **Section 7.5**, 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; and

- 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 2022 monitoring relative to these ERA trigger values is presented in **Table 8-15**.

Table 8-15: 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 - 2022
Groundwater quality indicates an increase in seepage from NV TSF	Five bores (CFW55R, CGW54a, GW-125, GW- 126, GW-129) showed water levels trending above the trigger values during the Q3 reporting period. Examination of these levels indicated a clear gradient from the Hunter River to the northeast. Water quality results show a decline in sulphate and EC with the rise in water levels, indicating the source is from rainfall/streamflow and not related to mine activities. Seepage from NV TSF was not identified as the source of these exceedances and, therefore, additional ecological monitoring is not triggered.
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 2021 data for the same 63 RRG trees. Most trees had a stable canopy cover or improved canopy cover. 22% of trees recorded a reduced overall condition, and 14% scored a reduced canopy density. The leaf die off assessment recorded most trees with no evidence of leaf loss. Herbivory was noted on some trees which resulted in a poor canopy health score and severe insect attack score. This is not dieback.
Adult tree death of 10% compared to the previous year	One tree has died since monitoring in 2021.
Remnant ecological health scores decline of 10% compared to the previous year	Remnant ecological health scores were slightly higher or similar in 2022 compared to 2021 scores for Carrington Billabong and the Priority Sites.
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)	A rapid decline has not been observed in the ecological health or function of the RRG population.

8.13.4 | MANAGEMENT ACTIONS

Weed Management

A targeted campaign to reduce the weed population along the Hunter River occurred in 2022, specifically within and adjacent to the Carrington Billabong, HR11 and HR13, and other priority areas along the Hunter River (**Figure 8-10**).

The weeds commonly found within these riparian areas include castor oil (Ricinus communis), balloon vine (Cardiospermum grandiflorum), boxthorn (*Lycium ferocissimum*) and green cestrum (*Cestrum parqui*) (**Figure 8-20**). The extensive floods that occurred reduced the extent of the standing exotic vegetation in many areas and the intention was to spray the germinating weeds that took advantage of the reduced competition. Managing the riparian vegetation along the Hunter River will reduce the weedy recruitment that is likely to occur within the stands of *E.camaldulensis* that occur within HVO lands along the river. While this is likely to be a never ending task while the river continues to flood, the benefits will be realised with the return to typical climatic conditions when native species can become established in sufficient densities that, hopefully, outcompete the germinating weeds.

Within the Billabong, HVO has been concentrating efforts on regular slashing the open areas and the adjacent grazing paddock to reduce the possibility for weeds to establish and reseed. Previously, the density of exotic weeds smothered the shorter native species in the area. While it was not possible to slash the Billabong area as frequently as we would have liked due to the risk of getting bogged, slashing did occur and the weeds did not obtain the height observed in previous years.

In addition, the creek line leading to the Billabong was brushcut around the existing RRGs to reduce the weed seed load originating from this feature. This concentrated effort has worked well with the exotic diversity within the Billabong recorded during the monitoring showing a decline in 2022 (**Table 8-13**).

The priority sites shown in **Figure 8-12** were also sprayed and/or slashed during 2022 along with extended areas of the Hunter River immediately adjacent to the priority RRG stands.

Previous reporting proposed that the dense stands of African olive that occurs in areas along the Hunter River would be mulched during 2022. Access to these areas was largely prevented by the height of the river for much of the year and the boggy conditions that prevailed once the levels had decreased. A focussed attention will be given to these areas when suitable access is possible.

Figure 8-20: Post Spraying of Weeds Within a Priority RRG Location at HVO

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 8-14). These tubestock were supplemented with 30 *Bursaria spinosa* planted in groups of five across the area as bird habitat 'islands'.

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 2022, 100 *E.camaldulensis* tubestock and 100 tubes of a mix of *Bursaria spinosa*, *Melaeuca decora* and *Callistemon citrinus* 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. Unfortunately, despite supplementary watering and hand weeding as needed during 2022 to assist survival and establishment, a clear majority of these tubestock failed at both HVO and the Reference site and will need to be repeated.

Additional plantings are planned to occur in 2024 in both the Billabong and the Reference Site and site preparation for this activity will occur in 2023.

Condition Assessments

To comply with the management actions outlined in the Strategy, environmental monitoring and a condition assessment was undertaken across the RRG sites at HVO. While the environmental monitoring has been discussed above, the condition assessment documented any identifying features indicating the presence of feral animals, erosion, presence of insect or fungus dieback, the condition of fences and summarised weeds present at each site. The results outlined the priority weeds at each site, summarised any bank erosion resulting from the flood events in 2022, stated what feral animal control was required if any, and did not identify any insect or fungus issues as occurring at each of the RRG sites. The findings and recommendations for each RRG location will be actioned across 2023.

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 2023 to facilitate improved habitat for the passive regeneration of the RRG populations.

Vertebrate Pest Control

As part of HVO's Vertebrate Pest Action Plan, programs 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. Feral pig control was undertaken in the Billabong and other RRG sites as a result of pig activity being observed. Further detail on vertebrate pest control undertaken in 2022 is included in **Section 8.10**.

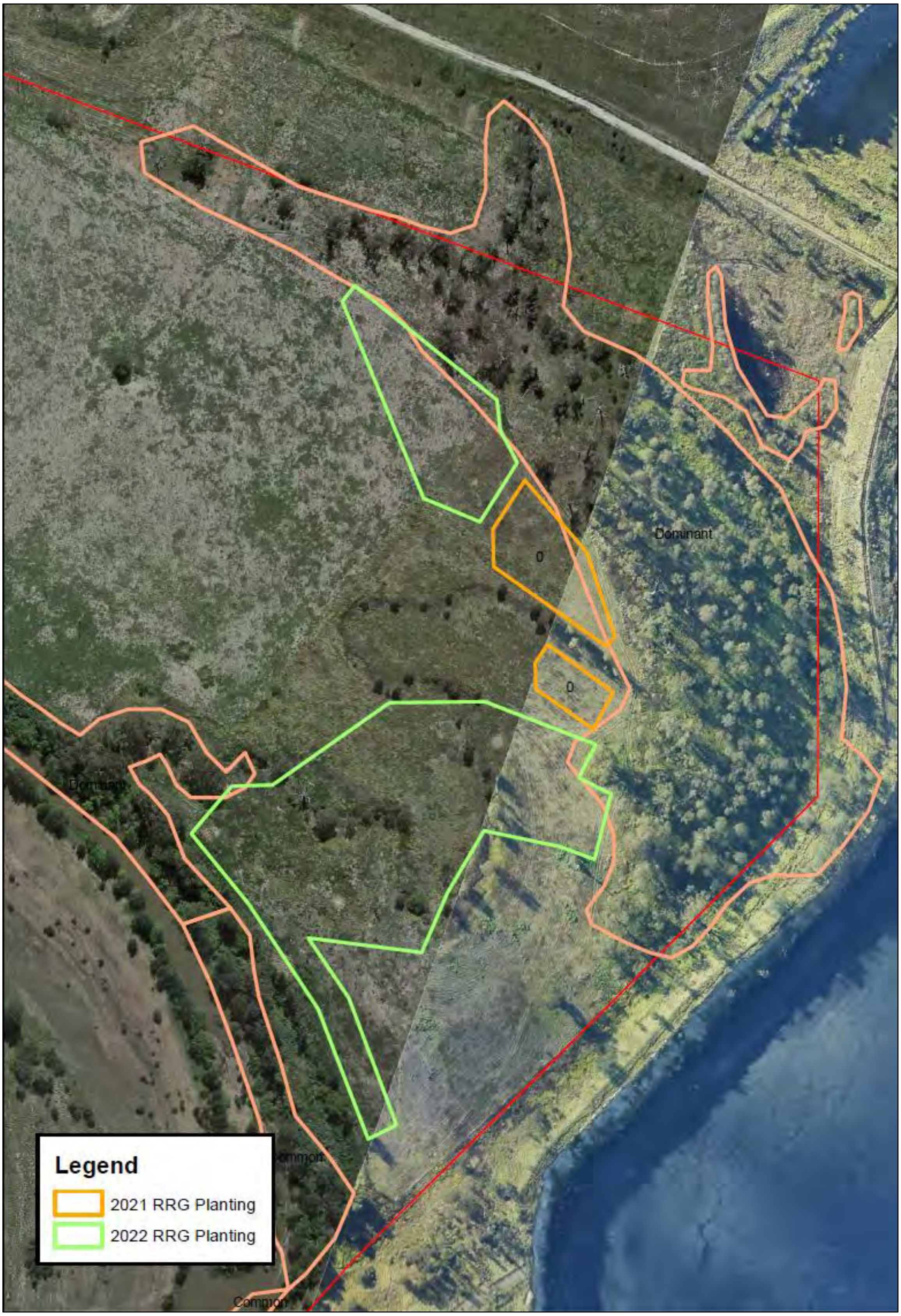

Figure 8-21: Location of 2022 Tubestock Plantings at the Carrington Billabong

8.13.5 | RIVER RED GUM CONDITION SUMMARY

Overall, the comparison of the monitoring data between 2022 and previous events have indicated that, weed management at each site needs to continue. With La Nina providing increased rainfall and flooding in areas, weed germination and seed dispersion will require management to ensure that recruitment at each of the RRG sites is not impended.

The condition assessments determined that the Billabong and the Priority Sites at HVO responded favourably to the improved environmental conditions. Despite the average canopy health in the Billabong increasing since 2017, additional works to encourage further improvement is required, particularly with some of the mature trees having being impacted by insects. During 2023, management activities will focus on the removal of kikuyu from the base of the RRG trees in the Billabong and focus on increasing the native component of the understorey within these communities.

The control of feral pests and weeds within areas managed for the RRGs at HVO will continue and efforts to enlarge and protect the stands of RRGs both at HVO and within the reference site will be planned during 2023.

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 8-23**). The Goulburn River BA is managed according to the Goulburn River Management Plan that is available on the HVO website.

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 2022 (**Figure 8-22**). In this period, the Merriwa (Roscommon gauge) received 862.8 mm, which is well above the mean average rainfall for the area (600 mm). Exceedances of the mean rainfall were typical of records occurring across the Hunter Valley during 2022.

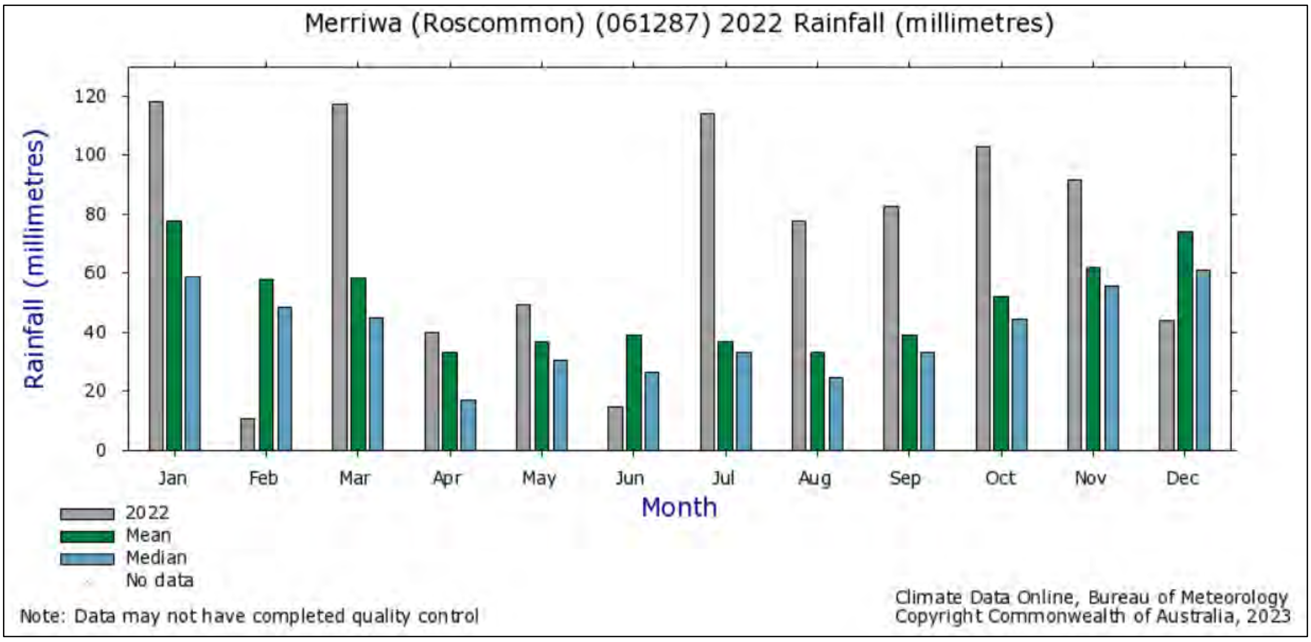

Figure 8-22: Rainfall records recorded at the Merriwa (Roscommon Gauge) - 2022

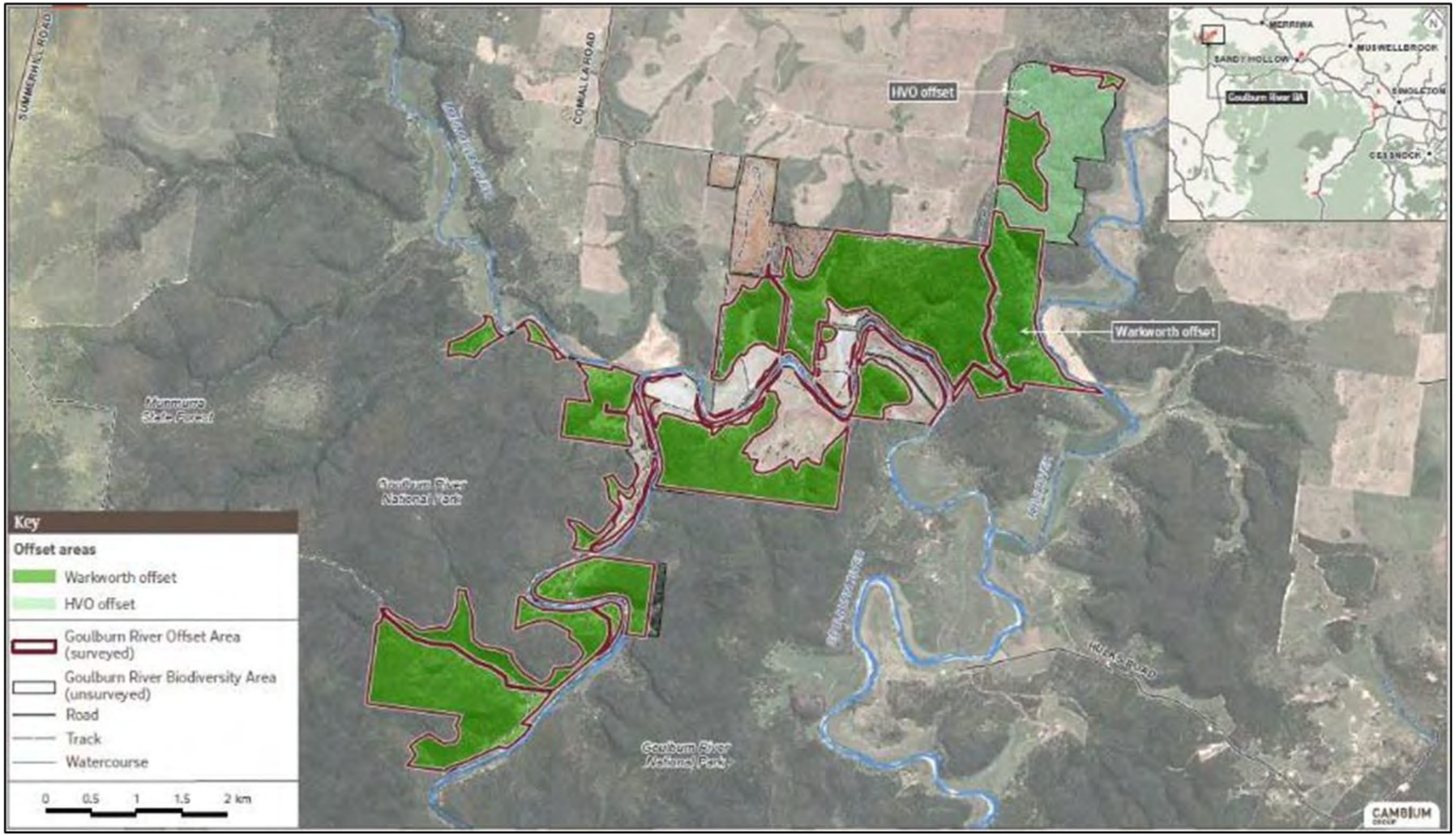

Figure 8-23: HVO's Goulbourn River Offset and adjoining Warkworth Mine Offset

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 and 2022, 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 an alternative access via an upgrade to a walk trail was installed. **Figure 8-24** indicates the two alternate locations to access the HVO offset. The previous access across the Goulburn River (yellow track) and the upgraded track (red track) that was constructed in February/March 2022.

A summary of the key actions in the offset management plan is outlined in **Table 8-16** below.

Table 8-16: Biodiversity Area Management Activities 2022

Activity	Description
Weed Control	No access obtained to undertake this activity.
Habitat Monitoring	Undertaken in accordance with the management plan.
Bird Assemblage Monitoring	Bird assemblage monitoring was completed.
Infrastructure Management and Improvement	Track upgraded to enable access to the HVO offset to avoid the river crossing.
Vertebrate Pest Management	Autumn/Winter and the Spring vertebrate pest management programmes undertaken. Night shooting/cat trapping occurred in October. Pig baiting occurred late November/early December.

Figure 8-24: Access locations from the MTW offset to HVO's Goulbourn River Offset

Habitat Monitoring

In September 2022, habitat monitoring assessed the condition of the native vegetation and determined whether the conservation objectives of the management plan were being met.

- The key conservation outcomes include:
- enhanced landscape connectivity within the surrounding landscape,
- improved fauna movement and flora dispersal opportunities within the surrounding landscape,
- increase in the total area of suitable habitats for threatened fauna species within protected reserves, specifically Regent Honeyeater and Swift Parrot, and

- contribute to and enhance the existing network of protected vegetation within the Hunter Valley.

To assess these outcomes, the key performance indicators and completion criteria are outlined in **Table 8-17** below.

Table 8-17: Habitat KPI and Completion Criteria for Goulburn River Biodiversity Area

Key Performance Indicators	Completion Criteria
Habitat improved condition over 10 years	Observed trajectory towards and/or attainment of benchmark values over 10 years measured biennially
Bird usage over 10 years	Observed richness or maintained species richness and usage by woodland birds over 10 years measured biennially

There are two management zones within the BA: called Management Zone MZ4 and MZ5.

Data recorded within both management zones showed the vegetation to be in good condition with many values achieving or exceeding the Benchmark range. Species richness was well above the Benchmark minimum for all plots and diversity was spread across all strata.

Within the two MZ5 plots, of note were the lack of native vegetation cover across the mid-storey and the lower scores for fallen logs and tree hollows. The data for MZ4 plots found the native overstorey cover and the number of hollows were both below Benchmark. These will be examined further prior to intervention.

Weed levels were generally very low throughout the Goulburn River BA. Most exotic species recorded were annual species that generally do not pose a threat to biodiversity. Common Prickly pear, *Opuntia stricta*, was recorded in one plot and is likely to occur at low density through the offset. Fireweed, *Senecio madagascariensis*, was also recorded. Although considered a priority weed, it does not threaten native biodiversity in native woodland areas with good diversity.

It was concluded that, on the whole, the remnant woodland vegetation was stable and should continue to recover from past disturbance with limited management intervention. Weed control targeting priority weds should continue and feral animal control, specifically feral pigs, should be undertaken. Canopy regeneration in management zone MZ4 should be monitored closely and management actions implemented if necessary.

Bird Assemblage Monitoring

A bird monitoring event was undertaken in October 2022 to determine the usage of the HVO biodiversity area by two priority species: the critically endangered regent honeyeater *Athochaera phrygia* and swift parrot *Lathamus discolour*. The monitoring also aimed to assess bird usage of the biodiversity area in general, with a particular focus on other threatened woodland birds, and to determine if management of the area is leading to an increase in woodland bird abundance and species richness over time.

No regent honeyeaters or swift parrots were detected occupying the biodiversity area during the survey. The summary of bird species richness and abundance during the monitoring event are presented in **Table 8-18.** Relative to 2020 data, bird species richness increased at all three monitoring sites surveyed in that year. Wet conditions in 2021-2022 may have impacted woodland bird abundance and species richness as blossom abundance within the biodiversity area was limited.

Five other threatened species were detected during surveys: wedge-tailed eagle (*Aquila audax*), speckled warbler (*Pyrrholaemus sagittatus*), varied sittella (*Daphoenositta chrysoptera*), dusky woodswallow (*Artamus cyanopterus*) and brown treecreeper (*Climacteris picumnus*).

Mean species richness and bird abundance increased in 2022 at all three sites that were surveyed in 2020, apart from woodland bird species richness at HVOGR2. Overall species richness also increased in 2022 relative to 2020.

Within monitoring sites, the increases in species richness (both total and only for woodland birds) were statistically significant at HVOGR1 relative to 2020 levels. Total and woodland bird abundance increased significantly at all sites surveyed in 2020. Increases were particularly large at HVOGR3 due to white box blossom attracting good numbers of nectarivores, as well as extraordinarily large numbers of migrating striated pardalotes (*Pardalotus striatus*).

The consultant reported that blossom abundance across the biodiversity area was generally low in winter/spring 2022. The wet weather may mean regent honeyeaters and swift parrots are occupying different habitats to where they typically occupy. Preliminary data from the National Regent Honeyeater Monitoring Program suggests regent honeyeaters are also not occupying other traditional breeding sites such as the Capertee Valley this spring.

The report stated that management of the biodiversity area is generally excellent. Continuation of feral pig management is recommended as there were widespread signs of pig presence within the property, although severe wet weather has made pig management a challenge in recent years. Understorey and midstorey vegetation are extensive and in good condition, which is reflected in the numbers of small woodland birds detected on site. A noisy miner cull could be considered on the eastern boundary of the property.

Table 8-18: Mean Bird Abundance and Species Richness Metrics at Goulburn River Biodiversity Area Monitoring Sites in 2020 and 2022

Site	Total Bird Species Richness		Woodland Bird Species Richness		Total Bird Abundance		Woodland Bird Abundance	
	2020	2022	2020	2022	2020	2022	2020	2022
HVOGR1	9.7	20	8.7	18	16.3	39.3	14.7	36.7
HVOGR2	14.7	15.3	14.3	13.3	21.7	29.7	20.7	26.7
HVOGR3	17.3	19.7	13.7	19	32.3	84.7	32	84
HVOGR4	n/a	9.7	n/a	9.3	n/a	17.7	n/a	17.3

Property Inspections and Rapid Condition Assessment

Due to the restricted access associated with elevated rainfall, not all the property inspections could be undertaken during 2022 as planned. For those that were undertaken, native regeneration was reported to be abundant across all areas. Native fauna species were active and observed. Feral pig activity was noted, no waste or illegal activity was observed to have occurred. Fences were recorded as being in fair condition with no repairs required at this time.

Due to the extensive vegetation growth, fuel loads were high and, as a result, routine track and fire break slashing occurred. The quadrat assessments averaged 100% groundcover which exceeded the >70% groundcover requirements in the management plan. In addition, the sward height averaged 40.9cm which also exceeded the management plan requirements of 10cm.

Feral Animal Control

Wild Dogs and Foxes

HVO undertakes vertebrate pest management activities within the offset properties that it manages. The aim of the vertebrate pest management programme is to target wild dogs and foxes that have been reported in and around the BA. The programme involves 1080 ground baiting and ejector baiting in conjunction with the Hunter Local Land Services (HLLS), National Parks and Wildlife Services (NPWS) and local landholders. The Autumn/Winter and the Spring programmes were the 14th and 15th respective programmes to have occurred at the Goulburn River BA.

During each programme, nine bait stations were established along with monitoring cameras to record the effectiveness of the stations.

During the Autumn/Winter programme, 13 takes were recorded within the HVO BA from the nine bait stations. Four were wild dogs, two from foxes and seven by feral pigs.

Comparing the Autumn/Winter results with previous years saw a decrease in baiting efficiency for both target and non-target species. The decrease in target species can be attributed to the exceptionally wet weather experienced over the previous six months and the cooler temperatures affecting foraging patterns of both predators and prey alike.

Within the spring programme, 93% of baits were taken at least once (across both HVO and MTW). Evidence indicated that 37% of baits were consumed by wild dogs, 15% by foxes and 41% were consumed by other species, including feral pigs and lace monitors. Research shows that the concentration in the meat baits is not of sufficient strength to adversely impact native fauna given their natural resistance to 1080.

The baiting efficiency for the Spring programme (81%) was consistent with previous programmes at the same time of year (70% and 82%) with a slight decline in non-target species takes.

Noisy Miners

Overabundant populations of the Noisy Miner (Manorina melanocephala) have been identified as having an impact on threatened and endangered birds, such as the Regent Honeyeater. In 2022, Yancoal obtained a permit under the Biodiversity Conservation Act 2016 to engage a contract shooter to reduce the population of Noisy Miners within the Goulburn River BA.

The shooting occurred over seven days in August 2022 across both the HVO and MTW portions of the Goulburn River BA. No Regent Honeyeaters were sighted during the programme. Within the HVO portion, the control events focused on the boundary with the adjacent farmland.

Within the areas containing noisy miners, significant numbers were present with no gaps in territories, and high numbers of bird groups holding, patrolling and calling within well-defined areas. The programme resulted in 230 noisy miners being removed from the programme boundaries within the HVO and MTW biodiversity areas.

Pigs

In November to December 2022, a 1080 pig bating programme was undertaken following a free-feed period. Eleven free-feed stations were monitored across both HVO and MTW biodiversity areas to determine the best places to install the 1080 bait station. A total of 72 feral pigs were observed interacting at the free-feed locations. Two 1080 bait stations were established within the HVO BA (**Figure 8-25**). During baiting, 66 feral pigs were observed during the effective period of baiting across both BAs. Post-baiting, six of the identified pigs returned with an additional previously unidentified seven feral pigs.

Other feral animals observed by the camera monitors included two foxes and four rabbits. No wild dogs were recorded which may explain why the large numbers of pigs were noted within the biodiversity area.

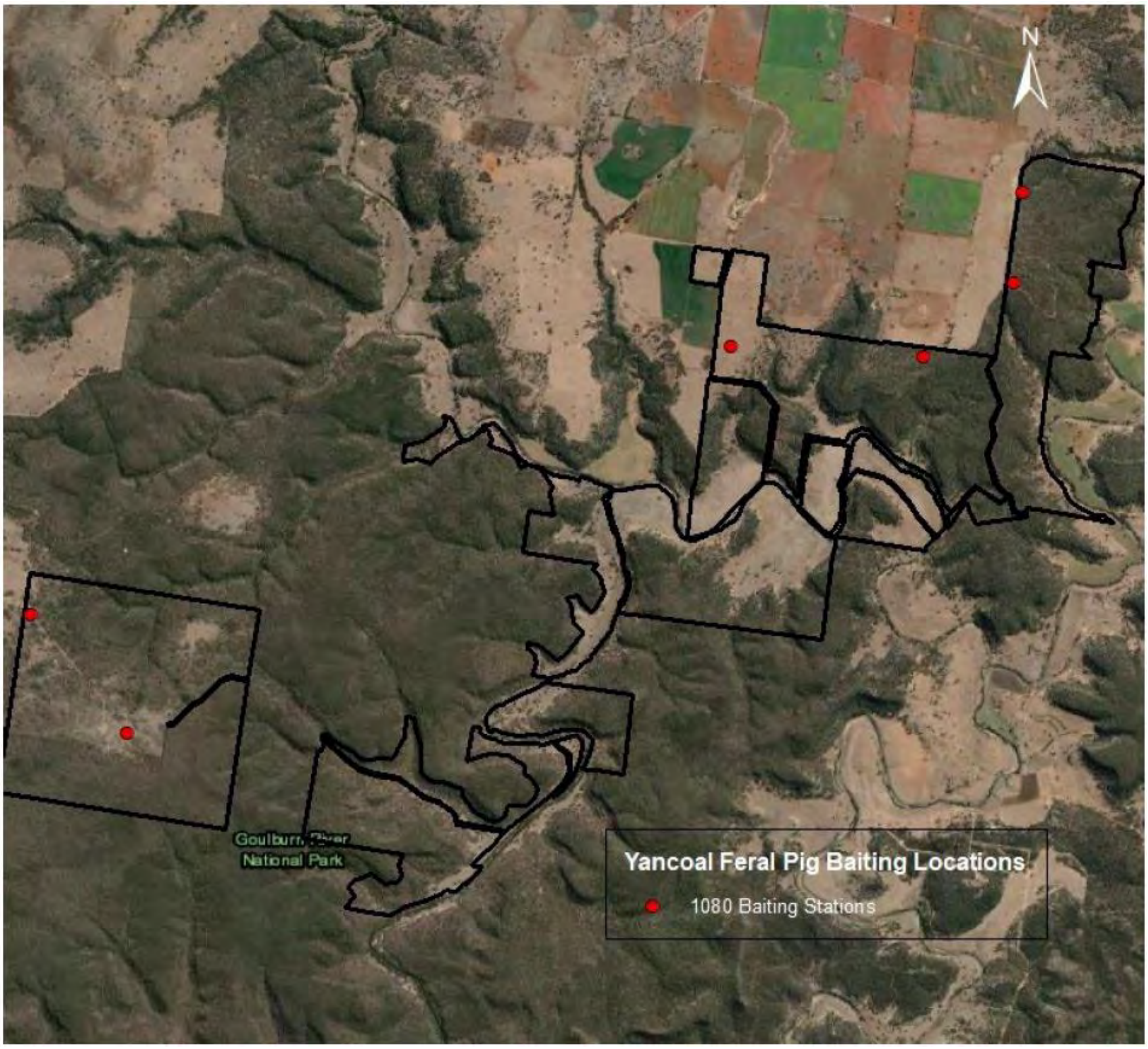

Figure 8-25: 2022 Feral Pig Baiting Locations at HVO's Goulburn River Offset. The HVO BA are the two stations to the North-East

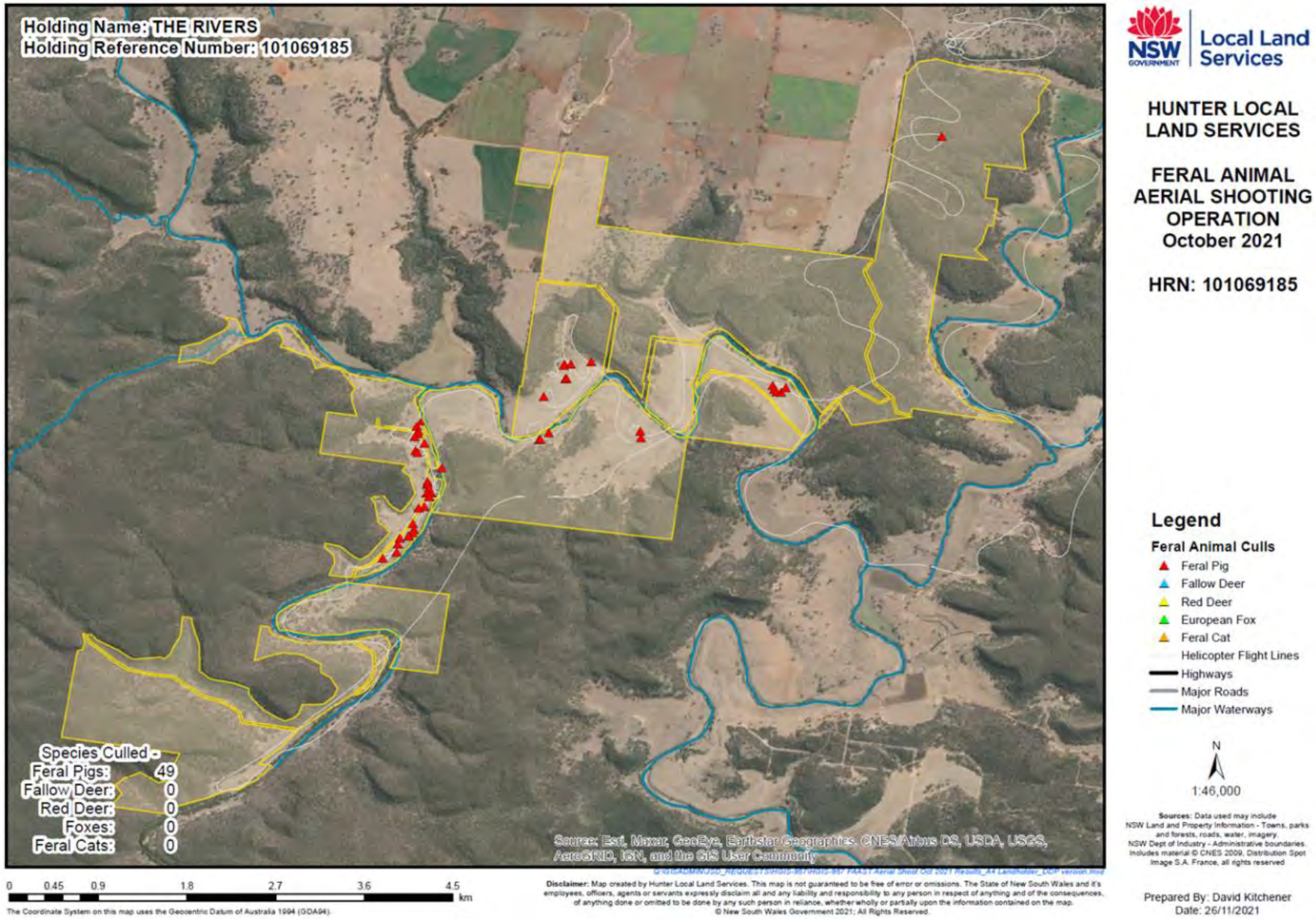

Figure 8-26: Aerial shooting of feral vertebrate pests at the Goulbourn River BA

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 7 complaints were received by HVO during 2022 (**Figure 9-1**) This represents a decrease of 18 community complaints from the previous year, and is lower than typically received at HVO (**Figure 9-3**). Complaints were predominantly received relating to blasting and dust. **Figure 9-2** provides further detail regarding the number of complaints per complaint type. Details of complaints received in 2022 are included in **Table 9-1**. Additional blast rules were put in place in response to blast dust complaints from a resident and the Hunter Valley Gliding Club.

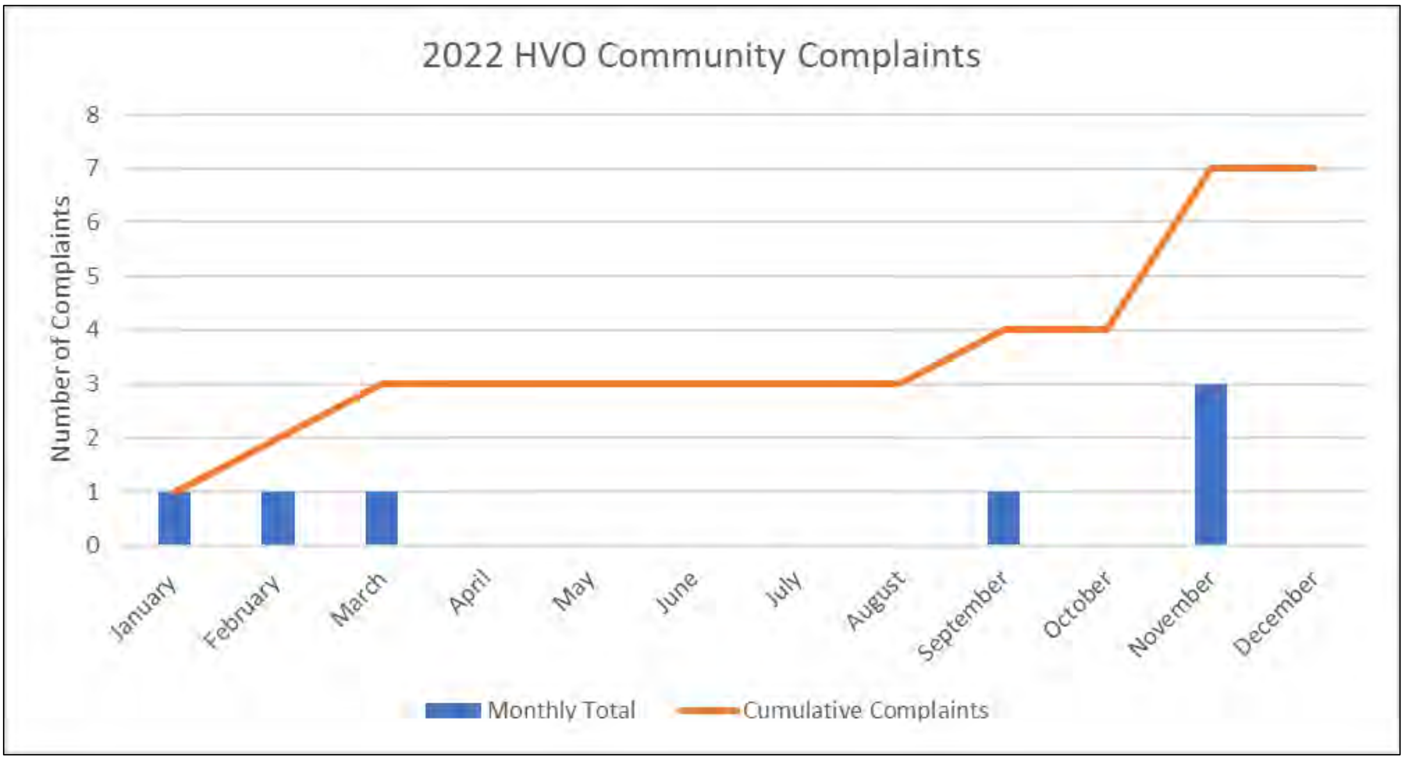

Figure 9-1: Summary of Community Complaints in 2022

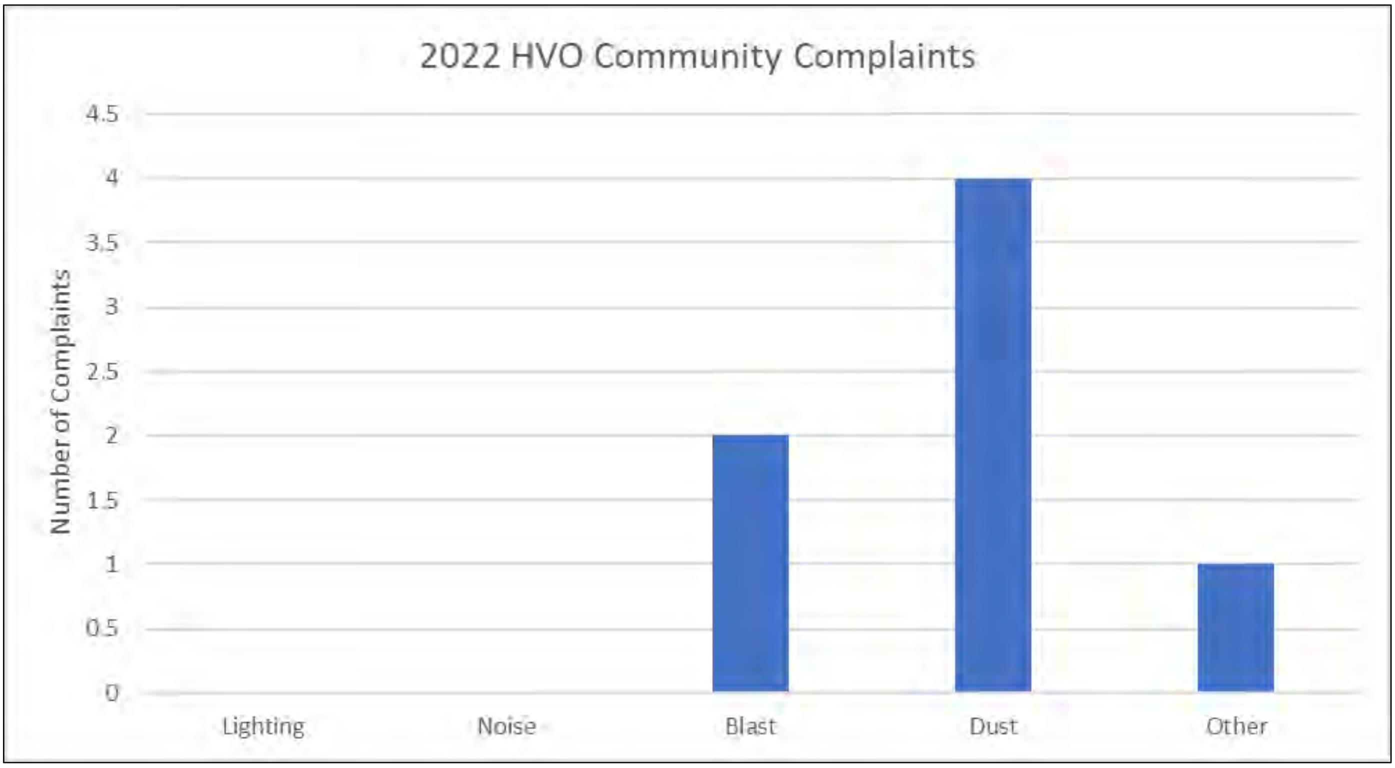

Figure 9-2: Number of Complaints per Type

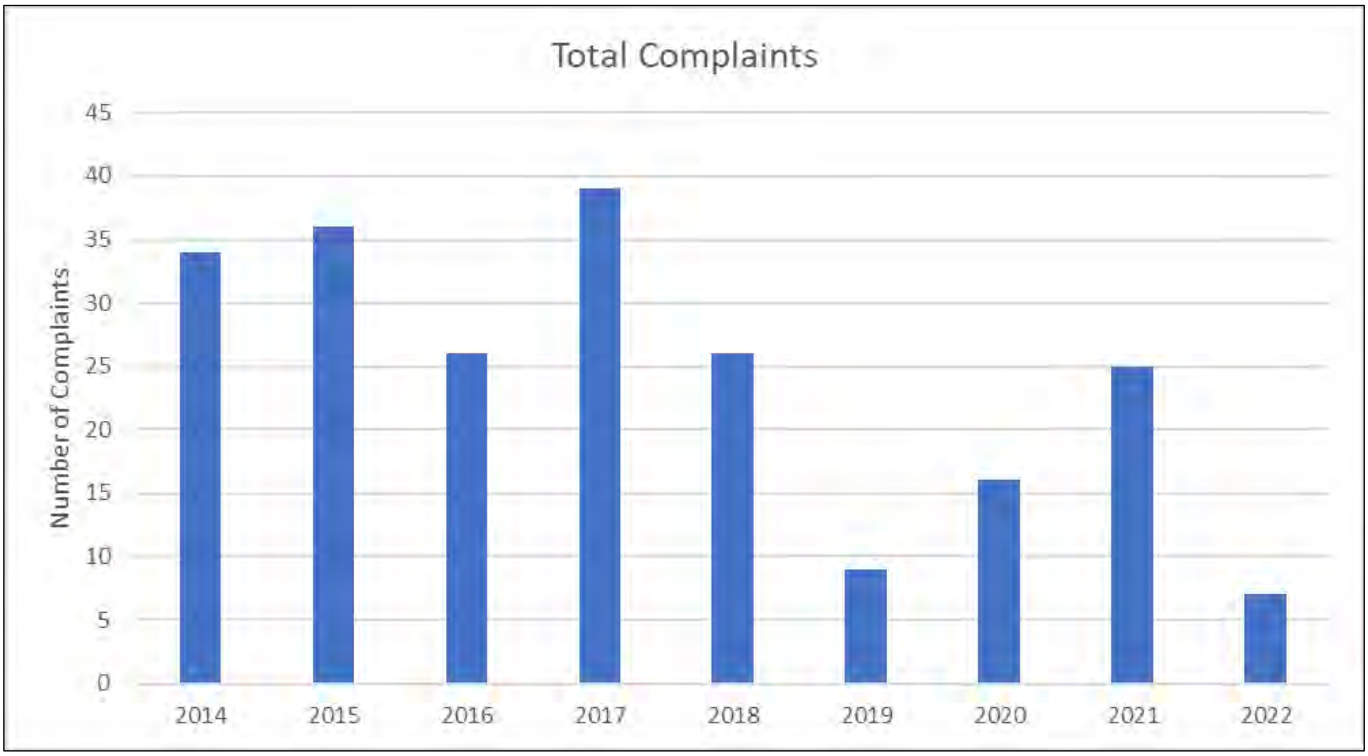

Figure 9-3: Community Complaints 2014 – 2022

Table 9-1: Details of Complaints Received in 2022

Date	Time	Nature of Complaint	Description	Follow Up Action
5 January 2022	1:24pm	Blast	A resident from Jerrys Plains called the Community Hotline at 1.24pm to mention that a blast fired at approximately 1:06pm was noisy and sounded like lighting had struck their house and that the windows rattled.	The Environment and Community Officer contacted the resident and confirmed that HVO fired a shot at 1.06pm from Cheshunt Pit 2. The recorded overpressure and ground vibration levels for the Jerrys Plains blast monitor were 108.39 dB and 0.04mm/s which are under compliance levels of 120dB and 10mm/s.
11 February 2022	1:05pm	Blast	A resident from Maison Dieu sent an SMS to the Environment and Community Officer at 1.05pm asking to record a complaint due to noise and movement from a blast at ~1pm. The complaint followed two successive blasts in Cheshunt Pit 2. The Environment and Community Officer confirmed HVO blast firing times aligned with the complaint and called the resident. The resident noted that "vibration and sound was the main issue, the blast shook the whole house, it was a long blast and its blasts like this one that create movement in the house and damage".	Maison Dieu is the closest monitor to the property and recorded low overpressure and vibration (94.75 dBL and 0.08 mm/s) – this is the highest vibration reading of the two shots fired. No anomalies were observed with the blast, however elevated noise was possible due to it being a shallow parting shot (holes less than 2m). Wind was ~3 m/s from the south east, blowing away from the residence.
19 March 2022	7.35pm	Other	A member of the public (who wished to remain anonymous) stated that they were driving along the Golden Highway near the secondary entrance to HVO South, when a car pulled out behind the complainant and tail gated the driver. The complainant reported that the rear driver sped past them (near the roadworks at Warkworth) and cracked the car windscreen of the car which was brand new. The care details were provided to HVO. They identified the driver to be wearing orange high visibility clothing.	A search was conducted of HVO carparks in days following the complaint however the vehicle was not able to be identified. A presentation slide about safe driving practices when traveling to and from HVO was communicated to employees and contractors.

Date	Time	Nature of Complaint	Description	Follow Up Action
19 September 2022	1.02pm	Blast Dust	A resident of Long Point called the Community Complaints Hotline at 1.02pm regarding a dust complaint. The complaint followed blasting in Cheshunt Pit 2. The resident was called back by the Environment and Community Officer at 1.03pm to ascertain the details relating to the complaint. The resident was annoyed and felt that it was unacceptable for HVO to be blasting given the windy conditions at the time and that the dust was bad for the environment.	A review of camera footage of the blasts fired at 12.52 and 12.53 pm confirmed that a dust plume was produced and started dispersing once leaving the pit crest. The wind speed was ~8 m/s at 12:50pm and wind direction was 292°. The resident's property is approximately 8 kilometres from the blast location at a bearing of ~295°. As there are no near neighbours between the bearings of 280 and 311° the maximum permitted wind speed for firing the blast was 9 m/s. The nearest real-time PM10 monitors are located downstream of the blast but on either side of the wind bearing and levels did not spike following the blast. A high volume air sampler is located within 150m of their residence and was monitoring particulates during the blast. Results from the filter paper from the monitor were received in early October which indicated no exceedance on the run day of the monitor which was also the date of the complaint. The blasting permissions for wind directions between 280 and 311° were modified with a maximum of 7 m/s wind speed restriction applied for blasts in Cheshunt.

Date	Time	Nature of Complaint	Description	Follow Up Action
12 November 2022	10:14am	Blast Dust	A resident of Long Point called the Community Complaints Hotline at 10.14am regarding a dust complaint. The complaint followed blasting in Cheshunt Pit 2 at 10.01 am.	The wind direction and wind speed at 10:00am prior to the blast was 321 degrees and 1.29m/s. The blast was visible but did not travel in the direction of the resident. No fume was recorded and the blast was fired in accordance with internal blasting permissions. TEOM data was reviewed which showed the monitor in closest proximity to Long Point (Knodlers Lane) was below the daily criteria limit of 50 μg/m^3 from 10am to 11:10am. A meeting was subsequently arranged with a number of matters discussed including HVO review of blasting permissions.
12 November 2022	10:35	Blast Dust	A representative of the Hunter Valley Glider Club phoned the complaints hotline to complain about blast plume residue entering the Glider Club property and covering the runway.	The wind direction and wind speed at 10:00am prior to the blast was 321 degrees and 1.29m/s. The TEOM data was checked and shows the monitor in closest proximity to the Glider Club (Warkworth) experienced a peak in dust levels (~100μg/m^3) above the daily criteria from approximately 11:20am, aligning with wind speed and direction. Photos were reviewed from HVO cameras and the Hunter Valley Gliding Club cameras. These indicated the dust plume travelled in the direction of the air strip. No fume was visible. Blasting permissions were subsequently modified to introduce a low wind speed restriction of 2 m/s for blasts in Cheshunt when wind is from the northwest.

Date	Time	Nature of Complaint	Description	Follow Up Action
24 November 2022	16:23	Blast Dust	A resident in Long Point rang the Community Complaints Hotline at 4:23pm to complain about dust from the blast at 3pm.	Discussion was held regarding previous review of blasting restrictions which applied a restriction to blasting in the direction of the residents house and that the blast was fired in accordance with these permissions. The resident was not satisfied with the dust from the blast or the additional controls to blasting. Camera footage was reviewed which showed that dust from the blast rose to height under light winds and dispersed reasonably quickly and predominantly above HVO within 10-15 minutes after firing.

9.2 | REVIEW OF COMMUNITY ENGAGEMENT

9.2.1 | COMMUNICATION

One near neighbour newsletter was sent to HVO's near neighbours during 2022 providing an overview of:

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

A new HVO webpage was launched consolidating HVO environmental information, the Continuation Project and general information about HVO.

9.2.2 | CONSULTATION AND ENGAGEMENT ACTIVITIES

Consultation and engagement activities included Community Grants, the support of the Jerrys Plains Primary School pre-school programme, Apprentice community working bee at the Singleton Community Gardens and the Community Consultative Committee.

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

Community information sessions were held at Jerrys Pains on 23 March and Maison Dieu on 30 April to provide information to near neighbours on current operations and the HVO Continuation Project.

9.2.3 | COMMUNITY CONSULTATIVE COMMITTEE

The HVO CCC meetings were held in February, May, August, and November 2022. 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 2022 CCC members were:

- Dr Colin Gellatly (Independent chairperson)
- Cr Hollee Jenkins (replaced by Cr Sue George from November onwards)
- Dr Neville Hodkinson
- Mrs Janelle Wenham
- Mr Brian Atfield
- Mrs Di Gee
- Mr Todd Mills

- Mr Michael Wellard
- Mrs Jeanie Hayes
- Mrs Sarah Purser (minute taker)
- HVO General Manager – Tony Morris
- HVO Environment & Community Manager – Andrew Speechly
- HVO Environment & Community Officer – Merri Bartlett

9.2.4 | COMMUNITY GRANTS

HVO supports applications for local donations and sponsorships that have a clear community benefit.

Round one of the community grants programme closed in April with a number of local organisations successful in obtaining funds totalling almost $32,000 including:

- Australian Stock Horse Society Eastern Branch – Eastern Branch ASHS Championships and Performance Weekend;
- Business Singleton – Gold Sponsors of the Singleton Business Awards
- Early Links Inclusion Support Services Inc – Fun Factory
- Friends of St James Church Jerrys Plains Incorporated – Jerrys Plains Bicentennial Celebrations
- Jerrys Plains Public School P and C – Jerrys Plains Bicentennial Celebrations
- Jerrys Plains School of Arts Hall – Mental Health First Aid Course
- Mercy Services – TrioBike Taxi for Residents
- Glen Gallic Shooting Club Inc – Replacement Archery Targets.

Round Two of our Community Grants Programme closed in September with a number of local organisations successful in obtaining funds totalling over $21,000 including:

- Equipment for Star Club Milbrodale & Broke
- Muswellbrook South Public School P&C's Colour Your Threads for Pos Ed
- Singleton PCYC Book Fair
- Singleton ADRA Food Pantry
- Cessnock Community Leo Club's Native Wildflower Initiative
- Rotary Club of Muswellbrook
- Upper Hunter Where There's a Will's Burn Bright Program

HVO also continued to support the Jerrys Plains Public School 2023 Jerrys Juniors and Ready4School program.

Five new partnership mining trucks have started work for the mine and for local charities. The trays of the trucks have been painted in the colours of Westpac Rescue Helicopter Service, Hunter Prostate Cancer Alliance, Type 1 Foundation, Singleton Family Support and Hunter Breast Cancer Foundation. The charities will get an agreed donation for every load the trucks haul plus other fundraising support throughout the year.

In December, members of the HVO team drove to flood effected Central West NSW to distribute gifts, billy carts and toy kitchenettes with local Salvation Army officers. HVO staff made the toys as well as wildlife nesting boxes as a team building exercise at recent training days. Local (Hunter) kids in need also received the toys and the nesting boxes were donated to organisations in the Upper Hunter and Lake Macquarie.

HVO delivered $5,000 in gift vouchers to Singleton Family Support and the Salvos in time for Christmas. Many employees donated back the gift voucher HVO gave them for Christmas and HVO matched their generosity. We also provided St Vincent de Paul food items that our staff put under HVO Christmas trees.

Two of our trucks wore moustaches during Movember to raise awareness about men’s health and $5,430 for the cause. Coffee carts and a hard hat sticker campaign raised $10,000 for the Mark Hughes Foundation.

9.2.5 | HVO CONTINUATION PROJECT

Community members and stakeholders have been consulted through each step of the HVO Continuation Project. Community feedback has helped to design and refine the proposal and our plans to minimise and manage social and environmental impacts.

HVO used a variety of tools to provide information and gather feedback consistent with the State Significant Development Engagement Guidelines 2021, Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 and the Secretary’s Environmental Assessment Requirements (SEARs) issued by DPE.

Engagement has also included the following:

- Project newsletters for the local community;
- Community information sessions in Jerrys Plains, Maison Dieu and Long Point;
- Other community and stakeholder meetings;
- Consultation with HVO’s Community Consultative Committee;
- Information on the HVO website;
- Consultation with 33 RAPs; and
- Responding to email and phone enquiries.

The HVO Continuation Project Environmental Impact Assessment was placed on public exhibition by DPE in Q1 2023 for public comment, with a Response to Submissions to be provided by HVO.

10 | INDEPENDENT AUDIT

The last Independent Environmental Audit (IEA) was undertaken in November 2022. 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 mining leases and EPL 640.

RPS AAP Consulting Pty Ltd (RPS) were engaged and endorsed by DPE as suitably qualified, independent experts to undertake the audit. The timeframe for the audit was from 2 December 2019 to 30 November 2022. The site inspection component of the audit was undertaken over three days between 28 and 30 November 2022.

The audit report and HVO's response to the auditor's recommendations were submitted to the DPE on 23 February 2023.

Out of 225 conditions the audit identified 14 non-compliances with PA 06_0261 and DA 450-10-2003:

- 6 non-compliances associated with PA 06_0261
- 8 non-compliances associated with DA 450-10-2003

The non-compliances primarily relate to incidents reported during the audit period. These findings, along with the auditor's recommendation and HVO's response to these recommendations, are summarized in **Table 10-1**. The next IEA is due in 2025. The 2022 IEA can be downloaded from the HVO Website.

Table 10-1: 2022 Hunter Valley Operations Response to Audit Recommendations

Ref	Recommendation	HVO Response	Due Date
HVO South – PA 06_0261 Non-Compliance Recommendations			
S2 C2	No Further Action Required	No Further Action Required	N/A
S2 C2A	Refer S2 C2	No Further Action Required	N/A
S3 C2	Reference in Table 9 of the Monthly Environmental Monitoring Reports should be updated to reference LA1, 1-minute criteria Where a tonality penalty has been applied, the monthly report should include discussion and clarification on whether this constitutes an exceedance or is attributable to other sources.	HVO will amend future Monthly Environmental Monitoring Reports to included updated reference HVO will amend future Noise Reports to include discussion and clarification regarding observed tonality penalties	30/03/2023
S2 C7	No Further Action Required	No Further Action Required	N/A
S3 C15	Ensure that the blasting schedule on the HVO website is maintained.	Issue with the Blasting Schedule link from the “Contacts” page has been rectified	Complete
S3 C15	It is recommended that management plans, and other necessary documents include a table itemising the matters raised during consultation with identified parties, and description of the resolution of these matters.	HVO will amend and include in future revised management plans and other necessary documents a table itemising the matters raised during consultation with identified parties, and description of the resolution of these matters.	4/07/2023*
S3 C18	Recommend updating Section 1, Table 1 to Table 3 of the BMP to ensure correct references in column 3 (“Section of BMP which addresses this requirement”, “Where Commitment is addressed”, “Where Condition is addressed”).	HVO will amend in the next revision of the Blast Management Plan.	4/07/2023*
S3 C19	9 It is recommended that operators are provided with refresher training to ensure awareness of these TARPs and to ensure more proactive management of wheel generated and plant-generated dust.	HVO will roll out refresher training to operators to ensure awareness of Dust TARPS	30/06/2023

Ref	Recommendation	HVO Response	Due Date
S3 C25	Repair the eroded batter to Dam 37S or redirect flow to the existing stabilised entries. Sediment should then be removed from the basin to restore capacity	HVO will include repair works in future works programs to ensure completion. HVO will undertake a review of current sediment storage capacity compared to dam design criteria to determine whether further desilting is required.	20/06/2024
S3 C27	Version 3.4 of the WMP has been issued to the secretary and is waiting approval. Review the contents of the WMP to reflect the audit findings when next updated.	HVO will amend in the next revision of the Water Management Plan.	4/07/2023*
S3 C58	Ensure that waste containers have lids fitted and/or are stored undercover to limit additional generation of contaminated liquid.	HVO will undertake a site inspection to ensure lids are fitted to waste containers on bunded pallets that are not undercover and reinforce this expectation with a site communication.	30/04/2023
HVO North – DA 450-10-2003 Non-Compliance Recommendations			
S2 C2	No Further Action Required	No Further Action Required	N/A
S2 C2A	Refer S2 C2	No Further Action Required	N/A
S3 C2	Where a tonality penalty has been applied, the monthly report should include discussion and clarification on whether this constitutes an exceedance or is attributable to other sources.	HVO will amend future Noise Reports to include discussion and clarification regarding observed tonality penalties	30/03/2023
S3 C4A	It is recommended that operators are provided with refresher training to ensure awareness of these TARPs and to ensure more proactive management of wheel generated and plant-generated dust	HVO will roll out refresher training to operators to ensure awareness of TARPS	4/07/2023
S3 C7	Reference in Table 9 of the Monthly Environmental Monitoring Reports should be updated to reference LA1, 1-minute criteria	HVO will amend future Monthly Environmental Monitoring Reports to included updated reference	30/03/2023

Ref	Recommendation	HVO Response	Due Date
S3 C10	Recommend updating Section 8.1.1, Table 8-1 to reference AS1055- 2018 (supersedes AS1055-1997), and include reference to NSW EPA Approved methods for the measurement and analysis of environmental noise in NSW, 2022.	HVO will amend in the next revision of the Noise Management Plan.	4/07/2023*
S3 C19	Recommend updating Section 1, Table 1 to Table 3 of the BMP to ensure correct references in column 3 ("Section of BMP which addresses this requirement", "Where Commitment is addressed", "Where Condition is addressed").	HVO will amend in the next revision of the Blast Management Plan.	4/07/2023*
S3 C20	No Further Action Required	No Further Action Required	N/A
S3 C21	No Further Action Required	No Further Action Required	N/A
S3 C27	Version 3.4 of the WMP has been issued to the secretary and is waiting approval. Review the contents of the WMP to reflect the audit findings when next updated. Repair the inlet to Dam 5N to stop ongoing sedimentation, remove sediment from the dam, and confirm the capacity of Dam 5N and Dam 2N meets industry guidelines.	HVO will amend in the next revision of the Water Management Plan. HVO will include repair works in future works programs to ensure completion. HVO will undertake a review of current storage capacity in relation to Bluebook Standard to confirm whether current storage capacities are sufficient or additional capacity is required.	4/07/2023* 30/12/2023 30/7/2023
S3 C28A	No Further Action Required	No Further Action Required	N/A

* Date indicates when Management Plans are submitted for Department approval. Timing of approval and finalisation of the plan with the changes is outside of HVO's control.

11 | INCIDENTS AND NON-COMPLIANCES

During 2022 there were four incidents that required reporting to DPE. These were related to water and are summarised below.

Dam 2N, 35S, 39S and 15N Overflow Event – March 2022

During consecutive rain days between 6 and 9 March 2022, HVO recorded 141.2mm and 141.6mm of rainfall at its North and South weather stations respectively. The rainfall recorded significantly exceeded the design rainfall depth for sediment dams 2N, 35S and 39S. It also exceeded the capacity of mine stormwater containment Dam 15N. It was deemed that the incident would not have caused environmental harm

Dam 32N (Coffeys) Overflow Event – March 2022

During March, HVO recorded 256.2mm and 265.6mm of rainfall at its North and South weather stations respectively. The rainfall recorded exceeded the capacity of the mine stormwater containment Dam 32N (Coffeys Dam) resulting in it spilling to Bayswater Creek at the Hunter Valley Load Point. The dam is classified as a mine water dam. Samples were collected that indicated spilling water was of fresh quality, receiving runoff predominantly from clean catchment. A pump was installed to dewater the dam to Ravensworth CHPP. Spilling of the dam ceased 3 April 2022.

Dam 2N Overflow Event – July 2022

Sediment Dam 2N overtopped to Farrells Creek following continued rainfall in the preceding days. Rainfall volume exceeded the dam design capacity. The dam was being pumped out at the time and continued to operate until the level reduced below the spillway and water quality samples were collected. Due to the fresh quality of the water and excessive rainfall in the local catchment there was no potential for environmental harm.

Dam 35S, 39S and 15N Overflow Event – July 2022

During consecutive rain days between 2 and 6 July 2022, HVO recorded 161.6mm and 157.2mm of rainfall at its North and South weather stations respectively. The rainfall recorded significantly exceeded the design rainfall depth for sediment dams 35S and 39S and exceeded the capacity of mine stormwater containment dam 15N. The dams were pumped out to reduce water levels and water quality samples were collected.

12 | ACTIVITIES TO BE COMPLETED IN 2023

12.1 | APPROVALS

HVO will continue to progress its application for the HVO Continuation Project. Following public exhibition a response to submissions report will be provided to DPE.

12.2 | NOISE

Noise management improvements identified for implementation in 2023 include:

- Sound Power Level testing of various heavy mining equipment.
- Investigate replacement options for ageing Barnowl monitors
- Fitting of sound attenuation to new heavy mining equipment brought to site

12.3 | AIR QUALITY

Air quality management improvements identified for implementation in 2023 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
- Refreshing employee training on response to visible dust triggers
- Commissioning E-Bam PM2.5 air quality monitors at Maison Dieu and Kilburnie South in place of HVAS monitors
- Continue the replacement programme for ageing HVAS monitors

12.4 | BLASTING

HVO will continue to manage blasting activities in 2023 in accordance with the *Blast Management Plan*.

12.5 | HISTORIC HERITAGE

Improvements to historic heritage identified for implementation in 2023 includes commencing the Historic Homestead Project, which will include the completion of detailed condition reports for the Archerfield, Wandewoi and Carrington Stud homesteads. In addition the project will prepare a long term maintenance and management plan for each homestead complex.

12.6 | WATER

Improvements to mine water management in 2023 include:

- Commence construction of water containment upgrades at the train load out facilities;

- Install water management structures ahead of mining in Mitchell Pit;
- Commence construction of Dam 15N enlargement project;
- Commence detailed engineering and scoping of water containment projects beyond 2023;
- Continue 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; and
- Updates to sites Operational Water Management Plan

12.7 | REHABILITATION

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

- Completion of annual rehabilitation target of 44 ha of new rehabilitation.
- Continuation of Section 240 rehabilitation maintenance plan including progression of historic cover crop management areas to final target land use.
- Finalise detailed design and commence works for remediation and rehabilitation of the former Eastern TSF at HVO North.
- Undertake contour repair works on the WOOP dump in line with the detailed design for the remainder of the contours.

12.8 | TAILINGS STORAGE FACILITIES

The following tailing storage facility activities are planned for 2023:

- Initial rehabilitation monitoring on Southeast TSF following completion of capping and rehabilitation of the remaining surface in 2022.
- Continuation of management activities for the North Void TSF, focusing on monitoring, dewatering and surface strength development.
- Review & Update of all tailings dam Operational and Maintenance Manuals; and
- Prepare for capping activities on Bob's Dump TSF.

12.9 | STAKEHOLDER ENGAGEMENT

The following stakeholder engagement activities are planned for 2023:

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

APPENDIX A: ANNUAL AIR QUALITY REVIEW

HUNTER VALLEY OPERATIONS
ANNUAL DATA REVIEW 2022

Hunter Valley Operations

22 March 2023

Job Number 22031404A

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HUNTER VALLEY OPERATIONS ANNUAL DATA REVIEW 2022

DOCUMENT CONTROL

Report Version	Date	Prepared by	Reviewed by
DRAFT - 001	09/02/2023	K Trahair	D Kjellberg
DRAFT - 002	20/03/2023	K Trahair & A Todoroski	
FINAL - 001	22/03/2023	K Trahair	

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Todoroski Air Sciences have conducted an annual review of the 2022 measured dust levels at monitors which are part of the Hunter Valley Operations (HVO) North and South air quality monitoring network. Elevated short term (i.e. 24-hour average) levels are investigated routinely throughout the year, hence the focus of this review is to present and assess any elevated annual average readings recorded in 2022.

This investigation has analysed the following elevated levels in detail:

- An annual average deposited dust level of 6.9g/m^2/month recorded at the Warkworth deposited dust gauge monitor.

It is noteworthy that the criteria for HVO North differ to those for HVO South. As outlined below, HVO South has more stringent criteria for some pollutants and averaging periods. This arises due to the criteria applicable to new or modified projects becoming more stringent over time.

2 ANNUAL AIR QUALITY CRITERIA

2.1 HVO North

2.1.1 Air Quality Criteria

As per HVO North consent DA 450-10-2003 "*Except for the air-affected land referred to in Table 1, the Applicant must ensure that all reasonable and feasible avoidance and mitigation measures are employed so that the particulate matter emissions generated by the development do not exceed the criteria listed in Tables 2, 3 or 4 at any residence on privately-owned land or on more than 25 percent of any privately-owned land. In this condition 'reasonable and feasible avoidance and mitigation measures' includes, but is not limited to, the operational requirements in Condition 5 of Schedule 4 and the requirements in Conditions 5 and 6 of Schedule 4 to develop and implement a real-time air quality management system that ensures effective operational responses to the risks of exceedance of the criteria.*"

The criteria from Tables 2 to 4 are set out below:

Table 2: Long term criteria for particulate matter

Pollutant	*Averaging period*	*[d]Criterion*
Total suspended particulate (TSP) matter	*Annual*	*[a] 90 µg/m³*
Particulate matter < 10 µm (PM_{10})	*Annual*	*[a] 30 µg/m³*

[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources)
[d] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents or any other activity agreed to by the Secretary.

Table 3: Short term criteria for particulate matter

Pollutant	*Averaging period*	*[d]Criterion*
Particulate matter < 10 µm (PM_{10})	*24 hour*	*[a]50 µg/m³*

[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources)
[d] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents or any other activity agreed to by the Secretary.

Table 4: Long term criteria for deposited dust

Pollutant	*Averaging period*	*Maximum increase in deposited dust level*	*Maximum total deposited dust level*
[c]Deposited dust	*Annual*	*[b]2 g/m²/month*	*[a]4 g/m²/month*

[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to other sources)
[b] Incremental impact (i.e. incremental increase in concentrations due to the development on its own)
[c] Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method

When the measured cumulative annual average deposited dust level at compliance monitors is below the criterion of 4g/m²/month in Table 4 it is inferred that compliance is achieved. If this criterion is exceeded, the applicant must demonstrate compliance with the maximum increase in the deposited dust level of 2g/m²/month.

2.1.2 Air Quality Acquisition Criteria

"*If particulate matter emissions generated by the development exceed the criteria in Tables 5, 6 or 7 on a systemic basis at any residence on privately-owned land or on more than 25 percent of any privately-owned land, then upon receiving a written request for acquisition from the landowner the Applicant must acquire the land in accordance with the procedures in Conditions 7 and 8 of Schedule 5.*"

Table 5: Long term acquisition criteria for particulate matter

Pollutant	*Averaging period*	*[d]Criterion*
Total suspended particulate (TSP) matter	*Annual*	*[a] 90 µg/m³*
Particulate matter < 10 µm (PM_{10})	*Annual*	*[a] 30 µg/m³*

[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources)
[d] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents or any other activity agreed to by the Secretary.

Table 6: Short term acquisition criteria for particulate matter

Pollutant	*Averaging period*	*[d]Criterion*
Particulate matter < 10 µm (PM_{10})	*24 hour*	*[a]150 µg/m³*
Particulate matter < 10 µm (PM_{10})	*24 hour*	*[b]50 µg/m³*

[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources)
[b] Incremental impact (i.e. incremental increase in concentrations due to the development on its own)
[d] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents or any other activity agreed to by the Secretary.

Table 7: Long term acquisition criteria for deposited dust

Pollutant	*Averaging period*	*Maximum increase in deposited dust level*	*Maximum total deposited dust level*
[c]Deposited dust	*Annual*	*[b]2 g/m²/month*	*[a]4 g/m²/month*

[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to other sources)
[b] Incremental impact (i.e. incremental increase in concentrations due to the development on its own)
[c] Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method

When the measured cumulative annual average deposited dust level at compliance monitors is below the criterion of 4g/m²/month in Table 4 it is inferred that compliance is achieved. If this criterion is exceeded, the applicant must demonstrate compliance with the maximum increase in the deposited dust level of 2g/m²/month.

2.2 HVO South

2.2.1 Air Quality Criteria

As per HVO South consent PA 06_0261 "*The Proponent must ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the project do no exceed the air quality impact assessment criteria listed in Table 8 at any residence on privately-owned land, the Hunter Valley Gliding Club (when in use) or on more than 25 percent of any privately-owned land.*"

Table 8: Air quality impact assessment criteria

Pollutant	*Averaging period*	*[d]Criterion*
Particulate matter < 10 µm (PM_{10})	*Annual*	*[a,c] 25 µg/m³*
	24 hour	*[b] 50 µg/m³*
Particulate matter < 2.5 µm ($PM_{2.5}$)	*Annual*	*[a,c] 8 µg/m³*
	24 hour	*[b] 25 µg/m³*
Total suspended particulate (TSP) matter	*Annual*	*[a,c] 90 µg/m³*

Air quality impacts at HVGC are to be assessed in the immediate vicinity of its residential facilities and/or clubhouse. Air quality limits are only applicable during times of use that have been notified by HVGC to the Proponent.
[a] Total impact (i.e. incremental increase in concentrations due to the project plus background concentrations due to all other sources).
[b] Incremental impact (i.e. incremental increase in concentrations due to the project on its own).
[c] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents or any other activity agreed to by the Secretary.

"However, if the Proponent has a written negotiated air quality agreement with any landowner or HVGC to exceed the air quality limits in Table 8 and a copy of this agreement has been forwarded to the Department and EPA, then the Proponent may exceed the air quality limits in Table 8 in accordance with the negotiated air quality agreement."

2.3 Air Quality Criteria Summary

The monitoring locations and annual average criteria for HVO North and HVO South set out in the relevant approvals are presented in **Table 2-1**.

Table 2-1: Annual air quality criteria

Location	HVO North		HVO South
Deposited Dust Gauges (g/m²/month)			
D112*	-	-	-
D118	2[1]	4[2]	-
D119	2[1]	4[2]	-
D122	2[1]	4[2]	-
DL14	2[1]	4[2]	-
DL2*	-	-	-
DL21	2[1]	4[2]	-
DL22	2[1]	4[2]	-
DL30	2[1]	4[2]	-
Knodlers Lane	2[1]	4[2]	-
Warkworth	2[1]	4[2]	-
PM_{10} TEOM (µg/m³)			
Wandewoi*	30		25
Golden Highway*	-		-
Howick*	-		-
Knodlers Lane	-		25
Warkworth	-		25
Jerrys Plains	30		25
Maison Dieu	-		25
PM_{10} HVAS (µg/m³)			
Cheshunt East	30		-
Gliding Club	-		25
Long Point	-		25
Kilburnie South	30		25
$PM_{2.5}$ HVAS (µg/m³)			
Maison Dieu	-		8
Kilburnie South	-		8
TSP HVAS (µg/m³)			
Cheshunt East	90		-
Warkworth	-		90
Wandewoi*	-		-
Maison Dieu	-		90
Long Point	-		90
Knodlers Lane	-		90
Kilburnie South	90		90

[1] Maximum increase in deposited dust level, [2] Maximum total deposited dust level

*Per HVO's Air Quality Management Plan Table 5: HVO Air Quality Monitoring – Planning Approval Compliance Assessment, D112, DL2, Golden Highway and Howick are not compliance monitors. D112, DL2 and Wandewoi are used as representative monitoring locations for mine-owned land.

2.4 Deposited Dust Data

Table 2-2 and **Figure 2-1** summarise the HVO deposited dust monitoring data for the 2022 period.

The Warkworth monitor recorded a total annual average level above the criterion of 4g/m²/month.

Table 2-2: HVO monthly deposited dust monitoring data (g/m²/month) – 2022

Month	D112	D118	D119	D122	DL14	DL2	DL21	DL22	DL30	Knodlers Lane	Warkworth
Jan	2.9	1.3	1.3	1.3	1.3	0.3	0.6	1.0	1.2	1.6	3.8
Feb	3.7c	1.7	1.7	1.0	0.8	0.6	1.2	1.0	2.5	1.5	7.5
Mar	2.2	1.3	1.5	2.6	0.8	9.7c	5.7	2.9	1.3	1.2	2.8
Apr	1.9	0.6	0.7	0.9	1.3	0.8	1.5	2.4	2.8	1.0	5.6
May	0.9	0.6	0.7	0.8	1.1	1.1	0.7	1.8	2.9	0.8	9.5
Jun	0.2	0.3	0.5	1.0	3.9	1.1	1.3	1.1	2.6	0.7	17.6
Jul	0.5	0.3	0.4	0.9	1.2	0.4	2.0	1.0	2.1	1.0	5.7
Aug	0.6	0.6	0.7	1.2	1.2	0.9	1.0	1.0	17.6c	11.9	7.6
Sep	1.5	1.2	1.2	1.1	1.3	0.7	1.2	1.1	17c	0.9	7.8
Oct	0.6	0.5	0.3	0.5	0.4	0.4	3.4	1.8	0.8	0.3	1.9
Nov	c	0.9	0.8	0.9	0.5	0.4	2.4	1.2	3.4	0.7	6.7
Dec	c	2.0	2.4	1.6	1.4	1.0	1.5	2.3	4.3	0.3	6.2
Annual Average	1.3	0.9	1.0	1.2	1.3	0.7	1.9	1.6	2.4	1.8	**6.9**

c - Sample contaminated, not included in annual average calculation

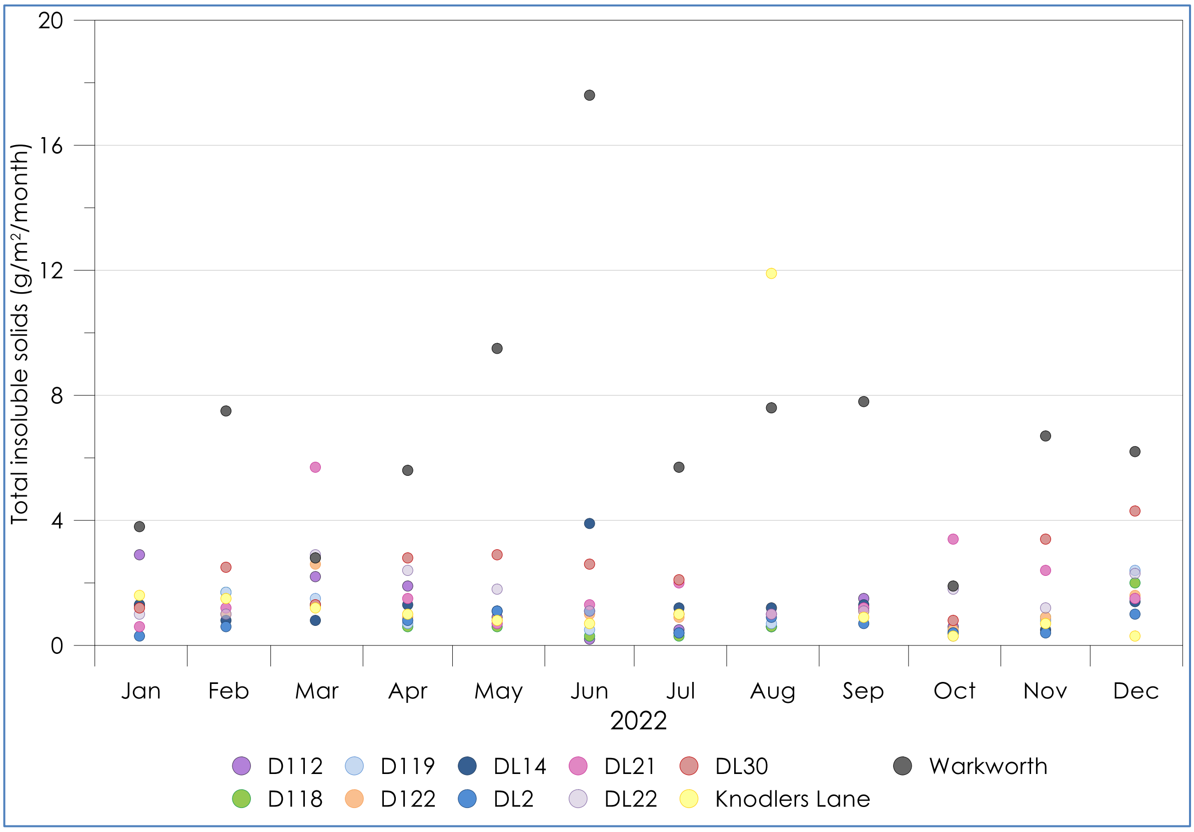

Figure 2-1: Monthly deposited dust results for 2022

Figure 2-2 presents a plan of the dust gauge monitoring locations in the area around HVO and the annual average deposited dust levels. The figure includes annual windrose plots of the meteorological data collected at the Cheshunt and HVO Corp Automatic Weather Stations (AWS) during 2022. Winds predominantly originated along a northwest/west-northwest and southeast/south-southeast axis at Cheshunt, and a west/west-northwest and southeast/east-southeast axis at HVO Corp.

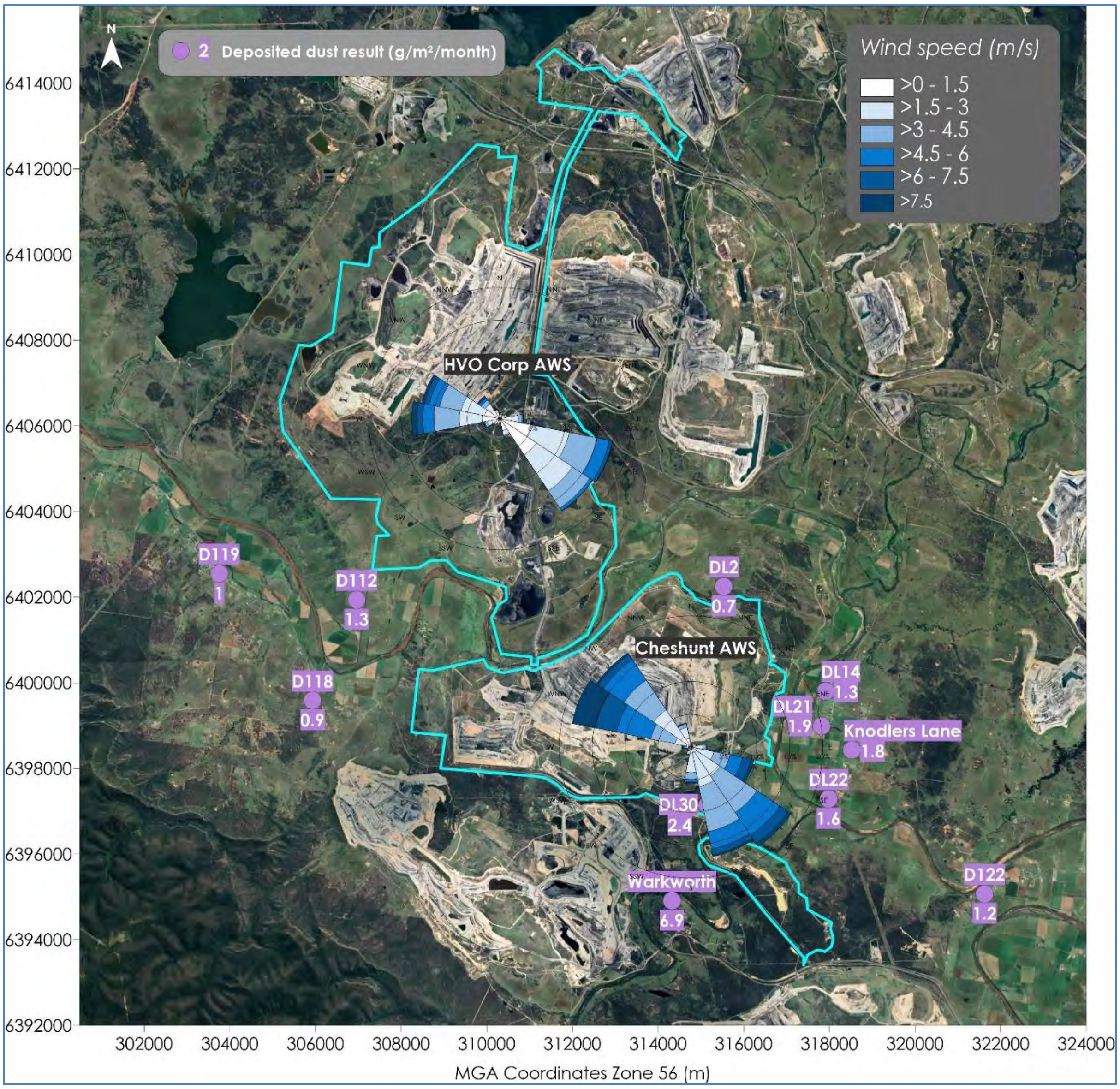

Figure 2-2: Annual deposited dust results for 2022

As set out in the Air Quality Criteria section, deposited dust criteria are applicable for HVO North as per DA 450-10-2003. It is important to note that, there are no criteria applicable to HVO South for deposited dust levels per PA 06_0261.

When the measured cumulative annual average deposited dust level is below the criterion of 4g/m^2/month it is generally inferred that compliance is achieved. The majority of dust which deposits on surfaces will not travel significant distances, and thus deposited dust levels are most affected by any very near sources. Hence if the cumulative criterion is exceeded, the applicant would need to show compliance with the maximum (incremental) increase in the deposited dust level of 2g/m^2/month due to their activities, (which means there is a closer "other source" affecting the cumulative total reading). When the deposited dust level exceeds the criteria, the operator would need to further evaluate their compliance.

Figure 2-2 indicates that the Warkworth monitor recorded an annual average of 6.9g/m^2/month in 2022 which is above the total criterion of 4g/m^2/month.

It is noted that over the past few years, neighbouring mining activities along one of the prominent wind axes have progressed significantly closer toward the Warkworth monitor which may be impacting the deposited dust levels.

Figure 2-2 shows that 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 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 D112, D119 and DL2 and as such, it is considered that HVO North could not have had significantly contributed to the Warkworth deposited dust level.

Table 2-2 and **Figure 2-2** show that D112, D119 and DL2 recorded annual average deposited dust levels below both the incremental and cumulative criteria and because dust from a mine cannot "leap frog" a monitor and cause higher impacts beyond the monitor it can be inferred that HVO North was compliant per DA 450-10-2003 at these and all other locations beyond. Note that D112 and DL2 are not compliance monitoring locations, however DL2 is on a prevailing wind axis relative to the HVO North operations, and is perhaps the best sited monitor to indicate the deposited dust levels due to the operation at that distance downwind.

2.4.1 Deposited Dust Investigation

A simple and conservative approach has been adopted in order to calculate HVO North's contribution to the levels recorded at the deposited dust gauges. If monitors were downwind of HVO North for less than 5% of the time during the monthly sample period, HVO North's contribution to the monitor was assumed to be zero for that sample. If the monitors were downwind of HVO North for at least 5% of the time, then HVO North's contribution was assumed to be the total recorded level minus the minimum recorded monthly value in the monitoring network. This estimation is likely to overestimate the contribution from HVO North as it assumes the total difference between the recorded value and the low background level is due to HVO North and does not account for the likely impact of other sources such as neighbouring mines or localised sources. For monitors outside HVO North's reasonable range of impact (as discussed above), HVO North's contribution was estimated to be less than or equal to the nearest intermediate monitor's contribution (D112, D119 or DL2). Monthly contributions were not calculated for monitors where the relevant monthly sample was invalid.

Table 2-3 presents the annual average deposited levels recorded in 2022 and HVO North's estimated contribution to the annual average deposited dust levels. The analysis shows that the estimated incremental contributions from HVO North to all monitors, including the elevated annual level at the Warkworth would be below the incremental annual average criterion of 2g/m^2/month.

The analysis shows that HVO North's conservatively calculated contribution to the Warkworth monitor in 2022 would have been a maximum of 0.1g/m^2/month or 1% of the 6.9g/m^2/month. This indicates that the deposited dust level at Warkworth in 2022 would be over the applicable total criterion of 4g/m^2/month regardless of the contribution from HVO North.

Table 2-3: HVO North's estimated contribution and annual average deposited dust levels 2022

Month		D112	D118	D119	D122	DL14	DL2	DL21	DL22	DL30	Knodlers Lane	Warkworth
		Percentage of time downwind of HVO (north) (%)										
January		8%	4%	7%	2%	4%	5%	3%	2%	2%	3%	1%
February		4%	2%	3%	5%	11%	13%	9%	7%	5%	8%	3%
March		5%	3%	4%	5%	8%	9%	8%	7%	4%	7%	2%
April		5%	2%	3%	14%	22%	26%	20%	17%	11%	18%	4%
May		7%	4%	6%	23%	43%	48%	38%	28%	16%	32%	6%
June		3%	2%	2%	26%	72%	84%	55%	30%	15%	40%	4%
July		6%	3%	3%	27%	48%	53%	43%	33%	19%	38%	6%
August		8%	2%	2%	22%	55%	64%	44%	29%	19%	35%	9%
September		7%	4%	5%	12%	31%	40%	24%	17%	12%	19%	6%
October		6%	3%	4%	11%	22%	29%	18%	13%	8%	15%	3%
November		7%	4%	5%	13%	34%	55%	26%	16%	10%	20%	4%
December		2%	1%	1%	2%	4%	5%	3%	3%	1%	3%	1%
Month		**HVO monthly deposited dust monitoring data (g/m^2/month)**										
January		2.9	1.3	1.3	1.3	1.3	0.3	0.6	1.0	1.2	1.6	3.8
February		3.7c	1.7	1.7	1.0	0.8	0.6	1.2	1.0	2.5	1.5	7.5
March		2.2	1.3	1.5	2.6	0.8	9.7c	5.7	2.9	1.3	1.2	2.8
April		1.9	0.6	0.7	0.9	1.3	0.8	1.5	2.4	2.8	1.0	5.6
May		0.9	0.6	0.7	0.8	1.1	1.1	0.7	1.8	2.9	0.8	9.5
June		0.2	0.3	0.5	1.0	3.9	1.1	1.3	1.1	2.6	0.7	17.6
July		0.5	0.3	0.4	0.9	1.2	0.4	2.0	1.0	2.1	1.0	5.7
August		0.6	0.6	0.7	1.2	1.2	0.9	1.0	1.0	17.6c	11.9	7.6
September		1.5	1.2	1.2	1.1	1.3	0.7	1.2	1.1	17c	0.9	7.8
October		0.6	0.5	0.3	0.5	0.4	0.4	3.4	1.8	0.8	0.3	1.9
November		c	0.9	0.8	0.9	0.5	0.4	2.4	1.2	3.4	0.7	6.7
December		c	2.0	2.4	1.6	1.4	1.0	1.5	2.3	4.3	0.3	6.2
Annual average		**1.3**	**0.9**	**1.0**	**1.2**	**1.3**	**0.7**	**1.9**	**1.6**	**2.4**	**1.8**	**6.9**
Month	**Estimated Background**	**HVO North's maximum estimated contribution to monitor (g/m^2/month)**										
Jan	0.3	2.6	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feb	0.6	-	0.0	0.0	0.0*	0.0*	0.0	0.0*	0.0*	0.0	0.0*	0.0
Mar	0.8	0.0	0.0	0.0	-*	-*	-	-*	-*	0.0	-*	0.0
Apr	0.6	0.0	0.0	0.0	0.2*	0.2*	0.2	0.2*	0.2*	0.2*	0.2*	0.0
May	0.6	0.3	0.0	0.1	0.5*	0.5*	0.5	0.5*	0.5*	0.5*	0.5*	0.5*
Jun	0.2	0.0	0.0	0.0	0.9*	0.9*	0.9	0.9*	0.9*	0.9*	0.9*	0.0
Jul	0.3	0.2	0.0	0.0	0.1*	0.1*	0.1	0.1*	0.1*	0.1*	0.1*	0.1*
Aug	0.6	0.0	0.0	0.0	0.3*	0.3*	0.3	0.3*	0.3*	-	0.3*	0.3*
Sep	0.7	0.8	0.0	0.0	0.0*	0.0*	0.0	0.0*	0.0*	-	0.0*	0.0*
Oct	0.3	0.3	0.0	0.0	0.1*	0.1*	0.1	0.1*	0.1*	0.1*	0.1*	0.0
Nov	0.4	-	0.0	0.4	0.0*	0.0*	0.0	0.0*	0.0*	0.0*	0.0*	0.0
Dec	0.3	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual average	**0.5**	**0.5**	**0.0**	**0.1**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.1**

*Contribution assumed to be equal to (or less than) that of intermediate DL2 monitor. Note that D112 and DL2 are not compliance monitors.

2.5 TSP Data

Table 2-4 and **Figure 2-4** summarise the annual average and 24-hour average TSP HVAS monitoring data respectively for the HVO area in 2022. The table shows that the TSP HVAS monitors recorded annual average levels below the criterion of 90µg/m^3 in 2022.

Table 2-4: TSP HVAS annual average monitoring data (all data) – 2022

Location	Measured HVAS TSP level (µg/m³)
Cheshunt East	41.6
Warkworth	72.2
Wandewoi	35.9
Maison Dieu	37.9
Long Point	33.9
Knodlers Lane	45.8
Kilburnie South	37.7

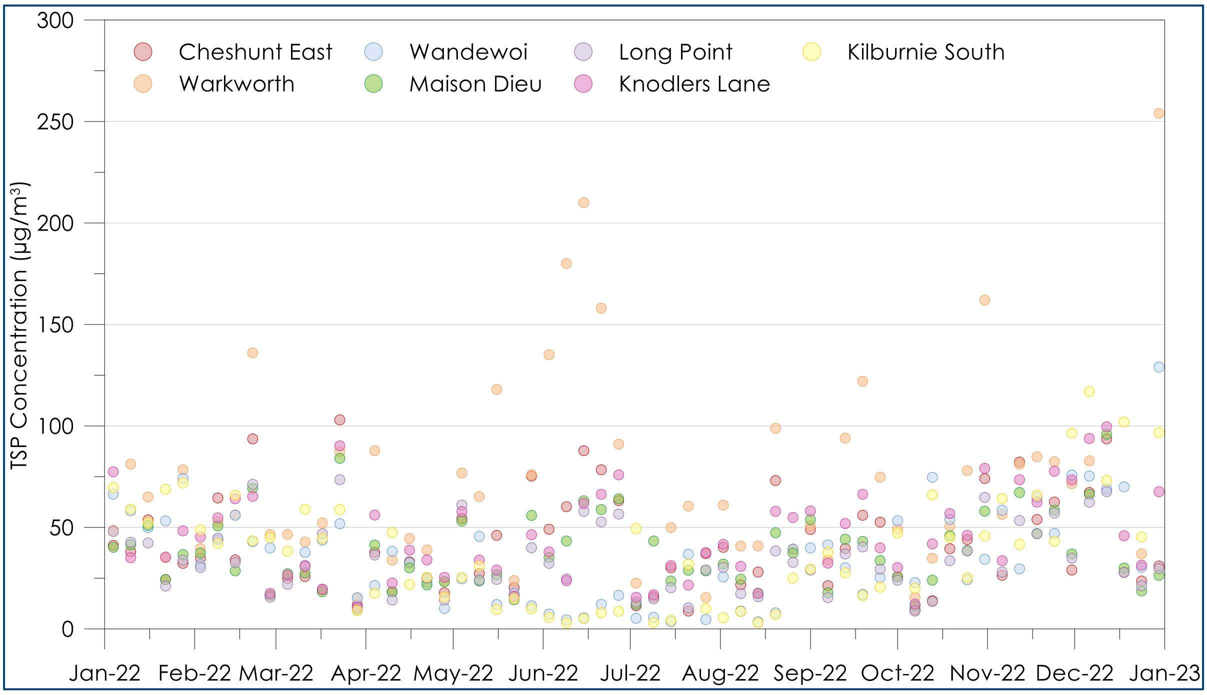

Figure 2-3: 24-hour average TSP HVAS results for 2022

The annual average TSP levels during the 2022 period are shown in **Figure 2-4**. The figure includes annual windrose plots of the meteorological data collected at the Cheshunt and HVO Corp Automatic Weather Stations (AWS) during 2022.

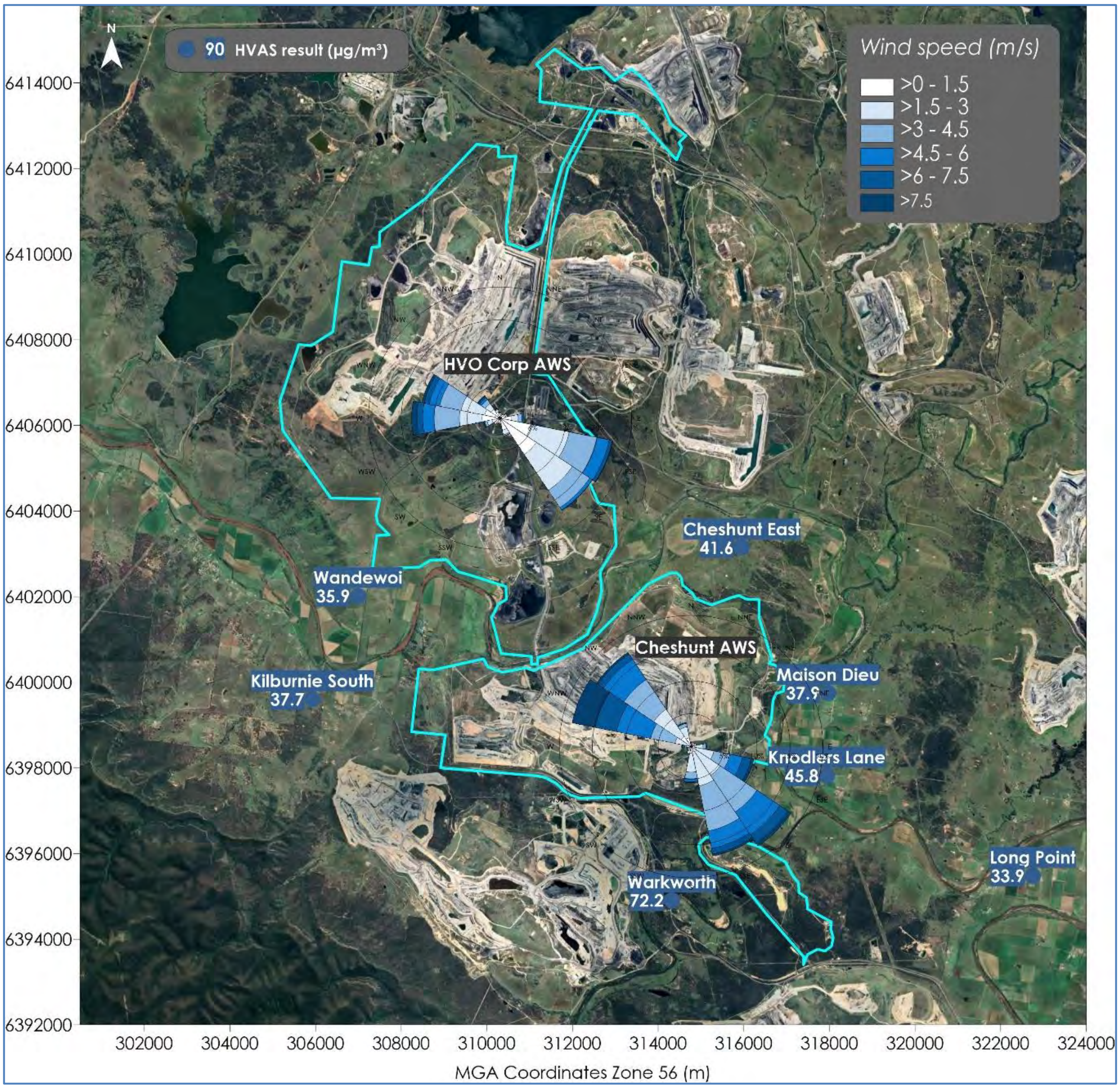

Figure 2-4: TSP HVAS results for 2022

2.5.1 TSP Investigation

The aim of this analysis is to determine the potential contribution of HVO North and HVO South to the 2022 annual average TSP levels recorded at the HVO HVAS monitors.

The contributions at the TSP HVAS monitors were estimated to be the 24-hour concentrations recorded at each monitor minus an estimated background level on the corresponding day. The background level in this context is considered to be the level which excludes the contribution from HVO but may include the influence of other sources, including other mines, localised sources, or regional sources of background dust.

For days when the monitor was not downwind of HVO North/ South (i.e. <5% downwind), the HVO North/ South contribution to this monitor was considered to be zero. Where the monitor was downwind of HVO North/ South for some part of the day, the background levels for that day were taken to be the average level recorded by the monitors in the local network which were downwind for less than 15% of the time.

For the Warkworth monitor, which is often downwind of HVO South and a neighbouring mine concurrently, the daily contribution is considered to include both mines. In order to determine the contribution from HVO South alone, the combined mining increment was scaled by the proportion of time the monitor was downwind of HVO South relative to the total time the monitor was downwind of both mines during each 24-hour average period.

Note that the 24-hour average contributions presented in this analysis are estimated using a simplistic and conservative method based on the daily contributions and would likely overestimate the HVO North/ South actual 24-hour average contribution. Where the downwind angle of the monitor from HVO North and South overlap, the estimated contributions for each HVO North and HVO South would include the influence of the other. Furthermore, the approach does not factor in dispersion of pollutants with distance, thus a more distant mine can make the same contribution as a closer mine for the same wind angle. This leads to calculating much higher contributions than may possibly be the actual case. Therefore, the data presented should only be used for estimating levels on an annual average basis.

Table 2-5 presents the annual average TSP levels recorded in 2022 and HVO's estimated contribution to the annual average TSP levels, for each analysis. **Appendix A** shows the 24-hour average TSP levels and the estimated TSP contribution of HVO North and HVO South where relevant at each of the HVO monitors for each monitoring day of 2022.

Table 2-5: HVO's estimated contribution and annual average TSP levels 2022

Location	HVO Compliance (level) (µg/m³)	Measured annual average TSP level (µg/m³)	Estimated contribution to annual average TSP level (µg/m³)	
			HVO North	HVO South
Cheshunt East	North (90)	41.6	16.4	-
Warkworth	South (90)	72.2	-	21.5
Wandewoi	-	35.9	-	-
Maison Dieu	South (90)	37.9	-	11.0
Long Point	South (90)	33.9	-	7.7
Knodlers Lane	South (90)	45.8	-	15.1
Kilburnie South	North (90) & South (90)	37.7	1.7	9.4

2.6 PM_{10} Data

Figure 2-5 and **Figure 2-6** present the 24-hour average HVO PM_{10} HVAS and PM_{10} TEOM results recorded during 2022 respectively. The HVAS and TEOM PM_{10} data show reasonably similar trends through 2022. The figures show that on occasion in 2022, 24-hour average PM_{10} levels above the criteria were recorded. The elevated results at compliance monitors were assessed through specific investigations conducted throughout the year, as summarised in **Table B-1** of **Appendix B**.

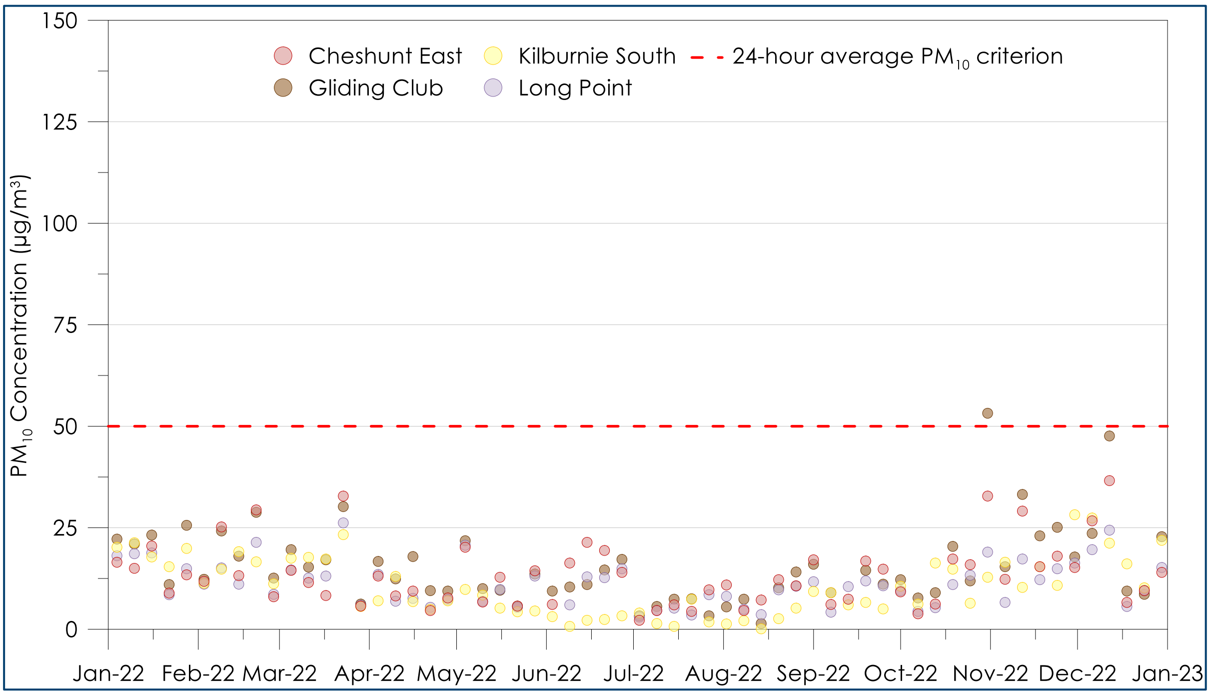

Figure 2-5: 24-hour average PM_{10} HVAS results for 2022

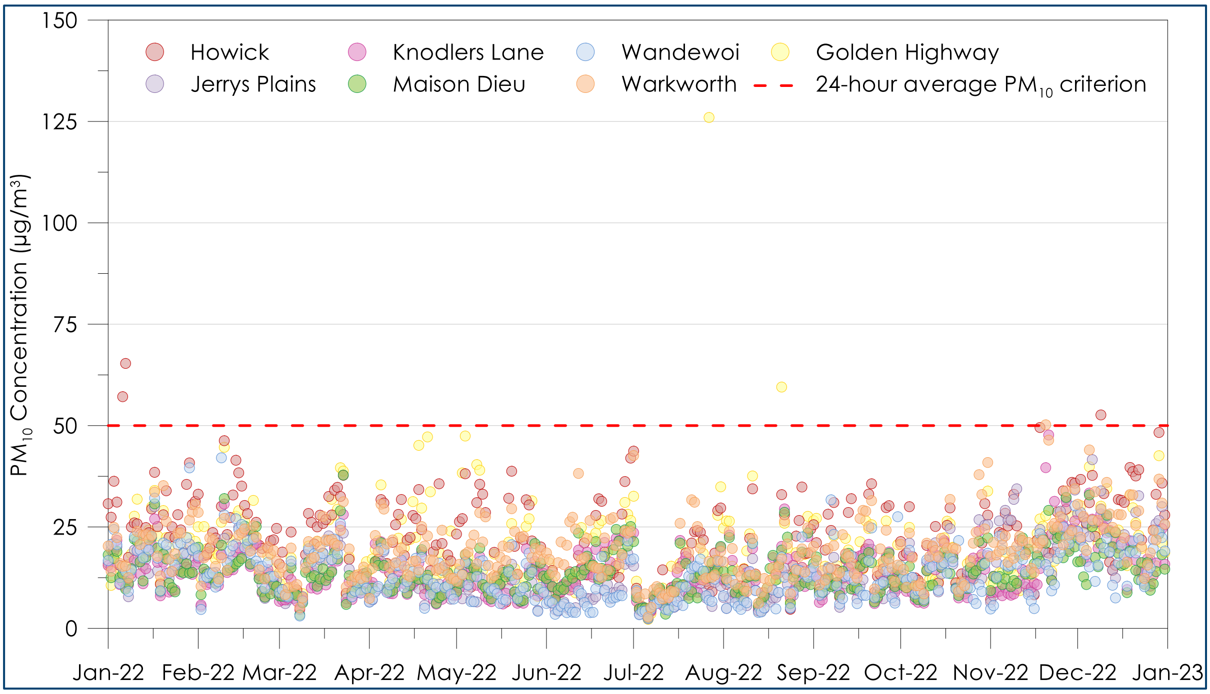

Figure 2-6: 24-hour average PM_{10} TEOM results for 2022

Table 2-6 includes a summary of all the annual average HVAS and TEOM PM_{10} monitoring data for the general HVO area in 2022. With regard to the HVAS PM_{10} and TEOM PM_{10} annual average data, obviously erroneous data, data with error codes and monitors which contain less than 75% data have not been included in **Table 2-6**.

Note for this annual review, TEOM data time was assessed per Australian Eastern Standard Time (AEST) as used by DPE, however some minor differences arise with the operational data which uses Australian Eastern Daylight Time (AEDT). Some minor differences also arise as HVO collects data in real-time from DPE monitors using a separate HVO logger which may result in minor additional time shift effect.

The table shows that the TEOM and HVAS monitors recorded annual average PM_{10} levels below the relevant criteria in 2022.

Table 2-6: HVAS and TEOM PM_{10} annual average monitoring data – 2022

Location	Measured HVAS PM_{10} (µg/m³)	Measured TEOM PM_{10} (µg/m³)
Wandewoi	-	13.5
Golden Highway	-	18.8
Howick	-	21.1
Knodlers Lane	-	13.9
Warkworth	-	19.3
Jerrys Plains	-	13.3
Maison Dieu	-	14.0
Cheshunt East	13.4	-
Gliding Club	15.6	-
Long Point	11.3	-
Kilburnie South	10.5*	-

*No readings available at Kilburnie South on 4/1/2023 and 10/1/2023 as the monitor was away for maintenance. As agreed with DPE, the missing Kilburnie South data has been supplemented with the Moses Crossing data from United Wambo.

Table 2-7 summarises the Upper Hunter Air Quality Monitoring Network (UHAQMN) PM_{10} annual average data for the 2022 period. The monitoring data for the 2022 review period show that the levels recorded by the UHAQMN network were similar to those recorded by the monitors surrounding HVO, with all the monitors recording levels below 25µg/m³.

Table 2-7: UHAQMN PM_{10} levels – 2022

Monitor	Measured PM_{10} level (µg/m³)
Muswellbrook	16.6
Singleton	14.5
Maison Dieu	14.0
Camberwell	16.0
Singleton NW	15.2
Mount Thorley	14.2
Bulga	10.6
Muswellbrook NW	14.3
Wybong	11.7
Aberdeen	12.3
Singleton South	14.0
Jerrys Plains	13.3
Warkworth	19.3
Merriwa	11.2

Annual average PM_{10} levels during the 2022 period are shown in **Figure 2-7**. The figure includes annual windrose plots of the meteorological data collected at the Cheshunt and HVO Corp Automatic Weather Stations (AWS) during 2022.

Figure 2-7: Annual average HVAS and TEOM PM_{10} results for 2022

2.6.1 PM_{10} Investigation

The aim of this analysis is to determine the potential contribution of HVO North and HVO South to the 2022 annual average PM_{10} levels recorded at the HVO TEOM and HVAS monitors.

The HVO North and HVO South contributions to the TEOM monitors were estimated on an hourly basis. The hourly contributions were estimated as the concentrations recorded at each monitor minus an estimated background level (average of upwind monitors) for the corresponding hour. The contribution for a given hour was considered to be zero where the monitor was not downwind of HVO (North/ South) for that hour. Where all monitors were downwind of HVO North/South (based on the representative Cheshunt or HVO Corp weather station), the minimum value recorded was selected as the background for that hour. The hourly contributions were then averaged for each 24-hour period to determine the 24-hour contributions from HVO North and HVO South.

The contributions at the HVAS monitors were estimated to be the 24-hour concentrations recorded at each monitor minus an estimated background level on the corresponding day.

The background level in this context is considered to be the level which excludes the contribution from HVO but may include the influence of other sources, including other mines, localised sources, or regional sources of background dust.

For days when the monitor was not downwind of HVO North/ South (i.e. <5% downwind), the HVO North/ South contribution to this monitor was considered to be zero. Where the monitor was downwind of HVO North/ South for some part of the day, the background levels for that day were taken to be the average level recorded by the monitors in the local network which were downwind for less than 15% of the time.

Note that the 24-hour average contributions presented in this analysis are estimated using a simple, conservative method based on the daily contributions and would likely overestimate the HVO North/ South actual 24-hour average contribution. Where the downwind angle of the monitor from HVO North and South overlap, the estimated contributions for each HVO North and HVO South would include the influence of the other. Furthermore, the approach does not factor in dispersion of pollutants with distance, thus a more distant mine can make the same contribution as a closer mine for the same wind angle. This leads to calculating much higher contributions than may possibly be the actual case. Therefore, the data presented in this section should only be used for conservatively estimating levels on an annual average basis. A more detailed analysis was conducted for some days where levels exceed the 24-hour average criterion.

Table 2-8 presents the annual average PM_{10} levels recorded in 2022 and HVO's estimated contribution to the annual average PM_{10} levels, for each analysis. **Appendix B** shows the 24-hour average PM_{10} levels and the estimated PM_{10} contribution of HVO North and HVO South where relevant at each of the HVO monitors for each monitoring day of 2022. Days in which HVO's contribution were already estimated (analyses for elevated 24-hour average readings) are presented in **Table B-1** of **Appendix B** and were used where possible. It is noted that the 24-hour TEOM values presented in **Table B-1** are based on the raw AEST readings.

Table 2-8: HVO's maximum estimated contribution and annual average PM_{10} levels 2022

Location	Monitor Type	HVO Compliance (level) (µg/m³)	Measured annual average PM_{10} level (µg/m³)	Estimated contribution to annual average PM_{10} level (µg/m³)	
				HVO North	HVO South
Wandewoi	TEOM	North (30) & South (25)	13.5	0.1	1.5
Golden Highway	TEOM	-	18.8	-	-
Howick	TEOM	-	21.1	-	-
Knodlers Lane	TEOM	South (25)	13.9	-	1.3
Warkworth	TEOM	South (25)	19.3	-	1.2
Jerrys Plains	TEOM	North (30) & South (25)	13.3	0.3	1.2
Maison Dieu	TEOM	South (25)	14.0	-	0.5
Cheshunt East	HVAS	North (30)	13.4	2.9	-
Gliding Club	HVAS	South (25)	15.6	-	3.9
Long Point	HVAS	South (25)	11.3	-	0.8
Kilburnie South	HVAS	North (30) & South (25)	10.5*	0.2	0.7

*No readings available at Kilburnie South on 4/1/2023 and 10/1/2023 as the monitor was away for maintenance. As agreed with DPE, the missing Kilburnie South data has been supplemented with the Moses Crossing data from United Wambo.

2.7 $PM_{2.5}$ Data

Figure 2-8 presents the 24-hour average $PM_{2.5}$ HVAS results recorded during 2022 for Kilburnie South and Maison Dieu. The figures show that two results above criteria were recorded during 2022. The results were assessed through investigation, as summarised in **Table C-1** of **Appendix C**, and were found to have not been significantly contributed to by HVO.

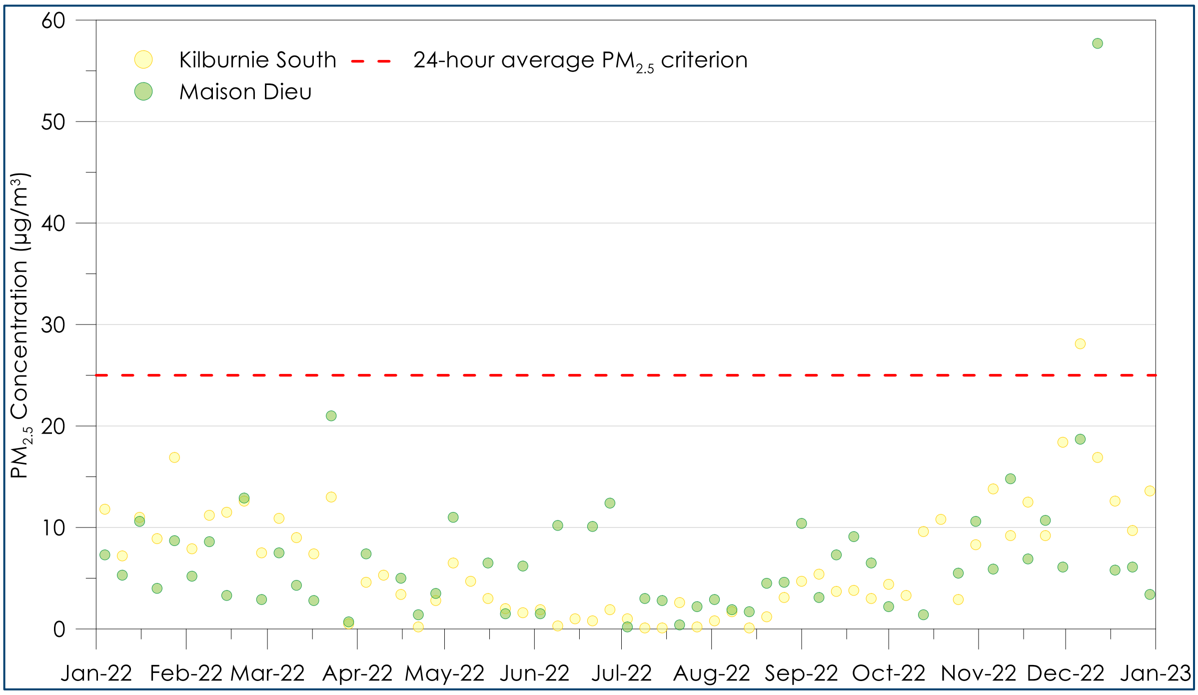

Figure 2-8: Kilburnie South and Maison Dieu 24-hour average $PM_{2.5}$ HVAS results for 2022

Table 2-9 includes the annual average HVAS $PM_{2.5}$ monitoring data for Maison Dieu and Kilburnie South in 2022. The monitoring data for the 2022 review period show that the HVO monitors recorded levels below 8µg/m³.

Table 2-9: HVAS $PM_{2.5}$ annual average monitoring data – 2022

Location	Measured HVAS $PM_{2.5}$ (µg/m³)
Maison Dieu	7.1
Kilburnie South	6.6

Table 2-10 includes the UHAQMN $PM_{2.5}$ annual average data for the 2022 period. The monitoring data for the 2022 review period show that the UHAQMN monitors recorded levels below 8µg/m³.

Table 2-10: UHAQMN $PM_{2.5}$ levels – 2022

Monitor	Measured $PM_{2.5}$ level (µg/m³)
Muswellbrook	6.2
Singleton	5.1
Camberwell	4.8
Merriwa	3.4

The annual average $PM_{2.5}$ levels during the 2022 period are shown at their monitor locations in **Figure 2-9**. The figure also includes annual windrose plots of the meteorological data collected at the Cheshunt and HVO Corp Automatic Weather Stations (AWS) during 2022.

Figure 2-9: HVAS $PM_{2.5}$ results for 2022

The data in **Table 2-9** and **Table 2-10** show that the $PM_{2.5}$ HVAS results recorded at Maison Dieu were high in comparison to the results recorded by the DPE monitoring stations. This is unusual considering both Kilburnie South and Maison Dieu monitors are situated away from any known significant sources of $PM_{2.5}$ (mines generate emissions in the coarser PM_{10} range), whereas the Muswellbrook, and to a lesser extent Singleton and Camberwell monitors, are known to be impacted by localised smoke from wood heaters. This is highlighted further in **Table 2-11** which shows the ratio of $PM_{2.5}$ / PM_{10} levels in the Upper Hunter since 2015. Both HVO monitors recorded higher $PM_{2.5}$ / PM_{10} ratios in 2022 than any other Upper Hunter monitor.

The $PM_{2.5}$ / PM_{10} ratios in 2022 for the Maison Dieu and Kilburnie South monitor are implausibly high for this locality, indicating a likely problem with the data. This is considered in more detail below.

Table 2-11: $PM_{2.5}$ / PM_{10} ratios in Upper Hunter

Year	$PM_{2.5}$ / PM_{10} ratio					
	Muswellbrook	Singleton	Camberwell	Merriwa	Maison Dieu	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
2022	0.39	0.36	0.32	0.31	0.40	0.57

- Not Applicable

Figure 2-10 shows how the $PM_{2.5}$ / PM_{10} ratios fluctuated over the year. Both locations at times recorded $PM_{2.5}$ levels which were higher than the recorded PM_{10} levels (i.e. $PM_{2.5}$ / PM_{10} ratio > 1), which in reality is not possible given that $PM_{2.5}$ is a sub-component of PM_{10}. This may be explained at Maison Dieu by the different measurement technology (TEOM) used to measure PM_{10}, which can result in slight differences in results, however at Kilburnie South both co-located $PM_{2.5}$ and PM_{10} measurements are conducted using the same reference standard of HVAS monitors.

The $PM_{2.5}$ / PM_{10} ratios at Maison Dieu and Kilburnie South were 0.40 and 0.57 on average for the whole year in 2022. Typically, the normal $PM_{2.5}$ / PM_{10} ratio of background particulate data is approximately 0.36 (**TAS, 2019**). Particulate emissions from HVO have a ratio of approximately 0.13 and Hunter Valley coal mines on average have a ratio of 0.15 (**PEL, 2014**). During only the wintertime in Muswellbrook, when air quality is significantly impacted by the $PM_{2.5}$ content of the local wood-heater smoke, and average $PM_{2.5}$ / PM_{10} ratio (for eight winters) is 0.68, but can be approximately 0.8 in some winters.

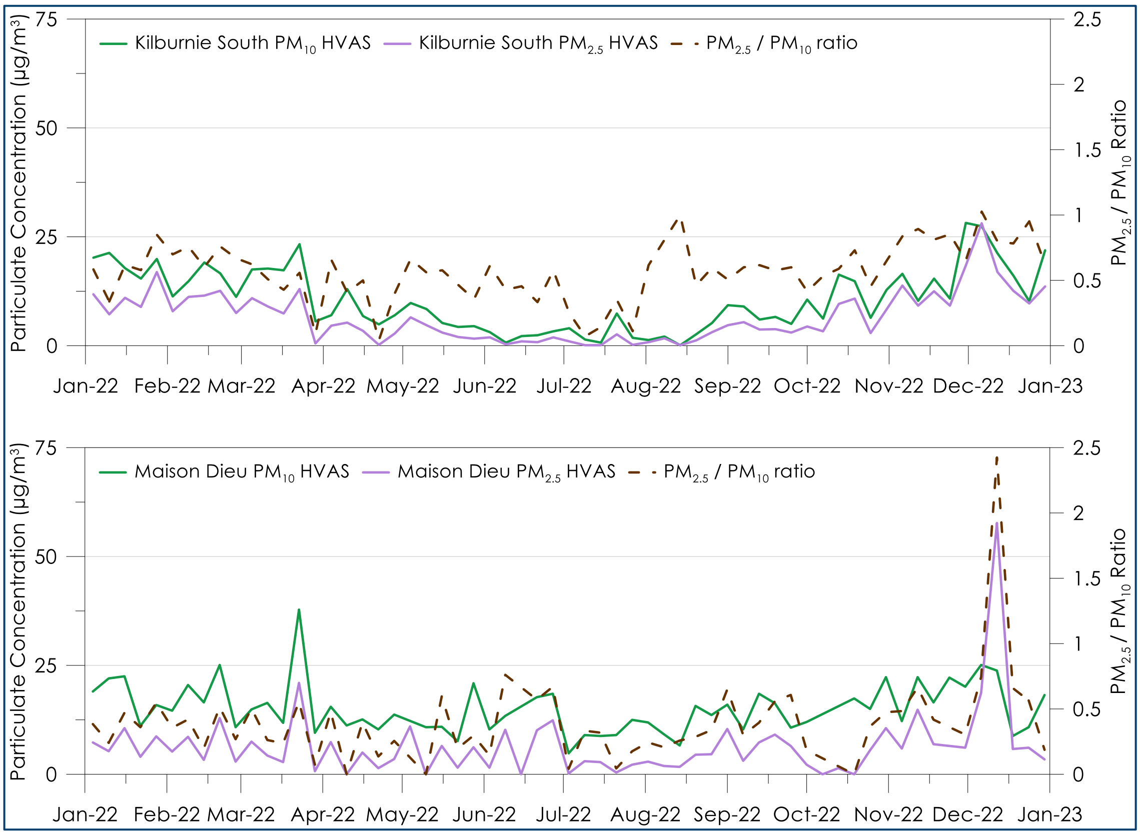

Figure 2-10: HVO $PM_{2.5}$ and PM_{10} data on HVAS run days in 2022

The high $PM_{2.5}$ / PM_{10} ratios, combined with the unusually high $PM_{2.5}$ results, indicate that there may be an issue (i.e. an overestimation) with the $PM_{2.5}$ measurements.

HVO engaged Jacobs to review the air quality monitoring network. Per the recommendations of the review, HVO are proposing that the $PM_{2.5}$ monitoring method be transition to BAM real-time monitoring in 2023 in line with the DPE $PM_{2.5}$ monitoring.

2.7.1 $PM_{2.5}$ Investigation

Even though the results recorded at Maison Dieu and Kilburnie South appear to be implausibly high, they have been used in order to estimate HVO South's increment to the recorded levels.

The aim of this analysis is to determine the potential contribution of HVO South to the 2022 annual average $PM_{2.5}$ levels recorded at the HVO HVAS monitors.

The contributions at the HVAS monitors were estimated to be the 24-hour concentrations recorded at each monitor minus an estimated background level on the corresponding day.

The background level in this context is considered to be the level which excludes the contribution from HVO but may include the influence of other sources, including other mines, localised sources, or regional sources of background dust.

For days when the monitor was not downwind of HVO South (i.e. <5% downwind), the HVO South contribution to this monitor was considered to be zero. Where the monitor was downwind of HVO South for some part of the day, the background levels for that day were taken to be the average level recorded by the upwind monitor. If the other $PM_{2.5}$ HVAS was not upwind (i.e. >5% downwind), the average of the levels recorded at Camberwell and Singleton were used as background.

Note that the 24-hour average contributions presented in this analysis are estimated using a simplistic and conservative method based on the daily contributions and would likely overestimate the HVO South actual 24-hour average contribution. Therefore, the data presented in this section should only be used for conservatively estimating levels on an annual average basis. A more detailed analysis was conducted for some days where levels exceeded the 24-hour average criterion. Days in which HVO South's contribution were already estimated (analyses for elevated 24-hour average readings) are presented in **Table C-1** of **Appendix C**.

Table 2-12 presents the annual average $PM_{2.5}$ levels recorded in 2022 and HVO South's estimated contribution to the annual average $PM_{2.5}$ levels. **Table C-2** of **Appendix C** shows the 24-hour average $PM_{2.5}$ levels and the estimated $PM_{2.5}$ contribution of HVO South at each of the HVO monitors for each monitoring day of 2022.

Table 2-12: HVO South's estimated contribution and annual average $PM_{2.5}$ levels 2022

Location	Monitor Type	Compliance (level) (µg/m³)	Measured annual average $PM_{2.5}$ level (µg/m³)	Estimated contribution to annual average $PM_{2.5}$ level (µg/m³)
Maison Dieu	HVAS	8 (HVO South)	7.1	1.8
Kilburnie South	HVAS	8 (HVO South)	6.6	2.3

Table 2-8 indicates that maximum HVO contributions, would have been:

- 1.8µg/m^3 or 25% of the 7.1µg/m^3 from HVO South at the Maison Dieu HVAS in 2022; and,
- 2.3µg/m^3 or 35% of the 6.6µg/m^3 from HVO South at the Kilburnie South HVAS in 2022.

The high results at Maison Dieu and Kilburnie South are unlikely in a rural setting away from a town, which further indicates (in addition to the issues discussed above) that the $PM_{2.5}$ HVAS results may not be reliable.

However, reliable or not, even if the implausibly high data are taken on face value, the analysis shows that the effect of the mine on $PM_{2.5}$ levels is relatively low at 25% to 35% of the measured level.

3 CONCLUSIONS

This investigation has reviewed the annual average deposited dust, TSP, PM_{10}, and $PM_{2.5}$ levels recorded at HVO during the 2022 calendar year.

An annual average deposited dust level above the cumulative criterion of 4g/m^2/month was recorded at the Warkworth monitor, however the analysis indicates that HVO North's contribution to this level was well below the 2g/m^2/month incremental criterion and that the total level would have been over 4g/m^2/month regardless of any contribution from HVO North.

The annual average TSP, PM_{10} and $PM_{2.5}$ levels were below the relevant criteria at all compliance monitoring locations.

4 REFERENCES

PEL (2014)

"Upper Hunter Air Quality Particle Model", Pacific Environment Limited, October 2014.

TAS (2019)

"Investigation into $PM_{2.5}/PM_{10}$ ratios for Hunter Valley Operations", Todoroski Air Sciences, March 2019.

Appendix A

24-hour Average Levels and Estimated Contributions - TSP

Table A-1: 24-hour average TSP HVAS levels, percent time downwind and estimated contributions – HVO North

Date	Percentage of time downwind (%)							24-hour average TSP level (µg/m³)								HVO North's estimated max. contribution to TSP level (µg/m³)	
	Cheshunt East	Warkworth	Wandewoi	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South	Estimated Background	Cheshunt East	Warkworth	Wandewoi	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South	Cheshunt East	Kilburnie South
4/01/2022	0%	0%	0%	0%	0%	0%	0%	51.1	41.2	48.7	66.4	40.2	48.0	77.4	69.7	0.0	0.0
10/01/2022	4%	1%	3%	2%	1%	1%	0%	50.1	38.1	81.2	58.2	41.5	42.7	35.1	59.0	0.0	0.0
16/01/2022	28%	2%	1%	27%	24%	26%	0%	42.3	53.7	65.0	49.9	51.0	42.3	-	52.4	11.4	0.0
22/01/2022	0%	0%	5%	0%	0%	0%	1%	28.0	24.3	35.1	53.2	24.3	21.1	35.4	68.8	0.0	0.0
28/01/2022	0%	1%	7%	0%	0%	0%	1%	45.9	32.3	78.4	74.1	36.6	33.9	48.3	71.9	0.0	0.0
3/02/2022	0%	0%	0%	0%	0%	0%	0%	39.4	34.9	39.6	31.6	37.4	30.3	45.3	48.8	0.0	0.0
9/02/2022	35%	8%	16%	35%	22%	33%	8%	42.1	64.5	52.8	43.9	50.7	44.7	54.7	42.1	22.4	0.0
15/02/2022	1%	0%	10%	1%	1%	1%	4%	43.1	34.0	56.1	56.0	28.6	32.7	64.1	65.9	0.0	0.0
21/02/2022	50%	6%	1%	31%	8%	15%	1%	43.2	93.6	136.0	43.0	69.3	71.2	65.3	43.4	50.4	0.0
27/02/2022	0%	0%	0%	0%	0%	0%	0%	22.6	16.6	46.4	39.9	16.7	15.6	17.5	45.0	0.0	0.0
5/03/2022	7%	3%	10%	6%	1%	5%	4%	29.4	24.9	46.5	-	27.2	22.0	26.5	38.3	0.0	0.0
11/03/2022	0%	0%	5%	0%	0%	0%	3%	31.7	25.8	42.8	37.7	27.6	31.3	30.8	58.9	0.0	0.0
17/03/2022	6%	7%	18%	7%	3%	10%	13%	31.3	19.3	52.2	43.8	18.3	46.9	19.6	44.6	0.0	13.3
23/03/2022	60%	2%	0%	53%	37%	42%	0%	51.8	103.0	87.2	51.8	84.0	73.5	90.2	58.8	51.2	0.0
29/03/2022	0%	0%	0%	0%	0%	0%	0%	11.1	11.7	15.4	15.3	9.4	10.3	10.8	9.0	0.0	0.0
4/04/2022	94%	1%	2%	63%	44%	49%	1%	19.5	37.7	87.8	21.4	41.3	36.4	56.1	17.5	18.3	0.0
10/04/2022	1%	2%	6%	1%	0%	1%	1%	25.8	18.3	33.9	38.2	18.2	14.2	22.6	47.4	0.0	0.0
16/04/2022	26%	7%	4%	27%	10%	26%	2%	21.8	33.0	44.5	32.5	30.1	-	38.8	21.8	11.2	0.0
22/04/2022	0%	0%	0%	0%	0%	0%	0%	28.9	25.1	38.9	22.9	21.7	25.0	34.0	25.4	0.0	0.0
28/04/2022	20%	14%	13%	14%	8%	14%	6%	14.2	17.8	23.3	10.1	23.3	14.2	25.4	15.6	3.6	1.4
4/05/2022	60%	11%	7%	61%	35%	53%	5%	25.1	54.4	76.8	24.7	53.1	61.0	57.8	25.4	29.4	0.0
10/05/2022	0%	0%	1%	0%	0%	0%	1%	34.8	27.3	65.2	45.6	23.6	24.1	33.9	31.0	0.0	0.0
16/05/2022	97%	3%	0%	79%	47%	55%	0%	10.8	46.1	118.0	12.0	26.6	24.4	29.0	9.5	35.4	0.0
22/05/2022	0%	0%	18%	0%	0%	0%	6%	18.1	20.3	23.8	17.5	14.4	16.0	16.1	15.0	0.0	0.0
28/05/2022	84%	15%	0%	88%	54%	72%	0%	10.7	75.3	75.9	11.4	55.9	40.0	46.4	9.9	64.7	0.0
3/06/2022	92%	4%	2%	85%	56%	65%	1%	6.5	49.1	135.0	7.3	35.2	32.3	37.9	5.6	42.7	0.0
9/06/2022	100%	0%	0%	83%	26%	26%	0%	3.7	60.2	180.0	4.4	43.3	24.6	23.8	2.9	56.6	0.0
15/06/2022	100%	0%	1%	84%	49%	50%	0%	5.3	87.8	210.0	5.5	63.1	57.9	61.8	5.1	82.5	0.0
21/06/2022	85%	10%	0%	88%	47%	63%	0%	10.1	78.4	158.0	12.1	58.8	52.7	66.3	8.0	68.4	0.0

Date	Percentage of time downwind (%)							24-hour average TSP level (µg/m³)								HVO North's estimated max. contribution to TSP level (µg/m³)	
	Cheshunt East	Warkworth	Wandewoi	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South	Estimated Background	Cheshunt East	Warkworth	Wandewoi	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South	Cheshunt East	Kilburnie South
27/06/2022	42%	3%	2%	45%	28%	47%	1%	8.7	63.2	91.0	16.5	64.1	56.6	75.9	8.7	54.5	0.0
3/07/2022	90%	2%	1%	90%	81%	85%	1%	27.3	11.4	22.5	5.2	12.2	13.3	15.6	49.4	0.0	0.0
9/07/2022	90%	4%	3%	93%	63%	72%	1%	4.4	15.8	-	5.7	43.3	14.8	16.8	3.1	11.4	0.0
15/07/2022	65%	23%	3%	83%	33%	74%	0%	4.0	30.1	49.9	3.6	23.6	20.3	31.2	4.3	26.2	0.0
21/07/2022	0%	0%	0%	0%	0%	0%	0%	26.0	8.8	60.5	36.8	28.9	10.4	21.6	31.8	0.0	0.0
27/07/2022	99%	0%	0%	90%	42%	44%	0%	7.3	37.1	15.5	4.6	28.6	29.1	37.6	10.0	29.8	0.0
2/08/2022	86%	8%	3%	75%	47%	58%	0%	15.6	40.2	61.0	25.6	31.9	30.3	41.7	5.5	24.7	0.0
8/08/2022	31%	19%	7%	40%	10%	48%	2%	13.0	21.7	40.8	8.8	24.5	17.4	30.8	8.5	8.8	0.0
14/08/2022	100%	0%	0%	85%	19%	19%	0%	3.3	28.0	40.9	3.5	17.6	15.9	17.5	3.0	24.8	0.0
20/08/2022	97%	1%	0%	90%	44%	48%	0%	7.5	73.1	98.8	7.9	47.4	38.4	57.9	7.0	65.7	0.0
26/08/2022	8%	18%	15%	11%	3%	20%	5%	36.5	39.3	39.2	39.3	37.4	32.8	54.9	25.0	2.8	0.0
1/09/2022	22%	8%	20%	17%	9%	15%	9%	29.0	49.0	50.8	39.9	53.9	29.0	58.1	29.5	20.0	0.5
7/09/2022	3%	11%	24%	8%	1%	13%	16%	21.7	21.3	34.0	41.4	17.8	15.4	32.4	37.7	0.0	16.0
13/09/2022	39%	2%	7%	41%	20%	41%	5%	27.6	39.6	94.0	30.1	44.2	36.9	51.9	27.6	12.0	0.0
19/09/2022	92%	0%	0%	70%	12%	13%	0%	51.8	56.0	122.0	17.0	43.1	40.4	66.3	16.4	4.2	0.0
25/09/2022	81%	3%	1%	63%	35%	41%	1%	23.0	52.6	74.8	25.3	33.7	29.4	39.9	20.6	29.7	0.0
1/10/2022	0%	0%	0%	0%	0%	0%	0%	30.9	25.7	49.2	53.3	25.6	24.0	30.2	47.3	0.0	0.0
7/10/2022	12%	3%	9%	10%	5%	8%	6%	10.5	9.4	15.5	22.8	11.3	8.8	12.2	20.0	0.0	9.5
13/10/2022	0%	0%	7%	0%	0%	0%	3%	25.6	13.9	34.8	74.7	24.0	13.5	41.9	66.0	0.0	0.0
19/10/2022	26%	1%	22%	23%	14%	19%	15%	33.6	39.5	50.7	54.0	45.9	33.6	56.8	44.9	5.9	11.3
25/10/2022	88%	7%	5%	78%	53%	60%	2%	24.7	44.0	78.0	24.2	38.6	38.4	46.1	25.2	19.3	0.0
31/10/2022	75%	8%	8%	72%	33%	46%	3%	45.8	74.1	162.0	34.3	58.0	64.8	79.1	45.8	28.3	0.0
6/11/2022	8%	2%	6%	10%	4%	8%	1%	36.1	26.4	56.4	58.5	-	28.0	33.6	64.1	0.0	0.0
12/11/2022	46%	9%	12%	43%	27%	43%	6%	41.6	82.2	81.1	29.6	67.2	53.4	73.5	41.6	40.6	0.0
18/11/2022	3%	7%	13%	6%	1%	7%	8%	59.0	53.9	84.8	64.8	47.0	46.9	62.5	65.9	0.0	6.9
24/11/2022	54%	13%	1%	53%	26%	47%	1%	43.2	62.5	82.4	47.0	58.5	57.1	77.7	43.2	19.3	0.0
30/11/2022	0%	0%	1%	0%	0%	0%	0%	49.1	29.0	71.5	75.8	36.9	34.9	73.4	96.5	0.0	0.0
6/12/2022	3%	0%	17%	1%	0%	0%	12%	74.5	67.2	82.8	75.3	66.3	62.4	93.8	117.0	0.0	42.5
12/12/2022	85%	4%	1%	60%	36%	44%	1%	71.1	93.6	-	68.9	95.9	67.6	99.6	73.2	22.6	0.0
18/12/2022	0%	0%	5%	0%	0%	0%	2%	32.9	27.9	-	70.0	30.0	27.8	45.9	102.0	0.0	0.0

Date	Percentage of time downwind (%)							24-hour average TSP level (µg/m³)								HVO North's estimated max. contribution to TSP level (µg/m³)	
	Cheshunt East	Warkworth	Wandewoi	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South	Estimated Background	Cheshunt East	Warkworth	Wandewoi	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South	Cheshunt East	Kilburnie South
24/12/2022	72%	0%	9%	63%	40%	43%	5%	18.7	23.6	37.0	30.3	18.7	21.2	31.4	45.3	4.9	0.0
30/12/2022	0%	0%	0%	0%	0%	0%	0%	81.7	31.0	254.0	129.0	26.4	29.7	67.6	96.7	0.0	0.0

- No data

Table A-2: 24-hour average TSP HVAS levels, percent time downwind and estimated contributions – HVO South

Date	Percentage of time downwind (%)							24-hour average TSP level (µg/m³)								HVO South's estimated max. contribution to TSP level (µg/m³)				
	Cheshunt East	Warkworth	Wandewoi	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South	Estimated Background	Cheshunt East	Warkworth	Wandewoi	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South	Warkworth	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South
4/01/2022	0%	0%	100%	0%	0%	0%	52%	51.1	41.2	48.7	66.4	40.2	48.0	77.4	69.7	0.0	0.0	0.0	0.0	18.6
10/01/2022	10%	2%	77%	11%	1%	6%	18%	50.1	38.1	81.2	58.2	41.5	42.7	35.1	59.0	0.0	0.0	0.0	0.0	8.9
16/01/2022	1%	28%	56%	4%	5%	27%	24%	42.3	53.7	65.0	49.9	51.0	42.3	-	52.4	19.7	0.0	0.0	-	10.1
22/01/2022	0%	0%	92%	0%	0%	0%	42%	28.0	24.3	35.1	53.2	24.3	21.1	35.4	68.8	0.0	0.0	0.0	0.0	40.8
28/01/2022	2%	1%	85%	1%	0%	0%	32%	45.9	32.3	78.4	74.1	36.6	33.9	48.3	71.9	0.0	0.0	0.0	0.0	26.0
3/02/2022	0%	0%	99%	0%	0%	0%	8%	39.4	34.9	39.6	31.6	37.4	30.3	45.3	48.8	0.0	0.0	0.0	0.0	9.4
9/02/2022	8%	36%	30%	15%	8%	31%	5%	42.1	64.5	52.8	43.9	50.7	44.7	54.7	42.1	7.4	8.6	2.6	12.6	0.0
15/02/2022	1%	1%	82%	1%	0%	1%	31%	43.1	34.0	56.1	56.0	28.6	32.7	64.1	65.9	0.0	0.0	0.0	0.0	22.8
21/02/2022	14%	17%	12%	51%	34%	49%	3%	43.2	93.6	136.0	43.0	69.3	71.2	65.3	43.4	23.0	26.1	28.0	22.1	0.0
27/02/2022	0%	0%	100%	0%	0%	0%	22%	22.6	16.6	46.4	39.9	16.7	15.6	17.5	45.0	0.0	0.0	0.0	0.0	22.4
5/03/2022	3%	7%	70%	5%	3%	5%	21%	29.4	24.9	46.5	-	27.2	22.0	26.5	38.3	10.0	0.0	0.0	0.0	8.9
11/03/2022	0%	0%	92%	0%	0%	0%	47%	31.7	25.8	42.8	37.7	27.6	31.3	30.8	58.9	0.0	0.0	0.0	0.0	27.2
17/03/2022	1%	13%	64%	3%	2%	6%	13%	31.3	19.3	52.2	43.8	18.3	46.9	19.6	44.6	17.3	0.0	0.0	0.0	13.3
23/03/2022	0%	42%	36%	19%	28%	58%	22%	51.8	103.0	87.2	51.8	84.0	73.5	90.2	58.8	24.5	32.2	21.7	38.4	7.0
29/03/2022	1%	0%	98%	0%	0%	0%	10%	11.1	11.7	15.4	15.3	9.4	10.3	10.8	9.0	0.0	0.0	0.0	0.0	0.0
4/04/2022	2%	49%	1%	47%	40%	91%	1%	19.5	37.7	87.8	21.4	41.3	36.4	56.1	17.5	34.7	21.9	17.0	36.7	0.0
10/04/2022	3%	3%	63%	0%	0%	0%	8%	25.8	18.3	33.9	38.2	18.2	14.2	22.6	47.4	0.0	0.0	0.0	0.0	21.6
16/04/2022	7%	31%	51%	6%	3%	15%	12%	21.8	33.0	44.5	32.5	30.1	-	38.8	21.8	18.2	8.3	-	17.0	0.0
22/04/2022	0%	0%	100%	0%	0%	0%	15%	28.9	25.1	38.9	22.9	21.7	25.0	34.0	25.4	0.0	0.0	0.0	0.0	0.0

Date	Percentage of time downwind (%)							24-hour average TSP level (µg/m³)								HVO South's estimated max. contribution to TSP level (µg/m³)				
	Cheshunt East	Warkworth	Wandewoi	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South	Estimated Background	Cheshunt East	Warkworth	Wandewoi	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South	Warkworth	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South
28/04/2022	13%	28%	25%	15%	8%	20%	10%	14.2	17.8	23.3	10.1	23.3	14.2	25.4	15.6	5.2	9.1	0.0	11.2	1.4
4/05/2022	14%	54%	4%	23%	17%	57%	1%	25.1	54.4	76.8	24.7	53.1	61.0	57.8	25.4	33.6	28.1	36.0	32.8	0.0
10/05/2022	0%	0%	99%	0%	0%	0%	20%	34.8	27.3	65.2	45.6	23.6	24.1	33.9	31.0	0.0	0.0	0.0	0.0	0.0
16/05/2022	0%	55%	0%	42%	58%	92%	0%	10.8	46.1	118.0	12.0	26.6	24.4	29.0	9.5	60.5	15.9	13.7	18.3	0.0
22/05/2022	1%	0%	69%	0%	0%	0%	27%	18.1	20.3	23.8	17.5	14.4	16.0	16.1	15.0	0.0	0.0	0.0	0.0	0.0
28/05/2022	0%	74%	1%	22%	35%	81%	1%	10.7	75.3	75.9	11.4	55.9	40.0	46.4	9.9	50.1	45.3	29.4	35.8	0.0
3/06/2022	1%	67%	3%	27%	33%	85%	2%	6.5	49.1	135.0	7.3	35.2	32.3	37.9	5.6	91.7	28.8	25.9	31.5	0.0
9/06/2022	0%	26%	0%	72%	90%	99%	0%	3.7	60.2	180.0	4.4	43.3	24.6	23.8	2.9	47.5	39.7	21.0	20.2	0.0
15/06/2022	0%	50%	0%	47%	67%	99%	1%	5.3	87.8	210.0	5.5	63.1	57.9	61.8	5.1	106.0	57.8	52.6	56.5	0.0
21/06/2022	1%	65%	0%	30%	44%	80%	0%	10.1	78.4	158.0	12.1	58.8	52.7	66.3	8.0	100.4	48.8	42.7	56.3	0.0
27/06/2022	8%	47%	39%	0%	0%	28%	3%	8.7	63.2	91.0	16.5	64.1	56.6	75.9	8.7	81.1	0.0	0.0	67.2	0.0
3/07/2022	3%	85%	3%	3%	21%	88%	0%	27.3	11.4	22.5	5.2	12.2	13.3	15.6	49.4	0.0	0.0	0.0	0.0	0.0
9/07/2022	4%	72%	0%	21%	40%	86%	0%	4.4	15.8	-	5.7	43.3	14.8	16.8	3.1	-	38.9	10.4	12.4	0.0
15/07/2022	4%	78%	1%	14%	17%	48%	1%	4.0	30.1	49.9	3.6	23.6	20.3	31.2	4.3	37.6	19.7	16.4	27.3	0.0
21/07/2022	0%	0%	97%	0%	0%	0%	51%	26.0	8.8	60.5	36.8	28.9	10.4	21.6	31.8	0.0	0.0	0.0	0.0	5.8
27/07/2022	0%	44%	0%	53%	80%	99%	0%	7.3	37.1	15.5	4.6	28.6	29.1	37.6	10.0	3.7	21.3	21.8	30.3	0.0
2/08/2022	0%	61%	2%	34%	48%	83%	1%	15.6	40.2	61.0	25.6	31.9	30.3	41.7	5.5	29.2	16.4	14.8	26.2	0.0
8/08/2022	12%	51%	14%	1%	1%	12%	8%	13.0	21.7	40.8	8.8	24.5	17.4	30.8	8.5	26.1	0.0	0.0	17.9	0.0
14/08/2022	0%	19%	0%	76%	95%	100%	0%	3.3	28.0	40.9	3.5	17.6	15.9	17.5	3.0	7.4	14.4	12.7	14.3	0.0
20/08/2022	1%	48%	0%	51%	54%	94%	0%	7.5	73.1	98.8	7.9	47.4	38.4	57.9	7.0	44.4	40.0	31.0	50.5	0.0
26/08/2022	5%	27%	51%	1%	0%	3%	40%	36.5	39.3	39.2	39.3	37.4	32.8	54.9	25.0	2.5	0.0	0.0	0.0	0.0
1/09/2022	6%	24%	37%	12%	12%	20%	28%	29.0	49.0	50.8	39.9	53.9	29.0	58.1	29.5	14.3	24.9	0.0	29.1	0.5
7/09/2022	0%	19%	63%	0%	0%	1%	16%	21.7	21.3	34.0	41.4	17.8	15.4	32.4	37.7	12.3	0.0	0.0	0.0	16.0
13/09/2022	1%	46%	44%	1%	0%	21%	30%	27.6	39.6	94.0	30.1	44.2	36.9	51.9	27.6	65.4	0.0	0.0	24.3	0.0
19/09/2022	3%	13%	0%	79%	84%	91%	0%	51.8	56.0	122.0	17.0	43.1	40.4	66.3	16.4	9.4	0.0	0.0	14.5	0.0
25/09/2022	1%	44%	2%	41%	45%	77%	1%	23.0	52.6	74.8	25.3	33.7	29.4	39.9	20.6	26.8	10.8	6.5	17.0	0.0
1/10/2022	0%	0%	100%	0%	0%	0%	17%	30.9	25.7	49.2	53.3	25.6	24.0	30.2	47.3	0.0	0.0	0.0	0.0	16.4
7/10/2022	7%	43%	50%	10%	6%	11%	17%	10.5	9.4	15.5	22.8	11.3	8.8	12.2	20.0	4.0	0.8	0.0	1.7	9.5
13/10/2022	1%	0%	81%	0%	0%	0%	14%	25.6	13.9	34.8	74.7	24.0	13.5	41.9	66.0	0.0	0.0	0.0	0.0	40.4
19/10/2022	2%	28%	43%	8%	8%	22%	16%	33.6	39.5	50.7	54.0	45.9	33.6	56.8	44.9	13.2	12.3	0.0	23.2	11.3
25/10/2022	1%	63%	1%	31%	37%	87%	0%	24.7	44.0	78.0	24.2	38.6	38.4	46.1	25.2	35.7	13.9	13.7	21.4	0.0

Date	Percentage of time downwind (%)							24-hour average TSP level (μg/m³)								HVO South's estimated max. contribution to TSP level (μg/m³)				
	Cheshunt East	Warkworth	Wandewoi	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South	Estimated Background	Cheshunt East	Warkworth	Wandewoi	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South	Warkworth	Maison Dieu	Long Point	Knodlers Lane	Kilburnie South
31/10/2022	2%	55%	10%	32%	47%	67%	6%	45.8	74.1	162.0	34.3	58.0	64.8	79.1	45.8	72.9	12.2	19.0	33.3	0.0
6/11/2022	0%	10%	70%	2%	3%	6%	31%	36.1	26.4	56.4	58.5	-	28.0	33.6	64.1	16.7	-	0.0	0.0	28.0
12/11/2022	3%	51%	22%	12%	16%	40%	8%	41.6	82.2	81.1	29.6	67.2	53.4	73.5	41.6	31.8	25.6	11.8	31.9	0.0
18/11/2022	7%	15%	76%	2%	1%	2%	33%	59.0	53.9	84.8	64.8	47.0	46.9	62.5	65.9	20.8	0.0	0.0	0.0	6.9
24/11/2022	1%	51%	23%	19%	19%	45%	3%	43.2	62.5	82.4	47.0	58.5	57.1	77.7	43.2	28.7	15.3	13.9	34.5	0.0
30/11/2022	0%	0%	97%	0%	0%	0%	43%	49.1	29.0	71.5	75.8	36.9	34.9	73.4	96.5	0.0	0.0	0.0	0.0	47.4
6/12/2022	1%	2%	66%	3%	1%	3%	48%	74.5	67.2	82.8	75.3	66.3	62.4	93.8	117.0	0.0	0.0	0.0	0.0	42.5
12/12/2022	1%	44%	0%	55%	41%	86%	0%	71.1	93.6	-	68.9	95.9	67.6	99.6	73.2	-	24.9	0.0	28.6	0.0
18/12/2022	1%	0%	93%	0%	0%	0%	65%	32.9	27.9	-	70.0	30.0	27.8	45.9	102.0	-	0.0	0.0	0.0	69.1
24/12/2022	3%	45%	15%	30%	36%	68%	13%	18.7	23.6	37.0	30.3	18.7	21.2	31.4	45.3	10.8	0.0	2.5	12.7	26.6
30/12/2022	0%	0%	100%	0%	0%	0%	39%	81.7	31.0	254.0	129.0	26.4	29.7	67.6	96.7	0.0	0.0	0.0	0.0	15.0

- No data

Appendix B

24-hour Average Levels and Estimated Contributions - PM_{10}

Table B-1: Detailed analyses for elevated 24-hour average PM_{10} readings

Date	Site	Measured 24-hour average PM_{10} level (µg/m³)	HVO 24-hour average PM_{10} Incremental Criteria (µg/m³)	Estimated HVO Incremental contribution to PM_{10} level (µg/m³)
31/10/2022	Gliding Club HVAS	53.2	50	33.5

Table B-2: 24-hour average PM_{10} TEOM levels, percent time downwind and estimated contributions – HVO North

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
1/01/2022	15.7	30.7	16.1	1.6	1.6	16.7	20.3	0%	67%	38%	0%	0%	17%	0%	1.6	0.0
2/01/2022	10.6	27.4	19.4	2.5	2.5	20.7	14.1	0%	67%	42%	0%	0%	8%	0%	2.5	0.2
3/01/2022	17.5	36.3	21.0	1.1	1.1	24.4	24.9	0%	100%	17%	0%	0%	0%	0%	1.1	0.0
4/01/2022	18.6	31.1	20.1	2.0	2.0	20.6	22.4	0%	100%	29%	0%	0%	0%	0%	2.0	0.0
5/01/2022	14.7	15.5	12.0	0.0	0.0	11.0	16.0	0%	100%	4%	0%	0%	0%	0%	0.0	0.0
6/01/2022	13.5	57.1	12.7	0.1	0.1	15.0	15.3	0%	100%	21%	0%	0%	0%	0%	0.1	0.0
7/01/2022	11.4	65.3	11.8	0.0	0.0	14.0	15.4	0%	92%	0%	0%	0%	4%	4%	0.0	0.0
8/01/2022	15.7	17.5	7.8	0.0	0.0	9.1	12.5	0%	38%	4%	17%	38%	21%	4%	0.0	0.3
9/01/2022	18.3	25.0	12.6	0.1	0.1	14.4	-	0%	100%	13%	0%	0%	0%	0%	0.1	0.0
10/01/2022	27.7	26.0	19.3	0.0	0.0	22.5	-	0%	83%	4%	0%	0%	4%	0%	0.0	0.0
11/01/2022	31.9	25.8	16.4	0.0	0.0	19.2	23.9	0%	83%	8%	0%	0%	4%	0%	0.0	0.0
12/01/2022	18.6	23.1	17.2	0.9	0.9	19.3	20.7	0%	71%	25%	0%	0%	13%	0%	0.9	0.7
13/01/2022	15.2	19.8	15.4	0.0	0.0	17.4	22.9	0%	83%	17%	0%	0%	8%	0%	0.0	0.0
14/01/2022	19.7	24.8	17.0	1.2	1.2	20.0	23.1	13%	46%	17%	17%	17%	42%	13%	1.2	2.8
15/01/2022	24.2	23.6	13.5	0.0	0.0	19.3	21.9	4%	25%	0%	29%	29%	8%	8%	0.0	0.7
16/01/2022	30.0	29.5	20.1	0.2	0.2	22.7	22.9	0%	83%	13%	17%	21%	0%	0%	0.2	0.0
17/01/2022	34.0	38.5	30.0	0.0	0.0	32.1	33.6	0%	88%	0%	0%	0%	4%	0%	0.0	0.1
18/01/2022	22.8	25.1	14.2	0.1	0.1	17.3	17.8	0%	79%	17%	4%	4%	8%	0%	0.1	0.4
19/01/2022	11.1	10.9	8.9	0.0	0.0	9.3	12.9	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
20/01/2022	29.1	28.0	18.1	0.0	0.0	21.1	35.2	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
21/01/2022	22.4	33.9	19.1	0.0	0.0	20.6	26.4	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
22/01/2022	19.9	22.4	12.3	0.9	0.9	13.7	17.1	0%	88%	25%	0%	0%	13%	0%	0.9	0.0

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
23/01/2022	14.2	25.1	14.0	0.5	0.5	16.8	14.0	0%	96%	13%	0%	0%	4%	0%	0.5	0.1
24/01/2022	15.0	22.4	14.4	0.3	0.3	15.5	18.4	0%	100%	8%	0%	0%	0%	0%	0.3	0.0
25/01/2022	22.0	28.0	17.1	0.0	0.0	20.6	23.5	0%	71%	4%	0%	0%	8%	0%	0.0	0.3
26/01/2022	14.8	24.3	17.2	1.4	1.4	21.1	23.5	0%	79%	33%	0%	0%	13%	0%	1.4	0.2
27/01/2022	19.5	-	18.6	0.6	0.6	18.4	-	0%	96%	17%	0%	0%	0%	0%	0.6	0.0
28/01/2022	22.5	35.5	18.2	1.0	1.0	22.3	-	0%	83%	21%	0%	0%	0%	0%	1.0	0.0
29/01/2022	22.3	40.8	20.8	0.3	0.3	39.6	26.7	0%	83%	17%	0%	0%	13%	0%	0.3	0.3
30/01/2022	18.9	30.5	19.2	0.0	0.0	19.3	28.7	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
31/01/2022	21.4	31.3	17.3	0.7	0.7	19.8	30.5	0%	50%	17%	4%	4%	17%	0%	0.7	0.2
1/02/2022	25.0	33.1	16.4	0.0	0.0	17.8	28.6	8%	17%	4%	38%	67%	0%	4%	0.0	0.0
2/02/2022	12.4	-	5.4	0.0	0.0	4.7	10.4	0%	63%	4%	21%	33%	0%	0%	0.0	0.0
3/02/2022	25.1	17.9	11.5	0.0	0.0	12.3	17.4	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
4/02/2022	19.6	18.2	14.0	0.1	0.1	12.6	18.6	0%	100%	8%	0%	0%	0%	0%	0.1	0.0
5/02/2022	18.9	19.8	12.4	0.0	0.0	13.5	22.3	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
6/02/2022	18.5	23.6	12.0	0.0	0.0	13.7	21.8	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
7/02/2022	17.1	22.3	13.8	0.0	0.0	10.2	15.3	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
8/02/2022	18.1	21.0	11.7	0.0	0.0	11.5	12.2	4%	92%	4%	0%	0%	8%	4%	0.0	0.0
9/02/2022	26.2	30.1	18.2	0.0	0.0	42.1	17.4	8%	21%	0%	33%	29%	13%	4%	0.0	0.8
10/02/2022	44.7	46.3	22.2	0.0	0.0	28.0	27.1	21%	46%	0%	50%	46%	0%	13%	0.0	0.0
11/02/2022	22.3	23.1	14.3	0.2	0.2	16.1	14.3	0%	100%	13%	0%	0%	0%	0%	0.2	0.0
12/02/2022	21.8	27.3	16.6	0.9	0.9	19.1	-	0%	100%	17%	0%	0%	0%	0%	0.9	0.0
13/02/2022	19.4	32.9	17.7	0.0	0.0	20.4	-	0%	100%	4%	0%	0%	0%	0%	0.0	0.0
14/02/2022	27.7	41.5	20.8	0.0	0.0	27.0	-	0%	88%	0%	0%	0%	8%	0%	0.0	0.3
15/02/2022	29.0	38.4	24.9	0.0	0.0	24.4	23.0	0%	79%	8%	0%	0%	8%	0%	0.0	0.0
16/02/2022	21.6	35.1	24.6	0.9	0.9	25.6	23.5	0%	75%	13%	0%	0%	17%	0%	0.9	0.1
17/02/2022	26.4	30.3	19.2	0.0	0.0	20.0	24.5	13%	17%	0%	29%	58%	13%	8%	0.0	0.4
18/02/2022	22.5	28.3	18.8	0.0	0.0	21.7	-	4%	50%	0%	46%	46%	0%	4%	0.0	0.0
19/02/2022	22.0	24.0	15.7	0.0	0.0	18.4	19.1	0%	100%	21%	0%	0%	0%	0%	0.0	0.0
20/02/2022	31.6	22.2	19.6	0.5	0.5	22.0	25.3	33%	8%	13%	46%	42%	13%	21%	0.5	0.7
21/02/2022	22.6	26.2	15.6	0.1	0.1	16.6	22.5	8%	29%	4%	13%	25%	0%	8%	0.1	0.0

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
22/02/2022	13.7	20.5	12.3	0.0	0.0	15.1	14.4	0%	96%	0%	0%	0%	4%	0%	0.0	0.1
23/02/2022	12.4	19.7	10.7	0.3	0.3	15.3	18.8	0%	96%	17%	0%	0%	0%	0%	0.3	0.0
24/02/2022	8.8	12.5	7.4	0.0	0.0	9.8	12.2	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
25/02/2022	18.0	19.8	13.6	0.0	0.0	16.3	20.1	0%	100%	17%	0%	0%	0%	0%	0.0	0.0
26/02/2022	13.3	21.6	11.6	0.0	0.0	12.8	18.3	0%	100%	4%	0%	0%	0%	0%	0.0	0.0
27/02/2022	14.7	21.8	11.6	0.0	0.0	12.8	19.2	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
28/02/2022	12.8	24.6	11.8	0.0	0.0	-	16.6	0%	96%	4%	0%	0%	0%	0%	0.0	-
1/03/2022	11.0	15.8	8.6	0.0	0.0	8.9	13.7	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
2/03/2022	9.2	18.8	9.6	0.0	0.0	9.5	15.0	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
3/03/2022	11.0	8.1	6.1	0.0	0.0	8.0	8.3	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
4/03/2022	10.0	13.2	7.0	0.0	0.0	7.8	10.0	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
5/03/2022	17.4	23.7	15.8	0.0	0.0	16.6	19.8	4%	79%	0%	8%	8%	8%	4%	0.0	0.0
6/03/2022	9.6	9.2	7.4	0.0	0.0	-	10.3	4%	71%	8%	13%	13%	13%	4%	0.0	-
7/03/2022	9.1	9.5	8.1	0.0	0.0	-	10.8	0%	96%	0%	0%	0%	4%	0%	0.0	-
8/03/2022	4.7	4.9	-	-	-	3.1	5.1	4%	38%	0%	38%	42%	4%	4%	-	0.0
9/03/2022	8.5	7.1	7.8	0.1	0.1	6.7	7.5	0%	63%	21%	29%	29%	0%	0%	0.1	0.0
10/03/2022	-	18.2	16.1	0.9	0.9	-	15.0	0%	92%	13%	0%	0%	8%	0%	0.9	-
11/03/2022	20.3	28.3	19.2	0.0	0.0	19.6	21.4	0%	92%	4%	0%	0%	8%	0%	0.0	0.2
12/03/2022	18.5	26.2	14.8	0.0	0.0	16.4	17.2	0%	83%	4%	0%	0%	13%	0%	0.0	0.3
13/03/2022	16.1	20.8	13.5	0.0	0.0	18.4	17.5	8%	71%	0%	8%	4%	8%	8%	0.0	0.5
14/03/2022	21.4	25.0	15.0	0.4	0.4	18.1	21.5	8%	79%	8%	13%	13%	8%	4%	0.4	1.0
15/03/2022	18.2	27.9	16.9	0.0	0.0	17.6	20.1	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
16/03/2022	18.3	25.9	18.6	0.1	0.1	18.5	27.6	0%	100%	8%	0%	0%	0%	0%	0.1	0.0
17/03/2022	17.3	26.8	16.8	0.0	0.0	21.4	21.8	4%	67%	8%	4%	4%	13%	4%	0.0	0.3
18/03/2022	26.8	32.5	22.8	0.1	0.1	21.8	21.6	0%	92%	13%	0%	0%	4%	0%	0.1	0.3
19/03/2022	31.8	28.0	16.9	0.0	0.0	16.9	21.9	0%	88%	13%	0%	0%	8%	0%	0.0	0.2
20/03/2022	27.9	34.1	19.6	0.0	0.0	22.0	20.9	21%	58%	17%	33%	38%	4%	8%	0.0	0.0
21/03/2022	29.4	34.8	21.8	0.0	0.0	18.4	20.4	13%	83%	4%	13%	13%	4%	8%	0.0	0.2
22/03/2022	39.6	32.5	20.4	0.0	0.0	25.8	24.2	13%	13%	0%	58%	67%	4%	8%	0.0	0.0
23/03/2022	38.8	37.7	23.5	0.0	0.0	-	31.2	0%	54%	4%	33%	42%	0%	0%	0.0	-

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
24/03/2022	8.2	8.7	7.3	0.0	0.0	-	10.2	0%	100%	0%	0%	0%	0%	0%	0.0	-
25/03/2022	17.6	17.0	14.6	0.2	0.2	-	19.6	0%	79%	17%	0%	0%	4%	0%	0.2	-
26/03/2022	11.1	9.2	7.8	0.1	0.1	7.8	11.7	0%	83%	17%	0%	0%	8%	0%	0.1	0.3
27/03/2022	13.1	11.3	9.1	0.0	0.0	9.2	12.7	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
28/03/2022	11.7	12.7	9.4	0.0	0.0	11.3	13.2	13%	58%	8%	21%	17%	4%	4%	0.0	0.0
29/03/2022	12.1	10.9	9.2	0.0	0.0	8.7	12.3	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
30/03/2022	14.2	13.5	12.6	0.0	0.0	11.6	15.1	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
31/03/2022	16.4	12.2	11.2	0.0	0.0	9.9	12.7	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
1/04/2022	14.4	9.2	6.6	0.0	0.0	6.5	7.4	0%	88%	0%	4%	4%	0%	0%	0.0	0.0
2/04/2022	17.1	10.4	7.0	0.0	0.0	7.2	14.8	8%	0%	0%	58%	67%	0%	8%	0.0	0.0
3/04/2022	19.5	16.3	9.2	0.0	0.0	9.0	22.9	4%	4%	0%	58%	67%	0%	0%	0.0	0.0
4/04/2022	21.6	17.0	9.8	0.0	0.0	10.3	18.9	8%	4%	0%	46%	54%	0%	4%	0.0	0.0
5/04/2022	35.4	31.7	16.5	0.0	0.0	19.7	30.6	17%	42%	0%	54%	54%	0%	13%	0.0	0.0
6/04/2022	20.2	30.9	19.0	0.1	0.1	19.4	29.4	0%	83%	4%	0%	0%	13%	0%	0.1	0.4
7/04/2022	15.7	16.0	9.5	0.0	0.0	8.9	20.8	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
8/04/2022	11.4	13.6	10.7	0.3	0.3	10.7	15.1	0%	92%	17%	0%	0%	0%	0%	0.3	0.0
9/04/2022	14.5	21.2	12.2	0.0	0.0	12.3	21.8	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
10/04/2022	15.2	25.6	16.0	0.0	0.0	15.4	16.2	0%	79%	0%	0%	0%	4%	0%	0.0	0.0
11/04/2022	22.2	28.1	11.9	0.0	0.0	15.5	19.0	17%	42%	0%	46%	46%	0%	4%	0.0	0.0
12/04/2022	26.9	31.8	15.0	0.0	0.0	16.8	19.8	0%	100%	4%	0%	0%	0%	0%	0.0	0.0
13/04/2022	19.9	18.0	11.0	0.0	0.0	10.1	15.3	0%	96%	0%	0%	0%	4%	0%	0.0	0.0
14/04/2022	14.4	21.8	10.4	0.0	0.0	11.5	13.2	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
15/04/2022	22.0	22.4	10.8	0.0	0.0	14.6	12.8	13%	54%	0%	21%	17%	13%	8%	0.0	0.0
16/04/2022	31.2	27.8	10.7	0.0	0.0	14.0	16.5	17%	58%	13%	25%	25%	4%	8%	0.0	0.0
17/04/2022	22.5	27.1	13.5	0.0	0.0	17.3	16.6	33%	46%	4%	38%	33%	0%	17%	0.0	0.0
18/04/2022	45.1	34.2	9.8	0.0	0.0	13.8	14.4	17%	29%	0%	50%	58%	4%	8%	0.0	0.0
19/04/2022	29.6	24.3	18.1	0.0	0.0	17.5	25.1	17%	0%	0%	67%	71%	13%	13%	0.0	0.0
20/04/2022	10.1	9.9	5.7	0.0	0.0	4.9	20.3	4%	0%	0%	71%	100%	0%	0%	0.0	0.0
21/04/2022	47.2	-	10.9	0.0	0.0	12.1	22.8	13%	63%	4%	38%	38%	0%	4%	0.0	0.0
22/04/2022	33.7	14.2	9.4	0.0	0.0	8.3	16.9	0%	100%	0%	0%	0%	0%	0%	0.0	0.0

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
23/04/2022	11.2	18.9	9.8	0.1	0.1	11.0	16.8	0%	92%	17%	0%	0%	8%	0%	0.1	0.1
24/04/2022	12.9	20.6	8.9	0.3	0.3	10.1	14.3	0%	92%	17%	0%	0%	8%	0%	0.3	0.0
25/04/2022	18.7	35.6	10.9	0.0	0.0	16.1	14.7	0%	75%	0%	4%	4%	17%	0%	0.0	0.6
26/04/2022	13.7	20.9	15.1	0.1	0.1	14.3	24.2	0%	79%	4%	0%	0%	13%	0%	0.1	0.1
27/04/2022	14.1	14.8	9.8	0.0	0.0	10.0	15.5	0%	58%	0%	0%	0%	8%	0%	0.0	0.0
28/04/2022	16.8	18.1	9.8	0.0	0.0	10.5	13.3	8%	54%	0%	29%	33%	0%	4%	0.0	0.0
29/04/2022	24.0	16.6	7.2	0.0	0.0	8.4	12.3	8%	21%	0%	58%	71%	4%	8%	0.0	0.0
30/04/2022	14.5	11.0	8.1	0.0	0.0	7.2	12.3	13%	0%	0%	83%	92%	0%	4%	0.0	0.0
1/05/2022	14.7	23.2	10.2	0.0	0.0	12.6	11.6	13%	58%	0%	42%	42%	0%	0%	0.0	0.0
2/05/2022	14.3	26.3	11.6	0.0	0.0	14.0	15.8	17%	63%	8%	29%	17%	8%	17%	0.0	0.0
3/05/2022	38.3	27.1	7.3	0.0	0.0	13.3	13.2	38%	46%	0%	42%	33%	8%	17%	0.0	0.0
4/05/2022	47.4	38.1	10.3	0.0	0.0	16.3	18.3	4%	8%	0%	58%	67%	4%	0%	0.0	0.0
5/05/2022	17.7	10.6	9.6	0.0	0.0	10.7	18.8	0%	0%	0%	58%	96%	4%	0%	0.0	0.0
6/05/2022	13.0	10.2	7.0	0.0	0.0	6.6	20.8	8%	0%	0%	67%	88%	0%	0%	0.0	0.0
7/05/2022	14.3	14.8	6.6	0.0	0.0	6.6	23.0	0%	0%	0%	63%	96%	0%	0%	0.0	0.0
8/05/2022	40.4	31.0	6.5	0.0	0.0	12.7	15.9	8%	33%	0%	58%	58%	4%	4%	0.0	0.0
9/05/2022	39.0	35.5	12.8	0.0	0.0	16.5	28.5	33%	71%	0%	33%	29%	0%	21%	0.0	0.0
10/05/2022	14.3	33.1	12.3	0.0	0.0	16.7	21.3	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
11/05/2022	10.2	28.6	-	-	-	15.5	27.5	0%	100%	0%	0%	0%	0%	0%	-	0.0
12/05/2022	8.9	9.8	9.4	0.0	0.0	10.1	15.5	0%	100%	4%	0%	0%	0%	0%	0.0	0.0
13/05/2022	12.1	8.9	7.7	0.3	0.3	9.2	12.4	4%	83%	33%	4%	4%	8%	4%	0.3	0.0
14/05/2022	18.3	18.8	9.0	0.0	0.0	9.8	13.0	25%	13%	17%	50%	54%	17%	8%	0.0	0.0
15/05/2022	12.9	12.7	9.0	0.0	0.0	8.5	15.1	4%	0%	0%	83%	100%	0%	0%	0.0	0.0
16/05/2022	10.5	10.7	-	-	-	6.1	17.6	17%	0%	0%	67%	75%	0%	8%	-	0.0
17/05/2022	11.8	14.4	-	-	-	7.2	20.3	4%	0%	0%	63%	96%	0%	4%	-	0.0
18/05/2022	11.8	6.5	-	-	-	7.0	16.7	8%	0%	0%	33%	88%	0%	4%	-	0.0
19/05/2022	21.2	32.1	9.8	0.0	0.0	13.9	20.0	17%	33%	21%	46%	46%	17%	4%	0.0	1.1
20/05/2022	25.8	38.8	15.8	0.3	0.3	20.6	29.5	0%	67%	33%	0%	0%	29%	0%	0.3	0.7

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
21/05/2022	14.7	20.2	8.9	0.0	0.0	12.0	23.9	0%	92%	8%	0%	0%	4%	0%	0.0	0.1
22/05/2022	10.2	13.3	7.1	0.0	0.0	7.3	13.4	0%	79%	21%	0%	0%	17%	0%	0.0	0.2
23/05/2022	10.6	22.5	7.7	0.0	0.0	9.2	22.5	0%	83%	4%	0%	0%	13%	0%	0.0	0.0
24/05/2022	12.4	21.9	7.5	0.0	0.0	10.1	22.7	0%	92%	8%	0%	4%	8%	0%	0.0	0.0
25/05/2022	25.1	31.7	8.6	0.4	0.4	16.0	-	21%	54%	25%	21%	4%	17%	17%	0.4	0.6
26/05/2022	27.0	30.4	13.6	0.0	0.0	18.5	-	29%	25%	8%	33%	29%	46%	25%	0.0	1.5
27/05/2022	31.5	21.6	11.3	0.0	0.0	13.8	17.4	33%	38%	8%	54%	63%	0%	25%	0.0	0.0
28/05/2022	15.9	14.3	8.3	0.0	0.0	6.9	19.7	8%	0%	0%	79%	96%	0%	4%	0.0	0.0
29/05/2022	7.8	14.1	4.4	0.0	0.0	4.2	17.7	0%	0%	0%	58%	92%	0%	0%	0.0	0.0
30/05/2022	13.0	20.1	8.6	0.0	0.0	10.1	19.3	13%	0%	0%	42%	92%	0%	4%	0.0	0.0
31/05/2022	11.8	13.5	9.2	0.0	0.0	8.9	17.1	0%	0%	0%	8%	75%	0%	0%	0.0	0.0
1/06/2022	8.9	10.9	8.2	0.0	0.0	6.1	18.6	0%	0%	0%	29%	75%	0%	0%	0.0	0.0
2/06/2022	16.1	10.2	6.4	0.0	0.0	6.8	17.0	25%	13%	0%	83%	83%	0%	8%	0.0	0.0
3/06/2022	11.6	14.3	6.2	0.0	0.0	6.3	13.9	8%	0%	0%	63%	88%	0%	8%	0.0	0.0
4/06/2022	7.2	6.7	4.6	0.0	0.0	3.5	12.9	0%	0%	0%	17%	92%	0%	0%	0.0	0.0
5/06/2022	7.7	8.7	4.2	0.0	0.0	4.4	16.2	8%	0%	0%	38%	96%	0%	8%	0.0	0.0
6/06/2022	9.6	9.1	5.7	0.0	0.0	5.4	21.3	0%	0%	0%	13%	96%	0%	0%	0.0	0.0
7/06/2022	10.6	10.6	6.5	0.0	0.0	6.0	15.7	0%	0%	0%	0%	71%	0%	0%	0.0	0.0
8/06/2022	9.8	10.5	5.1	0.0	0.0	3.9	20.5	0%	0%	0%	4%	88%	0%	0%	0.0	0.0
9/06/2022	10.1	13.9	4.5	0.0	0.0	5.1	26.3	0%	0%	0%	21%	96%	0%	0%	0.0	0.0
10/06/2022	12.3	11.6	4.3	0.0	0.0	4.0	27.4	0%	0%	0%	13%	88%	0%	0%	0.0	0.0
11/06/2022	8.8	11.1	5.1	0.0	0.0	3.9	24.5	0%	0%	0%	42%	100%	0%	0%	0.0	0.0
12/06/2022	13.5	17.9	9.8	0.0	0.0	9.2	38.2	0%	0%	0%	29%	96%	0%	0%	0.0	0.0
13/06/2022	24.8	14.8	7.9	0.0	0.0	8.5	17.0	8%	33%	8%	58%	63%	0%	4%	0.0	0.0
14/06/2022	22.5	21.0	6.8	0.0	0.0	6.4	17.4	17%	0%	0%	67%	79%	0%	17%	0.0	0.0
15/06/2022	13.3	13.2	7.4	0.0	0.0	5.4	22.2	0%	0%	0%	50%	83%	0%	0%	0.0	0.0

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
16/06/2022	15.5	16.1	7.3	0.0	0.0	3.9	26.6	0%	0%	0%	42%	79%	0%	0%	0.0	0.0
17/06/2022	22.3	13.2	7.1	0.0	0.0	4.0	15.3	25%	4%	4%	75%	79%	8%	8%	0.0	0.0
18/06/2022	23.5	27.9	7.8	0.0	0.0	9.7	14.9	33%	42%	0%	46%	42%	8%	4%	0.0	0.0
19/06/2022	25.8	31.9	11.6	0.3	0.3	12.9	14.8	0%	63%	21%	0%	0%	21%	4%	0.3	0.0
20/06/2022	26.6	31.3	12.5	0.0	0.0	17.7	12.6	25%	42%	17%	29%	21%	21%	8%	0.0	0.2
21/06/2022	18.1	18.8	9.2	0.0	0.0	9.4	22.3	17%	0%	0%	71%	100%	0%	8%	0.0	0.0
22/06/2022	18.8	14.6	10.8	0.0	0.0	7.6	14.4	33%	0%	0%	88%	92%	0%	25%	0.0	0.0
23/06/2022	13.7	13.2	7.3	0.0	0.0	6.4	26.9	0%	0%	0%	71%	92%	0%	0%	0.0	0.0
24/06/2022	14.8	13.7	8.8	0.0	0.0	7.5	27.3	0%	0%	0%	38%	83%	0%	0%	0.0	0.0
25/06/2022	15.9	15.4	8.9	0.0	0.0	7.7	20.4	13%	0%	0%	71%	100%	0%	0%	0.0	0.0
26/06/2022	14.5	12.6	10.1	0.0	0.0	8.2	15.8	25%	0%	0%	79%	92%	0%	4%	0.0	0.0
27/06/2022	21.9	28.2	9.4	0.0	0.0	8.1	18.1	8%	54%	8%	38%	38%	4%	0%	0.0	0.0
28/06/2022	31.0	36.2	15.8	0.0	0.0	17.2	24.0	13%	54%	25%	21%	21%	29%	4%	0.0	0.0
29/06/2022	28.1	22.3	18.4	0.0	0.0	21.6	23.5	38%	0%	0%	96%	96%	0%	13%	0.0	0.0
30/06/2022	26.6	42.0	16.4	0.0	0.0	16.9	23.9	4%	25%	13%	54%	63%	4%	0%	0.0	0.0
1/07/2022	32.6	43.7	15.4	0.0	0.0	17.1	42.6	0%	83%	0%	0%	0%	17%	0%	0.0	0.0
2/07/2022	11.6	9.9	8.4	0.0	0.0	9.3	8.9	8%	38%	8%	25%	25%	25%	8%	0.0	0.6
3/07/2022	5.6	4.9	3.5	0.0	0.0	3.3	7.6	0%	0%	0%	92%	96%	0%	4%	0.0	0.0
4/07/2022	5.4	5.2	5.3	0.0	0.0	4.2	-	0%	0%	0%	71%	75%	0%	0%	0.0	0.0
5/07/2022	5.0	5.0	4.7	0.0	0.0	4.3	8.5	0%	96%	0%	0%	0%	4%	0%	0.0	0.0
6/07/2022	2.2	2.7	2.5	0.0	0.0	2.4	2.8	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
7/07/2022	3.6	4.4	4.6	0.0	0.0	4.7	5.2	8%	13%	0%	42%	63%	0%	4%	0.0	0.0
8/07/2022	6.2	8.0	6.9	0.0	0.0	5.8	9.6	0%	0%	0%	38%	92%	0%	0%	0.0	0.0
9/07/2022	8.2	8.6	6.5	0.0	0.0	6.1	10.3	4%	0%	0%	79%	96%	4%	0%	0.0	0.0
10/07/2022	7.3	9.5	6.5	0.0	0.0	7.0	8.7	8%	33%	0%	54%	54%	13%	8%	0.0	0.1
11/07/2022	9.9	14.4	5.8	0.1	0.1	7.9	7.3	13%	46%	13%	25%	21%	8%	13%	0.1	0.4

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
12/07/2022	7.3	6.8	4.7	0.0	0.0	4.7	8.4	33%	0%	0%	83%	79%	0%	17%	0.0	0.0
13/07/2022	5.1	5.5	5.4	0.0	0.0	4.5	7.6	0%	4%	0%	63%	79%	0%	0%	0.0	0.0
14/07/2022	15.3	10.1	6.8	0.0	0.0	7.0	9.1	8%	71%	0%	13%	8%	0%	8%	0.0	0.0
15/07/2022	-	9.4	5.2	0.0	0.0	5.3	9.0	29%	0%	0%	75%	92%	0%	8%	0.0	0.0
16/07/2022	-	10.4	5.7	0.0	0.0	6.7	14.8	4%	0%	0%	67%	92%	0%	4%	0.0	0.0
17/07/2022	16.0	15.2	7.9	0.0	0.0	10.2	25.9	0%	0%	0%	63%	96%	0%	0%	0.0	0.0
18/07/2022	20.7	10.6	8.1	0.0	0.0	5.6	-	4%	4%	4%	4%	38%	4%	4%	0.0	0.0
19/07/2022	-	18.6	8.9	0.0	0.0	10.2	-	29%	67%	4%	29%	25%	4%	17%	0.0	0.0
20/07/2022	-	17.1	10.6	0.0	0.0	12.9	18.7	0%	88%	17%	0%	0%	8%	0%	0.0	0.1
21/07/2022	-	21.0	12.3	0.1	0.1	14.8	31.7	0%	96%	25%	0%	0%	0%	0%	0.1	0.0
22/07/2022	12.8	23.8	14.7	0.3	0.3	15.3	31.1	0%	100%	8%	0%	0%	0%	0%	0.3	0.0
23/07/2022	-	24.1	11.0	0.1	0.1	15.2	25.1	0%	67%	17%	0%	4%	17%	0%	0.1	0.0
24/07/2022	21.0	23.7	11.1	0.0	0.0	17.1	19.8	25%	50%	13%	25%	21%	25%	17%	0.0	0.2
25/07/2022	18.5	21.8	8.7	0.0	0.0	14.1	12.0	42%	13%	4%	50%	46%	8%	25%	0.0	0.1
26/07/2022	-	11.5	7.5	0.0	0.0	8.0	12.4	4%	0%	4%	25%	54%	8%	4%	0.0	0.0
27/07/2022	126.0	10.7	8.4	0.0	0.0	7.0	16.5	0%	0%	0%	46%	96%	0%	0%	0.0	0.0
28/07/2022	15.8	9.1	5.4	0.0	0.0	6.6	12.6	21%	0%	0%	96%	100%	0%	4%	0.0	0.0
29/07/2022	16.8	18.6	11.3	1.0	1.0	12.1	13.1	13%	33%	25%	50%	46%	8%	8%	1.0	0.2
30/07/2022	27.9	29.0	12.7	0.0	0.0	16.5	16.8	38%	46%	4%	29%	17%	8%	33%	0.0	0.0
31/07/2022	34.9	29.7	10.4	0.0	0.0	16.6	19.0	33%	33%	8%	50%	50%	4%	21%	0.0	0.0
1/08/2022	24.7	11.7	7.6	0.0	0.0	8.0	16.4	4%	4%	0%	33%	79%	0%	4%	0.0	0.0
2/08/2022	26.5	10.9	4.9	0.0	0.0	4.9	12.3	17%	0%	0%	58%	79%	4%	13%	0.0	0.0
3/08/2022	26.4	-	7.5	0.0	0.0	11.3	23.9	38%	0%	0%	79%	88%	0%	17%	0.0	0.0
4/08/2022	15.3	-	9.0	0.0	0.0	11.8	19.7	42%	0%	0%	67%	83%	0%	25%	0.0	0.0
5/08/2022	8.9	-	7.5	0.0	0.0	6.3	10.8	0%	0%	0%	21%	92%	0%	0%	0.0	0.0
6/08/2022	9.3	7.1	6.9	0.0	0.0	5.4	14.1	0%	0%	0%	13%	54%	0%	0%	0.0	0.0

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
7/08/2022	9.7	10.5	5.8	0.0	0.0	4.7	12.9	21%	0%	0%	79%	92%	0%	13%	0.0	0.0
8/08/2022	14.7	14.6	7.2	0.0	0.0	6.8	10.1	33%	38%	4%	42%	38%	4%	4%	0.0	0.0
9/08/2022	19.1	11.0	5.6	0.0	0.0	6.3	9.1	33%	67%	0%	33%	33%	0%	17%	0.0	0.0
10/08/2022	23.3	22.2	10.5	0.1	0.1	14.0	13.1	4%	88%	13%	8%	4%	0%	4%	0.1	0.0
11/08/2022	37.6	34.4	17.2	0.0	0.0	20.9	22.2	13%	50%	4%	33%	42%	8%	8%	0.0	0.2
12/08/2022	12.5	13.4	9.4	0.0	0.0	9.3	13.3	13%	46%	8%	25%	46%	0%	4%	0.0	0.0
13/08/2022	5.4	4.3	4.4	0.0	0.0	3.9	6.2	8%	4%	0%	29%	75%	0%	4%	0.0	0.0
14/08/2022	4.3	6.5	4.2	0.0	0.0	4.1	8.8	0%	0%	0%	17%	83%	0%	0%	0.0	0.0
15/08/2022	5.7	8.8	4.9	0.0	0.0	5.0	12.3	0%	0%	0%	4%	63%	0%	0%	0.0	0.0
16/08/2022	-	-	6.9	0.0	0.0	-	10.0	0%	0%	0%	8%	58%	0%	0%	0.0	-
17/08/2022	-	-	6.5	0.0	0.0	-	11.8	29%	0%	0%	58%	54%	13%	17%	0.0	-
18/08/2022	12.3	9.4	7.5	0.0	0.0	9.5	15.0	8%	0%	0%	58%	96%	0%	4%	0.0	0.0
19/08/2022	14.6	13.5	7.6	0.0	0.0	4.8	13.3	0%	0%	0%	50%	75%	0%	0%	0.0	0.0
20/08/2022	12.3	13.7	8.8	0.0	0.0	8.9	15.2	4%	0%	0%	54%	96%	0%	4%	0.0	0.0
21/08/2022	59.5	33.0	14.4	1.4	1.4	17.6	17.1	17%	50%	21%	25%	25%	17%	8%	1.4	0.5
22/08/2022	25.9	28.0	14.8	0.0	0.0	12.6	26.5	8%	0%	0%	71%	100%	0%	4%	0.0	0.0
23/08/2022	19.8	13.1	10.8	0.0	0.0	9.0	20.8	4%	8%	0%	29%	50%	0%	4%	0.0	0.0
24/08/2022	6.7	4.7	4.9	0.0	0.0	5.0	8.5	0%	0%	0%	83%	100%	0%	0%	0.0	0.0
25/08/2022	14.1	15.6	8.1	0.0	0.0	9.0	12.1	0%	21%	4%	50%	58%	8%	0%	0.0	0.0
26/08/2022	18.7	22.8	10.5	1.3	1.3	14.6	14.3	25%	71%	29%	25%	13%	8%	25%	1.3	0.5
27/08/2022	14.1	26.6	12.3	0.2	0.2	14.3	17.7	4%	88%	17%	8%	8%	13%	0%	0.2	0.0
28/08/2022	15.0	34.8	14.1	0.0	0.0	22.5	19.6	13%	63%	17%	17%	13%	21%	13%	0.0	1.8
29/08/2022	18.3	18.5	11.7	0.2	0.2	13.3	13.9	29%	42%	25%	38%	33%	21%	25%	0.2	0.7
30/08/2022	27.6	18.6	12.1	0.0	0.0	12.6	24.8	21%	4%	0%	71%	92%	0%	4%	0.0	0.0
31/08/2022	14.6	24.5	12.8	0.0	0.0	14.0	18.7	17%	71%	0%	29%	33%	0%	8%	0.0	0.0
1/09/2022	26.5	25.6	11.8	0.0	0.0	15.0	20.2	21%	33%	25%	25%	25%	17%	17%	0.0	0.0

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
2/09/2022	27.1	21.1	13.3	0.8	0.8	12.7	16.7	13%	42%	8%	46%	46%	13%	4%	0.8	0.0
3/09/2022	9.0	9.7	8.9	0.0	0.0	8.1	10.7	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
4/09/2022	9.0	12.0	8.1	0.0	0.0	9.0	14.2	0%	96%	0%	0%	0%	0%	0%	0.0	0.0
5/09/2022	15.3	19.3	9.4	0.1	0.1	11.0	11.9	29%	67%	25%	29%	25%	0%	13%	0.1	0.0
6/09/2022	14.8	28.1	15.0	0.0	0.0	14.7	19.7	0%	79%	21%	0%	0%	13%	0%	0.0	0.0
7/09/2022	12.4	24.1	14.8	0.6	0.6	31.7	14.8	17%	71%	8%	13%	8%	25%	17%	0.6	1.5
8/09/2022	22.8	31.0	17.5	0.0	0.0	23.2	20.4	0%	83%	21%	0%	0%	4%	0%	0.0	0.8
9/09/2022	15.4	14.4	9.7	0.0	0.0	10.5	12.9	13%	13%	0%	46%	54%	8%	8%	0.0	0.0
10/09/2022	8.8	7.7	5.2	0.0	0.0	6.0	13.7	0%	0%	0%	33%	67%	0%	0%	0.0	0.0
11/09/2022	10.1	12.2	9.5	0.0	0.0	7.3	23.1	0%	0%	0%	13%	92%	0%	0%	0.0	0.0
12/09/2022	22.2	17.1	11.0	0.0	0.0	12.8	18.4	4%	0%	0%	25%	67%	0%	4%	0.0	0.0
13/09/2022	19.3	28.6	15.1	0.7	0.7	13.0	17.7	13%	54%	17%	33%	33%	13%	0%	0.7	0.0
14/09/2022	14.7	32.0	15.1	0.2	0.2	17.9	16.1	0%	92%	17%	0%	0%	4%	0%	0.2	0.0
15/09/2022	15.1	17.6	10.1	0.0	0.0	11.8	13.5	8%	50%	13%	13%	13%	25%	0%	0.0	0.1
16/09/2022	10.0	9.3	7.3	0.0	0.0	6.1	12.4	4%	0%	0%	17%	67%	0%	4%	0.0	0.0
17/09/2022	21.4	15.7	10.5	0.0	0.0	9.1	27.1	0%	0%	0%	17%	38%	0%	0%	0.0	0.0
18/09/2022	14.7	14.9	12.0	0.0	0.0	8.2	29.1	0%	0%	0%	17%	71%	0%	0%	0.0	0.0
19/09/2022	26.5	19.6	17.0	0.0	0.0	8.1	28.9	0%	0%	0%	13%	71%	0%	0%	0.0	0.0
20/09/2022	24.6	33.1	19.4	0.0	0.0	16.7	25.1	21%	71%	0%	25%	21%	4%	13%	0.0	0.0
21/09/2022	25.6	35.6	19.5	0.0	0.0	24.8	31.5	0%	79%	17%	0%	4%	8%	0%	0.0	0.2
22/09/2022	6.7	8.9	7.4	0.1	0.1	7.6	9.7	0%	100%	13%	0%	0%	0%	0%	0.1	0.0
23/09/2022	9.1	12.8	8.9	0.0	0.0	10.7	14.1	0%	96%	4%	0%	0%	0%	0%	0.0	0.0
24/09/2022	15.8	13.2	10.1	0.0	0.0	11.0	19.6	13%	17%	4%	50%	63%	8%	8%	0.0	0.0
25/09/2022	15.7	14.6	7.3	0.0	0.0	11.5	16.5	8%	8%	0%	38%	67%	0%	4%	0.0	0.0
26/09/2022	26.5	29.8	11.2	0.0	0.0	14.2	24.2	38%	29%	0%	50%	58%	0%	33%	0.0	0.0
27/09/2022	17.6	30.2	14.0	0.0	0.0	16.1	17.1	17%	38%	8%	33%	42%	8%	4%	0.0	0.0

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
28/09/2022	12.9	11.1	8.4	0.0	0.0	7.6	14.9	0%	0%	0%	58%	75%	0%	0%	0.0	0.0
29/09/2022	11.7	9.8	6.8	0.0	0.0	6.2	11.5	13%	54%	0%	42%	42%	8%	0%	0.0	0.0
30/09/2022	20.6	14.1	9.8	0.0	0.0	27.5	15.6	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
1/10/2022	15.3	21.4	13.8	0.0	0.0	15.4	20.7	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
2/10/2022	13.3	18.0	11.4	0.0	0.0	12.7	14.5	4%	75%	25%	13%	13%	8%	0%	0.0	0.0
3/10/2022	11.7	18.5	11.6	0.0	0.0	11.9	10.1	33%	63%	8%	33%	25%	17%	17%	0.0	0.5
4/10/2022	24.9	30.0	21.0	0.0	0.0	19.3	23.5	25%	50%	0%	42%	42%	4%	13%	0.0	0.3
5/10/2022	10.7	17.7	12.6	0.0	0.0	12.5	17.4	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
6/10/2022	8.1	12.4	7.8	0.0	0.0	8.5	10.5	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
7/10/2022	11.4	11.9	7.2	0.0	0.0	9.3	10.5	4%	63%	8%	29%	29%	4%	8%	0.0	0.0
8/10/2022	9.3	10.3	7.7	0.0	0.0	9.2	11.0	8%	42%	0%	29%	38%	13%	4%	0.0	0.1
9/10/2022	7.2	8.2	7.6	0.0	0.0	7.1	8.5	0%	79%	13%	4%	13%	4%	0%	0.0	0.1
10/10/2022	14.6	20.4	16.2	0.2	0.2	16.9	21.0	0%	100%	8%	0%	0%	0%	0%	0.2	0.0
11/10/2022	12.1	17.0	15.7	0.3	0.3	14.9	17.7	0%	100%	4%	0%	0%	0%	0%	0.3	0.0
12/10/2022	12.2	20.0	17.6	0.0	0.0	15.3	20.3	0%	92%	8%	0%	0%	8%	0%	0.0	0.0
13/10/2022	12.0	25.1	21.1	3.0	3.0	17.5	19.2	0%	83%	17%	0%	0%	8%	0%	3.0	0.0
14/10/2022	11.7	11.2	9.0	0.0	0.0	9.4	17.6	0%	0%	0%	29%	54%	4%	4%	0.0	0.0
15/10/2022	15.7	16.7	13.4	0.0	0.0	15.7	22.2	21%	29%	4%	29%	29%	29%	0%	0.0	0.8
16/10/2022	22.3	21.2	16.5	0.0	0.0	16.2	20.9	21%	33%	4%	38%	42%	4%	4%	0.0	0.0
17/10/2022	26.4	25.4	17.3	0.0	0.0	13.6	19.8	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
18/10/2022	25.8	29.7	24.6	2.0	2.0	17.8	31.8	0%	96%	29%	0%	0%	4%	0%	2.0	0.0
19/10/2022	20.0	17.2	15.8	0.0	0.0	16.4	19.8	8%	50%	21%	29%	38%	29%	0%	0.0	0.0
20/10/2022	11.0	11.2	10.0	0.0	0.0	9.7	19.6	0%	100%	0%	0%	0%	0%	0%	0.0	0.0
21/10/2022	9.4	9.5	9.2	0.6	0.6	21.6	9.1	0%	79%	38%	4%	4%	8%	4%	0.6	0.2
22/10/2022	11.6	13.4	10.3	0.1	0.1	9.6	11.3	4%	75%	13%	8%	8%	17%	4%	0.1	0.7
23/10/2022	9.1	9.8	11.5	1.0	1.0	10.9	10.5	0%	79%	25%	13%	17%	13%	0%	1.0	0.2

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
24/10/2022	16.0	13.3	14.2	0.0	0.0	10.1	-	0%	88%	4%	8%	8%	4%	0%	0.0	0.3
25/10/2022	16.8	12.1	13.7	0.0	0.0	10.0	16.4	4%	0%	0%	75%	88%	0%	0%	0.0	0.0
26/10/2022	12.1	12.2	13.6	0.0	0.0	7.1	21.0	0%	0%	0%	4%	63%	0%	0%	0.0	0.0
27/10/2022	13.6	14.0	13.5	0.0	0.0	6.1	23.7	0%	0%	0%	25%	71%	0%	0%	0.0	0.0
28/10/2022	17.4	16.3	26.8	0.0	0.0	10.8	37.9	0%	0%	0%	17%	58%	0%	0%	0.0	0.0
29/10/2022	17.6	21.0	12.3	0.0	0.0	9.1	33.0	0%	0%	0%	17%	67%	0%	0%	0.0	0.0
30/10/2022	17.4	30.7	25.4	0.0	0.0	16.0	24.5	0%	29%	0%	38%	63%	0%	4%	0.0	0.0
31/10/2022	33.9	27.9	25.6	0.5	0.5	18.5	40.9	13%	8%	8%	63%	96%	4%	4%	0.5	0.0
1/11/2022	11.5	7.0	6.4	0.0	0.0	4.8	17.7	0%	0%	0%	13%	58%	0%	0%	0.0	0.0
2/11/2022	11.1	8.9	8.0	0.0	0.0	5.6	21.2	0%	0%	0%	8%	42%	0%	0%	0.0	0.0
3/11/2022	12.6	-	16.3	0.0	0.0	12.6	18.1	4%	42%	4%	38%	54%	0%	4%	0.0	0.0
4/11/2022	13.7	23.6	26.5	5.4	5.4	22.7	19.0	0%	96%	17%	0%	0%	0%	0%	5.4	0.0
5/11/2022	13.6	23.3	22.1	2.6	2.6	19.3	20.6	0%	83%	21%	0%	0%	17%	0%	2.6	0.8
6/11/2022	18.8	28.4	29.1	0.0	0.0	15.6	22.8	8%	75%	8%	4%	4%	0%	4%	0.0	0.0
7/11/2022	16.1	25.3	26.7	10.4	10.4	15.3	16.3	0%	67%	42%	0%	0%	13%	0%	10.4	0.2
8/11/2022	14.7	26.5	26.7	5.8	5.8	15.5	19.0	0%	88%	33%	0%	0%	0%	0%	5.8	0.0
9/11/2022	13.2	33.1	31.8	4.7	4.7	19.1	17.3	0%	92%	13%	0%	0%	8%	0%	4.7	0.7
10/11/2022	9.5	25.3	34.4	9.7	9.7	15.9	20.3	0%	79%	33%	0%	0%	17%	0%	9.7	0.7
11/11/2022	9.3	21.9	18.3	0.1	0.1	18.9	22.7	17%	4%	4%	50%	46%	21%	21%	0.1	2.7
12/11/2022	20.5	21.1	20.8	2.5	2.5	17.0	21.6	4%	29%	13%	46%	46%	13%	0%	2.5	1.1
13/11/2022	18.3	18.7	10.2	0.0	0.0	13.9	18.2	29%	4%	8%	71%	71%	21%	17%	0.0	0.5
14/11/2022	13.3	9.5	8.9	0.0	0.0	8.3	21.2	4%	0%	0%	17%	46%	0%	4%	0.0	0.0
15/11/2022	12.9	9.0	8.8	0.0	0.0	6.8	14.8	0%	0%	0%	38%	50%	0%	0%	0.0	0.0
16/11/2022	21.1	8.3	8.5	0.0	0.0	4.9	13.8	4%	4%	0%	29%	38%	0%	0%	0.0	0.0
17/11/2022	23.4	21.7	17.8	0.0	0.0	15.9	19.9	29%	50%	0%	50%	46%	0%	4%	0.0	0.0
18/11/2022	27.0	49.5	24.4	2.0	2.0	23.3	21.0	8%	79%	29%	8%	4%	8%	8%	2.0	0.2

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
19/11/2022	25.2	22.5	19.3	0.0	0.0	21.7	21.7	8%	13%	13%	25%	33%	38%	13%	0.0	2.1
20/11/2022	27.8	18.8	15.7	0.0	0.0	15.7	50.2	0%	0%	0%	17%	38%	0%	0%	0.0	0.0
21/11/2022	23.2	18.6	17.3	0.0	0.0	14.1	46.4	0%	0%	0%	21%	25%	0%	0%	0.0	0.0
22/11/2022	14.1	11.9	13.3	0.0	0.0	9.2	25.1	0%	0%	0%	0%	38%	0%	0%	0.0	0.0
23/11/2022	16.6	18.8	21.9	0.0	0.0	10.8	25.9	8%	0%	0%	29%	79%	0%	8%	0.0	0.0
24/11/2022	23.3	28.7	20.2	0.0	0.0	17.2	25.0	8%	33%	4%	54%	54%	0%	4%	0.0	0.0
25/11/2022	27.8	24.0	28.9	0.0	0.0	18.7	27.5	13%	33%	0%	33%	38%	4%	4%	0.0	0.0
26/11/2022	23.0	33.9	27.0	3.4	3.4	25.0	20.6	4%	71%	38%	4%	4%	21%	4%	3.4	0.6
27/11/2022	32.1	29.4	32.0	0.0	0.0	22.3	33.9	8%	8%	0%	38%	46%	13%	13%	0.0	0.5
28/11/2022	21.6	24.3	21.8	0.1	0.1	20.9	23.0	4%	71%	8%	4%	8%	0%	0%	0.1	0.0
29/11/2022	27.5	36.0	24.5	2.1	2.1	23.6	24.1	8%	54%	21%	29%	29%	8%	0%	2.1	0.0
30/11/2022	24.7	35.8	34.1	2.7	2.7	30.2	34.4	0%	100%	21%	0%	0%	0%	0%	2.7	0.0
1/12/2022	28.1	-	28.3	0.8	0.8	23.9	30.6	0%	100%	8%	0%	0%	0%	0%	0.8	0.0
2/12/2022	30.3	36.7	28.6	0.9	0.9	21.9	22.5	0%	100%	4%	0%	0%	0%	0%	0.9	0.0
3/12/2022	20.1	27.2	23.6	1.8	1.8	20.0	27.6	0%	79%	33%	0%	0%	4%	0%	1.8	0.0
4/12/2022	25.6	25.9	26.1	5.4	5.4	18.2	19.2	0%	71%	33%	0%	0%	8%	0%	5.4	0.2
5/12/2022	39.8	31.0	22.6	0.0	0.0	15.1	44.0	8%	0%	8%	50%	71%	8%	0%	0.0	0.0
6/12/2022	24.4	37.7	41.6	0.3	0.3	26.6	26.7	4%	75%	17%	4%	0%	17%	4%	0.3	0.1
7/12/2022	23.6	22.7	-	-	-	11.6	33.7	4%	0%	0%	38%	71%	0%	0%	-	0.0
8/12/2022	21.0	26.3	-	-	-	15.6	26.6	0%	42%	4%	8%	46%	0%	0%	-	0.0
9/12/2022	30.1	52.6	33.9	0.1	0.1	29.4	29.5	0%	100%	8%	4%	4%	0%	0%	0.1	0.0
10/12/2022	24.1	33.2	27.8	0.1	0.1	19.9	24.6	0%	100%	4%	0%	0%	0%	0%	0.1	0.0
11/12/2022	34.5	27.6	27.1	0.0	0.0	22.2	36.0	29%	4%	4%	58%	75%	17%	25%	0.0	0.1
12/12/2022	24.0	16.3	18.7	0.0	0.0	18.8	28.2	0%	0%	0%	33%	58%	0%	0%	0.0	0.0
13/12/2022	20.5	14.3	14.4	0.0	0.0	10.6	24.9	8%	0%	0%	42%	79%	0%	8%	0.0	0.0
14/12/2022	21.3	15.6	12.4	0.0	0.0	7.5	23.8	0%	0%	0%	33%	42%	0%	0%	0.0	0.0

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO North's estimated max. contribution to level (µg/m³)	
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Wandewoi
15/12/2022	24.3	31.8	-	-	-	16.1	28.1	21%	38%	17%	50%	42%	0%	21%	-	0.0
16/12/2022	21.1	31.6	-	-	-	20.5	28.0	0%	96%	50%	0%	0%	0%	0%	-	0.0
17/12/2022	18.6	31.0	23.1	3.4	3.4	18.0	22.3	0%	92%	38%	0%	0%	0%	0%	3.4	0.0
18/12/2022	15.5	20.3	16.5	3.0	3.0	10.4	16.3	0%	92%	38%	0%	0%	4%	0%	3.0	0.0
19/12/2022	32.7	39.7	-	-	-	18.8	33.0	0%	88%	8%	0%	0%	8%	0%	-	0.0
20/12/2022	29.7	38.6	-	-	-	21.5	32.9	0%	92%	29%	0%	0%	4%	0%	-	0.0
21/12/2022	25.9	37.6	28.6	4.0	4.0	18.6	25.4	0%	79%	25%	0%	4%	4%	0%	4.0	0.5
22/12/2022	22.9	39.1	32.7	0.0	0.0	22.2	29.0	0%	75%	21%	4%	4%	4%	0%	0.0	0.2
23/12/2022	19.7	21.8	13.6	0.0	0.0	11.7	20.1	4%	21%	13%	50%	67%	13%	0%	0.0	0.0
24/12/2022	15.1	13.7	11.4	0.9	0.9	10.3	12.3	0%	21%	8%	33%	67%	4%	0%	0.9	0.4
25/12/2022	15.7	-	15.8	0.2	0.2	13.8	15.6	4%	71%	13%	13%	17%	0%	0%	0.2	0.0
26/12/2022	11.3	-	16.9	1.5	1.5	14.9	18.6	0%	71%	42%	0%	0%	13%	0%	1.5	0.1
27/12/2022	13.1	24.3	21.9	3.4	3.4	19.7	24.1	0%	88%	38%	0%	0%	4%	0%	3.4	0.2
28/12/2022	15.4	33.1	25.8	5.2	5.2	24.1	21.8	4%	58%	33%	4%	0%	29%	4%	5.2	2.0
29/12/2022	42.6	48.3	26.6	0.0	0.0	23.9	36.8	0%	96%	0%	0%	0%	4%	0%	0.0	0.5
30/12/2022	21.1	35.8	30.0	1.0	1.0	22.4	30.9	0%	100%	8%	0%	0%	0%	0%	1.0	0.0
31/12/2022	18.7	28.0	25.5	0.0	0.0	19.1	25.7	0%	92%	0%	0%	0%	0%	0%	0.0	0.0

- No data

Note for this annual review, TEOM data time was assessed per Australian Eastern Standard Time (AEST) as used by DPE, however some minor differences arise with the operational data which uses Australian Eastern Daylight Time (AEDT). Some minor differences also arise as HVO collects data in real-time from DPE monitors using a separate HVO logger which may result in minor additional time shift effect.

Table B-3: 24-hour average PM_{10} TEOM levels, percent time downwind and estimated contributions – HVO South

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
1/01/2022	15.7	30.7	16.1	15.5	18.1	16.7	20.3	0%	0%	50%	0%	0%	75%	0%	0.8	0.0	0.0	2.0	0.0
2/01/2022	10.6	27.4	19.4	15.0	12.5	20.7	14.1	0%	0%	46%	0%	0%	83%	8%	3.9	0.0	0.0	6.1	0.0
3/01/2022	17.5	36.3	21.0	19.1	17.2	24.4	24.9	0%	0%	88%	0%	0%	100%	0%	2.8	0.0	0.0	6.0	0.0
4/01/2022	18.6	31.1	20.1	21.7	19.0	20.6	22.4	0%	0%	71%	0%	0%	100%	0%	2.1	0.0	0.0	3.3	0.0
5/01/2022	14.7	15.5	12.0	10.8	12.5	11.0	16.0	0%	4%	71%	0%	0%	96%	0%	0.3	0.0	0.0	0.4	0.0
6/01/2022	13.5	57.1	12.7	11.5	13.4	15.0	15.3	0%	0%	79%	0%	0%	100%	0%	0.4	0.0	0.0	2.1	0.0
7/01/2022	11.4	65.3	11.8	10.1	9.7	14.0	15.4	0%	4%	63%	0%	0%	83%	4%	0.8	0.0	0.0	3.0	0.0
8/01/2022	15.7	17.5	7.8	10.7	11.1	9.1	12.5	17%	0%	17%	46%	29%	33%	21%	0.0	0.6	0.3	0.5	0.5
9/01/2022	18.3	25.0	12.6	13.5	14.7	14.4	-	0%	0%	96%	0%	0%	100%	0%	0.5	0.0	0.0	1.5	-
10/01/2022	27.7	26.0	19.3	16.8	22.0	22.5	-	0%	0%	63%	4%	17%	75%	0%	0.9	0.1	0.7	2.0	-
11/01/2022	31.9	25.8	16.4	19.2	21.5	19.2	23.9	0%	8%	42%	0%	0%	67%	0%	0.0	0.0	0.0	0.3	0.0
12/01/2022	18.6	23.1	17.2	13.5	16.4	19.3	20.7	0%	0%	71%	8%	8%	71%	0%	1.5	0.0	0.0	2.1	0.0
13/01/2022	15.2	19.8	15.4	11.0	11.7	17.4	22.9	0%	0%	83%	0%	0%	88%	0%	2.8	0.0	0.0	3.8	0.0
14/01/2022	19.7	24.8	17.0	14.7	17.6	20.0	23.1	21%	13%	29%	13%	4%	33%	21%	0.9	0.0	0.0	1.6	1.5
15/01/2022	24.2	23.6	13.5	18.8	21.9	19.3	21.9	33%	8%	8%	54%	42%	8%	33%	0.0	2.4	2.4	0.9	0.9
16/01/2022	30.0	29.5	20.1	20.6	22.5	22.7	22.9	17%	8%	58%	21%	4%	71%	17%	1.2	0.3	0.0	1.4	0.4
17/01/2022	34.0	38.5	30.0	27.0	30.7	32.1	33.6	0%	8%	42%	0%	0%	71%	4%	0.7	0.0	0.0	4.0	0.5
18/01/2022	22.8	25.1	14.2	16.3	19.8	17.3	17.8	4%	0%	38%	8%	8%	63%	8%	0.5	0.0	0.2	0.8	0.0
19/01/2022	11.1	10.9	8.9	8.0	9.2	9.3	12.9	0%	0%	63%	0%	0%	100%	0%	0.4	0.0	0.0	0.5	0.0
20/01/2022	29.1	28.0	18.1	16.3	18.3	21.1	35.2	0%	0%	71%	0%	0%	100%	0%	0.2	0.0	0.0	0.6	0.0
21/01/2022	22.4	33.9	19.1	13.6	17.1	20.6	26.4	0%	0%	100%	0%	0%	100%	0%	1.7	0.0	0.0	2.0	0.0
22/01/2022	19.9	22.4	12.3	8.9	11.1	13.7	17.1	0%	4%	58%	0%	0%	83%	0%	1.4	0.0	0.0	2.2	0.0
23/01/2022	14.2	25.1	14.0	9.3	10.0	16.8	14.0	0%	13%	75%	0%	0%	88%	0%	2.4	0.0	0.0	4.1	0.0
24/01/2022	15.0	22.4	14.4	9.5	9.0	15.5	18.4	0%	0%	88%	0%	0%	100%	0%	2.5	0.0	0.0	3.2	0.0
25/01/2022	22.0	28.0	17.1	14.5	17.1	20.6	23.5	0%	0%	50%	0%	0%	71%	0%	0.8	0.0	0.0	1.4	0.0
26/01/2022	14.8	24.3	17.2	13.3	14.0	21.1	23.5	0%	0%	79%	0%	0%	79%	0%	1.7	0.0	0.0	1.9	0.0

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
27/01/2022	19.5	-	18.6	16.2	13.7	18.4	-	0%	0%	88%	0%	0%	96%	0%	2.7	0.0	0.0	2.6	-
28/01/2022	22.5	35.5	18.2	15.1	15.9	22.3	-	0%	0%	54%	0%	0%	88%	0%	0.5	0.0	0.0	3.8	-
29/01/2022	22.3	40.8	20.8	14.6	13.6	39.6	26.7	0%	8%	54%	0%	0%	79%	0%	3.6	0.0	0.0	19.9	0.0
30/01/2022	18.9	30.5	19.2	13.3	13.8	19.3	28.7	0%	0%	79%	0%	0%	100%	0%	3.5	0.0	0.0	2.3	0.0
31/01/2022	21.4	31.3	17.3	15.7	19.6	19.8	30.5	4%	4%	21%	8%	4%	46%	0%	1.7	0.0	0.0	2.7	0.0
1/02/2022	25.0	33.1	16.4	17.4	20.0	17.8	28.6	38%	8%	8%	58%	38%	8%	42%	0.0	1.2	2.9	0.3	1.4
2/02/2022	12.4	-	5.4	5.8	8.3	4.7	10.4	21%	4%	33%	33%	17%	63%	21%	0.3	0.3	0.0	0.2	1.4
3/02/2022	25.1	17.9	11.5	13.8	14.6	12.3	17.4	0%	0%	50%	0%	0%	100%	0%	0.1	0.0	0.0	0.7	0.0
4/02/2022	19.6	18.2	14.0	10.8	13.4	12.6	18.6	0%	0%	54%	0%	0%	100%	0%	0.9	0.0	0.0	1.3	0.0
5/02/2022	18.9	19.8	12.4	11.2	12.5	13.5	22.3	0%	0%	71%	0%	0%	100%	0%	0.8	0.0	0.0	1.4	0.0
6/02/2022	18.5	23.6	12.0	12.8	12.5	13.7	21.8	0%	0%	75%	0%	0%	100%	0%	0.4	0.0	0.0	0.7	0.0
7/02/2022	17.1	22.3	13.8	11.3	11.1	10.2	15.3	0%	21%	38%	0%	0%	88%	0%	2.0	0.0	0.0	0.7	0.0
8/02/2022	18.1	21.0	11.7	10.5	12.6	11.5	12.2	4%	25%	25%	4%	4%	75%	8%	0.2	0.0	0.1	1.7	0.0
9/02/2022	26.2	30.1	18.2	18.2	20.5	42.1	17.4	33%	4%	0%	33%	17%	13%	29%	0.0	0.8	0.9	23.7	1.3
10/02/2022	44.7	46.3	22.2	30.6	32.0	28.0	27.1	50%	8%	25%	29%	0%	46%	46%	0.8	1.9	0.0	3.1	2.7
11/02/2022	22.3	23.1	14.3	13.8	14.3	16.1	14.3	0%	8%	63%	0%	0%	92%	0%	0.5	0.0	0.0	2.3	0.0
12/02/2022	21.8	27.3	16.6	14.5	14.9	19.1	-	0%	0%	67%	0%	0%	100%	0%	1.9	0.0	0.0	3.6	-
13/02/2022	19.4	32.9	17.7	14.5	15.2	20.4	-	0%	0%	67%	0%	0%	100%	0%	1.5	0.0	0.0	4.9	-
14/02/2022	27.7	41.5	20.8	18.9	15.9	27.0	-	0%	4%	33%	0%	0%	83%	0%	2.3	0.0	0.0	5.5	-
15/02/2022	29.0	38.4	24.9	19.8	16.5	24.4	23.0	0%	4%	50%	0%	0%	83%	0%	4.4	0.0	0.0	2.9	0.0
16/02/2022	21.6	35.1	24.6	17.5	17.2	25.6	23.5	0%	0%	46%	0%	0%	75%	0%	3.6	0.0	0.0	5.2	0.0
17/02/2022	26.4	30.3	19.2	23.9	25.2	20.0	24.5	29%	4%	4%	63%	50%	8%	33%	0.0	3.2	4.0	0.0	0.3
18/02/2022	22.5	28.3	18.8	20.1	20.8	21.7	-	46%	4%	42%	42%	0%	46%	38%	4.5	2.1	0.0	4.2	-
19/02/2022	22.0	24.0	15.7	15.2	15.9	18.4	19.1	0%	0%	96%	0%	0%	100%	0%	0.3	0.0	0.0	2.0	0.0
20/02/2022	31.6	22.2	19.6	20.4	23.1	22.0	25.3	50%	8%	0%	25%	8%	4%	50%	0.0	0.6	0.0	0.1	4.7
21/02/2022	22.6	26.2	15.6	21.0	25.1	16.6	22.5	13%	0%	21%	46%	46%	21%	8%	0.5	1.5	4.4	0.6	0.2
22/02/2022	13.7	20.5	12.3	13.1	12.2	15.1	14.4	0%	0%	58%	0%	0%	96%	0%	2.2	0.0	0.0	3.8	0.0

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
23/02/2022	12.4	19.7	10.7	8.8	9.1	15.3	18.8	0%	0%	83%	0%	0%	96%	0%	1.5	0.0	0.0	3.5	0.0
24/02/2022	8.8	12.5	7.4	7.7	7.7	9.8	12.2	0%	0%	96%	0%	0%	100%	0%	0.5	0.0	0.0	1.6	0.0
25/02/2022	18.0	19.8	13.6	14.5	12.5	16.3	20.1	0%	4%	75%	0%	0%	100%	0%	0.1	0.0	0.0	1.2	0.0
26/02/2022	13.3	21.6	11.6	9.7	8.5	12.8	18.3	0%	0%	96%	0%	0%	100%	0%	1.8	0.0	0.0	2.4	0.0
27/02/2022	14.7	21.8	11.6	11.2	10.8	12.8	19.2	0%	0%	88%	0%	0%	100%	0%	1.5	0.0	0.0	1.4	0.0
28/02/2022	12.8	24.6	11.8	8.9	10.3	-	16.6	0%	0%	83%	0%	0%	96%	0%	1.9	0.0	0.0	-	0.0
1/03/2022	11.0	15.8	8.6	6.7	8.0	8.9	13.7	0%	0%	71%	0%	0%	100%	0%	0.5	0.0	0.0	1.2	0.0
2/03/2022	9.2	18.8	9.6	7.0	7.9	9.5	15.0	0%	4%	71%	0%	0%	100%	0%	1.3	0.0	0.0	1.3	0.0
3/03/2022	11.0	8.1	6.1	7.0	8.4	8.0	8.3	0%	42%	0%	0%	0%	71%	0%	0.0	0.0	0.0	1.7	0.0
4/03/2022	10.0	13.2	7.0	7.4	8.0	7.8	10.0	0%	4%	58%	0%	0%	100%	0%	0.5	0.0	0.0	1.4	0.0
5/03/2022	17.4	23.7	15.8	12.0	14.9	16.6	19.8	8%	8%	38%	8%	4%	71%	8%	1.3	0.1	0.0	2.3	0.5
6/03/2022	9.6	9.2	7.4	8.1	8.6	-	10.3	13%	0%	21%	13%	4%	71%	8%	0.0	0.1	0.0	-	0.3
7/03/2022	9.1	9.5	8.1	6.7	8.1	-	10.8	0%	21%	67%	0%	0%	83%	0%	0.3	0.0	0.0	-	0.0
8/03/2022	4.7	4.9	-	4.6	3.3	3.1	5.1	38%	29%	0%	46%	13%	33%	33%	-	0.3	0.2	0.0	0.5
9/03/2022	8.5	7.1	7.8	6.9	6.3	6.7	7.5	29%	8%	42%	29%	4%	63%	25%	0.9	0.1	0.0	0.6	0.2
10/03/2022	-	18.2	16.1	-	13.8	-	15.0	0%	0%	79%	0%	0%	92%	0%	2.2	-	0.0	-	0.0
11/03/2022	20.3	28.3	19.2	14.0	16.4	19.6	21.4	0%	0%	58%	0%	0%	92%	0%	2.1	0.0	0.0	1.9	0.0
12/03/2022	18.5	26.2	14.8	10.0	12.5	16.4	17.2	0%	0%	71%	0%	0%	83%	0%	2.7	0.0	0.0	3.5	0.0
13/03/2022	16.1	20.8	13.5	10.6	13.0	18.4	17.5	8%	0%	58%	0%	0%	71%	13%	2.3	0.0	0.0	3.5	0.6
14/03/2022	21.4	25.0	15.0	9.7	10.4	18.1	21.5	13%	0%	58%	4%	0%	79%	13%	2.6	0.2	0.0	4.2	0.7
15/03/2022	18.2	27.9	16.9	11.5	12.2	17.6	20.1	0%	0%	83%	0%	0%	100%	0%	2.7	0.0	0.0	3.3	0.0
16/03/2022	18.3	25.9	18.6	12.5	14.7	18.5	27.6	0%	8%	67%	0%	0%	96%	0%	2.6	0.0	0.0	2.7	0.0
17/03/2022	17.3	26.8	16.8	10.7	11.8	21.4	21.8	8%	4%	33%	4%	0%	63%	13%	2.1	0.3	0.0	5.6	0.1
18/03/2022	26.8	32.5	22.8	12.5	13.1	21.8	21.6	0%	0%	71%	0%	0%	92%	0%	4.5	0.0	0.0	3.8	0.0
19/03/2022	31.8	28.0	16.9	14.3	13.9	16.9	21.9	0%	4%	38%	0%	0%	88%	0%	0.3	0.0	0.0	1.0	0.0
20/03/2022	27.9	34.1	19.6	20.0	18.7	22.0	20.9	33%	4%	25%	17%	4%	50%	33%	0.9	0.2	0.0	2.6	2.7
21/03/2022	29.4	34.8	21.8	16.6	17.1	18.4	20.4	13%	21%	38%	0%	0%	75%	17%	2.0	0.0	0.0	1.9	0.8

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
22/03/2022	39.6	32.5	20.4	25.2	29.0	25.8	24.2	58%	0%	0%	54%	13%	0%	58%	0.0	2.1	0.0	0.0	1.8
23/03/2022	38.8	37.7	23.5	28.1	37.8	-	31.2	33%	0%	46%	50%	17%	50%	17%	2.2	3.2	4.0	-	0.4
24/03/2022	8.2	8.7	7.3	6.3	5.9	-	10.2	0%	4%	83%	0%	0%	96%	0%	0.5	0.0	0.0	-	0.0
25/03/2022	17.6	17.0	14.6	11.5	13.0	-	19.6	0%	0%	79%	0%	0%	92%	0%	0.2	0.0	0.0	-	0.0
26/03/2022	11.1	9.2	7.8	7.1	8.8	7.8	11.7	0%	0%	67%	0%	0%	88%	0%	0.2	0.0	0.0	1.0	0.0
27/03/2022	13.1	11.3	9.1	8.6	9.2	9.2	12.7	0%	0%	83%	0%	0%	100%	0%	0.2	0.0	0.0	0.6	0.0
28/03/2022	11.7	12.7	9.4	8.9	10.6	11.3	13.2	21%	8%	33%	13%	8%	50%	21%	0.1	0.0	0.0	0.7	0.8
29/03/2022	12.1	10.9	9.2	8.8	9.5	8.7	12.3	0%	4%	54%	0%	0%	96%	0%	0.2	0.0	0.0	0.6	0.0
30/03/2022	14.2	13.5	12.6	11.1	12.1	11.6	15.1	0%	21%	33%	0%	0%	83%	0%	0.6	0.0	0.0	1.4	0.0
31/03/2022	16.4	12.2	11.2	12.3	13.7	9.9	12.7	0%	8%	0%	0%	0%	100%	0%	0.0	0.0	0.0	0.2	0.0
1/04/2022	14.4	9.2	6.6	7.9	8.9	6.5	7.4	4%	46%	0%	13%	13%	54%	4%	0.0	0.1	0.2	0.2	0.0
2/04/2022	17.1	10.4	7.0	11.3	9.9	7.2	14.8	63%	0%	0%	63%	21%	0%	50%	0.0	1.0	0.2	0.0	4.1
3/04/2022	19.5	16.3	9.2	20.9	16.5	9.0	22.9	58%	0%	0%	92%	38%	0%	54%	0.0	8.4	1.0	0.0	5.7
4/04/2022	21.6	17.0	9.8	16.1	15.5	10.3	18.9	46%	0%	0%	92%	54%	0%	38%	0.0	3.3	1.4	0.0	3.8
5/04/2022	35.4	31.7	16.5	21.4	21.1	19.7	30.6	58%	4%	8%	42%	0%	38%	54%	0.0	0.3	0.0	1.9	5.1
6/04/2022	20.2	30.9	19.0	14.9	15.5	19.4	29.4	0%	4%	54%	0%	0%	75%	0%	1.7	0.0	0.0	2.3	0.0
7/04/2022	15.7	16.0	9.5	9.2	9.7	8.9	20.8	0%	0%	50%	0%	0%	100%	0%	0.3	0.0	0.0	0.1	0.0
8/04/2022	11.4	13.6	10.7	8.6	9.0	10.7	15.1	0%	0%	88%	0%	0%	100%	0%	0.9	0.0	0.0	1.0	0.0
9/04/2022	14.5	21.2	12.2	8.6	9.3	12.3	21.8	0%	0%	79%	0%	0%	100%	0%	0.6	0.0	0.0	0.8	0.0
10/04/2022	15.2	25.6	16.0	10.1	11.2	15.4	16.2	0%	21%	17%	0%	4%	63%	0%	0.8	0.0	0.0	1.7	0.0
11/04/2022	22.2	28.1	11.9	14.0	-	15.5	19.0	50%	4%	17%	33%	4%	33%	38%	0.0	1.3	-	0.9	1.0
12/04/2022	26.9	31.8	15.0	16.4	-	16.8	19.8	0%	0%	42%	0%	0%	100%	0%	0.4	0.0	-	2.0	0.0
13/04/2022	19.9	18.0	11.0	11.0	11.9	10.1	15.3	0%	0%	54%	0%	0%	96%	0%	0.6	0.0	0.0	0.2	0.0
14/04/2022	14.4	21.8	10.4	8.4	8.7	11.5	13.2	0%	0%	75%	0%	0%	100%	0%	1.0	0.0	0.0	2.2	0.0
15/04/2022	22.0	22.4	10.8	10.3	10.6	14.6	12.8	21%	13%	29%	13%	8%	50%	21%	0.9	0.2	0.0	2.4	1.5
16/04/2022	31.2	27.8	10.7	11.2	12.6	14.0	16.5	25%	13%	25%	13%	4%	54%	29%	0.0	0.0	0.0	0.7	1.0
17/04/2022	22.5	27.1	13.5	11.8	13.0	17.3	16.6	46%	8%	8%	13%	4%	38%	42%	0.1	0.0	0.0	2.1	1.2

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
18/04/2022	45.1	34.2	9.8	16.0	12.1	13.8	14.4	50%	13%	8%	46%	17%	17%	38%	0.0	1.3	0.3	0.0	0.6
19/04/2022	29.6	24.3	18.1	18.9	19.4	17.5	25.1	71%	0%	0%	63%	13%	0%	63%	0.0	1.9	0.1	0.0	3.7
20/04/2022	10.1	9.9	5.7	8.4	12.2	4.9	20.3	71%	0%	0%	96%	29%	0%	33%	0.0	1.2	0.7	0.0	7.4
21/04/2022	47.2	-	10.9	11.4	13.1	12.1	22.8	38%	0%	38%	25%	0%	63%	38%	0.0	0.1	0.0	0.8	3.4
22/04/2022	33.7	14.2	9.4	9.8	10.3	8.3	16.9	0%	0%	67%	0%	0%	100%	0%	0.1	0.0	0.0	0.0	0.0
23/04/2022	11.2	18.9	9.8	7.1	8.5	11.0	16.8	0%	0%	79%	0%	0%	92%	0%	1.1	0.0	0.0	1.7	0.0
24/04/2022	12.9	20.6	8.9	6.0	6.2	10.1	14.3	0%	4%	50%	0%	0%	88%	0%	0.6	0.0	0.0	1.8	0.0
25/04/2022	18.7	35.6	10.9	7.4	7.6	16.1	14.7	4%	0%	67%	4%	0%	71%	4%	0.9	0.0	0.0	2.6	0.0
26/04/2022	13.7	20.9	15.1	7.2	8.1	14.3	24.2	0%	0%	63%	0%	0%	79%	0%	1.3	0.0	0.0	2.4	0.0
27/04/2022	14.1	14.8	9.8	8.7	10.1	10.0	15.5	0%	13%	21%	8%	13%	42%	0%	0.0	0.0	0.0	0.4	0.0
28/04/2022	16.8	18.1	9.8	11.2	13.7	10.5	13.3	33%	17%	8%	29%	13%	29%	38%	0.0	0.1	0.9	0.0	0.3
29/04/2022	24.0	16.6	7.2	10.5	11.1	8.4	12.3	58%	8%	4%	63%	13%	8%	38%	0.0	2.0	0.2	0.0	0.5
30/04/2022	14.5	11.0	8.1	10.8	11.9	7.2	12.3	83%	0%	0%	88%	17%	0%	54%	0.0	2.6	0.6	0.0	1.9
1/05/2022	14.7	23.2	10.2	8.2	9.0	12.6	11.6	42%	8%	29%	29%	0%	54%	42%	0.8	0.2	0.0	2.4	1.4
2/05/2022	14.3	26.3	11.6	10.0	11.1	14.0	15.8	29%	4%	42%	13%	0%	58%	33%	1.2	0.4	0.0	0.8	0.8
3/05/2022	38.3	27.1	7.3	11.6	13.4	13.3	13.2	42%	13%	13%	13%	13%	17%	42%	0.0	0.0	0.8	0.1	0.5
4/05/2022	47.4	38.1	10.3	16.4	18.1	16.3	18.3	58%	4%	0%	75%	21%	0%	50%	0.0	2.1	1.9	0.0	1.4
5/05/2022	17.7	10.6	9.6	14.4	16.0	10.7	18.8	58%	0%	0%	100%	42%	0%	38%	0.0	3.2	0.7	0.0	4.0
6/05/2022	13.0	10.2	7.0	14.9	12.6	6.6	20.8	67%	0%	0%	92%	33%	0%	54%	0.0	6.1	0.3	0.0	6.7
7/05/2022	14.3	14.8	6.6	12.9	14.8	6.6	23.0	63%	0%	0%	100%	38%	0%	58%	0.0	3.0	0.5	0.0	7.4
8/05/2022	40.4	31.0	6.5	10.6	14.4	12.7	15.9	58%	17%	8%	54%	4%	21%	63%	0.0	0.6	0.2	0.8	5.1
9/05/2022	39.0	35.5	12.8	17.7	19.8	16.5	28.5	33%	0%	42%	0%	0%	67%	33%	0.0	0.0	0.0	0.0	1.3
10/05/2022	14.3	33.1	12.3	9.8	10.8	16.7	21.3	0%	0%	88%	0%	0%	100%	0%	1.0	0.0	0.0	4.8	0.0
11/05/2022	10.2	28.6	-	7.8	10.0	15.5	27.5	0%	0%	92%	0%	0%	100%	0%	-	0.0	0.0	2.4	0.0
12/05/2022	8.9	9.8	9.4	7.0	8.5	10.1	15.5	0%	8%	46%	0%	0%	100%	0%	0.1	0.0	0.0	0.8	0.0
13/05/2022	12.1	8.9	7.7	6.6	7.3	9.2	12.4	4%	17%	38%	0%	0%	71%	4%	0.1	0.0	0.0	1.1	0.1
14/05/2022	18.3	18.8	9.0	9.6	11.6	9.8	13.0	54%	8%	4%	38%	8%	4%	54%	0.0	0.2	0.0	0.0	1.7

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
15/05/2022	12.9	12.7	9.0	10.0	11.8	8.5	15.1	83%	0%	0%	96%	17%	0%	58%	0.0	1.4	0.4	0.0	2.2
16/05/2022	10.5	10.7	-	10.6	10.9	6.1	17.6	67%	0%	0%	83%	33%	0%	42%	-	1.5	0.1	0.0	5.1
17/05/2022	11.8	14.4	-	6.0	13.8	7.2	20.3	63%	0%	0%	96%	38%	0%	42%	-	0.2	0.6	0.0	3.1
18/05/2022	11.8	6.5	-	8.7	12.7	7.0	16.7	33%	0%	0%	92%	67%	0%	25%	-	2.4	2.4	0.0	1.3
19/05/2022	21.2	32.1	9.8	13.0	14.5	13.9	20.0	46%	0%	25%	29%	0%	38%	46%	0.4	0.9	0.0	1.1	5.0
20/05/2022	25.8	38.8	15.8	11.9	13.0	20.6	29.5	0%	8%	46%	0%	0%	63%	0%	0.4	0.0	0.0	1.7	0.0
21/05/2022	14.7	20.2	8.9	8.3	9.0	12.0	23.9	0%	0%	71%	0%	0%	92%	0%	0.5	0.0	0.0	1.2	0.0
22/05/2022	10.2	13.3	7.1	6.2	7.6	7.3	13.4	0%	4%	54%	0%	0%	75%	0%	0.6	0.0	0.0	0.3	0.0
23/05/2022	10.6	22.5	7.7	6.5	6.7	9.2	22.5	0%	4%	67%	0%	0%	88%	0%	0.1	0.0	0.0	0.8	0.0
24/05/2022	12.4	21.9	7.5	6.2	6.9	10.1	22.7	0%	0%	58%	4%	4%	88%	0%	0.9	0.0	0.0	1.3	0.0
25/05/2022	25.1	31.7	8.6	19.6	10.3	16.0	-	21%	13%	21%	0%	0%	54%	29%	0.2	0.0	0.0	1.0	-
26/05/2022	27.0	30.4	13.6	15.0	13.1	18.5	-	42%	0%	4%	13%	0%	25%	46%	0.8	0.0	0.0	2.0	-
27/05/2022	31.5	21.6	11.3	14.7	14.5	13.8	17.4	54%	4%	21%	29%	8%	38%	50%	0.0	1.9	1.4	2.7	2.3
28/05/2022	15.9	14.3	8.3	16.5	20.9	6.9	19.7	79%	0%	0%	92%	21%	0%	63%	0.0	5.0	2.0	0.0	6.9
29/05/2022	7.8	14.1	4.4	8.0	9.7	4.2	17.7	58%	0%	0%	100%	42%	0%	13%	0.0	0.4	0.5	0.0	0.6
30/05/2022	13.0	20.1	8.6	13.2	16.1	10.1	19.3	42%	0%	0%	88%	58%	0%	38%	0.0	2.3	1.9	0.0	5.0
31/05/2022	11.8	13.5	9.2	14.6	12.9	8.9	17.1	8%	0%	0%	100%	92%	0%	0%	0.0	3.6	2.6	0.0	0.0
1/06/2022	8.9	10.9	8.2	11.5	12.3	6.1	18.6	29%	0%	0%	100%	71%	0%	4%	0.0	1.8	1.9	0.0	0.5
2/06/2022	16.1	10.2	6.4	11.3	13.2	6.8	17.0	83%	4%	0%	63%	8%	8%	71%	0.0	1.9	0.2	0.0	6.8
3/06/2022	11.6	14.3	6.2	10.2	10.3	6.3	13.9	71%	0%	0%	92%	29%	0%	50%	0.0	1.7	0.5	0.0	1.9
4/06/2022	7.2	6.7	4.6	6.9	7.2	3.5	12.9	17%	0%	0%	100%	83%	0%	4%	0.0	1.3	1.0	0.0	0.3
5/06/2022	7.7	8.7	4.2	9.9	9.4	4.4	16.2	38%	0%	0%	92%	63%	0%	21%	0.0	3.1	0.4	0.0	2.5
6/06/2022	9.6	9.1	5.7	9.0	10.2	5.4	21.3	13%	0%	0%	100%	88%	0%	8%	0.0	1.0	2.0	0.0	0.7
7/06/2022	10.6	10.6	6.5	11.0	9.6	6.0	15.7	0%	0%	0%	100%	100%	0%	0%	0.0	2.2	0.9	0.0	0.0
8/06/2022	9.8	10.5	5.1	10.3	11.6	3.9	20.5	4%	0%	0%	100%	96%	0%	0%	0.0	2.2	3.2	0.0	0.0
9/06/2022	10.1	13.9	4.5	9.4	13.4	5.1	26.3	21%	0%	0%	100%	79%	0%	8%	0.0	0.6	2.8	0.0	0.2
10/06/2022	12.3	11.6	4.3	10.3	12.4	4.0	27.4	13%	0%	0%	100%	88%	0%	0%	0.0	1.7	1.9	0.0	0.0

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
11/06/2022	8.8	11.1	5.1	11.0	14.0	3.9	24.5	42%	0%	0%	100%	58%	0%	17%	0.0	2.3	1.8	0.0	1.5
12/06/2022	13.5	17.9	9.8	19.3	23.5	9.2	38.2	29%	0%	0%	100%	71%	0%	13%	0.0	4.9	3.9	0.0	3.0
13/06/2022	24.8	14.8	7.9	14.5	13.1	8.5	17.0	58%	4%	13%	54%	4%	29%	58%	0.0	4.0	0.0	0.0	5.6
14/06/2022	22.5	21.0	6.8	13.2	14.4	6.4	17.4	75%	0%	0%	75%	21%	0%	71%	0.0	1.8	0.0	0.0	4.6
15/06/2022	13.3	13.2	7.4	18.8	17.8	5.4	22.2	50%	0%	0%	100%	50%	0%	25%	0.0	7.6	2.4	0.0	1.4
16/06/2022	15.5	16.1	7.3	16.9	15.5	3.9	26.6	42%	0%	0%	100%	58%	0%	17%	0.0	4.5	0.7	0.0	2.8
17/06/2022	22.3	13.2	7.1	12.7	15.6	4.0	15.3	75%	0%	0%	58%	8%	0%	75%	0.0	2.0	0.3	0.0	6.1
18/06/2022	23.5	27.9	7.8	19.5	21.4	9.7	14.9	46%	25%	8%	13%	0%	17%	46%	0.0	1.2	0.0	0.0	1.6
19/06/2022	25.8	31.9	11.6	12.7	12.1	12.9	14.8	0%	4%	46%	4%	4%	63%	4%	1.0	0.0	0.0	0.8	0.0
20/06/2022	26.6	31.3	12.5	14.1	14.8	17.7	12.6	29%	8%	25%	17%	13%	38%	29%	0.3	0.0	0.0	0.9	0.0
21/06/2022	18.1	18.8	9.2	21.2	17.7	9.4	22.3	71%	0%	0%	83%	29%	0%	46%	0.0	6.0	1.6	0.0	4.0
22/06/2022	18.8	14.6	10.8	14.2	13.0	7.6	14.4	88%	0%	0%	67%	13%	0%	88%	0.0	4.8	0.0	0.0	3.8
23/06/2022	13.7	13.2	7.3	16.3	14.2	6.4	26.9	71%	0%	0%	100%	29%	0%	42%	0.0	5.8	0.2	0.0	7.0
24/06/2022	14.8	13.7	8.8	20.6	19.4	7.5	27.3	38%	0%	0%	100%	63%	0%	21%	0.0	8.2	3.3	0.0	3.0
25/06/2022	15.9	15.4	8.9	22.2	24.4	7.7	20.4	71%	0%	0%	88%	29%	0%	58%	0.0	10.1	1.7	0.0	5.7
26/06/2022	14.5	12.6	10.1	21.7	21.5	8.2	15.8	79%	0%	0%	75%	21%	0%	71%	0.0	5.6	1.5	0.0	4.0
27/06/2022	21.9	28.2	9.4	17.5	18.5	8.1	18.1	38%	8%	13%	29%	0%	50%	38%	0.0	1.8	0.0	0.0	2.2
28/06/2022	31.0	36.2	15.8	23.4	24.3	17.2	24.0	21%	13%	21%	21%	13%	42%	21%	0.0	1.7	1.4	1.0	0.8
29/06/2022	28.1	22.3	18.4	23.6	20.3	21.6	23.5	96%	0%	0%	63%	4%	0%	79%	0.0	2.5	0.0	0.0	4.5
30/06/2022	26.6	42.0	16.4	22.5	25.1	16.9	23.9	54%	4%	17%	63%	13%	25%	38%	0.0	1.8	0.9	0.8	0.7
1/07/2022	32.6	43.7	15.4	23.5	21.4	17.1	42.6	0%	4%	63%	4%	4%	79%	0%	0.3	0.0	0.0	0.0	0.0
2/07/2022	11.6	9.9	8.4	6.7	7.6	9.3	8.9	25%	8%	17%	17%	4%	38%	38%	0.2	0.1	0.0	0.4	0.2
3/07/2022	5.6	4.9	3.5	4.5	4.8	3.3	7.6	96%	0%	0%	96%	4%	0%	75%	0.0	1.0	0.0	0.0	3.1
4/07/2022	5.4	5.2	5.3	4.9	5.0	4.2	-	71%	0%	0%	79%	8%	0%	67%	0.0	0.6	0.3	0.0	-
5/07/2022	5.0	5.0	4.7	4.8	5.0	4.3	8.5	0%	0%	96%	0%	0%	96%	0%	0.7	0.0	0.0	0.2	0.0
6/07/2022	2.2	2.7	2.5	2.5	2.6	2.4	2.8	0%	25%	8%	0%	0%	92%	0%	0.0	0.0	0.0	0.3	0.0
7/07/2022	3.6	4.4	4.6	4.2	5.1	4.7	5.2	42%	8%	0%	67%	38%	0%	29%	0.0	0.4	0.2	0.0	0.3

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
8/07/2022	6.2	8.0	6.9	7.1	7.9	5.8	9.6	38%	0%	0%	100%	63%	0%	29%	0.0	0.6	0.8	0.0	0.6
9/07/2022	8.2	8.6	6.5	8.3	9.0	6.1	10.3	79%	0%	0%	92%	17%	0%	63%	0.0	1.1	0.0	0.0	2.4
10/07/2022	7.3	9.5	6.5	8.4	9.9	7.0	8.7	54%	8%	13%	46%	0%	33%	63%	0.0	0.9	0.0	0.1	1.2
11/07/2022	9.9	14.4	5.8	5.7	6.3	7.9	7.3	25%	13%	13%	17%	8%	38%	25%	0.2	0.0	0.0	0.2	0.5
12/07/2022	7.3	6.8	4.7	6.2	3.5	4.7	8.4	83%	0%	0%	54%	8%	0%	83%	0.0	0.9	0.0	0.0	2.5
13/07/2022	5.1	5.5	5.4	5.8	4.8	4.5	7.6	63%	0%	0%	96%	38%	0%	46%	0.0	1.2	0.1	0.0	1.5
14/07/2022	15.3	10.1	6.8	9.1	9.4	7.0	9.1	13%	33%	0%	8%	4%	17%	13%	0.0	0.0	0.0	0.2	0.2
15/07/2022	-	9.4	5.2	10.4	8.8	5.3	9.0	75%	0%	0%	63%	17%	0%	75%	0.0	2.1	0.0	0.0	2.2
16/07/2022	-	10.4	5.7	13.8	11.1	6.7	14.8	67%	0%	0%	96%	33%	0%	54%	0.0	5.3	0.8	0.0	4.9
17/07/2022	16.0	15.2	7.9	21.7	21.0	10.2	25.9	63%	0%	0%	100%	38%	0%	29%	0.0	8.5	2.1	0.0	4.7
18/07/2022	20.7	10.6	8.1	16.5	10.8	5.6	-	4%	0%	0%	67%	67%	0%	4%	0.0	4.0	1.5	0.0	-
19/07/2022	-	18.6	8.9	17.7	16.0	10.2	-	29%	0%	54%	0%	0%	67%	29%	0.0	0.0	0.0	0.1	-
20/07/2022	-	17.1	10.6	8.2	7.4	12.9	18.7	0%	0%	75%	0%	0%	88%	0%	1.8	0.0	0.0	2.9	0.0
21/07/2022	-	21.0	12.3	9.6	9.0	14.8	31.7	0%	0%	88%	0%	0%	100%	0%	1.1	0.0	0.0	2.3	0.0
22/07/2022	12.8	23.8	14.7	11.7	12.5	15.3	31.1	0%	0%	92%	0%	0%	100%	0%	1.1	0.0	0.0	2.5	0.0
23/07/2022	-	24.1	11.0	8.9	7.5	15.2	25.1	0%	0%	58%	8%	8%	67%	0%	0.3	0.0	0.0	1.5	0.0
24/07/2022	21.0	23.7	11.1	12.0	13.2	17.1	19.8	29%	17%	29%	0%	0%	42%	29%	0.3	0.0	0.0	2.3	1.5
25/07/2022	18.5	21.8	8.7	12.5	14.0	14.1	12.0	63%	8%	4%	21%	8%	8%	67%	0.0	0.9	0.0	0.0	1.8
26/07/2022	-	11.5	7.5	12.3	14.1	8.0	12.4	29%	0%	0%	92%	71%	0%	29%	0.0	2.7	2.3	0.0	0.4
27/07/2022	126.0	10.7	8.4	13.3	12.5	7.0	16.5	46%	0%	0%	100%	54%	0%	29%	0.0	3.7	0.1	0.0	3.0
28/07/2022	15.8	9.1	5.4	14.4	16.2	6.6	12.6	96%	0%	0%	79%	4%	0%	88%	0.0	5.2	0.0	0.0	5.6
29/07/2022	16.8	18.6	11.3	14.1	13.6	12.1	13.1	50%	0%	21%	42%	13%	33%	50%	0.2	1.6	0.1	0.4	2.8
30/07/2022	27.9	29.0	12.7	15.9	14.5	16.5	16.8	42%	8%	17%	8%	4%	46%	42%	1.1	0.4	0.0	1.6	4.0
31/07/2022	34.9	29.7	10.4	20.0	20.2	16.6	19.0	54%	13%	8%	21%	4%	17%	58%	0.0	0.5	0.0	0.4	2.0
1/08/2022	24.7	11.7	7.6	12.0	14.0	8.0	16.4	38%	4%	0%	83%	54%	0%	25%	0.0	2.0	1.3	0.0	2.4
2/08/2022	26.5	10.9	4.9	11.8	11.9	4.9	12.3	63%	0%	0%	79%	33%	0%	54%	0.0	2.9	0.7	0.0	3.1
3/08/2022	26.4	-	7.5	23.0	22.4	11.3	23.9	79%	0%	0%	58%	17%	0%	67%	0.0	6.1	1.3	0.0	8.6

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
4/08/2022	15.3	-	9.0	16.7	14.2	11.8	19.7	75%	0%	0%	54%	25%	0%	50%	0.0	3.1	0.3	0.0	6.3
5/08/2022	8.9	-	7.5	8.5	8.8	6.3	10.8	21%	0%	0%	100%	79%	0%	4%	0.0	1.6	1.2	0.0	0.0
6/08/2022	9.3	7.1	6.9	9.2	9.9	5.4	14.1	13%	0%	0%	100%	88%	0%	8%	0.0	1.9	1.1	0.0	1.4
7/08/2022	9.7	10.5	5.8	8.0	7.8	4.7	12.9	79%	0%	0%	79%	21%	0%	75%	0.0	1.6	0.0	0.0	4.2
8/08/2022	14.7	14.6	7.2	8.6	9.2	6.8	10.1	42%	13%	13%	13%	4%	13%	42%	0.0	0.0	0.4	0.0	0.6
9/08/2022	19.1	11.0	5.6	13.7	12.6	6.3	9.1	33%	25%	13%	0%	0%	54%	33%	0.0	0.0	0.0	0.8	1.2
10/08/2022	23.3	22.2	10.5	13.9	12.9	14.0	13.1	8%	4%	50%	4%	0%	75%	8%	0.0	0.1	0.0	1.3	0.0
11/08/2022	37.6	34.4	17.2	19.7	21.0	20.9	22.2	33%	13%	25%	33%	13%	42%	33%	0.6	1.2	0.2	2.1	2.0
12/08/2022	12.5	13.4	9.4	11.8	12.9	9.3	13.3	25%	0%	13%	38%	29%	46%	21%	0.2	1.0	1.3	0.2	0.7
13/08/2022	5.4	4.3	4.4	5.0	5.5	3.9	6.2	29%	4%	0%	83%	63%	0%	21%	0.0	0.9	0.6	0.0	0.6
14/08/2022	4.3	6.5	4.2	6.0	6.6	4.1	8.8	17%	0%	0%	100%	83%	0%	0%	0.0	1.1	1.5	0.0	0.0
15/08/2022	5.7	8.8	4.9	8.3	7.9	5.0	12.3	4%	0%	0%	100%	96%	0%	0%	0.0	1.4	1.9	0.0	0.0
16/08/2022	-	-	6.9	-	10.0	-	10.0	8%	0%	0%	67%	63%	0%	4%	0.0	-	0.5	-	0.0
17/08/2022	-	-	6.5	-	14.8	-	11.8	63%	0%	0%	38%	4%	0%	75%	0.0	-	0.0	-	2.8
18/08/2022	12.3	9.4	7.5	17.4	18.0	9.5	15.0	58%	0%	0%	92%	42%	0%	21%	0.0	7.8	3.8	0.0	1.9
19/08/2022	14.6	13.5	7.6	13.4	11.9	4.8	13.3	50%	0%	0%	100%	50%	0%	38%	0.0	4.4	0.3	0.0	1.9
20/08/2022	12.3	13.7	8.8	16.4	15.7	8.9	15.2	54%	0%	0%	96%	46%	0%	38%	0.0	5.1	0.4	0.0	2.4
21/08/2022	59.5	33.0	14.4	20.2	19.3	17.6	17.1	25%	21%	17%	13%	8%	33%	33%	1.1	0.5	0.1	0.5	0.8
22/08/2022	25.9	28.0	14.8	29.4	28.6	12.6	26.5	71%	0%	0%	92%	29%	0%	54%	0.0	10.1	2.8	0.0	2.0
23/08/2022	19.8	13.1	10.8	17.2	22.5	9.0	20.8	29%	0%	0%	54%	46%	0%	17%	0.0	4.3	3.3	0.0	2.7
24/08/2022	6.7	4.7	4.9	7.6	6.1	5.0	8.5	83%	0%	0%	100%	17%	0%	42%	0.0	2.6	0.1	0.0	2.1
25/08/2022	14.1	15.6	8.1	9.3	12.7	9.0	12.1	50%	13%	8%	75%	25%	8%	25%	0.0	1.1	0.6	0.0	0.3
26/08/2022	18.7	22.8	10.5	17.8	13.6	14.6	14.3	25%	4%	67%	4%	4%	67%	25%	2.0	0.0	0.0	2.3	0.3
27/08/2022	14.1	26.6	12.3	11.6	10.4	14.3	17.7	8%	0%	63%	4%	0%	88%	4%	1.4	0.0	0.0	2.6	0.0
28/08/2022	15.0	34.8	14.1	15.0	18.8	22.5	19.6	17%	0%	38%	4%	0%	63%	17%	1.7	0.0	0.0	4.4	1.0
29/08/2022	18.3	18.5	11.7	10.3	11.3	13.3	13.9	46%	13%	17%	21%	8%	33%	46%	0.2	0.4	0.3	0.1	0.7
30/08/2022	27.6	18.6	12.1	22.6	23.5	12.6	24.8	75%	0%	0%	71%	21%	0%	71%	0.0	6.5	2.1	0.0	7.6

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
31/08/2022	14.6	24.5	12.8	14.4	10.8	14.0	18.7	29%	0%	63%	17%	4%	67%	29%	1.3	0.1	0.0	2.4	1.2
1/09/2022	26.5	25.6	11.8	13.9	16.0	15.0	20.2	33%	8%	17%	21%	8%	21%	29%	0.3	1.1	0.8	0.9	3.2
2/09/2022	27.1	21.1	13.3	13.0	17.6	12.7	16.7	46%	0%	21%	33%	0%	42%	42%	1.1	1.6	0.0	0.8	1.8
3/09/2022	9.0	9.7	8.9	6.4	9.0	8.1	10.7	0%	17%	21%	0%	0%	100%	0%	0.1	0.0	0.0	0.4	0.0
4/09/2022	9.0	12.0	8.1	7.0	8.8	9.0	14.2	0%	17%	29%	0%	0%	88%	0%	0.0	0.0	0.0	0.8	0.0
5/09/2022	15.3	19.3	9.4	10.7	10.4	11.0	11.9	29%	0%	29%	0%	0%	67%	33%	0.1	0.0	0.0	0.6	0.6
6/09/2022	14.8	28.1	15.0	12.7	12.5	14.7	19.7	0%	4%	54%	0%	0%	83%	0%	2.2	0.0	0.0	1.9	0.0
7/09/2022	12.4	24.1	14.8	10.8	10.3	31.7	14.8	17%	0%	38%	0%	0%	71%	21%	2.9	0.0	0.0	18.1	0.3
8/09/2022	22.8	31.0	17.5	10.7	10.6	23.2	20.4	0%	17%	46%	4%	4%	71%	0%	2.8	0.0	0.0	3.8	0.0
9/09/2022	15.4	14.4	9.7	11.2	11.3	10.5	12.9	46%	0%	8%	67%	33%	13%	21%	0.7	1.2	0.4	1.0	0.7
10/09/2022	8.8	7.7	5.2	8.8	8.1	6.0	13.7	33%	0%	0%	100%	67%	0%	17%	0.0	1.5	0.9	0.0	1.2
11/09/2022	10.1	12.2	9.5	12.5	14.1	7.3	23.1	13%	0%	0%	100%	88%	0%	4%	0.0	1.4	3.5	0.0	0.7
12/09/2022	22.2	17.1	11.0	18.3	17.4	12.8	18.4	29%	0%	0%	88%	67%	0%	17%	0.0	4.6	1.3	0.0	0.0
13/09/2022	19.3	28.6	15.1	14.8	18.5	13.0	17.7	33%	8%	46%	21%	0%	46%	38%	2.5	0.2	0.0	2.1	1.4
14/09/2022	14.7	32.0	15.1	12.0	9.7	17.9	16.1	0%	4%	46%	0%	0%	92%	0%	2.7	0.0	0.0	5.4	0.0
15/09/2022	15.1	17.6	10.1	9.5	10.2	11.8	13.5	13%	17%	13%	4%	8%	33%	13%	0.1	0.0	0.1	0.9	0.1
16/09/2022	10.0	9.3	7.3	13.5	9.9	6.1	12.4	21%	0%	0%	96%	79%	0%	13%	0.0	4.9	0.9	0.0	0.8
17/09/2022	21.4	15.7	10.5	17.9	15.3	9.1	27.1	17%	0%	0%	100%	83%	0%	13%	0.0	3.8	1.0	0.0	0.6
18/09/2022	14.7	14.9	12.0	18.2	17.2	8.2	29.1	17%	0%	0%	100%	83%	0%	0%	0.0	3.3	3.3	0.0	0.0
19/09/2022	26.5	19.6	17.0	19.1	16.3	8.1	28.9	13%	0%	0%	83%	75%	0%	8%	0.0	2.3	1.3	0.0	3.4
20/09/2022	24.6	33.1	19.4	20.7	18.7	16.7	25.1	25%	4%	42%	4%	0%	71%	25%	3.4	0.3	0.0	1.2	2.2
21/09/2022	25.6	35.6	19.5	18.4	16.2	24.8	31.5	0%	0%	46%	13%	13%	75%	0%	0.0	0.0	0.0	3.1	0.0
22/09/2022	6.7	8.9	7.4	6.1	6.5	7.6	9.7	0%	0%	75%	0%	0%	100%	0%	0.4	0.0	0.0	0.8	0.0
23/09/2022	9.1	12.8	8.9	7.3	7.7	10.7	14.1	0%	8%	67%	0%	0%	96%	4%	0.7	0.0	0.0	1.2	0.0
24/09/2022	15.8	13.2	10.1	9.6	8.9	11.0	19.6	54%	4%	8%	58%	17%	13%	42%	0.3	0.8	0.6	0.0	2.6
25/09/2022	15.7	14.6	7.3	11.6	10.7	11.5	16.5	42%	0%	0%	79%	46%	0%	42%	0.0	1.6	1.1	0.0	2.2
26/09/2022	26.5	29.8	11.2	17.6	17.2	14.2	24.2	58%	8%	13%	33%	13%	21%	50%	0.0	0.6	0.1	1.3	3.7

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
27/09/2022	17.6	30.2	14.0	18.8	18.5	16.1	17.1	38%	8%	13%	38%	17%	33%	33%	0.2	2.5	1.4	0.7	0.4
28/09/2022	12.9	11.1	8.4	13.0	11.9	7.6	14.9	58%	0%	0%	100%	42%	0%	46%	0.0	4.3	0.4	0.0	4.1
29/09/2022	11.7	9.8	6.8	9.0	10.3	6.2	11.5	42%	25%	0%	29%	0%	38%	42%	0.0	0.2	0.0	0.0	3.0
30/09/2022	20.6	14.1	9.8	13.8	14.4	27.5	15.6	0%	21%	21%	0%	0%	92%	0%	0.2	0.0	0.0	15.9	0.0
1/10/2022	15.3	21.4	13.8	11.1	12.0	15.4	20.7	0%	0%	71%	0%	0%	100%	0%	0.5	0.0	0.0	1.8	0.0
2/10/2022	13.3	18.0	11.4	11.5	10.5	12.7	14.5	13%	17%	42%	8%	0%	75%	8%	1.8	0.0	0.0	1.2	0.4
3/10/2022	11.7	18.5	11.6	9.1	10.0	11.9	10.1	33%	0%	38%	0%	0%	63%	33%	1.0	0.0	0.0	2.2	0.8
4/10/2022	24.9	30.0	21.0	17.8	15.3	19.3	23.5	42%	0%	42%	17%	0%	50%	38%	2.9	0.4	0.0	2.9	1.5
5/10/2022	10.7	17.7	12.6	8.8	10.7	12.5	17.4	0%	0%	96%	0%	0%	100%	0%	1.5	0.0	0.0	2.1	0.0
6/10/2022	8.1	12.4	7.8	7.0	7.7	8.5	10.5	0%	21%	46%	0%	0%	88%	0%	0.2	0.0	0.0	1.1	0.0
7/10/2022	11.4	11.9	7.2	6.4	7.1	9.3	10.5	29%	21%	21%	29%	4%	42%	38%	0.2	0.0	0.0	1.2	0.7
8/10/2022	9.3	10.3	7.7	8.6	9.6	9.2	11.0	33%	13%	17%	38%	17%	29%	33%	0.6	1.0	0.7	2.2	1.6
9/10/2022	7.2	8.2	7.6	6.2	6.7	7.1	8.5	4%	8%	63%	13%	8%	79%	4%	0.6	0.1	0.0	0.8	0.0
10/10/2022	14.6	20.4	16.2	14.2	14.2	16.9	21.0	0%	0%	83%	0%	0%	100%	0%	2.1	0.0	0.0	1.8	0.0
11/10/2022	12.1	17.0	15.7	15.6	10.5	14.9	17.7	0%	0%	79%	0%	0%	100%	0%	2.0	0.0	0.0	1.5	0.0
12/10/2022	12.2	20.0	17.6	18.8	10.7	15.3	20.3	0%	0%	58%	0%	0%	92%	0%	3.7	0.0	0.0	1.1	0.0
13/10/2022	12.0	25.1	21.1	14.4	-	17.5	19.2	0%	21%	33%	0%	0%	75%	0%	2.3	0.0	-	2.8	0.0
14/10/2022	11.7	11.2	9.0	17.9	-	9.4	17.6	33%	0%	0%	92%	63%	0%	13%	0.0	7.3	-	0.0	0.0
15/10/2022	15.7	16.7	13.4	15.2	15.0	15.7	22.2	29%	0%	4%	8%	0%	29%	38%	0.0	0.4	0.0	0.5	3.3
16/10/2022	22.3	21.2	16.5	21.6	18.8	16.2	20.9	38%	17%	13%	33%	17%	21%	38%	0.3	0.6	1.5	0.3	1.5
17/10/2022	26.4	25.4	17.3	18.0	17.6	13.6	19.8	0%	4%	63%	0%	0%	96%	0%	2.0	0.0	0.0	0.1	0.0
18/10/2022	25.8	29.7	24.6	17.6	13.5	17.8	31.8	0%	0%	71%	0%	0%	96%	0%	6.9	0.0	0.0	1.6	0.0
19/10/2022	20.0	17.2	15.8	18.2	17.4	16.4	19.8	29%	0%	21%	29%	8%	46%	29%	0.1	0.6	0.0	0.5	0.8
20/10/2022	11.0	11.2	10.0	9.6	9.8	9.7	19.6	0%	0%	83%	0%	0%	100%	0%	0.4	0.0	0.0	0.3	0.0
21/10/2022	9.4	9.5	9.2	7.5	8.1	21.6	9.1	4%	4%	46%	8%	4%	71%	8%	0.4	0.0	0.0	14.3	0.0
22/10/2022	11.6	13.4	10.3	9.7	9.9	9.6	11.3	8%	38%	21%	4%	0%	46%	8%	0.3	0.1	0.0	0.3	0.4
23/10/2022	9.1	9.8	11.5	8.5	10.2	10.9	10.5	13%	0%	67%	17%	4%	75%	17%	2.9	0.2	0.0	2.1	1.3

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
24/10/2022	16.0	13.3	14.2	7.6	9.8	10.1	-	8%	8%	63%	8%	0%	79%	8%	2.5	0.0	0.0	0.8	-
25/10/2022	16.8	12.1	13.7	11.7	15.0	10.0	16.4	75%	0%	0%	96%	25%	0%	50%	0.0	1.3	0.3	0.0	1.9
26/10/2022	12.1	12.2	13.6	17.3	13.4	7.1	21.0	4%	0%	0%	100%	96%	0%	4%	0.0	4.9	2.4	0.0	0.3
27/10/2022	13.6	14.0	13.5	15.4	14.2	6.1	23.7	25%	0%	0%	100%	75%	0%	4%	0.0	3.2	2.0	0.0	0.5
28/10/2022	17.4	16.3	26.8	24.0	21.5	10.8	37.9	17%	0%	0%	100%	83%	0%	13%	0.0	4.1	2.6	0.0	0.2
29/10/2022	17.6	21.0	12.3	18.2	15.5	9.1	33.0	17%	0%	0%	100%	83%	0%	17%	0.0	2.5	0.1	0.0	3.0
30/10/2022	17.4	30.7	25.4	14.6	16.1	16.0	24.5	42%	4%	21%	67%	29%	25%	33%	2.2	0.6	0.2	3.1	0.6
31/10/2022	33.9	27.9	25.6	17.9	22.3	18.5	40.9	63%	0%	0%	83%	33%	8%	46%	0.0	1.0	0.8	0.7	6.0
1/11/2022	11.5	7.0	6.4	8.8	9.3	4.8	17.7	13%	0%	0%	100%	88%	0%	13%	0.0	1.2	1.4	0.0	0.4
2/11/2022	11.1	8.9	8.0	12.9	12.8	5.6	21.2	8%	0%	0%	100%	92%	0%	4%	0.0	2.9	3.3	0.0	0.7
3/11/2022	12.6	-	16.3	9.0	12.2	12.6	18.1	38%	0%	21%	50%	17%	42%	17%	1.4	0.0	0.0	1.5	1.0
4/11/2022	13.7	23.6	26.5	9.1	12.8	22.7	19.0	0%	0%	79%	0%	0%	100%	0%	7.6	0.0	0.0	9.4	0.0
5/11/2022	13.6	23.3	22.1	8.0	10.8	19.3	20.6	0%	0%	67%	0%	0%	83%	0%	7.1	0.0	0.0	5.3	0.0
6/11/2022	18.8	28.4	29.1	10.0	12.2	15.6	22.8	8%	0%	50%	0%	4%	75%	8%	12.5	0.0	0.0	2.4	1.0
7/11/2022	16.1	25.3	26.7	8.7	14.5	15.3	16.3	0%	0%	46%	0%	0%	75%	0%	5.7	0.0	0.0	2.7	0.0
8/11/2022	14.7	26.5	26.7	8.2	10.3	15.5	19.0	0%	0%	63%	0%	0%	96%	0%	8.8	0.0	0.0	2.9	0.0
9/11/2022	13.2	33.1	31.8	8.5	11.8	19.1	17.3	0%	0%	88%	0%	0%	92%	0%	19.0	0.0	0.0	5.6	0.0
10/11/2022	9.5	25.3	34.4	9.7	11.1	15.9	20.3	0%	4%	50%	0%	0%	79%	0%	16.3	0.0	0.0	3.5	0.0
11/11/2022	9.3	21.9	18.3	11.7	17.7	18.9	22.7	50%	0%	4%	50%	21%	4%	54%	0.4	0.2	1.3	0.9	2.3
12/11/2022	20.5	21.1	20.8	14.4	22.3	17.0	21.6	46%	0%	8%	46%	4%	33%	50%	2.5	0.7	0.0	1.1	4.9
13/11/2022	18.3	18.7	10.2	11.0	13.4	13.9	18.2	75%	0%	4%	50%	4%	4%	75%	0.0	0.0	0.0	0.3	4.7
14/11/2022	13.3	9.5	8.9	14.3	19.5	8.3	21.2	17%	0%	0%	96%	83%	0%	17%	0.0	3.6	7.6	0.0	0.8
15/11/2022	12.9	9.0	8.8	10.0	13.4	6.8	14.8	38%	0%	0%	96%	63%	0%	21%	0.0	2.4	2.0	0.0	1.0
16/11/2022	21.1	8.3	8.5	11.2	15.9	4.9	13.8	29%	0%	0%	71%	67%	0%	29%	0.0	1.8	4.0	0.0	1.0
17/11/2022	23.4	21.7	17.8	10.8	17.9	15.9	19.9	50%	4%	29%	25%	4%	46%	50%	1.8	0.5	1.0	2.6	3.3
18/11/2022	27.0	49.5	24.4	14.7	16.5	23.3	21.0	8%	0%	50%	0%	0%	88%	8%	3.9	0.0	0.0	4.0	0.0
19/11/2022	25.2	22.5	19.3	21.1	22.0	21.7	21.7	25%	0%	8%	29%	13%	13%	42%	0.1	2.0	1.0	0.8	2.8

Date	24-hour average level (µg/m^3)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m^3)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
20/11/2022	27.8	18.8	15.7	39.6	21.0	15.7	50.2	17%	0%	0%	100%	83%	0%	8%	0.0	14.6	1.7	0.0	0.2
21/11/2022	23.2	18.6	17.3	47.7	29.1	14.1	46.4	21%	0%	0%	100%	79%	0%	0%	0.0	23.8	8.2	0.0	0.0
22/11/2022	14.1	11.9	13.3	23.3	11.8	9.2	25.1	0%	0%	0%	100%	100%	0%	0%	0.0	9.0	0.8	0.0	0.0
23/11/2022	16.6	18.8	21.9	31.3	24.3	10.8	25.9	29%	0%	0%	83%	67%	0%	17%	0.0	10.8	4.2	0.0	0.8
24/11/2022	23.3	28.7	20.2	23.6	22.2	17.2	25.0	54%	8%	4%	54%	8%	38%	46%	0.0	3.7	0.0	2.5	3.7
25/11/2022	27.8	24.0	28.9	25.8	22.8	18.7	27.5	38%	0%	21%	46%	29%	25%	33%	2.4	4.0	0.7	1.3	2.7
26/11/2022	23.0	33.9	27.0	25.3	17.4	25.0	20.6	4%	4%	50%	0%	0%	71%	4%	4.8	0.0	0.0	4.0	0.0
27/11/2022	32.1	29.4	32.0	31.3	32.3	22.3	33.9	38%	0%	4%	54%	25%	8%	33%	0.0	4.1	2.7	0.1	3.3
28/11/2022	21.6	24.3	21.8	19.5	19.0	20.9	23.0	4%	0%	46%	8%	8%	67%	8%	3.3	0.0	0.0	2.3	0.0
29/11/2022	27.5	36.0	24.5	24.0	22.1	23.6	24.1	29%	0%	54%	29%	8%	54%	21%	3.1	0.1	0.2	3.0	1.1
30/11/2022	24.7	35.8	34.1	26.5	20.1	30.2	34.4	0%	0%	71%	0%	0%	100%	0%	5.6	0.0	0.0	5.0	0.0
1/12/2022	28.1	-	28.3	23.8	16.4	23.9	30.6	0%	0%	88%	0%	0%	100%	0%	6.6	0.0	0.0	2.3	0.0
2/12/2022	30.3	36.7	28.6	21.7	16.5	21.9	22.5	0%	0%	83%	0%	0%	100%	0%	8.6	0.0	0.0	3.2	0.0
3/12/2022	20.1	27.2	23.6	17.2	12.7	20.0	27.6	0%	0%	46%	0%	0%	96%	0%	4.8	0.0	0.0	2.7	0.0
4/12/2022	25.6	25.9	26.1	16.5	10.8	18.2	19.2	0%	0%	46%	0%	0%	88%	0%	5.1	0.0	0.0	2.4	0.0
5/12/2022	39.8	31.0	22.6	33.3	32.9	15.1	44.0	50%	0%	0%	75%	38%	0%	29%	0.0	3.4	5.7	0.0	3.6
6/12/2022	24.4	37.7	41.6	26.9	25.1	26.6	26.7	4%	4%	63%	0%	0%	75%	4%	12.3	0.0	0.0	5.4	0.0
7/12/2022	23.6	22.7	-	26.0	17.5	11.6	33.7	38%	0%	0%	96%	63%	0%	17%	-	6.4	0.6	0.0	0.3
8/12/2022	21.0	26.3	-	19.7	15.2	15.6	26.6	8%	4%	38%	54%	50%	38%	0%	-	1.5	0.1	3.5	0.0
9/12/2022	30.1	52.6	33.9	28.2	20.9	29.4	29.5	4%	0%	96%	8%	4%	100%	4%	8.7	0.6	0.0	4.6	0.4
10/12/2022	24.1	33.2	27.8	25.0	18.5	19.9	24.6	0%	0%	83%	0%	0%	100%	0%	4.7	0.0	0.0	0.9	0.0
11/12/2022	34.5	27.6	27.1	23.5	27.9	22.2	36.0	63%	4%	0%	58%	25%	0%	63%	0.0	1.5	2.0	0.0	7.6
12/12/2022	24.0	16.3	18.7	24.2	23.8	18.8	28.2	33%	0%	0%	96%	67%	0%	21%	0.0	6.5	2.7	0.0	3.6
13/12/2022	20.5	14.3	14.4	20.1	20.1	10.6	24.9	42%	0%	0%	83%	50%	0%	21%	0.0	2.2	1.0	0.0	1.3
14/12/2022	21.3	15.6	12.4	22.1	23.6	7.5	23.8	33%	0%	0%	83%	67%	0%	29%	0.0	7.7	5.5	0.0	3.1
15/12/2022	24.3	31.8	-	19.8	18.5	16.1	28.1	54%	0%	33%	42%	8%	38%	46%	-	1.9	0.0	2.7	8.3
16/12/2022	21.1	31.6	-	21.3	15.5	20.5	28.0	0%	0%	71%	0%	0%	100%	0%	-	0.0	0.0	3.0	0.0

Date	24-hour average level (µg/m³)							Percentage of time downwind (%)							HVO South's estimated max. contribution to level (µg/m³)				
	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Golden Highway	Howick	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth	Jerrys Plains	Knodlers Lane	Maison Dieu	Wandewoi	Warkworth
17/12/2022	18.6	31.0	23.1	17.2	15.8	18.0	22.3	0%	0%	63%	0%	0%	96%	0%	3.3	0.0	0.0	2.7	0.0
18/12/2022	15.5	20.3	16.5	9.6	8.8	10.4	16.3	0%	0%	75%	0%	0%	96%	0%	2.7	0.0	0.0	1.8	0.0
19/12/2022	32.7	39.7	-	21.6	19.1	18.8	33.0	0%	8%	79%	0%	0%	83%	0%	-	0.0	0.0	0.3	0.0
20/12/2022	29.7	38.6	-	21.3	19.3	21.5	32.9	0%	8%	79%	0%	0%	92%	0%	-	0.0	0.0	1.7	0.0
21/12/2022	25.9	37.6	28.6	16.8	14.3	18.6	25.4	0%	8%	63%	8%	8%	79%	0%	7.7	0.0	0.0	2.4	0.0
22/12/2022	22.9	39.1	32.7	14.1	12.0	22.2	29.0	4%	8%	58%	4%	0%	75%	13%	7.7	0.0	0.0	3.8	0.0
23/12/2022	19.7	21.8	13.6	14.0	16.2	11.7	20.1	50%	4%	8%	63%	17%	13%	58%	0.0	0.6	0.7	0.0	2.1
24/12/2022	15.1	13.7	11.4	11.0	10.8	10.3	12.3	33%	0%	17%	71%	42%	17%	17%	1.4	0.9	0.4	0.8	0.6
25/12/2022	15.7	-	15.8	17.1	16.2	13.8	15.6	13%	4%	38%	13%	4%	71%	13%	0.7	0.0	0.0	0.0	0.0
26/12/2022	11.3	-	16.9	10.4	9.4	14.9	18.6	0%	0%	58%	0%	0%	79%	4%	4.6	0.0	0.0	3.4	0.0
27/12/2022	13.1	24.3	21.9	13.0	11.0	19.7	24.1	0%	0%	67%	0%	0%	92%	0%	4.2	0.0	0.0	4.5	0.0
28/12/2022	15.4	33.1	25.8	16.1	14.0	24.1	21.8	4%	0%	38%	0%	0%	63%	4%	5.3	0.0	0.0	4.7	0.0
29/12/2022	42.6	48.3	26.6	23.4	23.3	23.9	36.8	0%	8%	54%	0%	0%	88%	4%	0.3	0.0	0.0	0.6	0.0
30/12/2022	21.1	35.8	30.0	24.6	18.2	22.4	30.9	0%	0%	92%	0%	0%	100%	0%	6.7	0.0	0.0	1.8	0.0
31/12/2022	18.7	28.0	25.5	15.8	14.6	19.1	25.7	0%	0%	83%	0%	0%	92%	0%	7.0	0.0	0.0	2.8	0.0

- No data

Note for this annual review, TEOM data time was assessed per Australian Eastern Standard Time (AEST) as used by DPE, however some minor differences arise with the operational data which uses Australian Eastern Daylight Time (AEDT). Some minor differences also arise as HVO collects data in real-time from DPE monitors using a separate HVO logger which may result in minor additional time shift effect.

Table B-4: 24-hour average PM_{10} HVAS levels, percent time downwind and estimated contributions – HVO North

Date	Percentage of time downwind (%)				24-hour average PM_{10} level (µg/m³)					HVO North's estimated max. contribution to PM_{10} level (µg/m³)	
	Cheshunt East	Gliding Club	Long Point	Kilburnie South	Estimated Background	Cheshunt East	Gliding Club	Long Point	Kilburnie South	Cheshunt East	Kilburnie South
4/01/2022	0%	0%	0%	0%	19.4	16.5	22.2	18.1	20.2*	0.0	0.0
10/01/2022	4%	1%	1%	0%	21.3	15.0	21.0	18.6	21.3*	0.0	0.0
16/01/2022	28%	3%	24%	0%	17.8	20.5	23.2	18.8	17.8	2.7	0.0
22/01/2022	0%	0%	0%	1%	12.4	8.9	11.0	8.5	15.4	0.0	0.0
28/01/2022	0%	1%	0%	1%	16.3	13.4	25.6	14.9	19.9	0.0	0.0
3/02/2022	0%	0%	0%	0%	15.0	11.8	12.3	11.1	11.3	0.0	0.0
9/02/2022	35%	12%	22%	8%	16.5	25.2	24.2	15.1	14.8	8.7	0.0
15/02/2022	1%	0%	1%	4%	18.8	13.2	18.0	11.1	19.1	0.0	0.0
21/02/2022	50%	9%	8%	1%	16.3	29.4	28.8	21.4	16.6	13.1	0.0
27/02/2022	0%	0%	0%	0%	12.1	8.0	12.6	8.6	11.2	0.0	0.0
5/03/2022	7%	6%	1%	4%	15.5	14.5	19.6	14.6	17.5	0.0	0.0
11/03/2022	0%	0%	0%	3%	16.0	11.5	15.3	12.6	17.7	0.0	0.0
17/03/2022	6%	8%	3%	13%	13.8	8.3	17.1	13.1	17.3	0.0	3.5
23/03/2022	60%	5%	37%	0%	23.3	32.8	30.2	26.2	23.3	9.5	0.0
29/03/2022	0%	0%	0%	0%	8.6	5.7	6.2	5.9	5.6	0.0	0.0
4/04/2022	94%	3%	44%	1%	11.0	13.1	16.7	13.5	7.0	2.1	0.0
10/04/2022	1%	3%	0%	1%	11.5	8.2	12.4	6.9	13.0	0.0	0.0
16/04/2022	26%	16%	10%	2%	7.2	9.4	17.9	7.6	6.8	2.2	0.0
22/04/2022	0%	0%	0%	0%	13.5	4.6	9.5	5.4	4.9	0.0	0.0
28/04/2022	20%	15%	8%	6%	7.3	7.7	9.4	7.3	7.0	0.4	0.0
4/05/2022	60%	17%	35%	5%	18.6	20.2	21.8	20.7	9.8	1.6	0.0
10/05/2022	0%	0%	0%	1%	11.6	6.7	10.0	6.9	8.4	0.0	0.0
16/05/2022	97%	8%	47%	0%	7.3	12.8	9.6	9.8	5.2	5.5	0.0
22/05/2022	0%	0%	0%	6%	8.1	5.7	5.7	5.4	4.3	0.0	0.0
28/05/2022	84%	18%	54%	0%	8.5	14.4	13.6	13.1	4.5	5.9	0.0
3/06/2022	92%	11%	56%	1%	7.5	6.1	9.4	-	3.1	0.0	0.0

Date	Percentage of time downwind (%)				24-hour average PM10 level (µg/m³)					HVO North's estimated max. contribution to PM10 level (µg/m³)	
	Cheshunt East	Gliding Club	Long Point	Kilburnie South	Estimated Background	Cheshunt East	Gliding Club	Long Point	Kilburnie South	Cheshunt East	Kilburnie South
9/06/2022	100%	0%	26%	0%	10.1	16.3	10.4	6.0	0.7	6.2	0.0
15/06/2022	100%	1%	49%	0%	7.0	21.4	11.0	12.9	2.2	14.4	0.0
21/06/2022	85%	15%	47%	0%	10.0	19.4	14.6	12.7	2.4	9.4	0.0
27/06/2022	42%	15%	28%	1%	6.4	14.0	17.2	14.9	3.3	7.7	0.0
3/07/2022	90%	3%	81%	1%	3.9	2.2	3.3	3.0	4.0	0.0	0.0
9/07/2022	90%	10%	63%	1%	5.6	4.6	5.6	4.6	1.4	0.0	0.0
15/07/2022	65%	42%	33%	0%	5.1	6.0	7.4	5.2	0.7	0.9	0.0
21/07/2022	0%	0%	0%	0%	11.6	4.4	7.5	3.5	7.4	0.0	0.0
27/07/2022	99%	1%	42%	0%	8.8	9.7	3.3	8.5	1.8	0.9	0.0
2/08/2022	86%	13%	47%	0%	5.5	10.9	5.5	8.1	1.3	5.4	0.0
8/08/2022	31%	35%	10%	2%	4.7	4.6	7.4	4.9	2.1	0.0	0.0
14/08/2022	100%	0%	19%	0%	4.7	7.2	1.4	3.6	0.1	2.5	0.0
20/08/2022	97%	3%	44%	0%	8.5	12.2	10.2	9.7	2.6	3.7	0.0
26/08/2022	8%	22%	3%	5%	11.6	10.7	14.1	10.6	5.2	0.0	0.0
1/09/2022	22%	10%	9%	9%	9.3	17.1	16.0	11.7	9.3	7.8	0.0
7/09/2022	3%	15%	1%	16%	7.8	6.1	9.0	4.2	9.0	0.0	1.2
13/09/2022	39%	19%	20%	5%	6.0	7.4	-	10.5	6.0	1.4	0.0
19/09/2022	92%	1%	12%	0%	17.8	16.8	14.5	11.9	6.6	0.0	0.0
25/09/2022	81%	6%	35%	1%	9.6	14.8	11.1	10.7	5.0	5.2	0.0
1/10/2022	0%	0%	0%	0%	13.0	9.2	12.2	9.5	10.6	0.0	0.0
7/10/2022	12%	3%	5%	6%	7.4	3.8	7.7	4.4	6.2	0.0	0.0
13/10/2022	0%	0%	0%	3%	11.4	6.2	9.0	5.3	16.3	0.0	0.0
19/10/2022	26%	6%	14%	15%	11.0	17.3	20.4	11.0	14.8	6.3	3.8
25/10/2022	88%	10%	53%	2%	10.5	15.9	11.9	13.3	6.4	5.4	0.0
31/10/2022	75%	16%	33%	3%	22.1	32.8	53.2	19.0	12.8	10.7	0.0
6/11/2022	8%	4%	4%	1%	13.8	12.3	15.4	6.6	16.5	0.0	0.0
12/11/2022	46%	17%	27%	6%	15.6	29.1	33.2	17.3	10.3	13.6	0.0

Date	Percentage of time downwind (%)				24-hour average PM10 level (µg/m³)					HVO North's estimated max. contribution to PM10 level (µg/m³)	
	Cheshunt East	Gliding Club	Long Point	Kilburnie South	Estimated Background	Cheshunt East	Gliding Club	Long Point	Kilburnie South	Cheshunt East	Kilburnie South
18/11/2022	3%	8%	1%	8%	17.8	15.4	23.0	12.2	15.4	0.0	0.0
24/11/2022	54%	19%	26%	1%	15.5	18.0	25.1	14.9	10.8	2.5	0.0
30/11/2022	0%	0%	0%	0%	22.9	15.2	17.8	16.3	28.2	0.0	0.0
6/12/2022	3%	0%	0%	12%	24.9	26.7	23.6	19.6	27.4	0.0	2.5
12/12/2022	85%	8%	36%	1%	18.8	36.6	47.6	24.4	21.2	17.8	0.0
18/12/2022	0%	0%	0%	2%	10.4	6.6	9.4	5.6	16.1	0.0	0.0
24/12/2022	72%	3%	40%	5%	8.6	9.5	8.6	9.6	10.2	0.9	0.0
30/12/2022	0%	0%	0%	0%	20.7	14.0	22.8	15.2	21.9	0.0	0.0

- No data, *Supplementary data from the United Wambo Moses Crossing monitor as agreed by DPE

Table B-5: 24-hour average PM_{10} HVAS levels, percent time downwind and estimated contributions – HVO South

Date	Percentage of time downwind (%)				24-hour average PM10 level (µg/m³)					HVO South's estimated max. contribution to PM10 level (µg/m³)		
	Cheshunt East	Gliding Club	Long Point	Kilburnie South	Estimated Background	Cheshunt East	Gliding Club	Long Point	Kilburnie South	Gliding Club	Long Point	Kilburnie South
4/01/2022	0%	64%	0%	52%	19.4	16.5	22.2	18.1	20.2*	2.8	0.0	0.8
10/01/2022	10%	71%	1%	18%	21.3	15.0	21.0	18.6	21.3*	0.0	0.0	0.0
16/01/2022	1%	69%	5%	24%	17.8	20.5	23.2	18.8	17.8	5.4	0.0	0.0
22/01/2022	0%	63%	0%	42%	12.4	8.9	11.0	8.5	15.4	0.0	0.0	3.0
28/01/2022	2%	76%	0%	32%	16.3	13.4	25.6	14.9	19.9	9.3	0.0	3.6
3/02/2022	0%	26%	0%	8%	15.0	11.8	12.3	11.1	11.3	0.0	0.0	0.0
9/02/2022	8%	57%	8%	5%	16.5	25.2	24.2	15.1	14.8	7.7	0.0	0.0
15/02/2022	1%	62%	0%	31%	18.8	13.2	18.0	11.1	19.1	0.0	0.0	0.3
21/02/2022	14%	66%	34%	3%	16.3	29.4	28.8	21.4	16.6	12.5	5.1	0.0

Date	Percentage of time downwind (%)				24-hour average PM_{10} level ($\mu g/m^3$)					HVO South's estimated max. contribution to PM_{10} level ($\mu g/m^3$)		
	Cheshunt East	Gliding Club	Long Point	Kilburnie South	Estimated Background	Cheshunt East	Gliding Club	Long Point	Kilburnie South	Gliding Club	Long Point	Kilburnie South
27/02/2022	0%	68%	0%	22%	12.1	8.0	12.6	8.6	11.2	0.5	0.0	0.0
5/03/2022	3%	68%	3%	21%	15.5	14.5	19.6	14.6	17.5	4.1	0.0	2.0
11/03/2022	0%	82%	0%	47%	16.0	11.5	15.3	12.6	17.7	0.0	0.0	1.7
17/03/2022	1%	73%	2%	13%	13.8	8.3	17.1	13.1	17.3	3.3	0.0	3.5
23/03/2022	0%	98%	28%	22%	23.3	32.8	30.2	26.2	23.3	6.9	2.9	0.0
29/03/2022	1%	49%	0%	10%	8.6	5.7	6.2	5.9	5.6	0.0	0.0	0.0
4/04/2022	2%	85%	40%	1%	11.0	13.1	16.7	13.5	7.0	5.7	2.5	0.0
10/04/2022	3%	55%	0%	8%	11.5	8.2	12.4	6.9	13.0	0.9	0.0	1.5
16/04/2022	7%	54%	3%	12%	7.2	9.4	17.9	7.6	6.8	10.7	0.0	0.0
22/04/2022	0%	31%	0%	15%	13.5	4.6	9.5	5.4	4.9	0.0	0.0	0.0
28/04/2022	13%	75%	8%	10%	7.3	7.7	9.4	7.3	7.0	2.1	0.0	0.0
4/05/2022	14%	74%	17%	1%	18.6	20.2	21.8	20.7	9.8	3.2	2.1	0.0
10/05/2022	0%	76%	0%	20%	11.6	6.7	10.0	6.9	8.4	0.0	0.0	0.0
16/05/2022	0%	99%	58%	0%	7.3	12.8	9.6	9.8	5.2	2.3	2.5	0.0
22/05/2022	1%	34%	0%	27%	8.1	5.7	5.7	5.4	4.3	0.0	0.0	0.0
28/05/2022	0%	100%	35%	1%	8.5	14.4	13.6	13.1	4.5	5.1	4.6	0.0
3/06/2022	1%	97%	33%	2%	7.5	6.1	9.4	-	3.1	1.9	-	0.0
9/06/2022	0%	100%	90%	0%	10.1	16.3	10.4	6.0	0.7	0.3	0.0	0.0
15/06/2022	0%	100%	67%	1%	7.0	21.4	11.0	12.9	2.2	4.0	5.9	0.0
21/06/2022	1%	99%	44%	0%	10.0	19.4	14.6	12.7	2.4	4.6	2.7	0.0
27/06/2022	8%	57%	0%	3%	6.4	14.0	17.2	14.9	3.3	10.9	0.0	0.0
3/07/2022	3%	92%	21%	0%	3.9	2.2	3.3	3.0	4.0	0.0	0.0	0.0
9/07/2022	4%	95%	40%	0%	5.6	4.6	5.6	4.6	1.4	0.0	0.0	0.0
15/07/2022	4%	94%	17%	1%	5.1	6.0	7.4	5.2	0.7	2.3	0.1	0.0
21/07/2022	0%	88%	0%	51%	11.6	4.4	7.5	3.5	7.4	0.0	0.0	0.0
27/07/2022	0%	100%	80%	0%	8.8	9.7	3.3	8.5	1.8	0.0	0.0	0.0
2/08/2022	0%	98%	48%	1%	5.5	10.9	5.5	8.1	1.3	0.0	2.6	0.0

Date	Percentage of time downwind (%)				24-hour average PM10 level (µg/m³)					HVO South's estimated max. contribution to PM10 level (µg/m³)		
	Cheshunt East	Gliding Club	Long Point	Kilburnie South	Estimated Background	Cheshunt East	Gliding Club	Long Point	Kilburnie South	Gliding Club	Long Point	Kilburnie South
8/08/2022	12%	69%	1%	8%	4.7	4.6	7.4	4.9	2.1	2.7	0.0	0.0
14/08/2022	0%	100%	95%	0%	4.7	7.2	1.4	3.6	0.1	0.0	0.0	0.0
20/08/2022	1%	99%	54%	0%	8.5	12.2	10.2	9.7	2.6	1.7	1.2	0.0
26/08/2022	5%	74%	0%	40%	11.6	10.7	14.1	10.6	5.2	2.5	0.0	0.0
1/09/2022	6%	59%	12%	28%	9.3	17.1	16.0	11.7	9.3	6.7	2.4	0.0
7/09/2022	0%	72%	0%	16%	7.8	6.1	9.0	4.2	9.0	1.2	0.0	1.2
13/09/2022	1%	92%	0%	30%	6.0	7.4	-	10.5	6.0	-	0.0	0.0
19/09/2022	3%	94%	84%	0%	17.8	16.8	14.5	11.9	6.6	0.0	0.0	0.0
25/09/2022	1%	90%	45%	1%	9.6	14.8	11.1	10.7	5.0	1.5	1.1	0.0
1/10/2022	0%	49%	0%	17%	13.0	9.2	12.2	9.5	10.6	0.0	0.0	0.0
7/10/2022	7%	72%	6%	17%	7.4	3.8	7.7	4.4	6.2	0.3	0.0	0.0
13/10/2022	1%	62%	0%	14%	11.4	6.2	9.0	5.3	16.3	0.0	0.0	4.9
19/10/2022	2%	74%	8%	16%	11.0	17.3	20.4	11.0	14.8	9.4	0.0	3.8
25/10/2022	1%	92%	37%	0%	10.5	15.9	11.9	13.3	6.4	1.4	2.8	0.0
31/10/2022	2%	97%	47%	6%	22.1	32.8	53.2	19.0	12.8	33.5	0.0	0.0
6/11/2022	0%	66%	3%	31%	13.8	12.3	15.4	6.6	16.5	1.6	0.0	2.7
12/11/2022	3%	81%	16%	8%	15.6	29.1	33.2	17.3	10.3	17.7	1.8	0.0
18/11/2022	7%	70%	1%	33%	17.8	15.4	23.0	12.2	15.4	5.2	0.0	0.0
24/11/2022	1%	85%	19%	3%	15.5	18.0	25.1	14.9	10.8	9.6	0.0	0.0
30/11/2022	0%	95%	0%	43%	22.9	15.2	17.8	16.3	28.2	0.0	0.0	5.3
6/12/2022	1%	88%	1%	48%	24.9	26.7	23.6	19.6	27.4	0.0	0.0	2.5
12/12/2022	1%	77%	41%	0%	18.8	36.6	47.6	24.4	21.2	28.8	5.6	0.0
18/12/2022	1%	78%	0%	65%	10.4	6.6	9.4	5.6	16.1	0.0	0.0	5.7
24/12/2022	3%	96%	36%	13%	8.6	9.5	8.6	9.6	10.2	0.0	1.0	1.6
30/12/2022	0%	97%	0%	39%	20.7	14.0	22.8	15.2	21.9	2.1	0.0	1.2

- No data, *Supplementary data from the United Wambo Moses Crossing monitor as agreed by DPE

Appendix C

24-hour Average Levels and Estimated Contributions - $PM_{2.5}$

Table C-1: Detailed analyses for elevated 24-hour average $PM_{2.5}$ readings

Date	Site	Measured 24-hour average $PM_{2.5}$ level (µg/m³)	HVO South 24-hour average $PM_{2.5}$ Incremental Criteria (µg/m³)	Estimated HVO South Incremental contribution to $PM_{2.5}$ level (µg/m³)
6/12/2022	Kilburnie South HVAS	28.1	25	9.4
12/12/2022	Maison Dieu HVAS	57.7	25	4.4

Table C-2: 24-hour average $PM_{2.5}$ HVAS levels, percent time downwind and estimated contributions – HVO South

Date	Percentage of time downwind of HVO South (%)		24-hour average $PM_{2.5}$ level (µg/m³)			HVO South's estimated max. contribution to $PM_{2.5}$ level (µg/m³)	
	Maison Dieu	Kilburnie South	Background	Maison Dieu	Kilburnie South	Maison Dieu	Kilburnie South
4/01/2022	0%	52%	7.3	7.3	11.8	0.0	4.5
10/01/2022	11%	18%	7.8	5.3	7.2	0.0	0.0
16/01/2022	4%	24%	9.1	10.6	11.0	0.0	2.0
22/01/2022	0%	42%	4.0	4.0	8.9	0.0	4.9
28/01/2022	1%	32%	8.7	8.7	16.9	0.0	8.2
3/02/2022	0%	8%	5.2	5.2	7.9	0.0	2.7
9/02/2022	15%	5%	7.0	8.6	11.2	1.6	0.0
15/02/2022	1%	31%	3.3	3.3	11.5	0.0	8.2
21/02/2022	51%	3%	12.6	12.9	12.6	0.3	0.0
27/02/2022	0%	22%	2.9	2.9	7.5	0.0	4.6
5/03/2022	5%	21%	4.8	7.5	10.9	0.0	6.2
11/03/2022	0%	47%	4.3	4.3	9.0	0.0	4.7
17/03/2022	3%	13%	3.8	2.8	7.4	0.0	3.7
23/03/2022	19%	22%	10.4	21.0	13.0	10.6	2.6
29/03/2022	0%	10%	0.7	0.7	0.5	0.0	0.0
4/04/2022	47%	1%	4.6	7.4	4.6	2.8	0.0
10/04/2022	0%	8%	3.5	-	5.3	-	1.9
16/04/2022	6%	12%	5.2	5.0	3.4	0.0	0.0
22/04/2022	0%	15%	1.4	1.4	0.2	0.0	0.0
28/04/2022	15%	10%	4.0	3.5	2.8	0.0	0.0
4/05/2022	23%	1%	5.1	11.0	6.5	6.0	0.0
10/05/2022	0%	20%	3.4	-	4.7	-	1.3
16/05/2022	42%	0%	3.0	6.5	3.0	3.5	0.0
22/05/2022	0%	27%	1.5	1.5	2.0	0.0	0.5
28/05/2022	22%	1%	1.6	6.2	1.6	4.6	0.0
3/06/2022	27%	2%	1.9	1.5	1.9	0.0	0.0
9/06/2022	72%	0%	0.3	10.2	0.3	9.9	0.0
15/06/2022	47%	1%	1.0	-	1.0	-	0.0
21/06/2022	30%	0%	0.8	10.1	0.8	9.3	0.0

Date	Percentage of time downwind of HVO South (%)		24-hour average $PM_{2.5}$ level (µg/m³)			HVO South's estimated max. contribution to $PM_{2.5}$ level (µg/m³)	
	Maison Dieu	Kilburnie South	Background	Maison Dieu	Kilburnie South	Maison Dieu	Kilburnie South
27/06/2022	0%	3%	1.9	12.4	1.9	0.0	0.0
3/07/2022	3%	0%	1.0	0.2	1.0	0.0	0.0
9/07/2022	21%	0%	0.1	3.0	0.1	2.9	0.0
15/07/2022	14%	1%	0.1	2.8	0.1	2.7	0.0
21/07/2022	0%	51%	0.4	0.4	2.6	0.0	2.2
27/07/2022	53%	0%	0.2	2.2	0.2	2.0	0.0
2/08/2022	34%	1%	0.8	2.9	0.8	2.1	0.0
8/08/2022	1%	8%	4.7	1.9	1.7	0.0	0.0
14/08/2022	76%	0%	0.1	1.7	0.1	1.6	0.0
20/08/2022	51%	0%	1.2	4.5	1.2	3.3	0.0
26/08/2022	1%	40%	6.1	4.6	3.1	0.0	0.0
1/09/2022	12%	28%	8.0	10.4	4.7	2.4	0.0
7/09/2022	0%	16%	4.8	3.1	5.4	0.0	0.6
13/09/2022	1%	30%	4.4	7.3	3.7	0.0	0.0
19/09/2022	79%	0%	3.8	9.1	3.8	5.3	0.0
25/09/2022	41%	1%	3.0	6.5	3.0	3.5	0.0
1/10/2022	0%	17%	2.2	2.2	4.4	0.0	2.2
7/10/2022	10%	17%	3.9	-	3.3	-	0.0
13/10/2022	0%	14%	1.4	1.4	9.6	0.0	8.2
19/10/2022	8%	16%	6.8	-	10.8	-	4.0
25/10/2022	31%	0%	2.9	5.5	2.9	2.6	0.0
31/10/2022	32%	6%	3.7	10.6	8.3	6.9	4.6
6/11/2022	2%	31%	3.8	5.9	13.8	0.0	10.1
12/11/2022	12%	8%	5.9	14.8	9.2	8.9	3.3
18/11/2022	2%	33%	6.3	6.9	12.5	0.0	6.2
24/11/2022	19%	3%	9.2	10.7	9.2	1.5	0.0
30/11/2022	0%	43%	6.1	6.1	18.4	0.0	12.3
6/12/2022	3%	48%	18.7	18.7	28.1	0.0	9.4
12/12/2022	55%	0%	16.9	57.7	16.9	4.4	0.0
18/12/2022	0%	65%	5.8	5.8	12.6	0.0	6.8
24/12/2022	30%	13%	5.2	6.1	9.7	0.9	4.6
30/12/2022	0%	39%	3.4	3.4	13.6	0.0	10.2

- No data

APPENDIX B: ANNUAL GROUNDWATER REVIEW

umwelt

Environmental & Social Consultants

HUNTER VALLEY OPERATIONS

2022 GROUNDWATER ANNUAL REVIEW

FINAL

March 2023

HUNTER VALLEY OPERATIONS

2022 GROUNDWATER ANNUAL REVIEW

FINAL

Prepared by

Umwelt (Australia) Pty Limited

on behalf of

Hunter Valley Operations Pty Ltd

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Report No.	21188/R07
Date:	March 2023

umwelt
Environmental & Social Consultants

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

Disclaimer

Document Status

Rev No.	Prepared By		Approved for Issue	
	Name	Date	Name	Date
Draft V1	K Cooksey	22/03/2023	K Cooksey	22/03/2023
Final V2	K Cooksey	31/03/2023	K Cooksey	31/03/2023

Table of Contents

Figures

Tables

Appendices

1.0 Introduction

1.1 Overview

The Hunter Valley Operations (HVO) coal mining complex is located approximately 24 km northwest of Singleton, NSW. HVO is comprised of multiple open cut pits within the HVO North and HVO South operations, separated by the Hunter River. Mining is currently being undertaken in Cheshunt Pit and Riverview Pit and West Pit, including pre-strip occurring in the Wilton/Mitchell Pit.

The Hunter Valley Operations Water Management Plan (WMP) (V3) (HVO, 2018) dated 16 October 2018 covers approval commitments in Project Approvals:

- DA 450-10-2003 (Schedule 3, Condition 27) for HVO North.
- PA 06_0261 (Schedule 3, Condition 27 and 28) for HVO South.
- Individual bore license conditions (20BL173587-89, 20BL173847 and 20BL173392).
- Conditions of Environment Protection Licence 640.

This includes requirements for the monitoring of groundwater, assessment of potential impacts and reporting. As part of compliance with mine approval conditions, routine groundwater monitoring is conducted across HVO, and the data reviewed and analysed on a quarterly basis.

This report summarises the groundwater level and quality results for monitoring completed between 1 January and 31 December 2022 (the reporting period).

Umwelt have been engaged to undertake the annual review of the groundwater monitoring data collected during the reporting period. This report presents a summary of the groundwater data collected, high level discussion on any missing data or trigger exceedances, and recommendations (where relevant). This report has been developed in accordance with the approval conditions and requirements outlined within the 2018 WMP (HVO, 2018).

1.2 Scope

This report presents:

- Site background:
  - Legislative requirements and conditions relevant to groundwater.
  - Mine activities over reporting period.
  - Hydrogeological regime.
  - Groundwater monitoring network and programme.

- Data review:
  - Review and illustration (i.e., hydrographs) of groundwater level trends.
  - Review and illustration (i.e., hydrographs) of groundwater quality trends.
  - Comparison of water level and quality trends to relevant trigger levels and natural trends (i.e., surface water levels and rainfall).
  - Assess compliance with mine approval conditions and present a checklist summarising findings.
- Discussion of groundwater impacts and compliance over the reporting period and provision of recommendations.

2.0 HVO Complex

The following section provides a description of the HVO Complex relevant to this annual groundwater review. The site layout is shown in **Figure 2.1**.

2.1 Mine Operations

The mine areas across HVO and approved mining timeframes and activities undertaken over 2022, are summarised in **Table 2.1**. During 2022, Active mining was undertaken in West Pit, Cheshunt Pit and Riverview Pit with pre-strip occurring in the Wilton/Mitchell Pit.

Table 2.1 HVO Activities

Mine Area		Approved Life of Mining	Target Seam	Activities in 2022
HVO North	Alluvial Lands	1993 to 2003	Vaux	Inactive, fully rehabilitated
	Carrington Pit	2000 to 2025	Bayswater	Inactive, used for tailings storage and water storage
	Carrington West Wing	2023 to 2025	Bayswater	Not commenced
	Glider Pit	2016 to 2017	Vaux	Inactive, fully rehabilitated
	North Pit	1979 to 2003	Vaux	Inactive, converted to TSF
	West Pit (Includes Wilton and Mitchell Pits)	1949 to 2025	Bayswater to Hebden	Active mining
HVO South	Cheshunt Pit	2002 to 2030	Bayswater	Active mining in Pits 1 & 2
	Riverview Pit	1997 to 2030	Bayswater	Active mining
	Lemington mine (Underground)	1971 to 1992	Mt Arthur	Inactive
	South Lemington Pit 1	1998 to 2024	Bowfield	Inactive, used for water storage
	South Lemington Pit 2	2015 to 2030	Vaux	Not commenced

Table 2.2 summarises the tailings storage facilities (TSF) across HVO. The TSF's are managed in accordance with the site Fine Rejects Management Strategy, including decant requirements to enable consolidation of the material.

Table 2.2 Approved Tailing Storage Facilities Summary

Mine Area	Location	Status
Dam 6W	West Pit	Active (intermittent deposition).
Bobs Dump TSF (20W)	West Pit	Capping and rehabilitation yet to commence.
North Void TSF (DM6)	North Pit	Inactive, ceased receiving tailings in 2019. Decommissioning and management of decant pond commenced.
South East TSF (27N)	North Pit	Capping complete and rehabilitation 85% complete.

Mine Area	Location	Status
Central TSF (28N)	North Pit	Inactive.
Carrington Out of Pit Fine Reject Emplacement (COOP FRE)	Carrington area – out of pit emplacement	Approved but not constructed.
Carrington In Pit Fine Reject Emplacement (FRE)	Carrington area – in pit emplacement	Active, receiving tailings since 2019.
Cumnock Void TSF	Ravensworth	Active. On Ravensworth land and Glencore's responsibility.
West Pit	West Pit	Approved but not constructed.
Lemington 1 TSF Cell A	Lemington South	Rehabilitated.
Lemington 1 TSF Cell B	Lemington South	Rehabilitated.
Lemington 2 TSF	Lemington South	Rehabilitated.
Lemington 3 TSF	Lemingtion South	Rehabilitated.
Lemingotn 4 TSF Cell A	Lemington South	Rehabilitated.
Lemington 4 TSF Cell B	Lemingtion South	Rehabilitated.
Lemington 5 TSF	Lemington South	Rehabilitated.
Howick TSF	West Pit	Rehabilitated.
Eastern TSF	North Pit	Rehabilitated.
Western TSF Cell A	West Pit	Rehabilitated.
Western Cell TSF Cell B	West Pit	Rehabilitated.

During 2022 only Carrington In Pit Fine Reject Emplacement was actively used for tailings storage. North Void ceased receiving tailings in January 2019; decommissioning has commenced.

Groundwater was abstracted from the Lemington Underground Bore (LUG) during 2022. LUG Bore is a production bore constructed into the historical Lemington Underground beneath HVO that mined the Mt Arthur Seam of the Whittingham Coal Measures, with this mine having been inactive since 1999. Abstraction from LUG Bore is managed by Yancoal for the Mt Thorley Warkworth (MTW) operations.

FIGURE 2.1

Site Layout

Legend

- Barrier Walls
- Road
- Mapped Watercourses (named)
- Mine Areas

Scale 1:85,000 at A4
GDA 1994 MGA Zone 56

Image Source: ESRI Basemap (2022) **Data source:** NSW DFSI (2022)

2.2 Groundwater Impact Predictions

Groundwater impacts associated with the approved operations at HVO have been progressively assessed for each mining area, including:

- Alluvial Lands Project Groundwater Assessment (MMA, 1992).
- Carrington Pit Groundwater Assessment (MER, 1998).
- West Pit Extension Groundwater Assessment (MER, 2003).
- Carrington Pit Extended Groundwater Assessment (MER, 2005).
- Carrington West Wing Groundwater Assessment (MER, 2010).
- HVO South Groundwater Assessment (ERM, 2008).
- HVO North Modification 4 Groundwater Assessment – Carrington Out of Pit Fine Reject Emplacement (AGE, 2013b).
- HVO North Modification 6 Groundwater Assessment – Carrington In Pit Fine Reject Emplacement (AGE, 2016).
- HVO South Modification 5 Groundwater Assessment (AGE, 2017).
- HVO Continuation Project Groundwater Assessment (AGE, 2022).

2.2.1 Groundwater Assessment for Current Approval

The Environmental Assessment prepared for HVO South Modification 5 includes a groundwater assessment completed by AGE (2017). The groundwater assessment included development of a numerical groundwater model to represent groundwater response to approved mine activities and the proposed modification.

The approved operations included mining at Cheshunt Pit, Riverview Pit, Glider Pit and West Pit, as well as surrounding non-HVO mining operations (i.e., Ravensworth, United Wambo and Mt Thorley Warkworth) and abstraction from the LUG Bore. The model also included approved mining at Carrington West Wing until 2021; however, no mining has occurred at Carrington West Wing to date.

The model was calibrated to the end of 2015 and groundwater conditions and groundwater response to approved mining to the end of 2015, as reported by AGE (2017), indicated:

- Groundwater within the hard rock units is directly intercepted by approved operations at HVO.
- Groundwater within the confined to semi-confined Permian coal measures became depressurised around the area of active mining. Groundwater drawdown responses were observed around 2 km to 6 km from active mine areas within the Permian coal measures.
- There is no direct interception of groundwater within alluvium for active mine operations at HVO. However, historically the South Lemington Pit 1 footprint did directly intercept alluvium and barrier walls were established at Alluvial Lands and Carrington Pit to separate mine areas from alluvium.

- With depressurisation of the coal measures, the model predicted a reduction in upward seepage to the alluvium that was referred to as 'indirect take'.

- These findings largely aligned with historical groundwater assessments conducted for the approved operations across HVO. Groundwater licenses have been obtained for the approved operations, as discussed in **Section 2.4**. Management and monitoring requirements of potential groundwater related impacts from approved operations are captured within the development consent conditions. Schedule 3, Condition 27 of Development Consent (DA 450 10 2003) for HVO North, last updated January 2017 for Modification 6 and again in July 2017 (no changes to groundwater conditions in July 2017).

- Schedule 3, Condition 28 of the Project Approval (PA 06 0261 24) for HVO South, last updated October 2012.

These conditions are addressed within the site Water Management Plan (WMP). Further discussion on the monitoring and management requirements is included within **Section 2.3**.

2.3 Groundwater Approval Conditions

In accordance with the development consent approval conditions, HVO are required to prepare and implement a Water Management Plan (WMP) to the satisfaction of the Secretary. **Table 2.3** presents a summary of the relevant groundwater conditions from the development consent and WMP. The table identifies where the conditions relating to routine groundwater monitoring for 2022 have been addressed.

Table 2.3 Groundwater Conditions Addressed Within WMP

Approval Condition	Condition	Where Addressed
Sch. 3, Cond. 27(c) (PA 06_0261)	A groundwater monitoring programme that includes:	
	• *Additional baseline data of groundwater levels yield and quality in the region, and privately-owned groundwater bores, which could be affected by the project;*	See WMP. No private bores predicted to be impacted for current approved operations and no monitoring of private bores.
	• *Groundwater impact assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts of the project; and*	See **Section 4.3** for criteria **Section 6.0** comparison to triggers.
	• *A programme to monitor:* o *Groundwater inflows to the open cut mining operations; and*	See WMP.
	o *Impacts of the project on the region's aquifers, any groundwater bores, and surrounding watercourses, and in particular, the Hunter River and Wollombi Brook and adjacent alluvium; and*	See **Section 6.0**.

Approval Condition	Condition	Where Addressed
Sch. 3, Cond. 27(c) (DA450-10-2003)	A Groundwater Management Plan, which includes:	
	• *Detailed baseline data on groundwater levels, yield and quality in the region, and privately- owned groundwater bores, that could be affected by the development;*	See WMP.
	• *Groundwater assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts;*	See **Section 4.3** for criteria **Section 6.0** comparison to triggers.
	• *A programme to monitor:*	
	o *Groundwater inflows to the open cut mining operations;*	See WMP.
	o *the impacts of the development on:* ▪ *The alluvial aquifers, including additional groundwater monitoring bores as required by NOW;*	See **Section 5.1**.
	▪ *The effectiveness of the low permeability barrier;*	See **Section 5.3**.
	o *Base flows to the Hunter River;*	Groundwater trends reviewed in **Section 5.0**.
	o *Any groundwater bores on privately-owned land that could be affected by the development;*	No private bores predicted to be impacted for current approved operations and no monitoring of private bores.
	o *Groundwater dependent ecosystems, including the River Red Gum Floodplain Woodland EEC located in the Hunter River alluvium;*	See WMP.
	o *The seepage/leachate from water storages, backfilled voids and the final void;*	See **Section 5.3** – including discussion on groundwater trends within North Pit spoil.
	o *The development, including an independent review of the model, every three years and comparison of monitoring results with modelled predictions; and*	See **Section 8.0**.
	o *A plan to respond to any exceedances of the groundwater assessment criteria.*	See **Section 9.2**.
Sch. 3, Cond. 27(c) (DA450-10-2003)	• *A programme to validate and recalibrate (if necessary) the groundwater model for the development, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions;*	See **Section 8.0**.

Approval Condition	Condition	Where Addressed
HVO South Statement of Commitments	In addition to the mitigation measures undertaken at HVO for groundwater management, the following controls specific to the proposal will be implemented: • *Groundwater Flow To and From Rivers:* o *development of protocols for monitoring and reporting of NOW stream gauge results to clearly record any reductions in flows that are attributed to mining. This will include monitoring Hunter River flows immediately up gradient and down gradient of the site. In addition, consideration will be given to tying in specific CNA water level recordings with current NOW gauging locations;*	See Surface Water Review.
	o *monitoring of groundwater elevations within alluvium between the Hunter River and the Cheshunt Pit; and*	See **Section 5.1.3**.
	o *measured groundwater elevations and river flow will be assessed against predictions to determine whether application of additional management measures is required; and*	See **Section 8.0**.
	o *offset seepage to pits in accordance with regulatory requirements.*	See WMP.

Consent conditions for the approved Carrington West Wing extension (Modification 3) are also included in the WMP; however, there are no current plans to commence mining in this area in the near future.

Groundwater monitoring is conducted in accordance with the Groundwater Monitoring Programme outlined within Appendix A of the WMP. The programme outlines groundwater monitoring frequency, parameters to be tested and groundwater triggers for electrical conductivity (EC) and pH. This annual review is based upon the monitoring and reporting requirements documented within the October 2018 version of the WMP. However, an updated WMP was submitted by HVO to DPE and is awaiting approval. Further discussion on the groundwater monitoring programme and triggers is included in **Section 4.0**.

2.4 Groundwater Licensing

Under the Water Act 1912 and Water Management Act 2000, sufficient water access licences (WAL) are required for approval of the mine developments. HVO holds sufficient licences for direct and indirect take associated with approved operations. Groundwater licenses held for HVO are outlined in **Table 2.4**.

Table 2.4 Groundwater Licences Held by HVO

License Number	Description	Water Sharing Plan	Water Source - Management Zone	Approved Extraction (ML)
WAL 40462	HVO Pit Excavations – Alluvial Lands Bores	North Coast Fractured and Porous Rock	Permian Coal Seams	2,400
WAL 40463				180
WAL 40466				460
WAL41527	HVO North – Carrington Pit			700
WAL41533	HVO North Pit Excavation			20
WAL39798	Lemington Underground (LUG) Bore			1,800
WAL18127	Carrington BB1	Hunter Unregulated and Alluvial Water Sources	Hunter Regulated River Alluvial Water Source – Upstream Glennies Creek Management zone	383
WAL18158	Ollenberry			65
WAL18307	HVO West – Parnells Creek Dam (Diversion Works Bywash)		Jerrys Management Zone	500
WAL18327	HV Loading Point Pump Bayswater Creek (Diversion Works)			150
WAL36190	HVO North, old farm bore			120
WAL23889	Greenleek		Lower Wollombi Brook Water Source	144
WAL962 (20AL201237)	Surface water access – West Pit area	Hunter Regulated River Water Source	Hunter River (Zone 1b) between Goulburn River junction and Glennies Creek junction.	3,165
WAL970, WAL1006 & WAL1070 (20AL201256, 20AL201337 & 20AL201500)	Surface water access – HVO North and HVO South areas		Hunter River (Zone 2a) between Glennies Creek junction and Wollombi Brook junction.	1,500 (500 each)

3.0 Environmental Setting

3.1 Climate

The climate within the HVO area is sub-tropical, with temperatures, rainfall and evaporation highest over the summer months of December to February. Daily rainfall data is collected at HVO at the site meteorological gauge HVO Corp. **Table 3.1** provides the historical average monthly rainfall data (2012 to 2022), as well as monthly data from site. During the reporting period the area experienced above average rainfall in March, May, July to November, with significant rainfall recorded in March (256 mm), July of (184 mm) and October (117 mm).

Climate data was also obtained from the Scientific Information for Land Owners (SILO) database of historical climate records for Australia hosted by the Department of Environment and Science (DES). This service interpolates raw rainfall and evaporation records obtained from the Bureau of Meteorology (BOM), with data gaps addressed through data processing in order to provide a spatially and temporally complete climate dataset.

Climate data was obtained for a SILO grid point (Latitude -32.50, Longitude 151.00) at HVO between 01/01/1900 to 31/12/2022. A summary of rainfall data for SILO is presented in **Table 3.1**. The rainfall data indicates slightly higher rainfall over the summer months, from November to March. Based on the SILO dataset, average annual rainfall is 635 mm. Rainfall over 2022 was above average with 1066 mm recorded.

Table 3.1 Monthly Rainfall (mm)

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Site Historical Average	81	71	118	42	22	38	42	35	35	48	78	65	**676**
Site 2022	61	68	256	34	34	8	184	86	86	117	92	20	**1047**
SILO Historical Average	73	70	65	45	39	46	41	36	40	50	62	68	**635**
SILO 2022	63	68	288	27	54	7	177	75	70	108	109	20	**1066**

Long term climate trends in the HVO site (HVO Corp) rainfall data from 2012 to present are displayed using a cumulative rainfall departure (CRD) rainfall plot in **Figure 3.1**. The CRD graphically shows trends in recorded rainfall compared to long-term averages and provides a historical record of relatively wet and dry periods. A rising trend in slope in the CRD graph indicates periods of above average rainfall, whilst a declining slope indicates periods when rainfall is below average. A level slope indicates average rainfall conditions. The area has generally experienced below average rainfall from 2016 until the end of 2019, with above average rainfall recorded from January 2020 onwards. Over the reporting period the site experienced above average rainfall. **Figure 3.2** shows that the SILO average monthly actual evapotranspiration exceeds rainfall in all months.

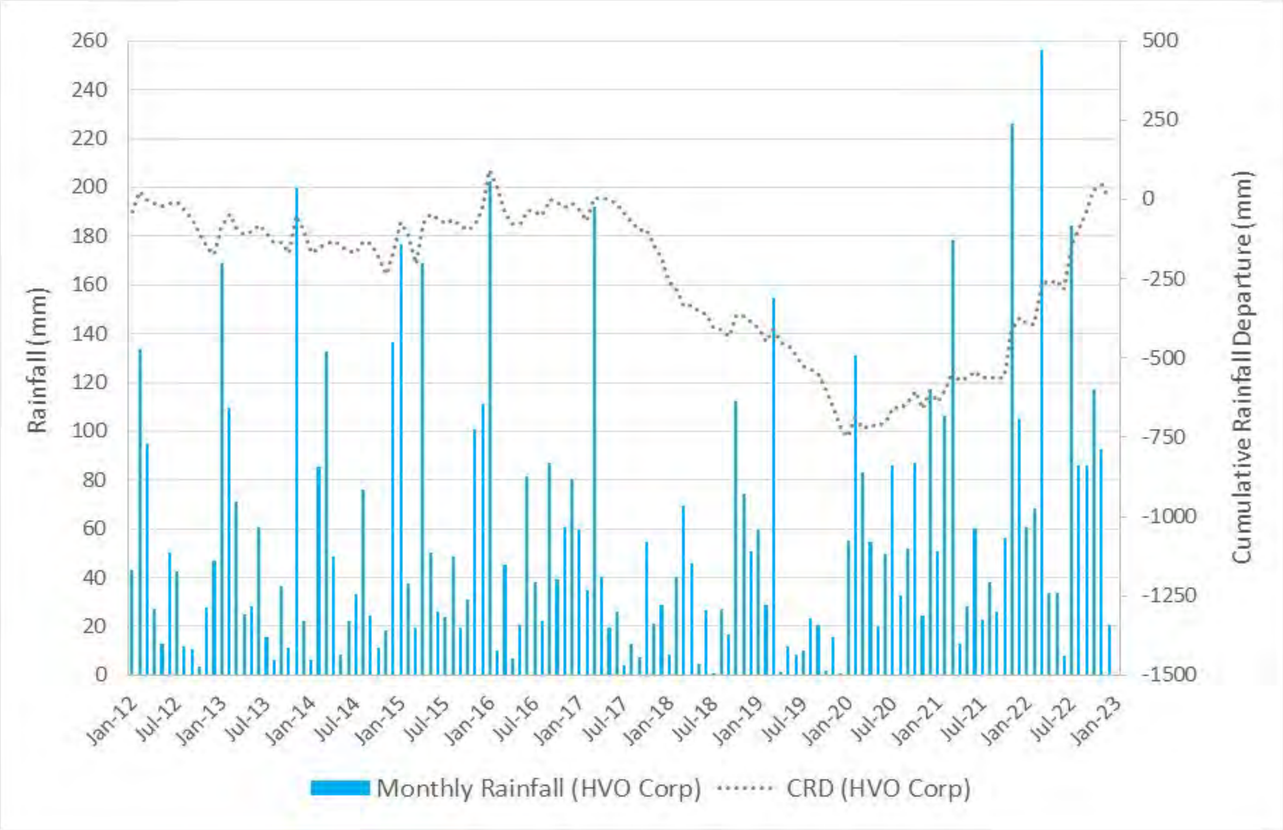


Figure 3.1 Cumulative Rainfall Departure and Monthly Site Rainfall

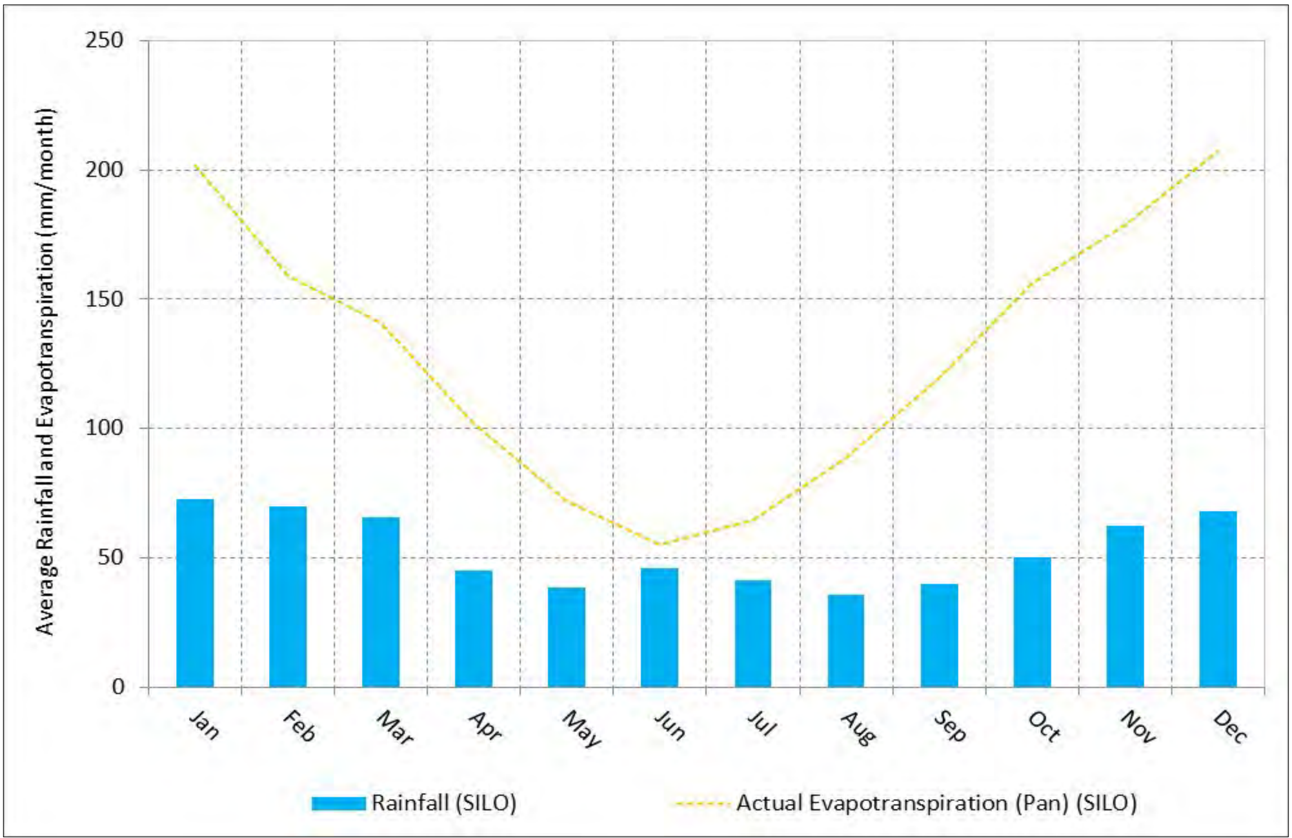


Figure 3.2 Evaporation

3.2 Streamflow

The terrain and drainage at HVO are dominated by the easterly flowing Hunter River, which dissects the complex in a general east-west direction. Ground elevations range between 60 m Australian Height Datum (mAHD) along the Hunter River alluvial plains to 180 mAHD in the northern parts of HVO North and in the western parts of HVO South. Minor ephemeral drainage features are also present around HVO North (i.e., Parnells Creek, Farrells Creek and Bayswater Creek) and HVO South (Wollombi Brook), which drain into the Hunter River (SLR, 2020).

Real time stream flow data is monitored along the Hunter River and Wollombi Brook at WaterNSW gauging stations via the Hunter Integrated Telemetry System (HITS). Time series river water elevations (mean level above zero-gauge elevation) are shown in **Figure 3.3** for three HITS stations (Hunter River @ Liddell, Hunter River @ U/S Foy Brook and Wollombi Brook @ Warkworth). In addition, HVO monitors the Hunter River monthly at surface water sites WL03 and WL05, WL10 and WL14, although sites WL03 and WL05 have not been monitored over 2022 due to access issues.

During the reporting period, stream elevations within the Hunter River ranged from 72.74 mAHD upstream at Liddell (210083), down to 49.91 mAHD at Foy Brook (210126). Approximately seven significant increases in levels were recorded over the reporting period in response to rainfall events with the largest increase recorded in early July. Review of stream discharge for the Hunter River at Foy Brook indicates discharge rates peaked early in July 2022 with the highest flow of 94,894 ML/day recorded on the 6 July 2022 following a significant rainfall event.

During the reporting period, stream elevations within Wollombi Brook at Warkworth (210004) ranged between 49.36 mAHD and 58.45 mAHD. Stream discharge indicates flow within Wollombi Brook ranged from 48 ML/day to 8,066 ML/day during the reporting period.

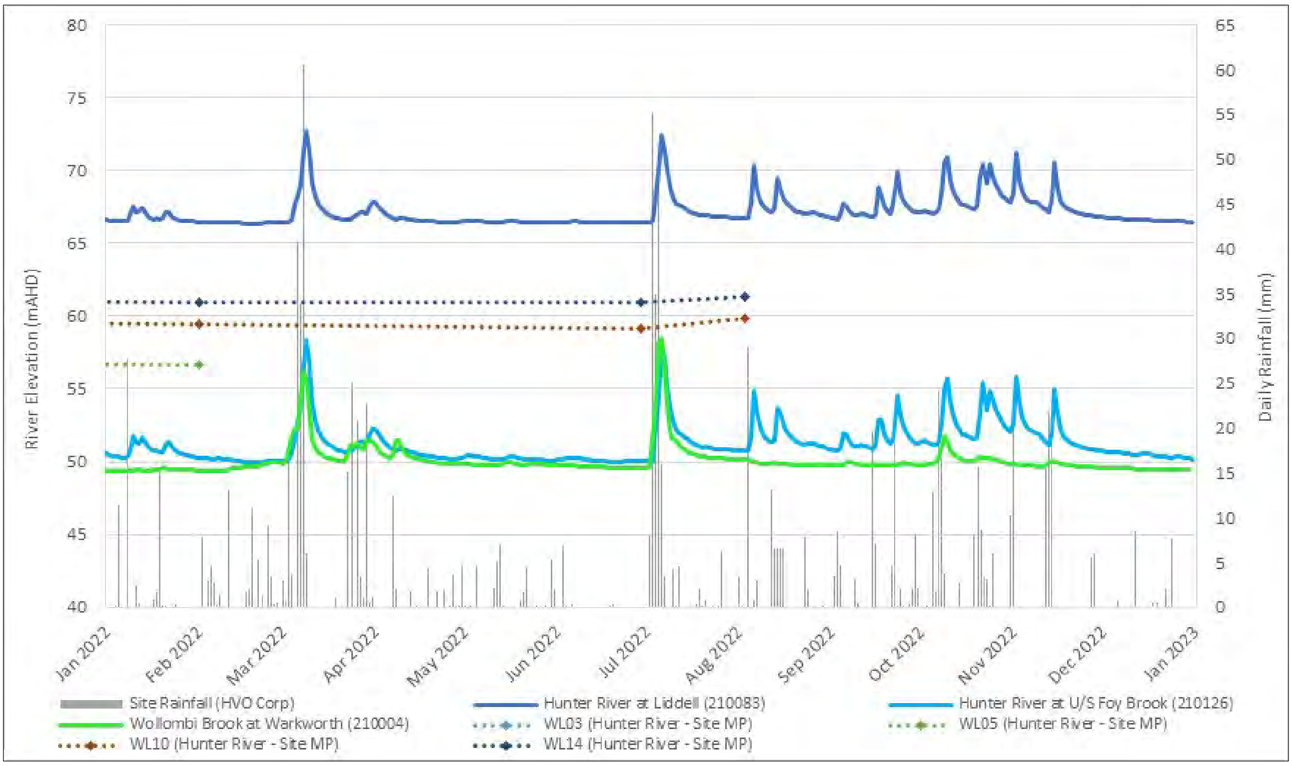


Figure 3.3 Surface Water Levels

3.3 Geology

HVO lies within the Hunter Coalfields, which are dominated by the Permian aged Whittingham Coal Measures of the Sydney Basin. The Whittingham Coal Measures are comprised of the Jerrys Plains Sub-group and Van Sub-group, which consist of coal seams with overburden and overburden (sandstone, siltstone, tuffaceous mudstone and conglomerate). The Whittingham Coal Measures are truncated to the east by the Hunter-Mooki Thrust Fault and occur at HVO as stratified (layered) sequences that dip at a shallow angle to the southwest. The coal seams subcrop to the north and east of the HVO complex (SLR, 2020). The Muswellbrook Anticline and the Bayswater Syncline are also present to the west and north and east of HVO, respectively (EMM, 2022b).

The Whittingham Coal Measures are incised by a paleochannel of the Hunter River within HVO North. The properties and extent of the paleochannel were assessed and mapped by MER (2008). The paleochannel comprises heterogeneous distribution of silts, sands and gravels.

Quaternary alluvium, comprising surficial sediments of silts and clays, unconformably overlies the Permian coal measures along the Hunter River and Wollombi Brook. Along the Hunter River and Wollombi Brook, the surficial sediments overlie basal sands and gravels that are between 7 m to 20 m thick (SLR, 2020).

Within HVO North, mined out areas have been backfilled with spoil and fine rejects. The spoil consists of Permian interburden and overburden waste material (EMM, 2022b).

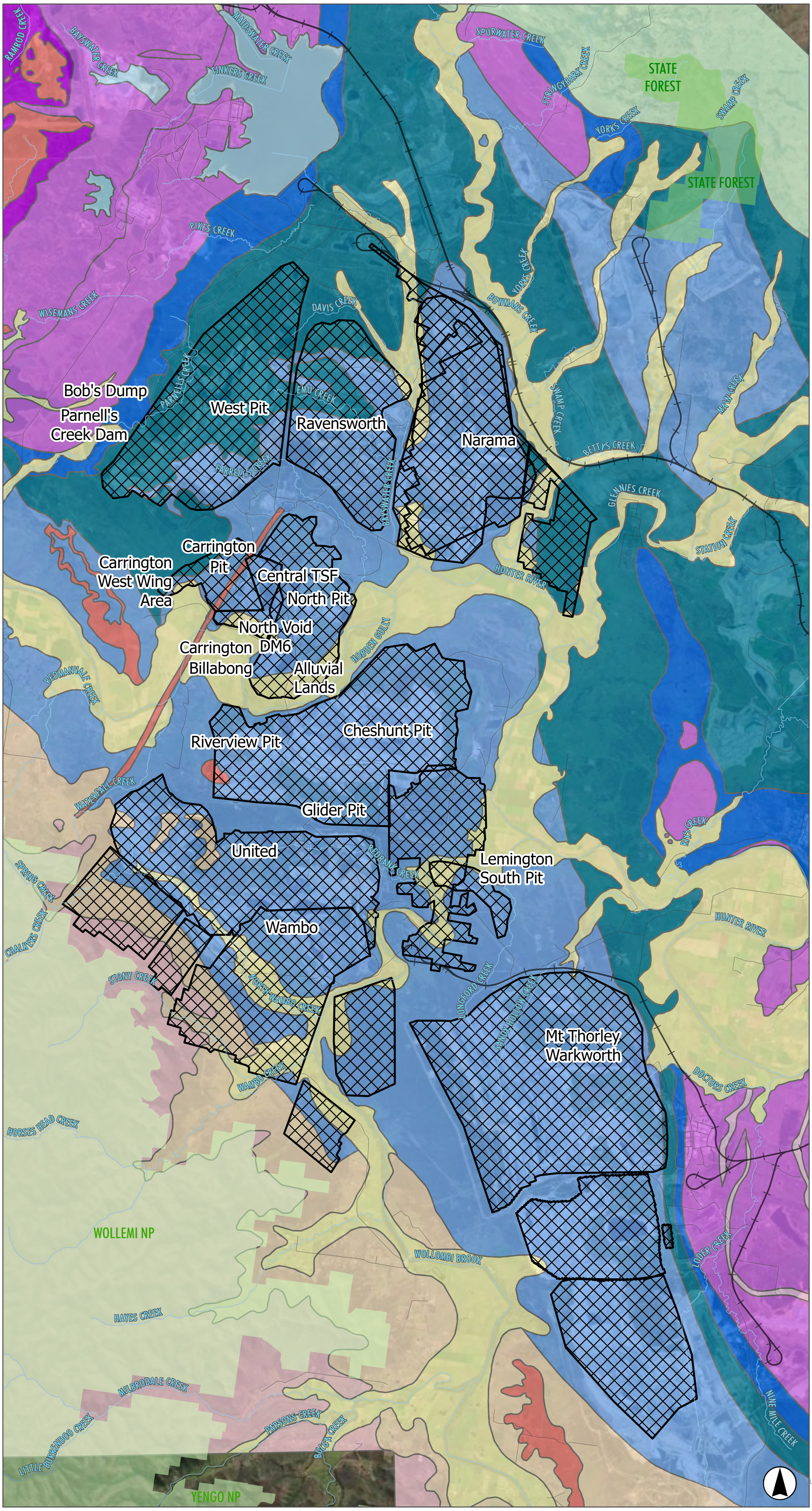
The surface geology within the HVO complex is summarised in **Table 3.2** and shown in **Figure 3.4**.

Table 3.2 HVO Generalised Stratigraphy (*After*: SLR, 2020)

<table>
<tr><th>Age</th><th colspan="2">Stratigraphic Unit</th><th>Description</th></tr>
<tr><td rowspan="4">Cainozoic</td><td rowspan="2">Quaternary alluvial sediments (Qa)</td><td>Surficial alluvium (Qhb)</td><td>Shallow sequences of clay, silty sand and sand.</td></tr>
<tr><td>Productive basal sand/gravel (Qha)</td><td>Basal sands and gravels along major watercourses (i.e., Hunter River and Wollombi Brook).</td></tr>
<tr><td colspan="2">Silicified weathering profile (Czas)</td><td>Silcrete.</td></tr>
<tr><td colspan="2">Alluvial terraces (Cza)</td><td>Silt, sand and gravel.</td></tr>
<tr><td>Jurassic</td><td colspan="2">Volcanics (Jv)</td><td>Flows, sills and dykes.</td></tr>
<tr><td rowspan="4">Permian</td><td rowspan="4">Whittingham Coal Measures</td><td>Jerrys Plains Sub-group (Pswj)</td><td>Coal bearing sequences interbedded with sandstone and siltstone. Coal seams (youngest to oldest) include Whybrow, Redbank Creek, Wambo, Whynot, Blakefield, Glen Munro, Woodlands Hill, Arrowfield, Bowfield, Warkworth, Mt Arthur, Piercefield, Vaux, Broonie and Bayswater.</td></tr>
<tr><td>Archerfield Sandstone (Pswv)</td><td>Lithic sandstone marker bed.</td></tr>
<tr><td>Vane Sub-group (Pswv)</td><td>Coal bearing sequences interbedded with sandstone and siltstone. Coal seams (youngest to oldest) include Lemington, Pikes Gully, Arties Liddell, Barrett and Hebden.</td></tr>
<tr><td>Saltwater Creek Formation (Psws)</td><td>Sandstone and siltstone, minor coaly bands, siltstone at base.</td></tr>
</table>

FIGURE 3.4

Surface Geology



Legend

Mine Areas
Road
Mapped Watercourses (named)

Surface Geology

- Cz - Cainozoic Sediments
- Jv - Jurassic Volcanics
- Pgr - Rowan Formation
- Pmb - Branxton Formation
- Pmm - Mulbring Siltstone
- Pms - Muree Sandstone
- Psl - Newcastle Coal Measures
- Pswc - Saltwater Creek Formation
- Pswj - Jerry's Plains Subgroup
- Psww - Archerfields Ss. Vane Subgroup
- Qa - Quaternary alluvium
- Rn - Narrabean Group
- water

0 1 2
Kilometres

Scale 1:150,000 at A4
GDA 1994 MGA Zone 56

Image Source: ESRI Basemap (2022) **Data source:** NSW DFSI (2022)

3.4 Groundwater Units

The main groundwater units at HVO and the surrounding area are the productive alluvium associated with the Hunter River and Wollombi Brook, and the Permian coal seams of the Whittingham Coal Measures. Groundwater unit information has been derived from historical groundwater assessment reports, summarised in **Section 2.2**.

3.4.1 Alluvium

The Quaternary alluvium is an unconfined groundwater system that is recharged by rainfall infiltration, streamflow and upward leakage from the underlying stratigraphy, particularly in undisturbed areas (i.e., away from active mining). The flow direction within the alluvium generally follows topography. (Groundwater within the Hunter River alluvium flows in an easterly direction, while water within the Wollombi Brook alluvium flows in a north to north-easterly direction towards the Hunter River (SLR, 2020).

Regionally, the Hunter River and Wollombi Brook predominantly gain water from the surrounding alluvium, as well as from rainfall and regulated flow. However, there are also areas with losing conditions where rivers recharge the underlying alluvium. These losing conditions can occur around areas of active mining, where the hydraulic gradient is increased due to depressurisation of the underlying coal measures. Losing conditions also occur within the more topographically elevated tributaries of the main water courses, where the water table is deeper and not connected directly to the streams (SLR, 2020).

The less productive groundwater within the surficial alluvium does not meet the ANZECC (2000) water quality guidelines for stock water supply. However, the water quality of the highly productive alluvium, which includes basal sands and gravels is considered suitable for stock water supply. However, most agricultural producers (crop and cattle) utilise surface water resources (Hunter River and Wollombi Brook) in preference to alluvial groundwater (SLR, 2020).

The alluvial aquifer of the Hunter River supports Carrington Billabong, an ephemeral freshwater wetland located south of Carrington Pit that is considered a Groundwater Dependant Ecosystem (GDE). Alluvial groundwater levels around Carrington Billabong have remained relatively stable during active mining at Carrington Pit. This is due to installation of a barrier wall through the unconsolidated alluvial sediments, which separates the Billabong from Carrington Pit. The stable alluvial groundwater levels in this area are also taken to indicate limited hydraulic connection between the nearby paleochannel alluvium and the underlying depressurised coal measures (SLR, 2020).

3.4.2 Permian Coal Measures

The Whittingham Coal Measures outcrop across the north and east of the HVO complex. The coal measures form unconfined groundwater systems at outcrop, becoming semi-confined to confined as they dip towards the southwest.

Recharge occurs from direct rainfall infiltrating into the formations through the thin soil cover and weathered profile. The coal measures also occur at subcrop in localised zones beneath the alluvium associated with the Hunter River and Wollombi Brook, where the unit is recharged by downward seepage where gradients induce flow. The coal seams are typically moderately to slightly permeable, with hydraulic conductivity of the interburden generally less than coal seams but more variable, depending on the predominance of fractures in the rock mass. The hydraulic conductivity of the coal seams generally decreases with depth due to the closure of the cleats with increasing stratigraphic pressure (SLR, 2020).

Groundwater flow direction within the Whittingham Coal Measures is influenced by the local geomorphology and structural geology. The long history of mining within the region has also significantly altered groundwater flow paths within the Permian units. On a regional scale, groundwater flow in the Permian aquifers follows topography, flowing in a north-easterly direction. On a local scale, groundwater levels show drawdown impacts associated with the extensive active mining areas. Groundwater discharge from the Whittingham Coal Measures occurs as discharge to active mining and abstraction bores, as well as upward seepage to the Quaternary alluvium where hydraulic gradients induce flow (SLR, 2020).

Due to the poor water quality of the Permian coal measures, that generally exceeds ANZECC (2000) water quality guidelines for stock supply, there is no significant usage of groundwater from the Permian coal measures. Stock supply is primarily derived from perennial surface water flows (Hunter River and Wollombi Brook) and the more productive alluvial aquifer (SLR, 2020).

3.5 Groundwater Dependent Ecosystems

The Groundwater Dependant Ecosystem (GDE) is one in which the plant and/or animal community is dependent on the availability of groundwater to maintain its structure and function, which can be classified into three broad types:

- Ecosystems dependent on the subsurface presence of groundwater (terrestrial GDEs, including some riparian vegetation communities).
- Ecosystems dependent on the surface expression of groundwater (aquatic GDEs, including river baseflow systems, springs and swamps).
- Aquifer and cave ecosystems (subterranean GDEs).

The GDE Atlas (BoM, 2022) classifies ecosystems based on the potential for dependence on groundwater, based on multiple lines of scientific evidence. Ecosystems are mapped as either:

- High potential for groundwater interaction (indicating a strong possibility the ecosystem is interacting with groundwater).
- Moderate potential for groundwater interaction.
- Low potential for groundwater interaction (indicating it is relatively unlikely the ecosystem will be interacting with groundwater and will include ecosystems that are not interacting with groundwater).

Within the HVO complex, ecosystems with the potential to rely on the surface or subsurface expression of groundwater include (EMM, 2022b):

- The Hunter River, Wollombi Brook and their tributaries where groundwater provides baseflow to surface water.
- Shallow groundwater systems.
- Vegetation overlying shallow groundwater.

Potential GDE assessments have been undertaken for the HVO complex and have identified (EMM, 2022b):

- Stygofauna within the Hunter River, Wollombi Brook and their tributaries.
- River Red Gums within the Carrington Billabong, near the Hunter River.
- River Oak Grassy Riparian Woodland in the Hunter River riparian zone.
- Warkworth Sands Woodland community within the South Lemington area (intermittently reliant on perched water table).

4.0 Groundwater Monitoring

4.1 Groundwater Monitoring Program

Groundwater monitoring is conducted at HVO in accordance with the WMP (HVO, 2018), which includes details on the Groundwater Management Plan and Groundwater Monitoring Program. The monitoring results are used to monitor trends in physical and geochemical parameters of groundwaters that are potentially influenced by mining.

The groundwater monitoring network at HVO is comprised of a series of monitoring bores and vibrating wire piezometers (VWPs), detailed in **Appendix A**. The groundwater monitoring network, outlined within the WMP, is comprised of 127 monitoring sites which includes 119 compliance monitoring bores and eight vibrating wire piezometers (VWPs), as detailed in **Table 4.1**. Of the 119 compliance monitoring bores, 104 have water quality triggers and five have water level triggers defined. The groundwater monitoring network is presented in **Figure 4.1** to **Figure 4.3**.

In 2019 SLR undertook a network review which identified some changes in target geology compared to the WMP, as outlined in **Appendix A**. The network review also assessed the condition and purpose of each bore and made recommendations to remove bores from the monitoring network that were damaged or destroyed, not providing representative groundwater data, where duplicate monitoring locations existed and where site activities have ceased. It was recommended that these bores be removed from the next update of the WMP leaving 77 bores within the groundwater compliance monitoring network with triggers assigned. Groundwater quality triggers were reviewed, and the trigger levels were updated based on all historical data available and set based on geographical and target stratigraphy. The baseline data was used to update the 95th percentile for EC and 5th and 95th percentiles for pH. An updated groundwater monitoring program has been included in the draft WMP (version 3.4) which is currently with DPE awaiting approval. For the purposes of annual reporting, the results are presented in comparison to the details in the current WMP (HVO, 2018) and, if exceedances recorded, discussed with reference to the revised monitoring programme recommendations.

Table 4.1 Groundwater Monitoring Network

Geology	Location	No. of Bores
Alluvium	Carrington	5
	Carrington West Wing	9
	Cheshunt/North Pit	17
	Lemington South	3
	West Pit	5
Permian coal measures	Carrington	5
	Carrington West Wing	2
	Cheshunt	13
	Lemington South	30
	Southern	12
	West Pit	11 (8 VWPs)
Spoil	Carrington	2
	North Pit	13

Monitoring of groundwater levels and groundwater quality is undertaken at the bores detailed in the WMP (HVO, 2018), and defined below:

- Groundwater Level (127 bores):
  - Manual groundwater elevation/depth to groundwater measurements at a monthly (4), quarterly (94) or six monthly (29) frequency.
  - Monitoring bore data logger/VWP sensor download quarterly, and verification and validation of instrument drift and correction.
- Groundwater Quality Analysis – Standard (119 bores):
  - Quarterly: field readings of water temperature, pH and electrical conductivity (EC).
- Groundwater Quality Analysis – Comprehensive (65 bores):
  - Six Monthly (27) or Annually (38): the standard analysis with the addition of laboratory analysis of pH, EC, Total Dissolved Solids (TDS), Aluminium, Arsenic, Boron, Calcium, Cadmium, Chloride, Carbonate, Copper, Mercury, Potassium, Magnesium, Sodium, Nickel, Lead, Selenium, Sulphate, Zinc, Total Alkalinity, Bicarbonate Alkalinity, Carbonate Alkalinity, Hydroxide Alkalinity. Three of the six monthly monitoring bores (CHPZ1A, PZ2CH400 and PZ3CH800) require the following additional analyses: Beryllium, Cobalt, Fluoride, Iron, Manganese, Ammonia, Nitrite, Nitrate, Phosphorus, Rubidium, Antimony, Silica, Strontium.

Groundwater quality sampling is undertaken quarterly by external contractors AECOM in accordance with AS/NZS 5667.1:1998 (R2016) Guidance on the design of sampling programs, sampling techniques and the prevention and handling of samples and AS/NZ 5667.11:1998 (R2016) Guidance on sampling of groundwater. Field sheets, detailing the sample location, date, time, field EC, field pH and water level below top of casing are completed by AECOM during each monitoring round. The field sheets compiled by AECOM and results stored in HVO's EMD have been reviewed by Umwelt for this report.

4.2 Data Recovery

Groundwater level and quality data, along with field and lab sheets, were downloaded from the site database (EMD) by Umwelt. As per the WMP, groundwater level monitoring and sampling is required to be carried out at 127 monitoring bores. Over 2022, monitoring of 121 bores was undertaken. Six bores were unable to be monitored throughout the year either due to no access due to flooding (BZ8-2), bore mined out (NPz5) or data unable to be downloaded due to failed VWP units (GW-100a, GW-101a, GW-102, GW-103).

Monitoring bores with a data capture rate of less than 100 per cent are summarised in **Table 4.2**.

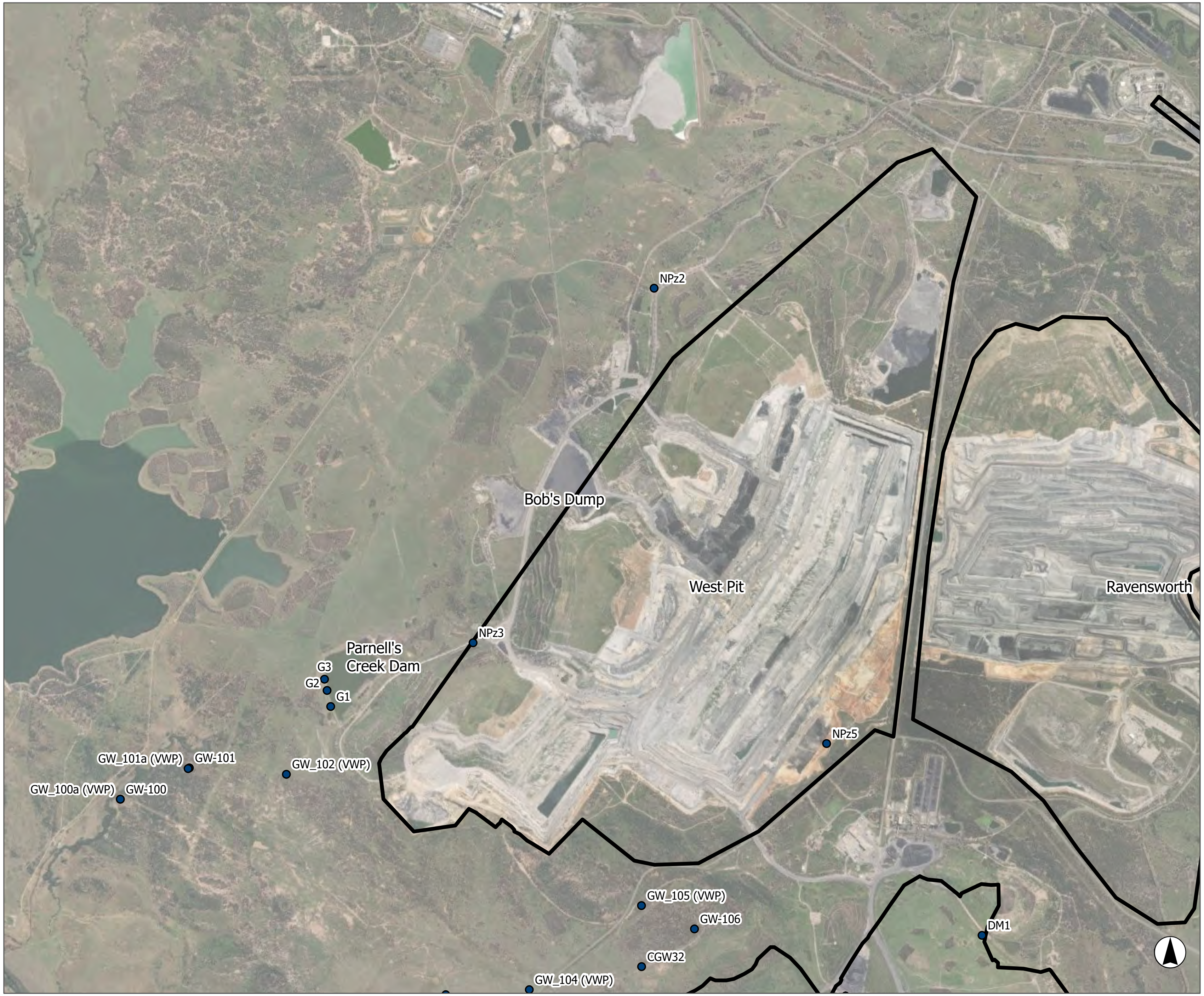
Table 4.2 Groundwater Monitoring Data Recovery – Compliance Bores

Bore ID	Type Not Measured	Data Recovery	Comments
4034P	SWL, WQ	75%	No access due to flooding in Q1
4036C	SWL, WQ	50%	No access due to flooding in Q1 and bore blocked in Q4
4051C	SWL, WQ	0%	Bore blocked
4116P	SWL, WQ	50%	No access due to flooding in Q1 and Q2
4119P	SWL, WQ	25%	No access due to flooding in Q1, Q2 and Q3
B425(WDH)	SWL, WQ	50%	Bore dry in Q2 and no access Q4 due to flooding
BZ3-1	SWL, WQ	25%	Bore blocked in Q2, Q3 and Q4
BZ4A(2)	WQ	50%	Insufficient water to sample in Q3 and Q4
BZ8-2	SWL, WQ	0%	No access due to flooding in Q1, Q2, Q3 and Q4
C122(BFS)	WQ	75%	Insufficient water to sample in Q4
C919(ALL)	SWL, WQ	25%	No access due to flooding in Q2
CGW32	SWL, WQ	75%	Not measured in Q2, reason unknown
CGW39	WQ	75%	Bore dry in Q1
CGW45	SWL, WQ	0%	Bore blocked
CGW46	SWL, WQ	75%	No access due to flooding in Q1
CGW47a	SWL, WQ	75%	No access due to flooding in Q1
CGW51a	SWL, WQ	75%	No access due to flooding in Q1
CGW52	SWL, WQ	75%	No access due to flooding in Q1
CGW52a	SWL, WQ	75%	No access due to flooding in Q1
CGW53	SWL, WQ	75%	No access due to flooding in Q1
CGW53a	SWL, WQ	75%	No access due to flooding in Q1
CGW55a	SWL, WQ	75%	No access due to flooding in Q1
D510(AFS)	SWL, WQ	50%	Bore blocked in Q2 and Q4
DM1	SWL, WQ	75%	No access due to flooding in Q1
DM3	SWL, WQ	50%	No access due to flooding in Q1 and blocked in Q4
DM4	SWL, WQ	75%	No access due to flooding in Q1
DM7	SWL, WQ	75%	No access due to flooding in Q1
GA3	SWL, WQ	50%	No access due to flooding in Q1 and Q3
GW-100	SWL, WQ	75%	No access due to flooding in Q1
GW-100a (VWP)	SWL	0%	Awaiting installation of new units
GW-101	WQ	50%	No access due to flooding in Q1, bore dry in Q2, Q3 and Q4
GW-101a (VWP)	SWL	0%	Awaiting installation of new units
GW-102 (VWP)	SWL	0%	Awaiting installation of new units

Bore ID	Type Not Measured	Data Recovery	Comments
GW-103 (VWP)	SWL	0%	All sensors failed in 2020
GW-104 (VWP)	SWL	50%	Not downloaded in Q3 or Q4
GW-107	SWL, WQ	50%	No access due to flooding in Q1, insufficient water to sample in Q2 and Q3, bore dry in Q4
GW-108	SWL, WQ	50%	No access due to flooding in Q1 and Q3, insufficient water to sample in Q2, bore blocked in Q4
GW-114	SWL, WQ	75%	No access due to flooding in Q1
GW-115	SWL, WQ	75%	No access due to flooding in Q1
HV3(2)	SWL, WQ	50%	No access due to flooding in Q1 and Q3
MB14HVO01	SWL, WQ	50%	No access due to flooding in Q1 and Q2
MB14HVO02	SWL, WQ	50%	No access due to flooding in Q1 and Q2
MB14HVO03	SWL, WQ	75%	No access due to flooding in Q1
MB14HVO04	SWL, WQ	50%	No access due to flooding in Q1 and Q3
MB14HVO05	SWL, WQ	50%	No access due to flooding in Q1 and Q2
NPz2	SWL, WQ	75%	No access due to flooding in Q1
NPz3	SWL, WQ	75%	Bore blocked in Q4
NPz5	SWL, WQ	0%	No longer exists, mined through

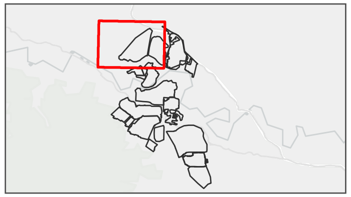
FIGURE 4.1

Groundwater Monitoring Network – HVO North: West Pit



Legend

- Groundwater Compliance Monitoring Network
- Mine Areas



0 0.5 1

Kilometers

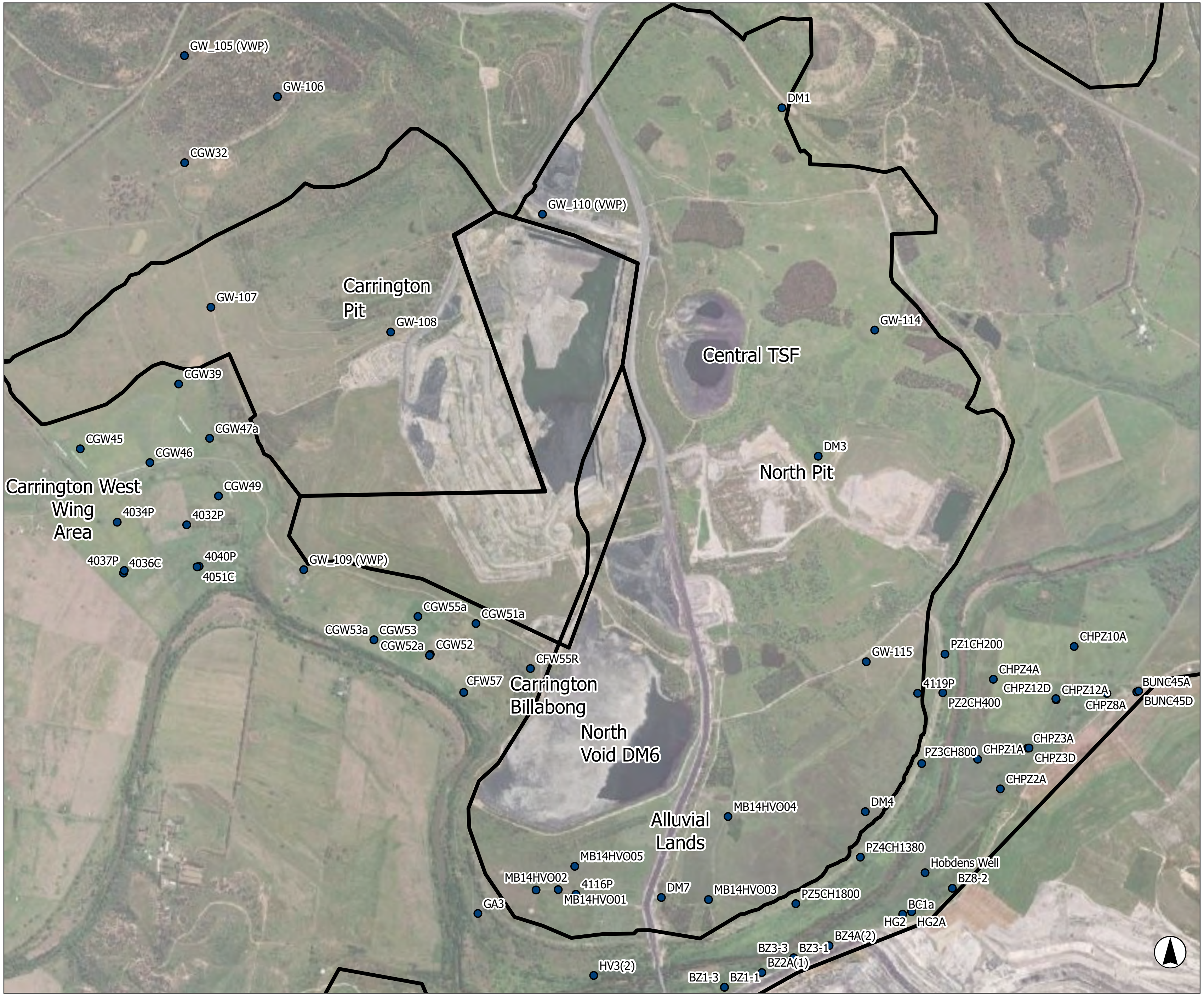
Scale 1:50,000 at A4

GDA 1994 MGA Zone 56

Image Source: ESRI Basemap (2022) **Data source:** NSW DFSI (2022)

FIGURE 4.2

Groundwater Monitoring Network – HVO North: North Pit and Carrington



Legend

- Groundwater Compliance Monitoring Network
- Mine Areas

0 0.5 1

Kilometers

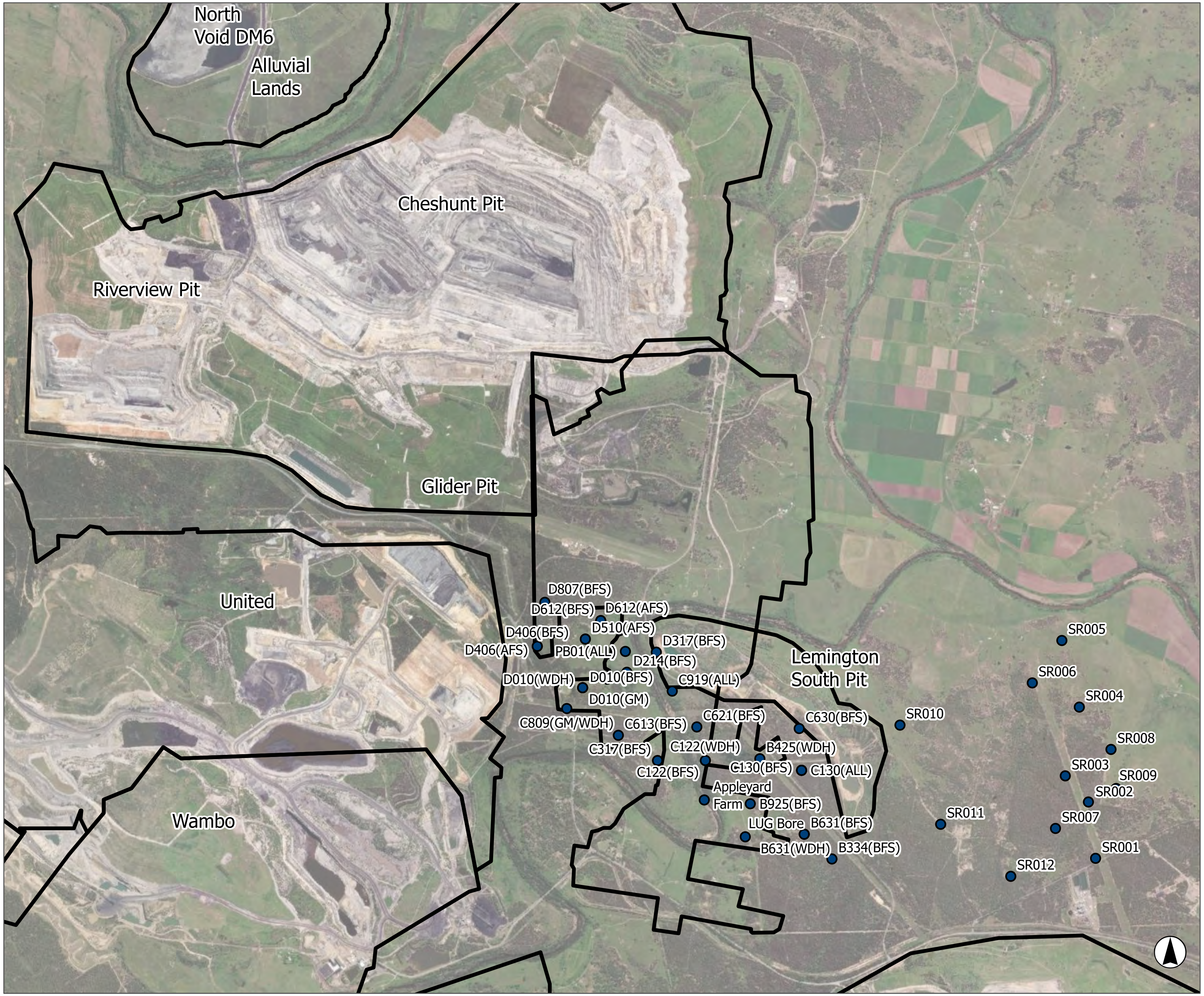
Scale 1:28,500 at A4

GDA 1994 MGA Zone 56

Image Source: ESRI Basemap (2022) **Data source:** NSW DFSI (2022)

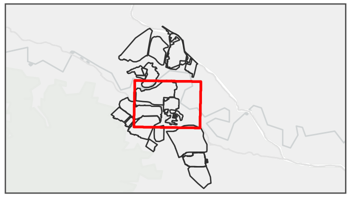
FIGURE 4.3

Groundwater Monitoring Network – HVO South: Riverview Pit, Cheshunt Pit and Lemington South



Legend

- Groundwater Compliance Monitoring Network
- Mine Areas



0 0.5 1
Kilometers

Scale 1:50,000 at A4
GDA 1994 MGA Zone 56

Image Source: ESRI Basemap (2022) **Data source:** NSW DFSI (2022)

4.3 Groundwater Triggers

Groundwater assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts, are detailed in the WMP (HVO, 2018). These criteria are summarised in **Table 4.3**.

Table 4.3 Groundwater Impact Assessment Criteria

Criteria	Description
1	The groundwater level does not decline more than 2 m at any privately owned bores and wells identified in the HVO complex EA's (with the exception of a single bore on land owned by the Ravensworth mine (10011459) which is predicted to decline by a maximum of 2.7 m).
2	Water quality does not lower the beneficial use category of the groundwater source beyond 40 m from the mining pit. This will be identified using groundwater triggers (EC) for individual monitoring bores specified in the Groundwater Monitoring Programme.
3	The alluvial groundwater source within 40 m of the recognised GDE communities does not experience more than a 10% reduction in piezometric levels predicted in the EA's for HVO North and HVO South (allowing for typical climatic variation).

Criteria 2 in **Table 4.3** relates to the trigger levels established for EC based on the 95th percentile, and the 5th and 95th percentiles for pH, of data collected from 2011 onwards (HVO, 2018). The trigger levels, as presented in the WMP (HVO, 2018) are summarised in **Table 4.4**. Groundwater quality data from the compliance monitoring bores have been compared to the trigger levels in **Section 6.0**.

Table 4.4 Groundwater Quality Trigger Levels

Location	Target Stratigraphy	pH (5th Percentile)	pH (95th Percentile)	EC (µS/cm) (95th Percentile)
Carrington	Alluvium	7.0	8.0	6,154
	Interburden (sandstone/siltstone)	6.7	7.4	10,824
	Broonie Seam	6.8	7.1	8,628
Carrington West Wing	Alluvium	7.0	7.5	2,775
	Bayswater	7.3	7.6	3,531
	LBL	6.5	7.2	1,894
Cheshunt	Mt Arthur Seam	6.5	7.6	3,350
	Interburden (sandstone/siltstone)	6.9	7.7	6,213
	Piercefield Seam	6.4	6.8	2,596
Cheshunt/North Pit	Alluvium	6.6	7.5	4,462
Lemington South	Bowfield Seam	6.7	7.9	12,440
	Woodlands Hill Seam	6.6	7.6	20,240
	Arrowfield Seam	6.8	7.5	15,324
	Alluvium	6.6	7.7	3,938
	Glen Munro Seam	6.7	7.1	11,408
	Interburden (sandstone/siltstone)	6.8	7.0	22,700
North Pit	Spoil	6.5	7.8	12,460
West Pit	Interburden (sandstone/siltstone)	6.9	8.0	13,428

The WMP (HVO, 2018) also includes individual groundwater level triggers for five bores in the Carrington alluvium, based on the 5th and 95th percentile of the available standing water level (SWL) data for each bore. The trigger levels are detailed in **Table 4.5**. The SWL triggers for the five alluvium bores were derived to meet the AIP criteria for GDE communities at HVO (HVO, 2018).

Table 4.5 Water Level Trigger Levels – Carrington Alluvium

Bore	SWL Trigger (mAHD) (5th Percentile)	SWL Trigger (mAHD) (95th Percentile)
CFW55R	57.06	59.41
CFW57	58.24	59.24
CGW52a	58.23	60.52
CGW53a	58.33	59.19
CGW55a	57.49	58.43

A trigger exceedance is defined as three consecutive measurements of EC, pH or SWL that exceed trigger values specified in the WMP (HVO, 2018). An exceedance will trigger a site-specific investigation, which will determine the source and risk of impact on water quality, impacts to GDE communities and will be reported in the annual review (HVO, 2018).

In addition, triggers have been developed for the North Void Tailings Facility (NV TSF) assessment under the Environmental Protection Licence (EPL). Water level triggers were assigned to alluvial bores positioned within and just outside the extent of impacted groundwater. These triggers will supersede triggers outlined in **Table 4.5** and have been updated in the revised WMP which is awaiting approval.

Similarly, groundwater level and groundwater quality triggers have also been revised for a number of other bores in the revised WMP (version 3.4) which is awaiting approval from DPE.

5.0 Monitoring Results

A summary of the water level and water quality results is provided for each of the main water bearing units (alluvium, Permian coal measures and spoil) in **Section 5.1** to **Section 5.3**. Routine water level readings for 2022 are presented in **Appendix B** and historical trends are presented in **Appendix C**. Routine EC and pH readings and historical trends are presented in **Appendix D** and **Appendix E**, respectively.

Under the WMP, standard groundwater quality monitoring (pH and EC) is required quarterly for 80 of the monitoring bores within the network. In addition, groundwater quality samples are submitted quarterly to ALS for laboratory analysis of TDS, hydroxide alkalinity, carbonate alkalinity, bicarbonate alkalinity, total alkalinity, sulphate, chloride, calcium, magnesium, sodium, potassium, and total and dissolved metals aluminium, arsenic, boron, cadmium, copper, mercury, nickel, lead, selenium, zinc. Additional analysis of beryllium, lithium, manganese, antimony, rubidium, strontium, iron, silica, fluoride, ammonia, nitrite, nitrate, phosphorus was undertaken for CHPZ1A, PZ2CH400, and PC3CH800. A summary of the water quality data is presented in **Appendix F**.

It is noted that above average rainfall over 2022 lead to a number of flooding events in the Hunter River and Wollombi Brook. Numerous bores were able to be accessed due to flooding primarily in Q1 of 2022. Additional monitoring was undertaken in April and May to compensate for bores missed in the Q1 sampling round.

5.1 Alluvium

One bore was recorded as dry part way through the year (CGW39) in Q1 and one bore was recorded as dry throughout 2022 (GW-101).

Most alluvial bores recorded a general increase in groundwater levels over 2022, which is a continuing trend since 2020 in response to above average rainfall over the same period. Where saturated, groundwater within the alluvium occurred between 0.70 m (bore G1) and 22.68 m below surface (bore GW-106) over 2022. Discussion of water level trends within the alluvium is included for each of the mine areas from **Section 5.1.2** to **Section 5.1.3**.

5.1.1 West Pit

5.1.1.1 Groundwater Level Trends

Groundwater levels for the five alluvial/regolith bores north and north-west of West Pit are presented in **Figure 5.1**. Over 2022 groundwater elevations within the three bores (G1, G2 and G3) on the south-western side of Parnell's Creek Dam ranged between 106.69 mAHD (1.91 mbgl) and 109.68 mAHD (0.92 mbgl), in bores G3 and G2, respectively. Groundwater levels remained relatively stable over 2022.

Bores GW-100 and GW-101 are located along Parnell's Creek, downslope of the dam (18W). Groundwater levels within bore GW-100 increased slightly over 2022. Review of the bore construction log indicates GW-100 is 6 m deep and has a screen from 4.4 m to 5 m below surface within gravels (colluvial deposit). Groundwater levels within bore GW-100 show a general decline since 2015 from 4.68 m below top of casing (TOC) to 6.21 mbTOC near the base of the bore in December 2019. Groundwater levels increased from January 2020 to 3.56 mbTOC in December 2022 in response to above average rainfall.

Bore GW-101 was recorded as dry throughout 2022. Bore GW-101 extends to 12 m depth and has a screen from 9 m to 12 m depth within clay. Bore GW-101 has recorded groundwater levels over 12 mbTOC and noted as dry or having insufficient water to sample since 2013. This may relate to the construction of the bore screen across low permeability clay.

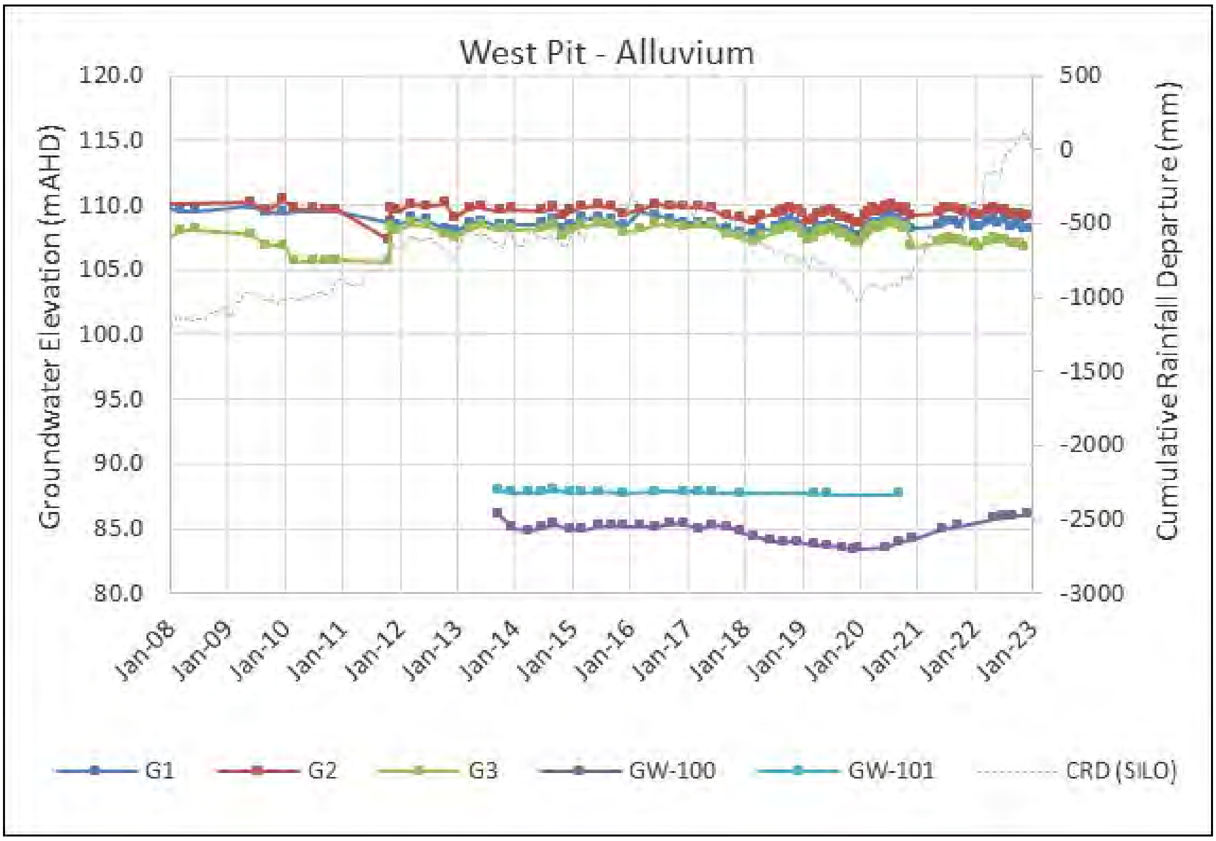


Figure 5.1 Groundwater Levels – West Pit Alluvium

5.1.1.2 Groundwater Quality Trends

The pH and EC readings recorded over 2022 are summarised in **Table 5.1**.

Table 5.1 Summary of pH and EC Recorded Over 2022 – West Pit Alluvium

Screened Lithology	pH Range	EC Range (µS/cm)	Comment
Alluvium	7.1–7.6	870–10,450	No exceedances

Groundwater within the alluvium at bore G1 became significantly fresher from April 2022 with EC concentrations ranging between 870 µS/cm to 2,340 µS/cm. Prior to April 2022 EC concentrations had large fluctuations and ranged between 1,257 µS/cm and 11,310 µS/cm. In comparison, EC concentrations in nearby bores G2 and G3 remained consistent with previous years with EC concentrations over 3,000 µS/cm. It is recommended the condition of bore G1 is checked to determine the cause of the water quality fluctuations.

5.1.2 Carrington and Carrington West Wing

5.1.2.1 Groundwater Level Trends

Groundwater levels for alluvial bores on the western limb of the paleochannel, near Carrington West Wing, are shown in **Figure 5.2**. Over 2022 groundwater elevations (mAHD) within bores 4032P, 4034P, 4037P, and 4040P in this area ranged between 60.51 mAHD and 62.11 mAHD (10.95 mbgl and 9.66 mbgl), in bores 4034P and 4037P respectively. Groundwater levels increased slightly over 2022 in all four bores by approximately 1 m corresponding to increased rainfall and stream flow trends.

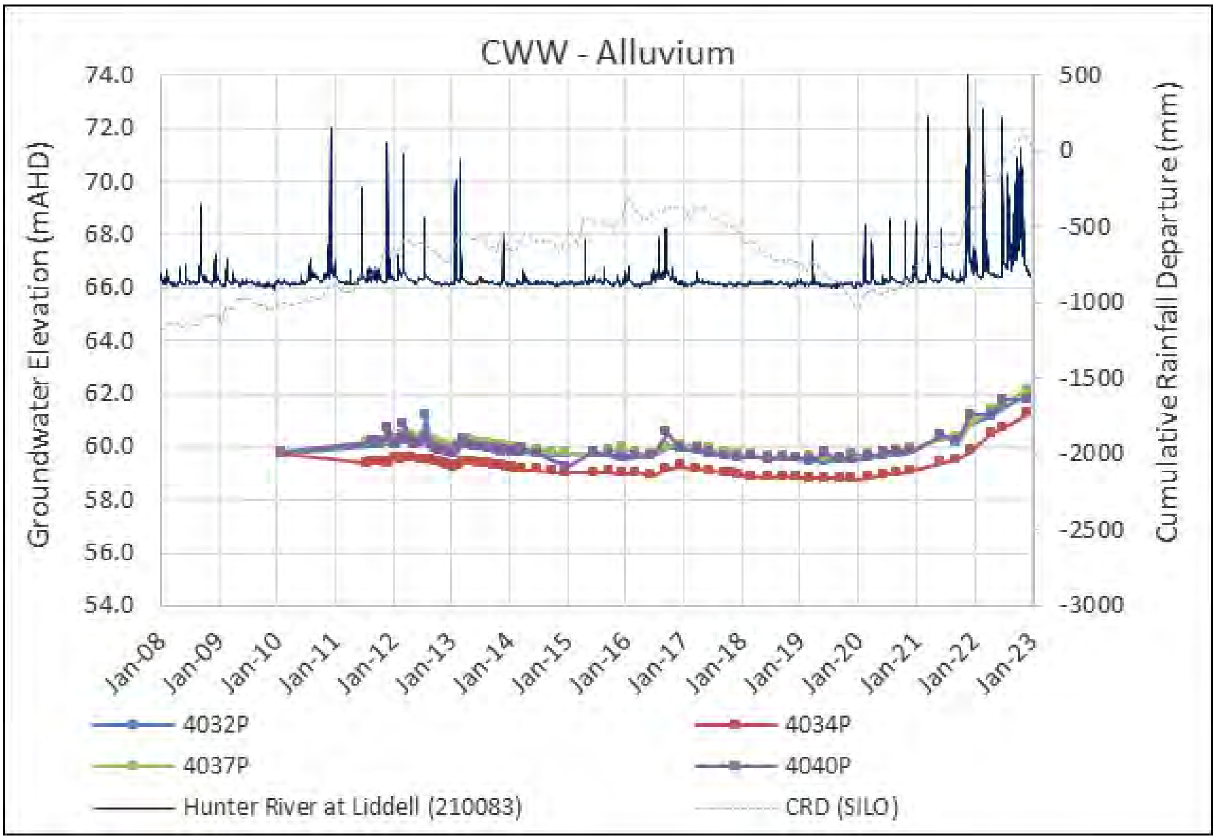


Figure 5.2 Groundwater Levels – Carrington West Wing Alluvium (Western Limb)

Groundwater levels for bores within the floodplain alluvium on the northern end of the paleochannel (CGW32 and GW-106) and the two bores on the western limb of the paleochannel (CGW39 and CGW47a) near Carrington and Carrington West Wing are shown in **Figure 5.3**. Over 2022 groundwater elevations within the four bores in this area ranged between 59.50 mAHD (18.98 mbgl) and 61.65 mAHD (8.74 mbgl). Groundwater levels in bores CGW32 and GW-106 remained relatively stable over 2022. In comparison, levels in bore CGW39 increased by 1.37 m and 0.74 m in bore CGW47a. Bores CGW32 and GW-106 are approximately 3 km north of the Hunter River, whereas bores CGW39 and CGW47a are 900 m north of the river and groundwater levels in these two bores increased in response to above average rainfall and stream flow. It is also noted that the network review undertaken by SLR (2019) revised the screened lithology of bore CGW47a to the Broonie Seam and this has been updated in the revised WMP which is awaiting approval.

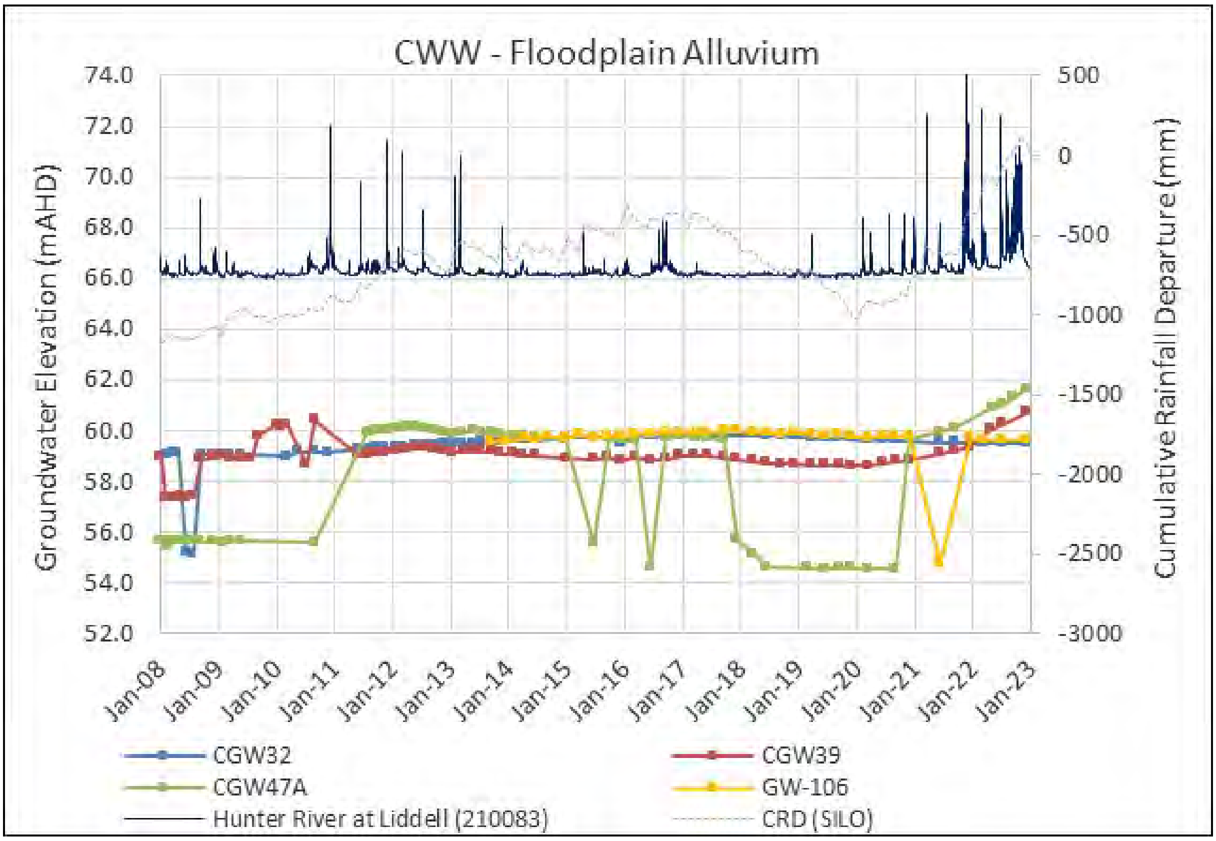


Figure 5.3 Groundwater Levels – Carrington West Wing – Floodplain Alluvium (Western Limb)

Groundwater levels for bores within the alluvium on the five bores on the eastern limb of the paleochannel near Carrington are shown in **Figure 5.4**. The groundwater levels in all five bores, CFW55R, CGW53a, CFW57, CGW55a, and CGW52a, increased slightly over 2022 by just under 1 m, in response to increased rainfall and stream flow trends. Groundwater levels ranged between 59.12 mAHD (10.66 mbgl) and 60.85 mAHD (8.98 mbgl), in bores CFW55R and CGW53a, respectively.

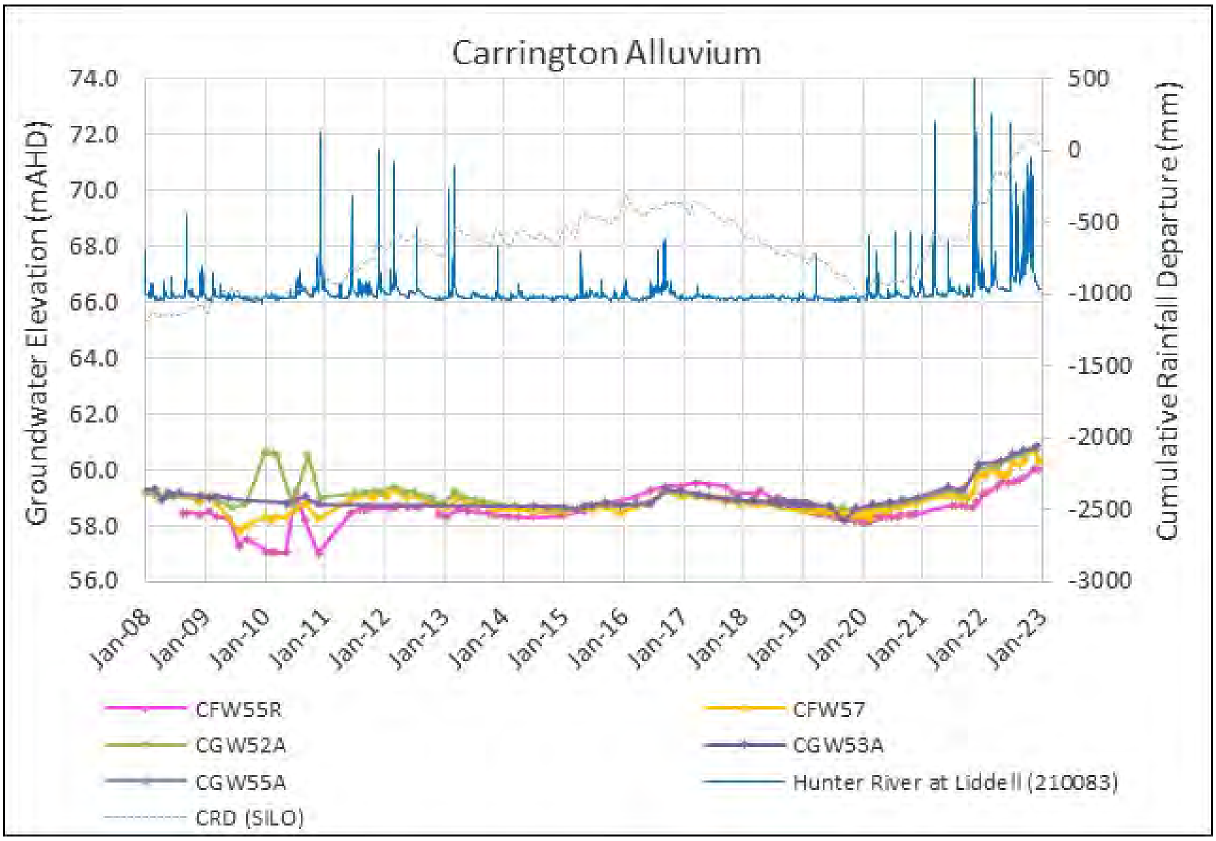


Figure 5.4 **Groundwater Levels – Carrington Alluvium**

Existing groundwater monitoring bores located to the west of the NV TSF, are used to monitor groundwater levels and quality within the Carrington Billabong area and monitor the extent of impacts and response to management practices. Groundwater level triggers were assigned to five alluvial bores at Carrington; CFW55R, CFW57, CGW52a, CGW53a and CGW55a. Groundwater level graphs for each of the bores are compared to CRD in **Figure 5.5** and **Figure 5.9**.

Groundwater levels within all five bores have continued to increase since the start of 2020 in response to above average rainfall and stream flow from 2020 onwards. With the exception of CFW55R and CGW52a, groundwater levels have exceeded the 95th percentile trigger since mid to late 2021. Bores CFW55R and CGW52a exceeded the 95th percentile trigger since June 2022 and September 2022, respectively. The exceedances are discussed further in **Section 6.0**.

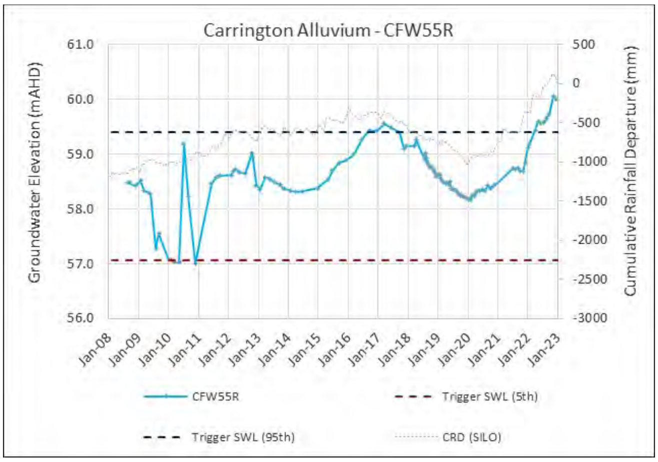


Figure 5.5 Groundwater Levels – CFW55R

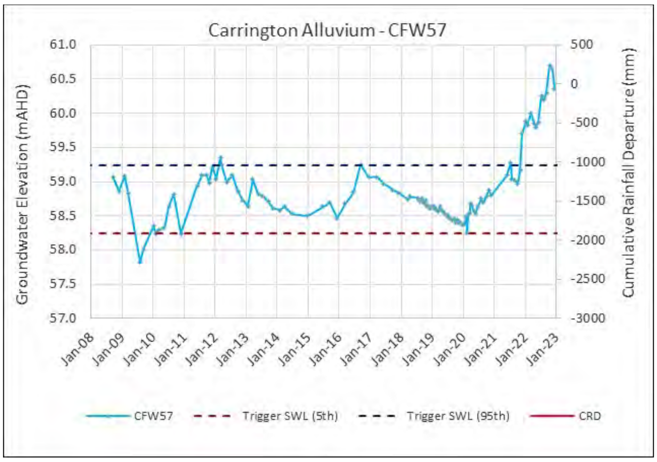


Figure 5.6 Groundwater Levels – CFW57

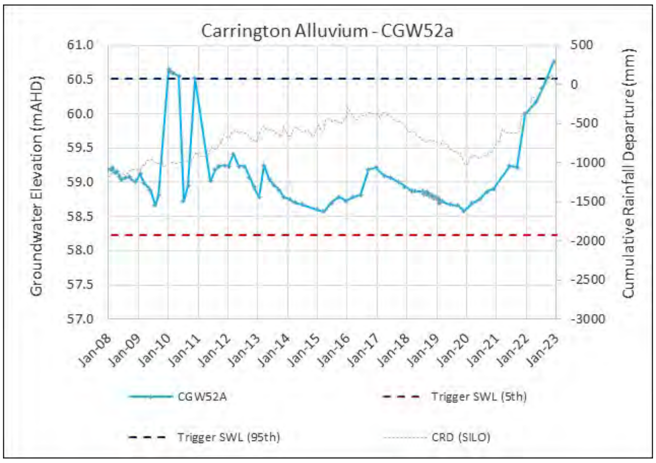


Figure 5.7 Groundwater Levels – CGW52a

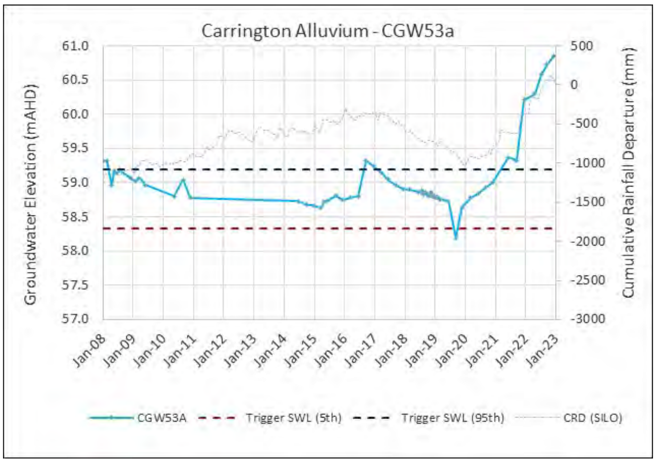


Figure 5.8 Groundwater Levels – CGW53a

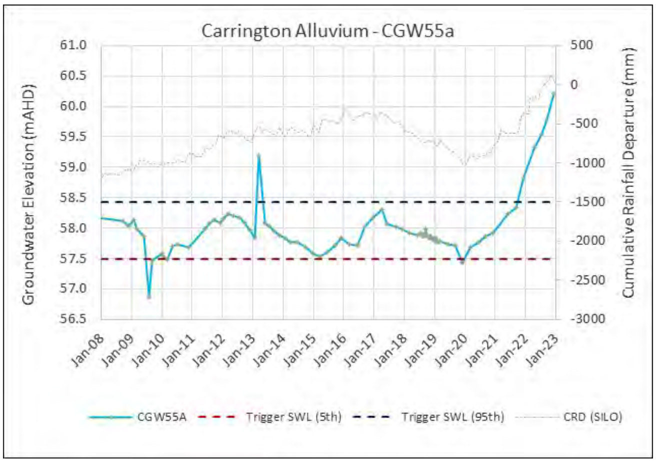


Figure 5.9 Groundwater Levels – CGW55a

5.1.2.2 Groundwater Quality Trends

The pH and EC readings recorded over 2022 are summarised in **Table 5.2**.

Table 5.2 Summary of pH and EC Recorded Over 2022 – Carrington and Carrington West Wing Alluvium

Screened Lithology	pH Range	EC Range (µS/cm)	Comment
Carrington Alluvium	6.7–7.6	993–8,970	Bore CGW49 recorded a pH level (7.6) above the upper trigger level in Q4.
			Bore GW-106 recorded consecutive pH readings (6.7) below the lower trigger level in Q1, Q2 and Q3.
Carrington West Wing Alluvium	7.0–7.8	548–8,960	Bore CFW55R recorded consecutive EC readings above the trigger level from January to April 2022 (Q1), declining from 8,960 µS/cm (Jan) to 6,880 µS/cm (Apr).

Bore CGW49 intersects alluvium within the western limb of the paleochannel. Historical readings show that bore CGW49 has recorded pH ranging between 6.6 and 8.1. Review of pH readings remained fairly stable and within historical levels over 2022. The results show no adverse impacts due to mining.

Bore CFW55R is an alluvial bore located approximately 50 m north of Carrington Billabong, 80 m west of the North Void Tailings. The 2017 annual groundwater review initially identified trigger exceedances which investigated in 2018, which included installation of additional groundwater monitoring bores, hydraulic testing and increased groundwater monitoring. This was in addition to changes in North Void management undertaken from 2018, including installation of a flocculation plant to discharge flocculated tailings to enhance consolidation, cessation of tailings discharge and water management. Assessment of trigger exceedances and impacts is ongoing and has been conducted in consultation with the regulatory authority (SLR, 2020). The monitoring of groundwater levels and groundwater quality are analysed annually within the NV TSF annual analysis report (Umwelt, 2023a).

Over 2022 EC readings for CFW55R declined from 8,960 µS/cm in January to 3,570 µS/cm in December and remained below the historical maximum reading of 10,840 µS/cm (2008). EC concentrations were recorded above the trigger level in the current WMP (version 3.0) from January to April 2022. Monthly water quality monitoring is not required by the WMP but is undertaken as part of monitoring of groundwater quality within the NV TSF area. The exceedance is discussed further in **Section 6.0** and additional ongoing monitoring and investigation is undertaken as part of the NV TSF annual analysis.

Bore GW-106 intersects a remnant patch of paleochannel alluvium between West Pit and Carrington Pit. Since monitoring commenced at the bore in September 2013, bore GW-106 has recorded pH levels ranging between 6.6 and 7.0. Review of pH readings are within historical concentrations. The results show no adverse impacts due to mining. Although the 2022 pH readings for these three bores is within the historical range, they are consecutive and therefore constitute an exceedance and this is discussed further in **Section 6.0**.

5.1.3 Cheshunt Pit/North Pit

5.1.3.1 Groundwater Level Trends

Groundwater levels for bores within the alluvium north and south of the Hunter River, between North Pit and Cheshunt Pit are shown in **Figure 5.10**. Where the alluvium is saturated, groundwater levels ranged between 53.22 mAHD (19.68 mbgl) and 62.70 mAHD (8.30 mbgl), in bores BUNC45A and Hobdens Well, respectively. Over 2022, groundwater levels remained generally stable; however, levels in some bores increased by up to 2.34 m (HV3(2)) in response to above average rainfall and stream flows.

It is also noted that bore BZ1-1 is included in the current WMP as being within the alluvium, however as identified in prior annual reviews (AGE, 2013) the bore likely intersects interburden material. The target lithology has been updated in the draft WMP which has been submitted to DPE for approval.

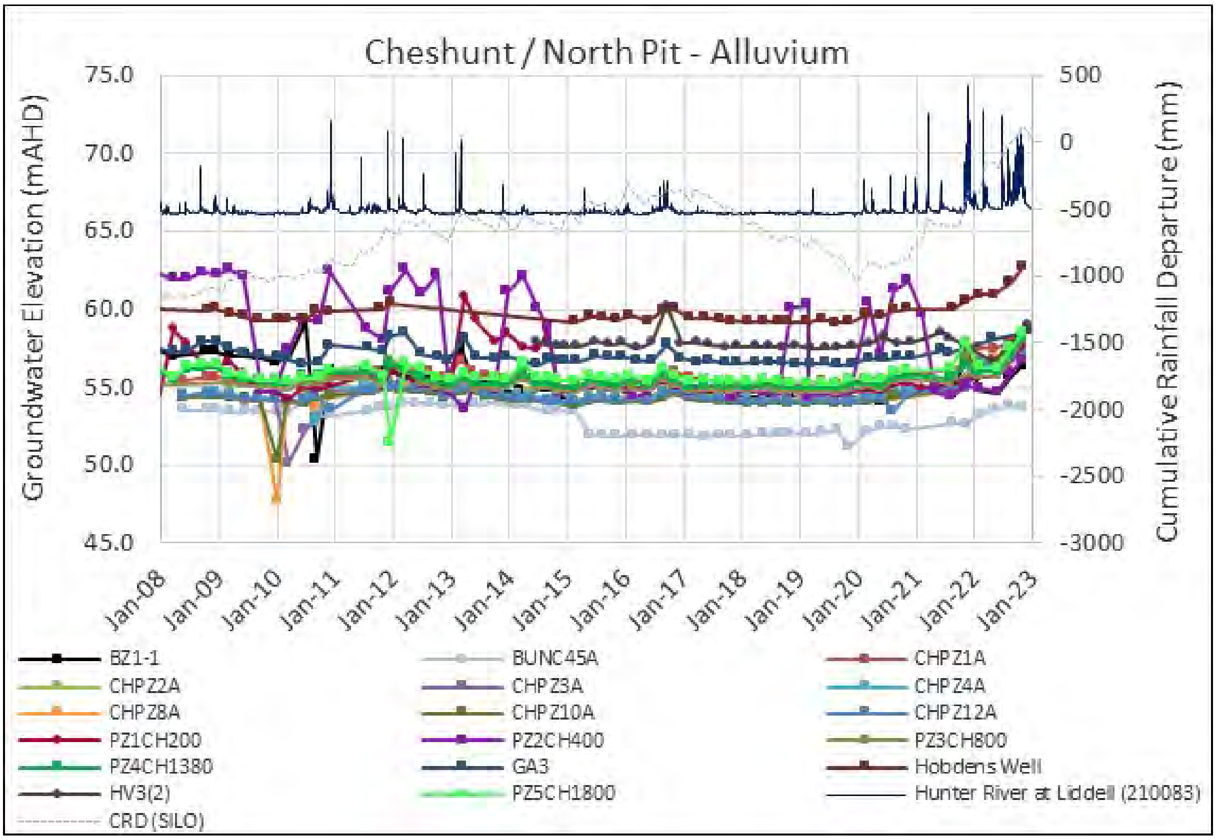


Figure 5.10 Groundwater Levels – Cheshunt/North Pit Alluvium

5.1.3.2 Groundwater Quality Trends

The pH and EC readings recorded over 2022 are summarised in **Table 5.3**.

Table 5.3 Summary of pH and EC Recorded Over 2022 – Cheshunt and North Pit Alluvium

Screened Lithology	pH Range	EC Range (µS/cm)	Comment
Alluvium	6.6–7.7	85–3,590	Bore Hobdens Well recorded pH levels above the trigger level in Q2 and Q3.

Hobdens Well is screened within alluvium, located between the Hunter River and Cheshunt Pit. Historical readings show that Hobdens Well has recorded pH ranging between 7.1 and 8.2. Review of pH readings indicated levels fluctuated slightly, but within historical levels over 2022. The results show no adverse impacts due to mining.

5.1.4 Lemington South

5.1.4.1 Groundwater Level Trends

Groundwater levels for four bores within the alluvium at Lemington South, along Wollombi Brook, are shown in **Figure 5.11**. With the exception of bore Appleyard Farm, groundwater levels in the alluvium increased over 2022 by up to 3.3 m (D317(ALL)) in response to above average rainfall and stream flow. Groundwater levels ranged from 37.58 mAHD (5.82 mbgl) to 51.52 mAHD (2.85 mbgl) in bores Appleyard Farm and PB01(ALL), respectively.

Bore PB01(ALL) is located approximately 150 m from Wollombi Brook and bore Appleyard Farm is located 50 m of Wollombi Brook and 1.2 km upstream of Lemington South Pit. The Wollombi Brook at Warkworth stream gauge is located approximately 350 m upstream of Appleyard Farm. Bores PB01(ALL) and Appleyard Farm remained relatively stable with the exception of periods of flooding within Wollombi Brook where groundwater levels responded quickly, increasing in response to higher flow volumes within the brook. The groundwater level trends show a close correlation with increasing stream flow levels and discharge for Wollombi Brook. Groundwater levels declined from October onwards in response to decreased stream flow.

Bore D317(ALL) is located 45 m from Lemington South Pit, approximately 190 m from Wollombi Brook. Groundwater levels increased by 3.3 m between June and August before declining again by 1.55 m between October and December, in response to rainfall and streamflow levels.

Bore C919(ALL) is located 100 m east of Wollombi Brook and 200 m west of Lemington South Pit. Groundwater levels have continued to increase since July 2020 in response to above average rainfall. Over 2022, levels increased by 2.5 m, but did not fluctuate in response to changes in flow volumes in Wollombi Brook. By December 2022, groundwater levels were higher than water levels recorded at the stream gauge within Wollombi Brook located approximately 1.6 km downstream from bore C919(ALL).

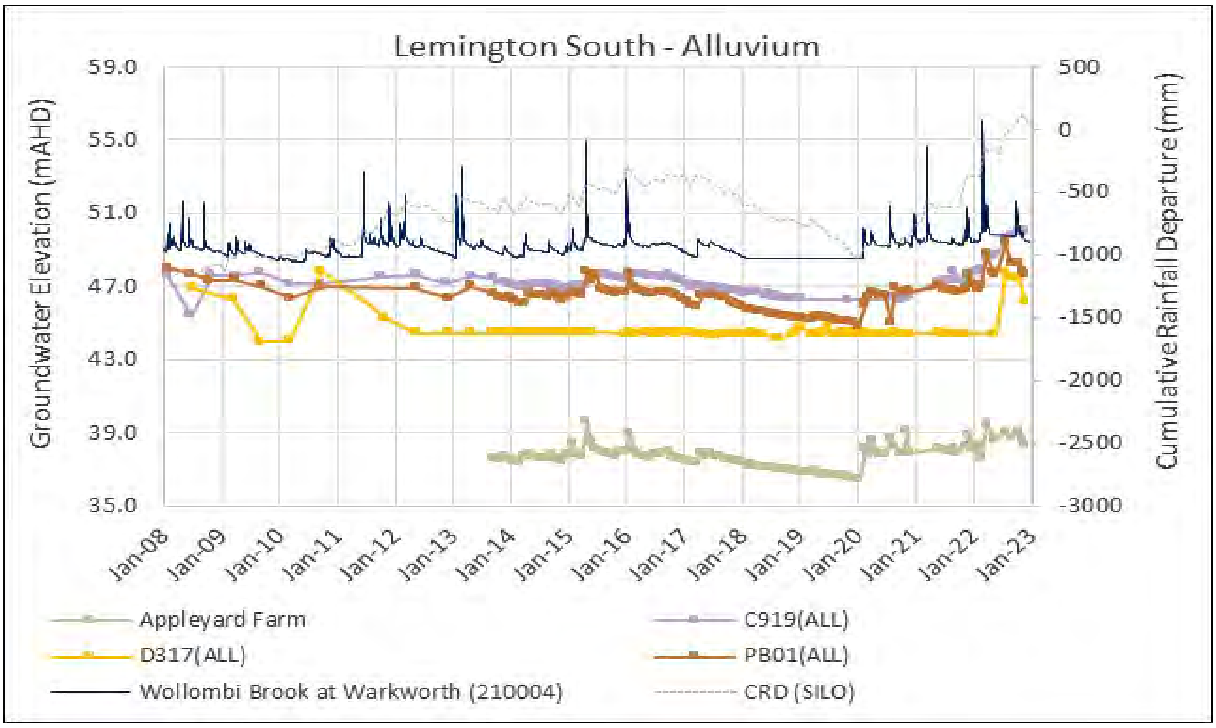


Figure 5.11 Groundwater Levels – Lemington South Alluvium

5.1.4.2 Groundwater Quality Trends

The pH and EC readings recorded over 2022 are summarised in **Table 5.4**.

Table 5.4 Summary of pH and EC Recorded Over 2022 – Lemington South

Screened Lithology	pH Range	EC Range (µS/cm)	Comment
Alluvium	6.1–7.6	205–3,080	Bore PB01(ALL) recorded pH levels (6.1 and 6.5) below the lower trigger level (6.6) in Q3 and Q4.

Bore PB01(ALL) is screened within alluvium, located on the northern banks of the Wollombi Brook, in an area with no active mining or land clearance. Historical readings show that PB01(ALL) recorded pH levels ranging between 6.1 and 8.3. Review of pH readings declined over 2022 but remained within historical levels.

Groundwater elevations in PB01(ALL) ranged between 46.87 mAHD (7.5 mbgl) and 51.52 mAHD (2.85 mbgl) and trends generally correlate to changes in stream flow along Wollombi Brook. The groundwater level data is compared to trends for Wollombi Brook as recorded at HITS station Wollombi Brook @ Warkworth (Station 210004). **Figure 5.11** shows that water levels within bore PB01(ALL) roughly mimic water level trends within the Wollombi Brook. With increased flow along Wollombi Brook due to above average rainfall and several flooding events over 2022 there has only been an overall increase in groundwater levels in PB01(ALL) of 0.46 m. Groundwater levels did respond to flooding events where levels increased by up to 4.65 m but receded quickly following the cessation of flooding. The decline in pH levels was recorded in the month following flooding in July. The field sheet also notes suspended fine in the sample. It is likely sediment has been flushed into the bore during the flooding event effecting water quality results.
No adverse impacts due to mining have been identified.

5.2 Permian Coal Measures

Three bores in the Permian coal measures were recorded as blocked (CGW45, 4051C and D510(AFS)) over 2022, with three other bores recorded as blocked in Q4 (4036C, BZ3-1 and NPz3). Discussion in water level trends within the Permian coal measures is included for each of the mine locations from **Section 5.2.1** to **Section 5.2.4**.

5.2.1 West Pit

5.2.1.1 Groundwater Level Trends

Three bores target the Permian coal measures at West Pit, including NPz2, NPz3 and NPz5. Bore NPz5 intersects the Jerrys Plains Subgroup between West Pit and Carrington Pit; however, was mined out in 2020.

Groundwater elevations for the bores at West Pit are presented in **Figure 5.12**. Groundwater levels within bore NPz2 remained relatively stable until September 2022. Between September and December 2022 levels declined by 5.8 m. The decline is unique to the bore and no known land use activities in the area that may have caused the decline. Groundwater levels in bore NPz3 increased slightly by 0.6 m over 2022, before becoming blocked in Q4. These two bores are located upslope, on the northwest side of West Pit. Review of the geology mapped at bore NPz2 identified that it intersects the Saltwater Creek Formation (Pswc) and bore NPz3 intersects Mulbring Siltstone (Pmm). The Saltwater Creek Formation underlies the Vane Subgroup mined at West Pit. The Saltwater Creek Formation comprises laminated sequences of siltstone and sandstone, and the underlying Mulbring Siltstone comprises low permeability siltstone and claystone units and is considered to act as a confining unit (SLR, 2020).

The cause of the groundwater trend at NPz2 is unclear and would require further information regarding historical land use activities in the region. However, based on available information, the cause for the changes in groundwater levels do not appear to correlate to mine activities conducted at West Pit. Bores NPz2 and NPz3 have been removed from the compliance network within the draft WMP as the location and construction of the bores precludes them from providing an indication of potential impacts (SLR, 2019). The draft WMP has been submitted to DPE for approval. It is recommended that these bores remain in the operational monitoring program to assist with future assessments and assessment of post closure groundwater conditions.

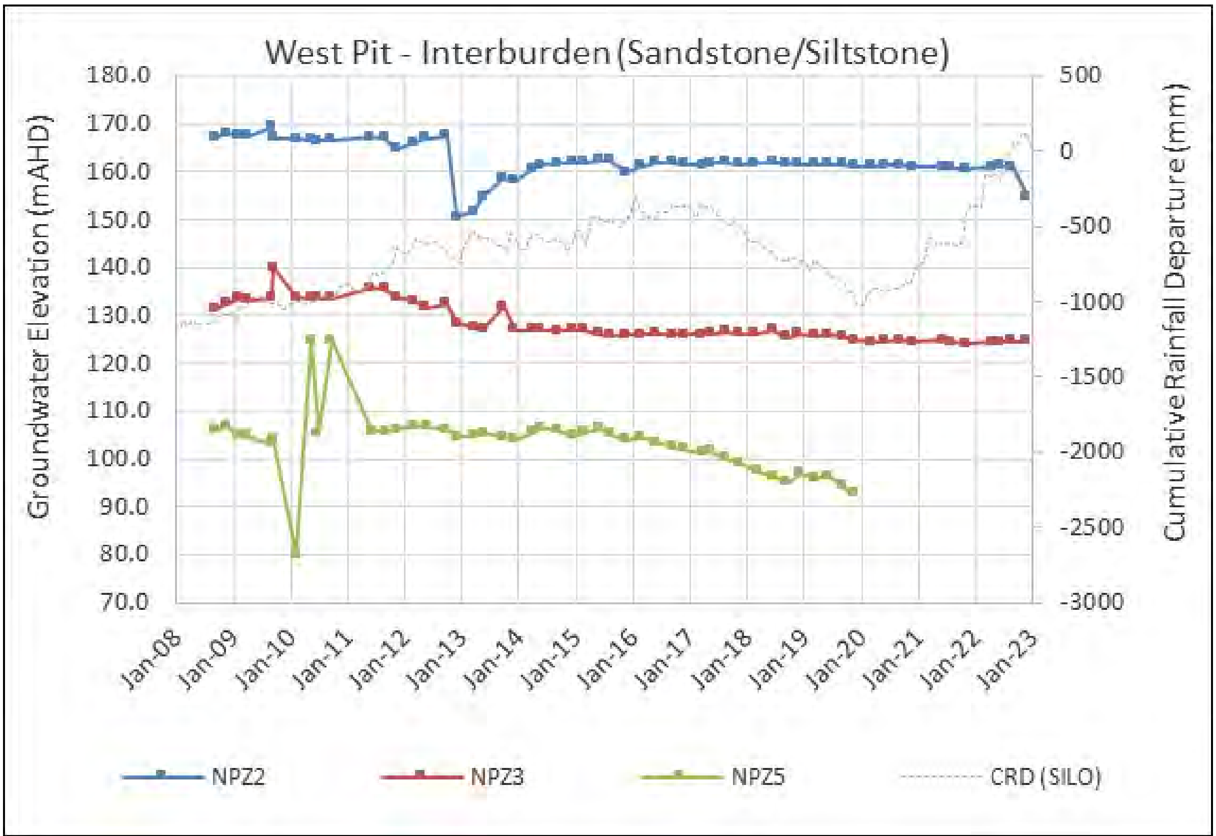


Figure 5.12 Groundwater Levels – West Pit Permian Coal Measures

Vibrating Wire Piezometers

In 2012, six vibrating wire piezometers (VWPs) were installed to monitor the coal seam and interburden sequences of the Permian coal measures in the West Pit area (GW-103, GW-104 and GW-105), as summarised in **Table 6.3**. Over time a number of sensors within each VWP site have failed. Over 2022, only data from GW-105 and data up to the end of May 2022 for GW-104, was downloaded. Review of the data identified that some sensors have previously failed, including GW-100a. In addition, data from GW-101a and GW-102 have not been downloaded as the VWP units are awaiting replacement.

VWP GW-103, VWP GW-104 and VWP GW 105 are located south of West Pit. GW-103 failed in 2020, while GW-105 has remained relatively stable since 2020. GW-104 VWP1 (Lower Pikes Gully Seam), VW2 (interburden material) and VWP3 (in sandstone above the Barrett Seam) all declined over time due to depressurisation from coal mining at West Pit. Groundwater level trends for the VWPs are presented in **Figure 5.20** and **Figure 5.21**.

Table 5.5 VWP Summary – West Pit

VWP ID	Sensor ID	Depth (mbgl)	Geology	Location	Comment
GW-100a	VW1	51.0	Barret Seam and Interburden	West of West Pit	Faulty sensor, scheduled to be replaced.
GW-101a	VW1	51.0	Interburden (siltstone/sandstone)	West of West Pit	Not downloaded in 2022, awaiting installation of new units.

VWP ID	Sensor ID	Depth (mbgl)	Geology	Location	Comment
GW-102	VW1	60.5	Interburden (sandstone with minor coal)	West of West Pit	Not downloaded in 2022, awaiting installation of new units.
GW-103	VW1	25.5	Undifferentiated and weathered coal	South of West Pit	All sensors failed 20/01/2020.
	VW2	64.0	Siltstone and coal		
	VW3	119.5	Sandstone		
GW-104	VW1	59.0	Lower Pikes Gully Seam	South of West Pit	Levels have continued to decline up to May 2022. Inaccessible for download in Q3 and Q4 due to flooding.
	VW2	107	Sandstone near Upper Liddell Seam		
	VW3	135	Sandstone above Barrett Seam		
GW-105	VW1	33.0	Undifferentiated coal	South of West Pit	Relatively stable since October 2020.
	VW2	103.5	Tuffaceous coal		Relatively stable since November 2019.
	VW3	154.0	Coal		Sensor failed 17/02/2020.

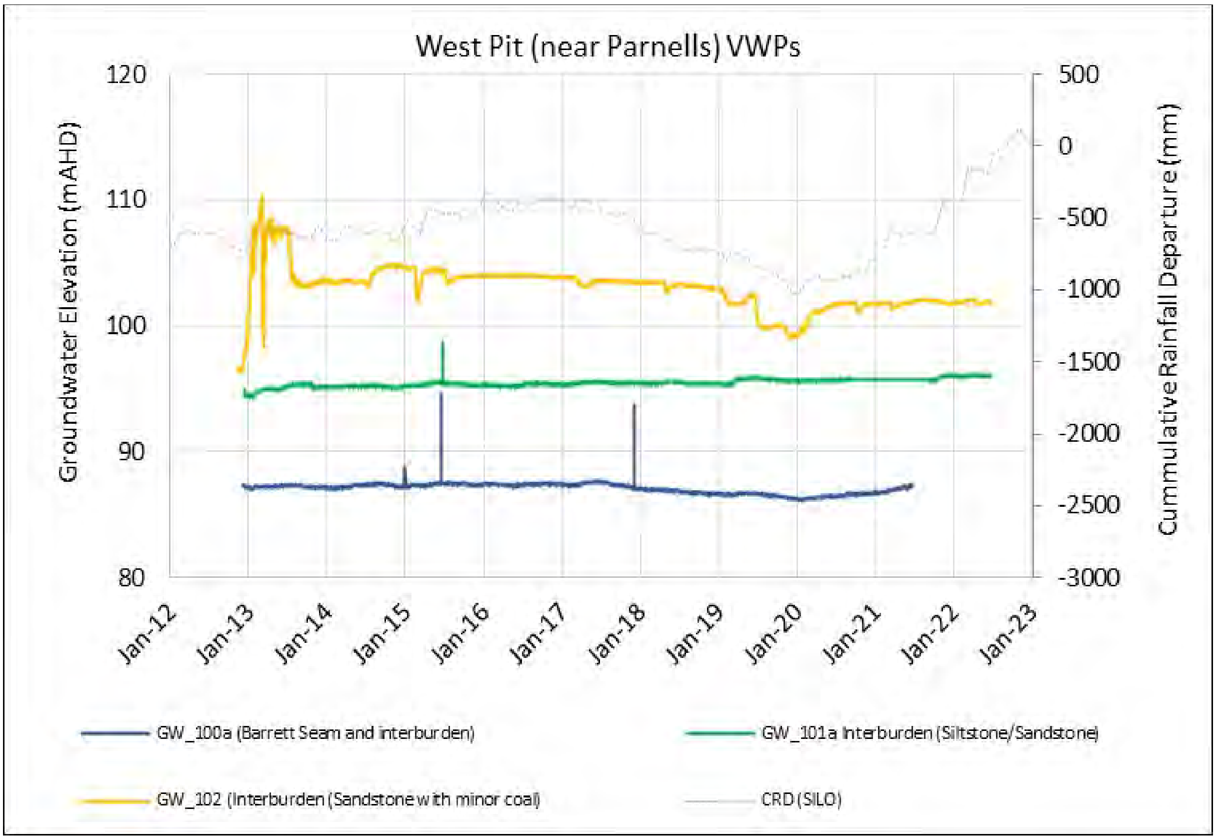


Figure 5.13 Groundwater Levels (VWPs) – West Pit Permian Coal Measures Near Parnells Dam

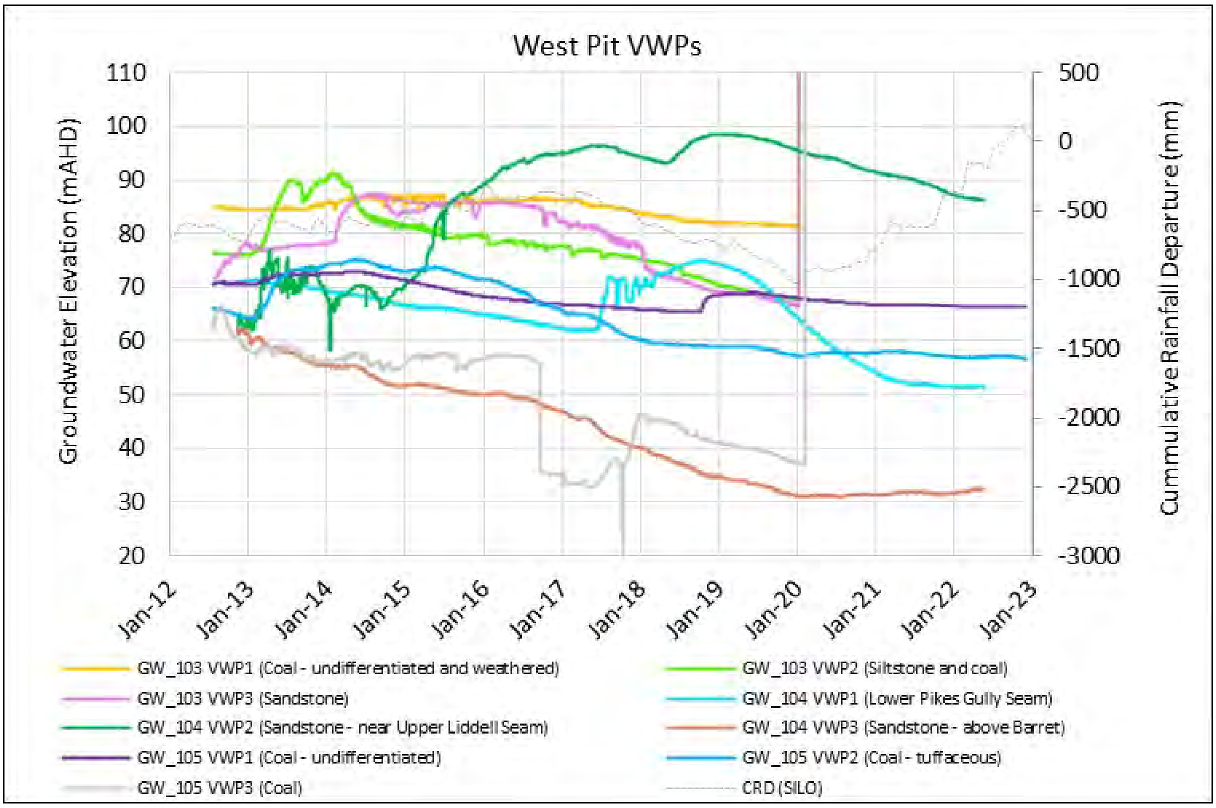


Figure 5.14 Groundwater Levels (VWPs) – West Pit Permian Coal Measures

5.2.1.2 Groundwater Quality Trends

The pH and EC readings recorded over 2022 are summarised in **Table 5.6**.

Table 5.6 Summary of pH and EC Recorded Over 2022 – West Pit Permian Coal Measures

Screened Lithology	pH Range	EC Range (µS/cm)	Comment
Sandstone/siltstone	7.0–7.8	12,320–15,410	Bore NPz2 recorded EC concentrations above the trigger level in Q1, Q3 and Q4.

Bore NPz2 is located approximately 4.5 km northeast of Plashett Reservoir and 1 km northwest of the West Pit mine area. The bore intersects interburden material (siltstone/sandstone) of the deeper Permian coal measures; with a screened interval between 57 mbgl to 60 mbgl. Historical EC readings for NPz2 since 2008 show regular fluctuations between 12,590 µS/cm and 19,400 µS/cm at the site. The 2022 readings of 15,410 µS/cm, 13,160 µS/cm, 13,800 µS/cm and 13,550 µS/cm are considered consistent with historical concentrations. Although the 2022 pH readings for these three bores is within the historical range, they are consecutive and therefore constitute and exceedance and this is discussed further in **Section 6.0**.

Based on available information, the cause for the changes in EC at NPz2 do not appear to correlate to mine activities conducted at West Pit. The network review undertaken by SLR in 2019 recommended that NPz2 be removed from the compliance network as the bore location and construction does not provide information on potential impacts related to site activities, and this has been undertaken in the draft WMP which is awaiting approval. This bore should continue to be monitored to assist with other assessments and post closure monitoring.

5.2.2 Carrington and Carrington West Wing

5.2.2.1 Groundwater Level Trends

The WMP includes seven monitoring bores with screens that intersect the Permian coal measures at Carrington and Carrington West Wing. This includes two bores within the Bayswater Seam (CGW45 and CGW46), two within the Broonie Seam (CGW52 and CGW53) and three within the interburden material (4036C, 4051C and CGW51a). Bore CGW45 and 4051C were reported as blocked in 2022 and bore 4036C was recorded as blocked in Q4. Groundwater elevations for the seven bores are presented in **Figure 5.15**.

Bore CGW46 intersects the shallow Bayswater Seam (approximately 13 m deep) underlying alluvium on the western limb of the paleochannel. Over 2022, groundwater levels ranged between 61.21 mAHD (10.74 mbgl) and 52.61 mAHD (19.34 mbgl). Recorded groundwater levels declined by approximately 9 m between July and December 2022. However, review of groundwater levels within nearby monitoring bores indicates the recorded level is an error on the field sheet.

Groundwater levels in bore CGW52 increased over 2022 by 1.16 m, while bore CGW53 recorded fluctuations in groundwater levels throughout the year with an overall increase in levels of 0.9 m. Bores CGW52 and CGW53 both intersect the Broonie Seam and have recorded a rise in water levels since 2019, which appears to relate to recovery in groundwater conditions with cessation of mining at Carrington Pit.

SLR (2020) noted that available bore details indicate bore CGW51a is screened within alluvium comprising fine to medium grained gravel and sand immediately overlying coal. As a result, groundwater within the bore is representative of alluvial groundwater and groundwater within the weathered coal measures. SLR (2020) also recommended that due to the construction of the bore, it should be decommissioned to minimise potential mixing. Groundwater levels within the backfilled Carrington Pit should continue to be monitored to ensure the void continues to act as a groundwater sink. To enable this, it was recommended that a new bore be installed within the spoil material to replace CGW51a. It is noted that bore CGW51a has been removed from the draft WMP which is awaiting approval.

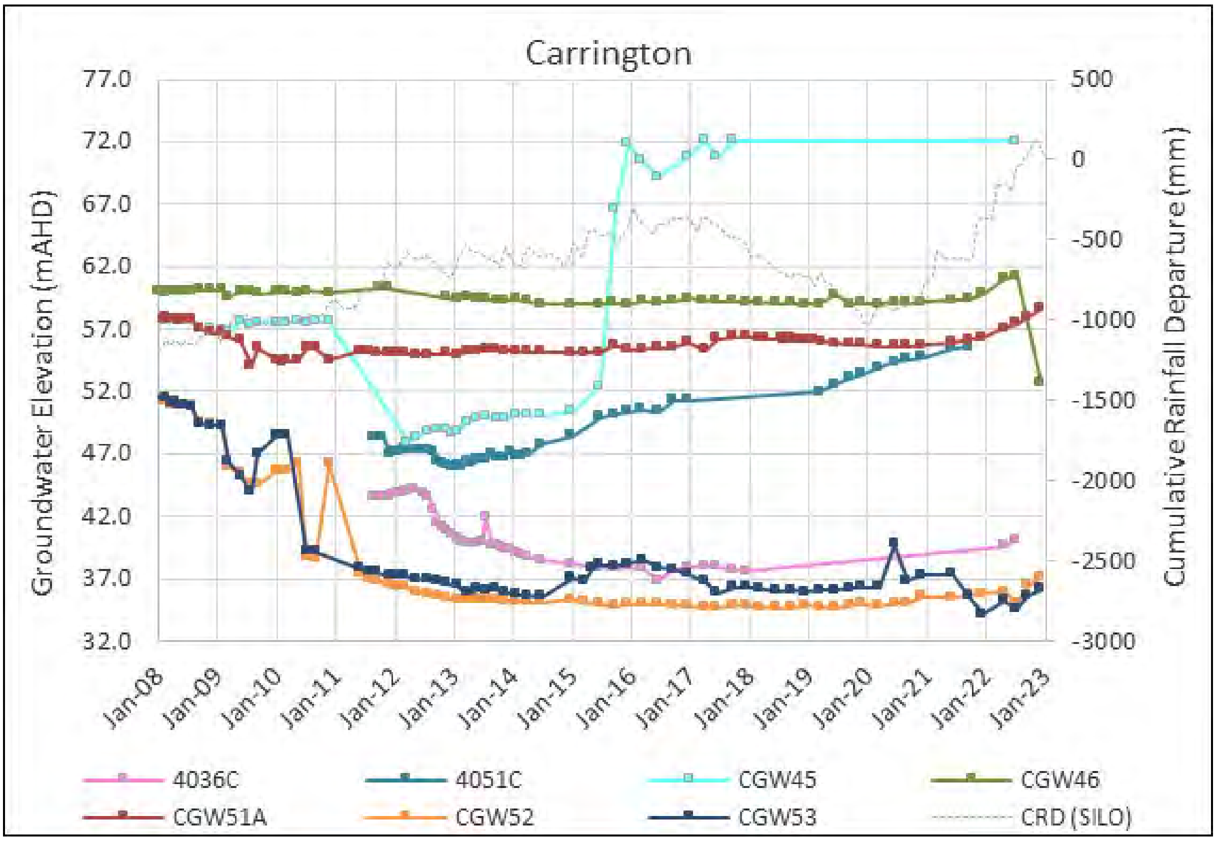


Figure 5.15 Groundwater Levels – Carrington Permian Coal Measures

Vibrating Wire Piezometers

In 2012, two vibrating wire piezometers (VWPs) were installed to monitor the coal seam and interburden sequences of the Permian coal measures in the Carrington area (GW-109 and GW-110), as summarised in Table 5.7. Over time a number of sensors within each VWP site have failed. Groundwater level trends for the VWPs are presented in **Figure 5.16**.

Review of the data identified that some sensors have previously failed. Sensor VW3 (coal seam) within GW-109 did not record data between 2012 and June 2021. In addition, calibration details for GW-110 were not available at the time of reporting, therefore data could not be converted and graphed. However, GW-110 is located near the highwall within Carrington Pit void and may be decommissioned. Ongoing monitoring of groundwater level recovery in spoil material near Carrington Pit void can continue to be conducted at bores GW-107 and GW-108.

GW-109 is located within the west of the Carrington Pit and the sensor within weathered coal (VW1) recorded a slight decline in water levels over October 2021, while the deeper sensor within tuffaceous coal (VW2) recorded relatively stable groundwater levels at a lower elevation. The difference in the two sensors may relate to instrument drift or an additional source of recharge to the shallow stratigraphy. It is recommended that local site conditions and the condition of the GW-109 be reviewed, and groundwater conditions within the spoil in Carrington Pit continue to be monitored.

Table 5.7 VWP Summary – Carrington Area

VWP ID	Sensor ID	Depth (mbgl)	Geology	Location	Comment
GW-109	VW1	31.5	Weathered coal	West of Carrington Pit	Slight decline in levels since October 2021.
	VW2	65.0	Tuffaceous coal		Remained relatively stable since 2012.
	VW3	59.5	Bayswater Seam		Sensor failed between 2012 and 2021. Levels have increased since July 2021.
GW-110	VW1	38.0	Sandstone	North of Carrington Pit	Calibration data required to convert raw data.
	VW2	63.0	Sandstone		
	VW3	93.0	Bayswater Seam		

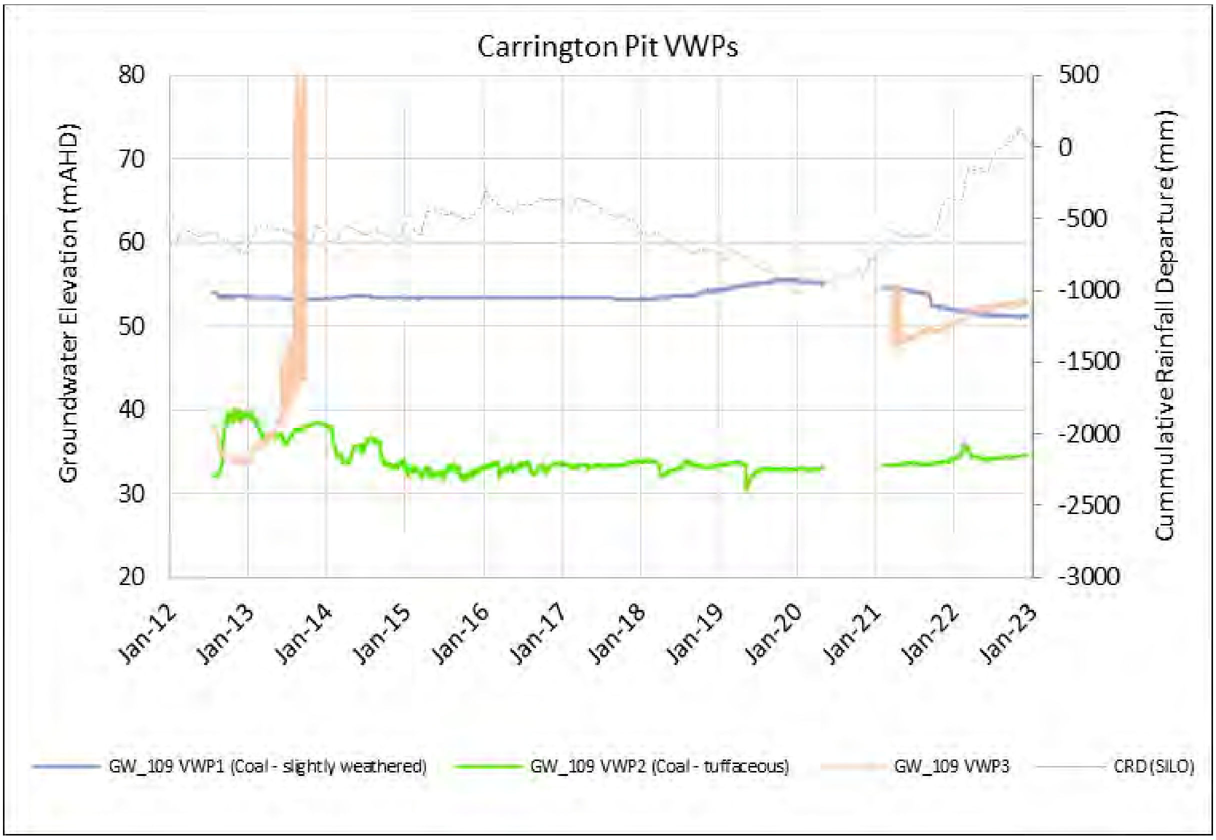


Figure 5.16 Groundwater Levels (VWPs) – Carrington Permian Coal Measures

5.2.2.2 Groundwater Quality Trends

The pH and EC readings recorded over 2022 are summarised in **Table 5.8**.

Table 5.8 Summary of pH and EC Recorded Over 2022 – Carrington and Carrington West Wing Permian Coal Measures

Screened Lithology	pH Range	EC Range (µS/cm)	Comment
Carrington Interburden	6.8–7.6	3,350–7,160	Bore CGW51a recorded pH (7.6) above the upper pH trigger level in Q3 and Q4.
Carrington Broonie Seam	6.6–7.0	6,000–8,240	Bore CGW53 recorded pH (6.6 and 6.7) below the lower trigger level in Q3 and Q4.
CWW Bayswater Seam	7.1–7.3	761–824	Bore CGW46 recorded pH (7.1) below the trigger level in Q4.

Bore CGW51a was identified to actually be screened within the alluvium by SLR (2020). As a result, groundwater within the bore is representative of alluvial groundwater and groundwater within the weathered coal measures. SLR (2020) also recommended that due to the construction of the bore, it should be decommissioned to minimise potential mixing. Historical pH readings for the bore since 2005 show minor fluctuations of between 6.8 and 8.1. The 2022 readings ranging from 7.4 to 7.6 are considered consistent with historical concentrations, with no adverse impacts identified.

Bore CGW53 is located along the Hunter River. Available bore information indicates bore CGW53 is constructed with screen from 38.5 m to 41.5 m below surface with 25 mm diameter casing and screened across coal (Broonie Seam). Historical pH readings for the bore since 2005 show regular fluctuations of between 6.6 and 7.8. The 2022 readings ranging from 6.6 to 6.8 are considered consistent with historical concentrations, with no adverse impacts identified.

Bore CGW46 is located approximately 900 m of the Hunter River and is constructed to a depth of 13.6 m below surface, screened across coal (Bayswater Seam). Historical pH readings for the bore since 2005 show regular fluctuations of between 7.1 and 7.8. The 2022 readings ranging from 7.1 to 7.3 are considered consistent with historical concentrations, with no adverse impacts identified.

5.2.3 Cheshunt Pit/North Pit

5.2.3.1 Groundwater Level Trends

The WMP includes thirteen monitoring bores screened within the Permian coal measures at Cheshunt Pit. This includes nine bores within the Mt Arthur Seam (BC1a, BZ1-3, BZ2A(1), BZ3-3, BZ4A(2), CHPZ3D, CHPZ8D, CHPZ12D, HG2a), one within the Piercefield Seam (BUNC45D) and three within interburden (BZ3-1, BZ8-2 and HG2). Over 2022, bore BZ3-1 was recorded as blocked in Q3 and Q4, while bores BZ4A(2) and B425(WDH) recorded groundwater levels below the base of the screen. Bore BZ8-2 was inaccessible throughout the year due to flooding.

Groundwater elevations for the bores are presented in **Figure 5.17** to **Figure 5.19**. With the exception of bores CHPZ3D, CHPZ12D and BZ3-3, groundwater levels within the Mt Arthur Seam remained relatively stable over 2022 ranging from 24.42 mAHD (46.97 mbgl) to 57.60 mAHD (2.29 mbgl) in bores BZ1-3 and CHPZ8D, respectively. Bores CHPZ3D, CHPZ12D and BZ3-3 recorded an increase in groundwater levels of up to 0.9 m over 2022.

Mt Arthur Seam bores (CHPZ3D, CHPZ8D and CHPZ12D) and Piercefield Seam bore (BUNC45D) are located over 1 km northeast of Cheshunt Pit, to the north of the rehabilitated Barry's Pit. All four bores recorded minor fluctuations in groundwater levels but were relatively stable over 2022.

Groundwater levels in bore BZ3-1, which intersects the Cheshunt Interburden, declined slightly by 0.26 m; however, the bore was recorded as blocked in Q3 and Q4 and was unable to be measured. In comparison, groundwater levels within bore HG2, which is also screened within the Cheshunt Interburden, increased by 1.6 m over 2022.

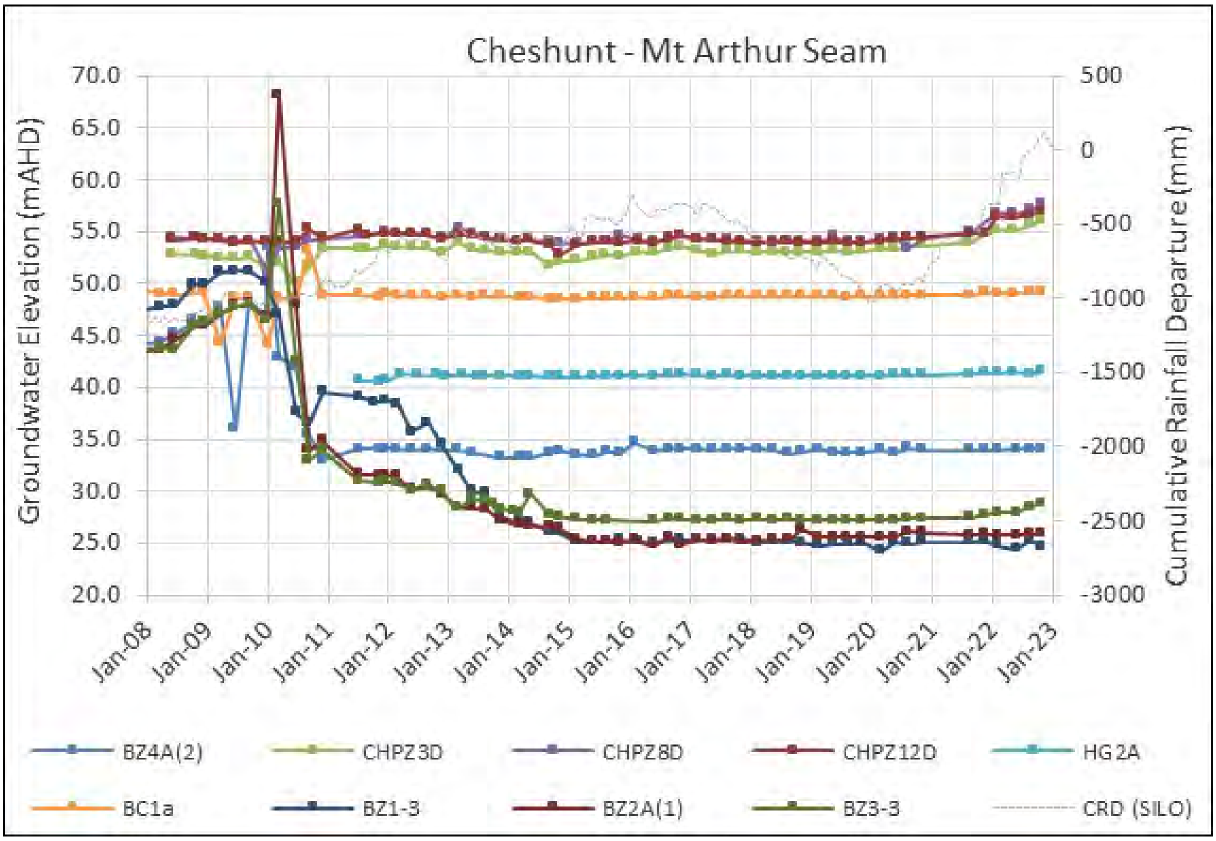


Figure 5.17 Groundwater Levels – Cheshunt Mt Arthur Seam

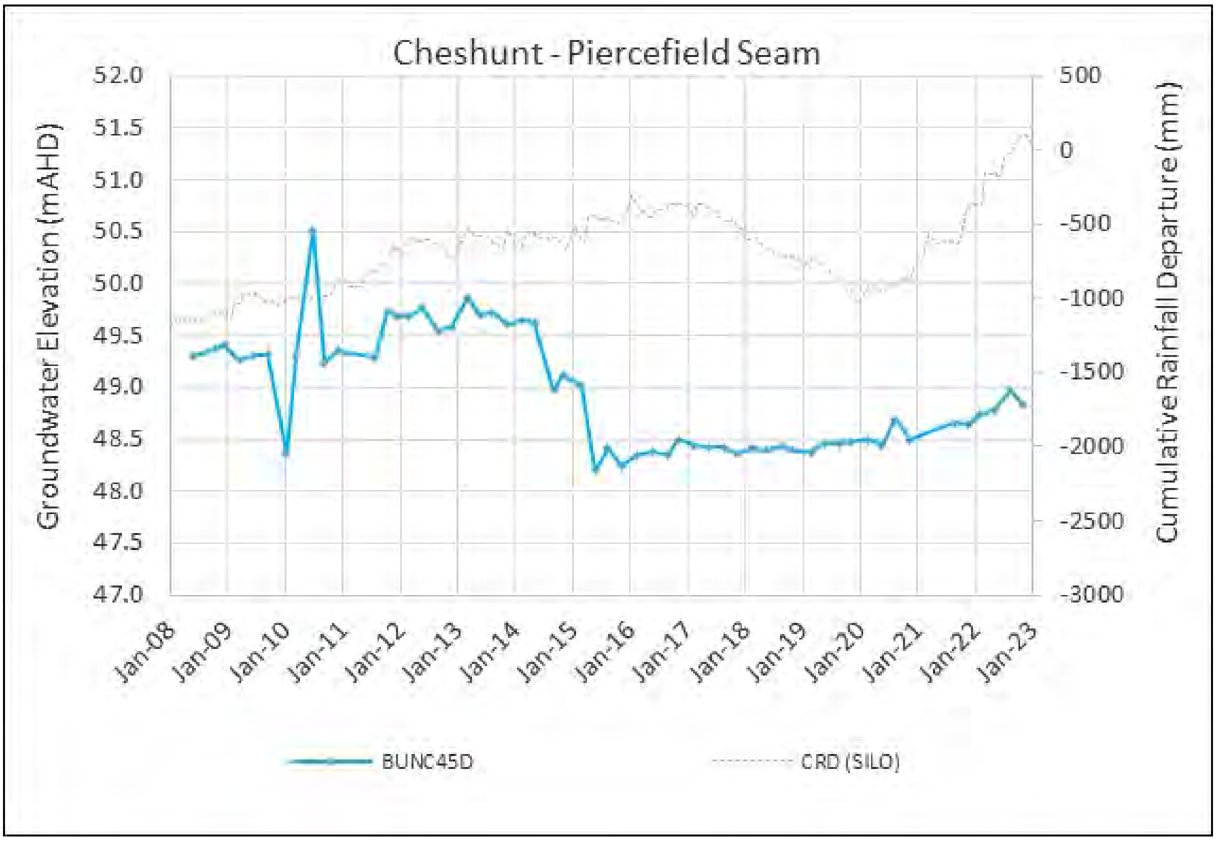


Figure 5.18 Groundwater Levels – Cheshunt Piercefield Seam

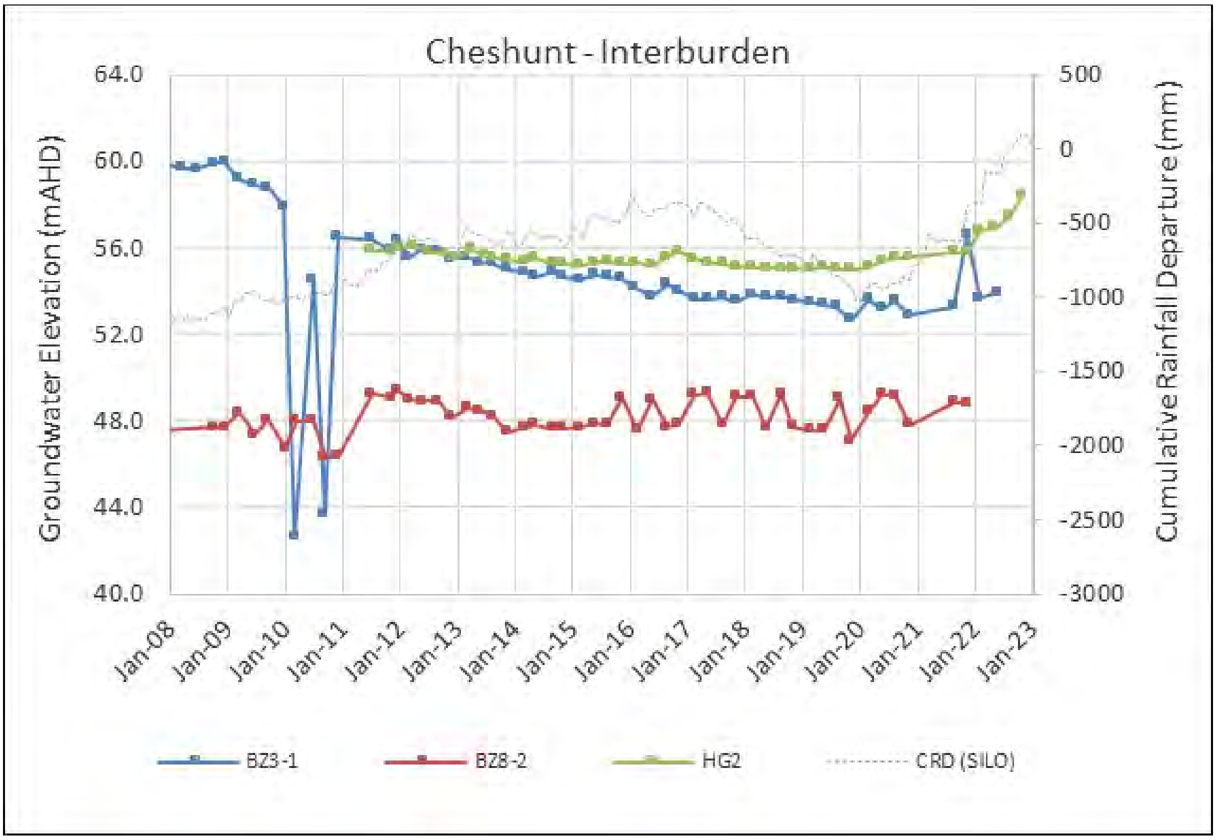


Figure 5.19 Groundwater Levels – Cheshunt Interburden

5.2.3.2 Groundwater Quality Trends

The pH and EC readings recorded over 2022 are summarised in **Table 5.9**.

Table 5.9 Summary of pH and EC Recorded Over 2022 – Cheshunt/North Pit Permian Coal Measures

Screened Lithology	pH Range	EC Range (µS/cm)	Comment
Interburden	7.4–7.7	1,558–3,740	No exceedances
Mt Arthur Seam	6.1–7.4	203–2,370	Bores BZ2A(1), BZ3-3, BZ4A(2) - pH ranged between 6.1 and 6.5, below the lower pH trigger level throughout 2022, constituting an exceedance
Piercefield Seam	6.5–6.8	2,260–2,430	No exceedances

Bores BZ2A(1), BZ3-3 and BZ4A(1) intersect the Mt Arthur Seam and are located between Cheshunt Pit and the Hunter River. The trigger range for the bores is 6.5 to 7.6, while the range in historical data for the bores is 6.0 to 7.4. Although the 2022 pH readings for these three bores is within the historical range, they are consecutive and therefore constitute an exceedance and this is discussed further in **Section 6.0**.

5.2.4 Lemington South

5.2.4.1 Groundwater Level Trends

The WMP includes 29 monitoring bores with screen that intersects the Permian coal measures at Lemington South. This includes:

- Four bores within the Arrowfield Seam – C130(AFS1), D406(AFS), D510(AFS) and D612(AFS).
- One bore within the shallow interburden material (siltstone/sandstone) – C130(ALL).
- Eight bores within the Glen Munro Seam and/or Woodlands Hill Seam – B425(WDH), B631(WDH), C122(WDH), C130(WDH), C317(WDH), C809(GM/WDH), D010(WDH) and D010(GM).
- Sixteen bores within the Bowfield Seam – B334(BFS), B631(BFS), B925(BFS), C122(BFS), C130(BFS), C317(BFS), C613(BFS), C621(BFS), C630(BFS), D010(BFS), D214(BFS), D317(BFS), D406(BFS), D510(BFS), D612(BFS) and D807(BFS).

Groundwater level trends for bores targeting the Arrowfield Seam are presented in **Figure 5.20**. It is noted that bore D510(AFS) was recorded as blocked over 2022. Groundwater levels in bores screened within the Arrowfield Seam remained relatively stable over 2022 with only bore C130(AFS1) recording a slight increase of 0.5 m.

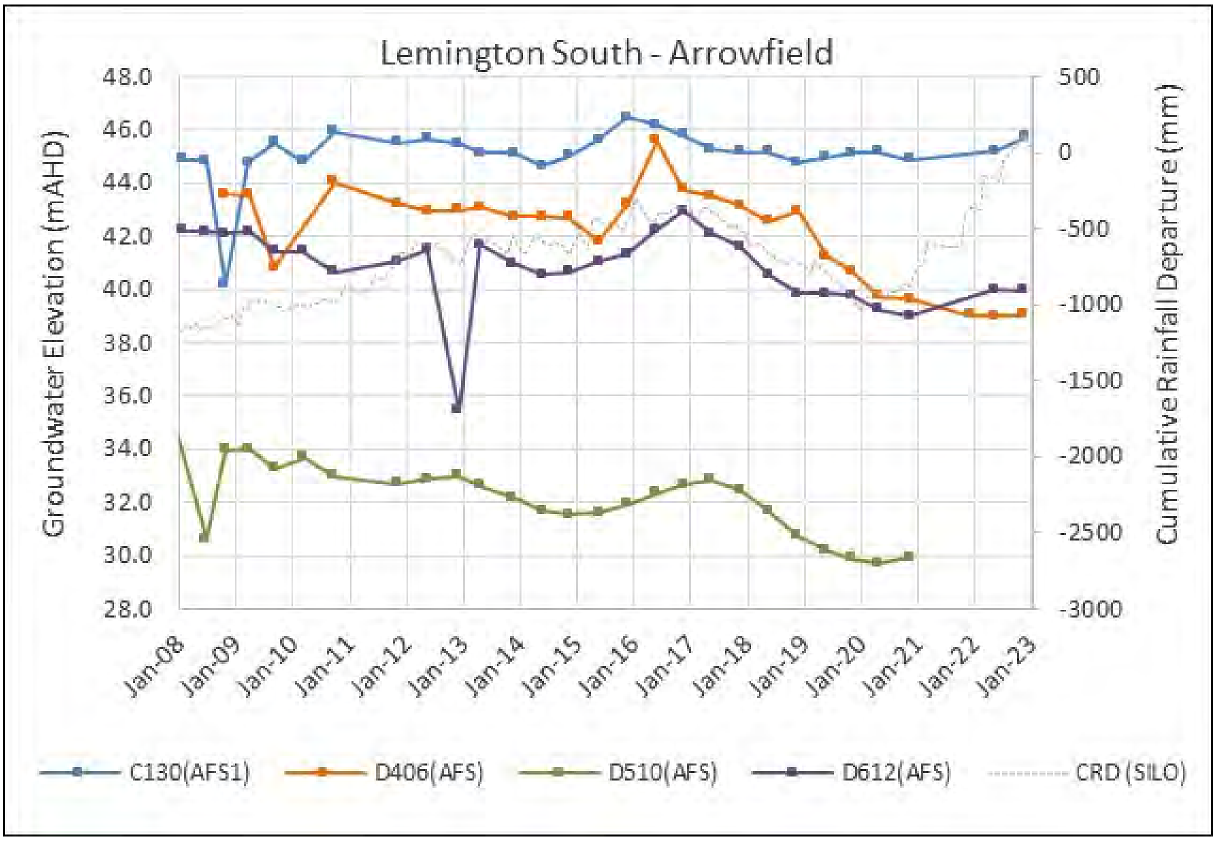


Figure 5.20 Groundwater Levels – Lemington South Arrowfield Seam

Groundwater level trends for bores targeting the shallow interburden, Woodlands Hill Seam and Glen Munro Seam are presented in **Figure 5.21**. B425(WDH) groundwater levels ranged between 43.66 mAHD (12.29 mbgl) and 50.10 mAHD (5.85 mbgl) over 2022. Groundwater levels remained relatively stable in bores B425(WDH), B631(WDH), C122(WDH), C130(WDH), and C317(WDH). Levels increased in bore C809(GM/WDH) by 1.7 m and 1.45 m in bore D010(WDH). In comparison, groundwater levels declined in bore D010(GM) by 5.43 m over 2022. Bore D010(GM) is approximately 17 m deep and intersects the shallow subcrop of the Glen Munro Seam, while D010(WDH) is slightly deeper at 22.5 mbgl within the Woodlands Hill Seam. Historical trends show higher groundwater levels in D010(GM) than D010(WDH), therefore the rapid decline in December for D010(GM) is unique and may be due to an erroneous recording.

Following the decline of groundwater levels in bore B425(WDH) during 2017, the bore was recorded as dry throughout from the end of 2017. These elevations and trends correspond more closely with trends observed for the Bowfield Seam bores. The 2019 network review undertaken by SLR recommended that the bore be removed from the monitoring network in favour of ongoing monitoring at nearby bore C130(WDH) (SLR, 2020). It is noted that B425(WDH) has been removed from revised WMP which is awaiting approval.

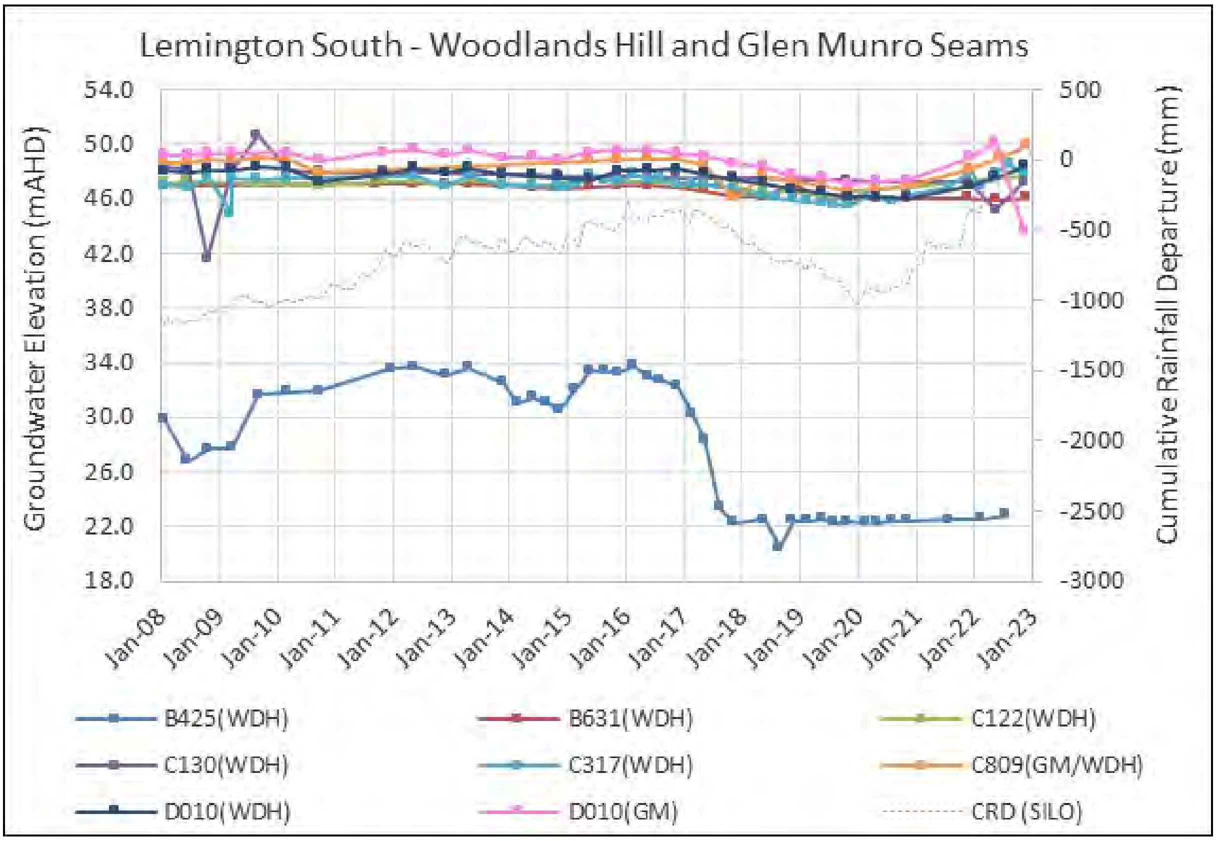


Figure 5.21 Groundwater Levels – Lemington South Woodlands Hill and Glen Munro Seams

Groundwater level trends for bores targeting the Bowfield Seam are presented in **Figure 5.22**. Groundwater elevations ranged between -0.60 mAHD (58.80 mbgl) and 41.97 mAHD (21.67 m). Interpolated groundwater elevation contours for the Bowfield Seam are presented in **Figure 5.23**, based on November 2022 readings, where available. Groundwater levels in bore C630(BFS), located west of Lemington South Pit, remained relatively stable over 2022. Bore C122(BFS) continues to remain dry.

Groundwater levels in bores D314(BFS), D317(BFS), C613(BFS), C621(BFS), C317(BFS), C130(BFS), B925(BFS) and B631(BFS) increased by over 7 m over 2022 in response to the cessation of abstraction from LUG Bore. The bores are located between 300 m (B925(BFS)) and 1.3 km (C621(BFS)) of LUG Bore. The LUG bore intersects the historical Lemington Underground workings, which mined through the Bowfield Seam. Over the 2022 (calendar year) only 54.2 ML of water was abstracted from the bore in December, at an average rate of 1.74 ML /day. The recovery of groundwater levels in these bores is likely to the cessation of abstraction from LUG Bore for the majority of 2021 and 2022. However, groundwater elevations are still higher in the northwest as shown in **Figure 5.23**, which illustrates groundwater flow towards LUG Bore from the northwest. This trend is visible in a range of bores intersecting the Permian coal measures in the area.

Groundwater levels in bores D807(BFS), D406(BFS), D612(BFS), D510(BFS), D010(BFS), and B334(BFS) declined by up to 12.2 m over 2022. With the exception of B334(BFS), all of the bores are northwest of the Lemington South Pit, between the United Wambo Pit and Wollombi Brook. B334(BFS) is located south of Lemington South Pit. Abstraction from LUG Bore only occurred from mid December 2022 and is unlikely to be the cause of the declining groundwater levels. The declining trend likely relates to depressurisation of the coal measures from active mining within the United Open Cut, which is located approximately 700 m to the west of these bores. This is consistent with cumulative impacts predicted by AGE (2016).

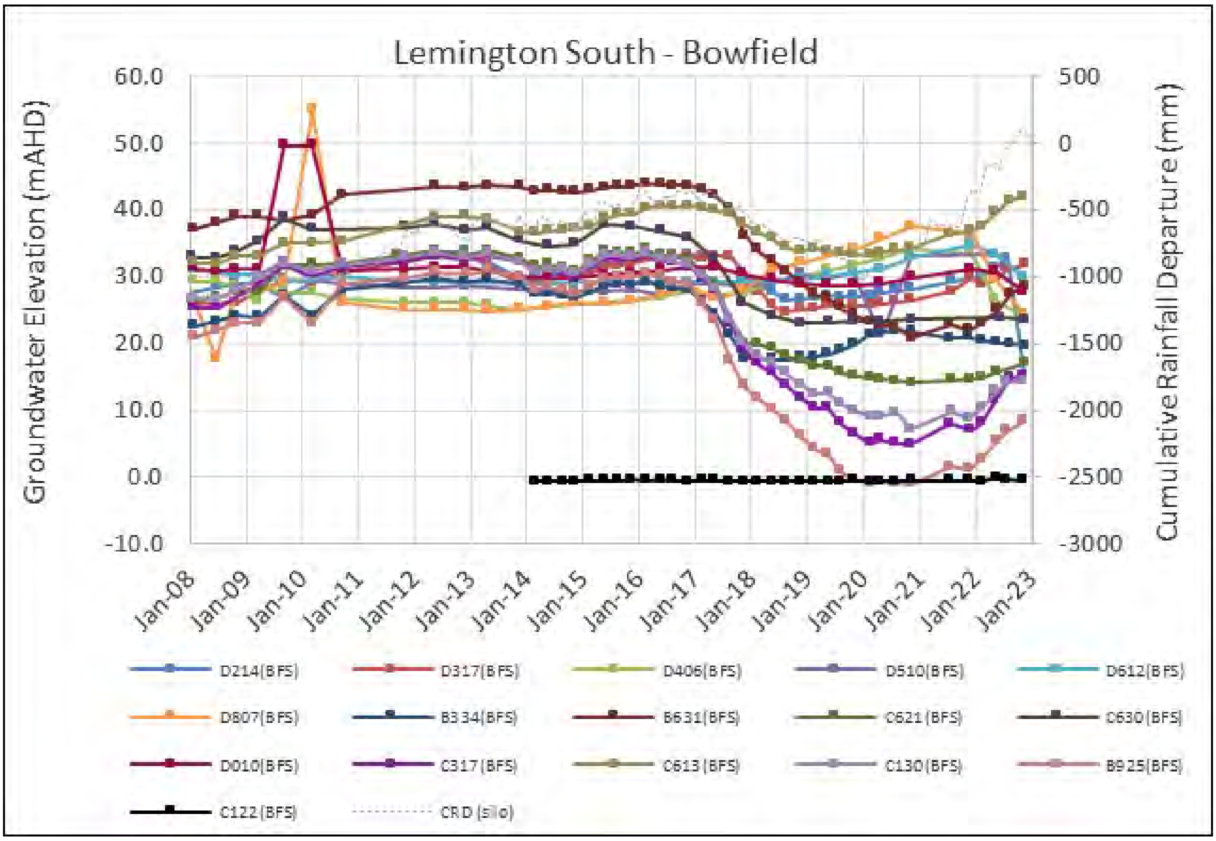


Figure 5.22 Groundwater Levels – Lemington South Bowfield Seam

5.2.4.2 Groundwater Quality Trends

The pH and EC readings recorded over 2022 are summarised in **Table 5.10**.

Table 5.10 Summary of pH and EC Recorded Over 2022

Screened Lithology	pH Range	EC Range (µS/cm)	Comment
Interburden	6.2–7.8	18,670–20,800	Bore C130(ALL) recorded pH above the upper trigger level in Q4.
Arrowfield Seam	6.8–7.3	11,230–14,700	No exceedances.
Bowfield Seam	5.7–10.2	123–12,330	Bores B631(BFS) (Q4), C122(BFS) (Q2), C630(BFS) (Q2), D214(BFS) (Q4), and D510(BFS) (Q4) recorded pH above the trigger level. It is noted the sample collected for C122(BFS) in Q2 was likely below the base of the screen and not representative of the Bowfield Seam.

Screened Lithology	pH Range	EC Range (µS/cm)	Comment
Glen Munro Seam	6.8	10,370–10,700	No exceedances.
Woodlands Hill Seam	6.6–7.4	2,020–19,890	No exceedances. It is noted that the Q4 reading for D010(WDH) was 287.9 µS/cm, which appears anomalous compared to previous readings and has not been included in the EC range for 2022.

Bore C130(ALL) is located between Lemington South pit and the LUG Bore and intersects shallow weathered overburden to 17 m depth. Historical readings since 2000 show regular fluctuations of pH between 6.4 to 7.9. The 2022 readings for pH are considered consistent with historical concentrations.

Bore B631(BFS) is located approximately 560 m southwest of Lemington South pit and around 660 m east of the LUG Bore and intersects the Bowfield Seam (BFS). Historical readings since 2000 show regular fluctuations of pH between 5.7 to 7.3. The 2022 readings are therefore considered consistent with historical concentrations.

Bore C630(BFS) is located between Lemington South Pit and LUG Bore and intersects the Bowfield Seam (BFS). Historical readings show regular fluctuations for pH between 7.1 to 8.3. The 2022 readings are therefore considered consistent with historical concentrations.

Bore D214(BFS) is located approximately 560 m southwest of Lemington South pit and around 660 m east of the LUG Bore and intersects the Bowfield Seam (BFS). Historical readings since 2000 show regular fluctuations of pH between 6.2 to 7.9. The Q4 reading of 5.7 is below the historical range. It is noted that the EC reading in the same sampling round is very fresh (123 µS/cm) and the results are not likely representative of groundwater in the area. The groundwater level also dropped 17.9 m between August and November 2022. The decline in groundwater levels was specific to bore D214(BFS) as surrounding bores screened within the Bowfield Seam did not record a similar decline. Results from the next monitoring round should be reviewed to determine if the trend has continued and if so the condition of the bore should be investigated.

Bore D510(BFS) is located approximately 560 m southwest of Lemington South pit and around 660 m east of the LUG Bore and intersects the Bowfield Seam (BFS). Historical readings since 2000 show regular fluctuations of pH between 6.6 to 7.9. The Q4 reading of 6.2 is below the historical range. The field sheet notes suspended fines and solids in the water quality sample which may be due to flooding in the area and may have impacted water quality results. Results from the next monitoring round should be reviewed to determine if the trend has continued and if so the condition of the bore should be investigated.

Bore D010(GM) is located between Lemington South Pit and LUG Bore and intersects the Glen Munro Seam (GM). Historical readings show regular fluctuations of pH between 6.5 to 8.1. The 2022 readings are therefore considered consistent with historical concentrations.

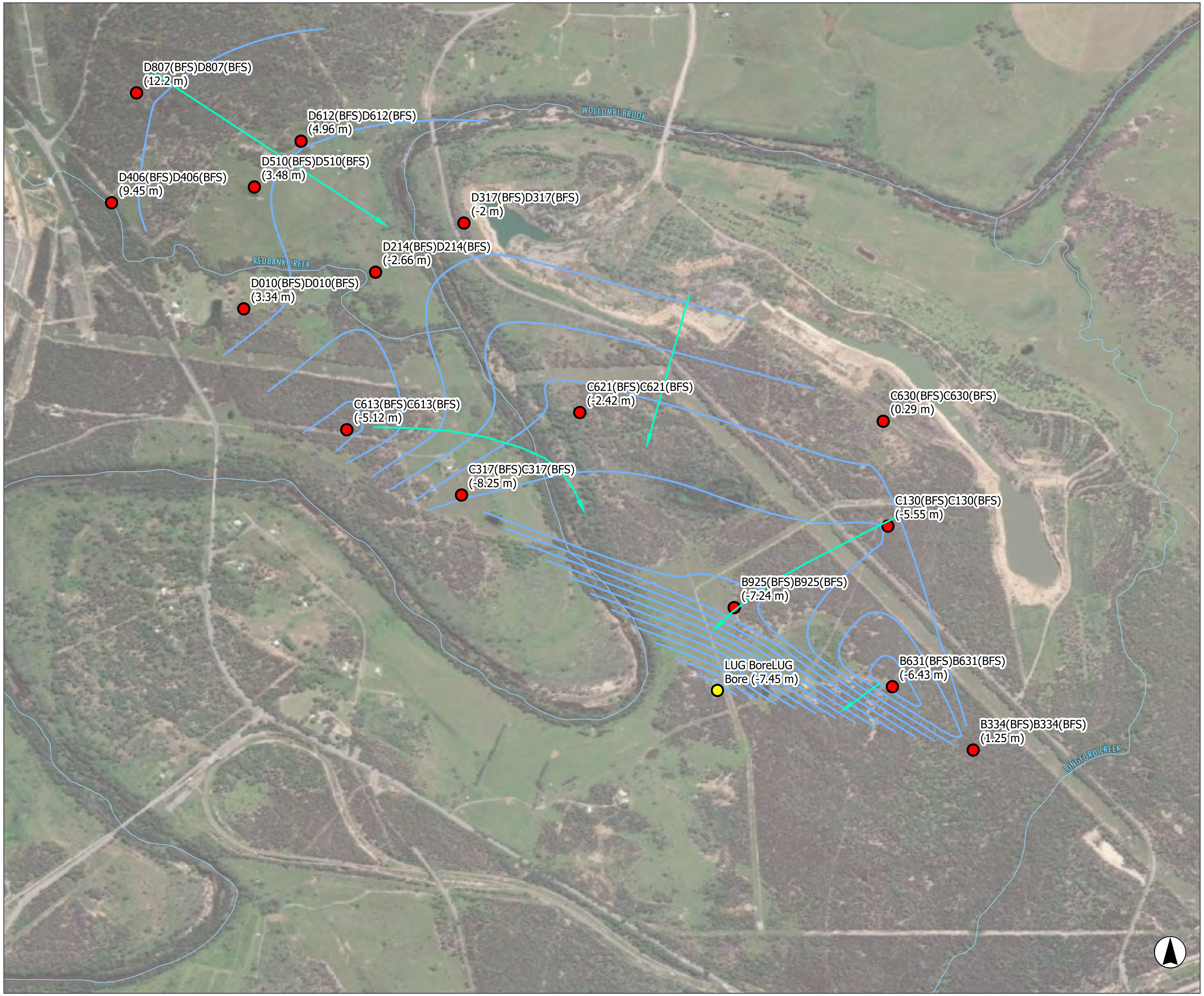


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FIGURE 5.23

Interpolated LUG Bore Groundwater Drawdown – Bowfield Seam

Legend

- Groundwater Flow Direction
- LUG Bore
- Bowfield Seam Drawdown
- Interpolated Groundwater Contours (mAHD)
- Mapped Watercourses (named)

0 0.5 1
Kilometers

Scale 1:20,000 at A4
GDA2020

Image Source: ESRI Basemap (2022) **Data source:** NSW DFSI (2022)

5.3 Spoil

Within the WMP, fifteen monitoring bores intersect spoil material within North Pit. Bores DM3 and GW-108, located within North Pit, were recorded as blocked over 2022. Comparison of groundwater levels and bore screen intervals indicates bores GW-107 and GW-114 are likely dry, and readings may relate to water within the sump at the base of the bore.

5.3.1 North Pit

5.3.1.1 Groundwater Level Trends

Groundwater levels for the spoil are presented in **Figure 5.24**. Groundwater levels within the bores ranged between 34.99 mAHD (32.11 mbgl) and 78.96 mAHD (23.77 mbgl) over 2022, in bores MB14HVO03 and DM1, respectively. Groundwater levels increased by up to 2.5 m (DM7), consistent with rainfall trends. Groundwater within the spoil flows from northern-most bore DM1 in a southerly direction towards the southern-most bore MB14HVO03.

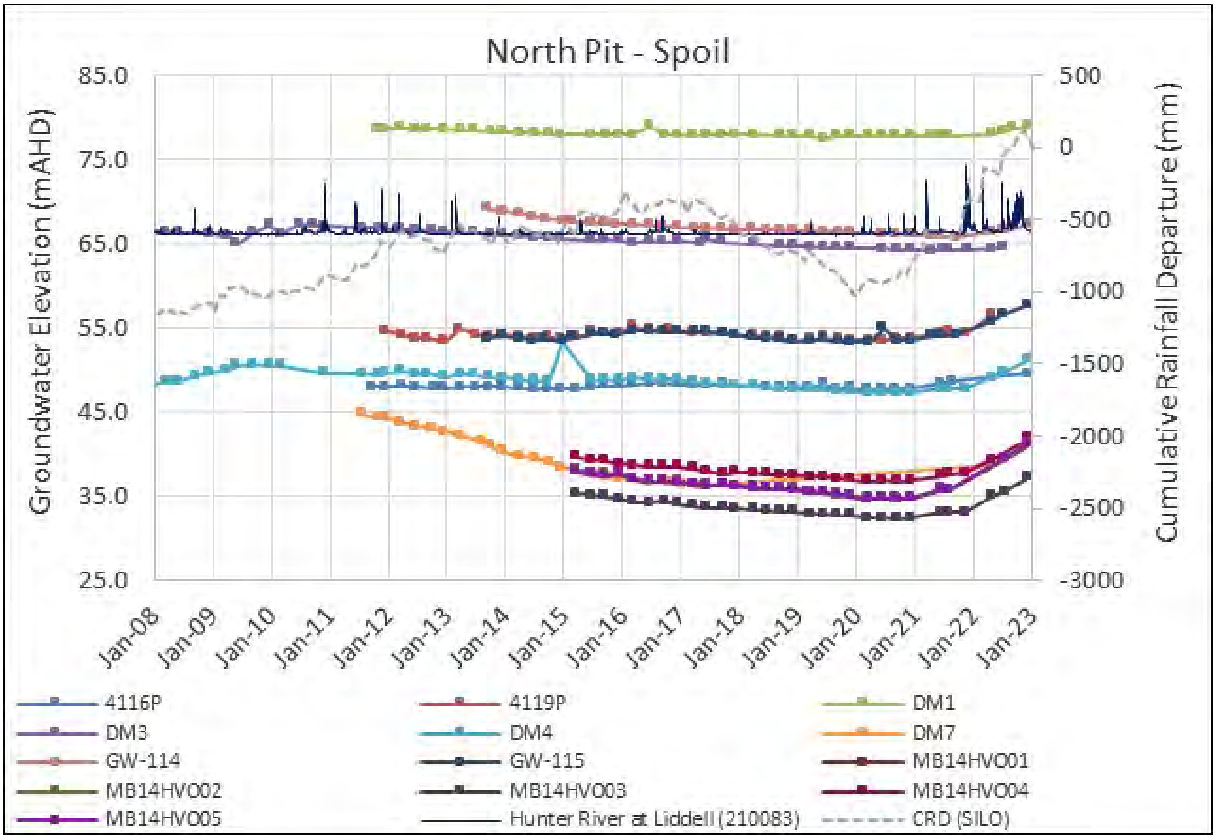


Figure 5.24 Groundwater Levels – North Pit Spoil

5.3.1.2 Groundwater Quality Trends

Routine monitoring of EC and pH was conducted for the spoil monitoring bores over 2022 on a quarterly basis. However, bore DM3 was recorded as blocked in Q4. Over 2022, water within the spoil material at North Pit recorded an EC of between 2,780 µS/cm and 12,820 µS/cm, and a pH of between 6.4 and 7.4, both of which are within historical levels.

5.3.2 Carrington

5.3.2.1 Groundwater Level Trends

Groundwater levels for the spoil are presented in **Figure 5.25**. However, bore GW-108 was blocked and water levels in bore GW-107 were below the base of the screen, essentially dry, over 2022.

Although not included in the WMP, bore GW-129 has also been reviewed as it monitors groundwater levels within the spoil in the Carrington area to the west of the NV TSF. Over 2022, groundwater levels within GW-129 increased from 57.45 mAHD to 59.27 mAHD (14.85 to 13.03 mbgl) in response to above average rainfall and stream flows over the same period.

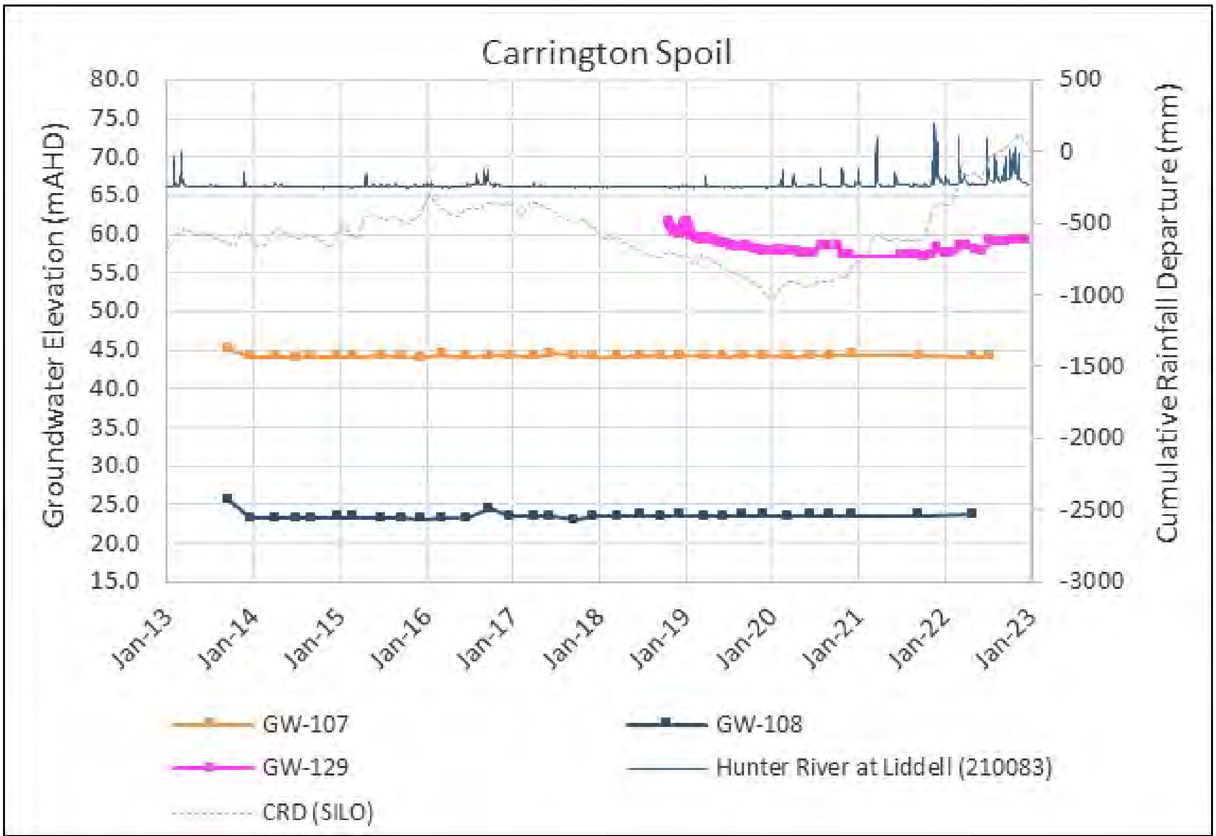


Figure 5.25 Groundwater Levels – Carrington Spoil

5.3.2.2 Groundwater Quality Trends

Routine monitoring of EC and pH was unable to undertaken at bores GW-107 and GW-108 which were recorded as dry (GW-107) and blocked (GW-108) over 2022. Although not included in the WMP, due to limited data for the Carrington spoil water quality data from bore GW-129 has been reviewed. Over 2022, pH levels ranged from 6.8 to 7.0, while EC concentrations fluctuated throughout the year ranging from 8,310 µS/cm to 9,850 µS/cm.

6.0 Trigger Exceedances

6.1 Groundwater Levels

Groundwater level data collected over 2022 have been compared to the trigger values for the five monitoring bores which have trigger levels assigned as outlined in the WMP (HVO, 2018).

Bores CFW55R, CFW57, CGW53a and CGW55a recorded groundwater level exceedances over 2022. The trigger exceedances have been reviewed by comparing groundwater levels and climate trends as shown in **Figure 5.5** to **Figure 5.9**. An analysis of the trigger exceedance is summarised in **Table 6.2** and location shown on **Figure 6.1**.

It is noted that these water level trigger levels have been superseded with the trigger criteria for NV TSF that were established to monitor performance of measures to minimise seepage to alluvium. The trigger levels have been updated in the revised WMP which is awaiting approval.

6.2 Groundwater Quality

Water quality data collected over 2022 have been compared to the trigger values outlined in the WMP (HVO, 2018). Bores where pH or EC values were outside the trigger level are summarised in **Table 6.2**. However, only bores with three or more consecutive readings outside the trigger level are considered an exceedance. Trigger exceedances have been reviewed by comparing the data to groundwater levels and climate indicated by the cumulative rainfall departure plot. An analysis of the trigger exceedances is summarised in **Table 6.3** and the locations shown on **Figure 6.2**.

Table 6.1 Summary of Water Quality Readings Outside Trigger Levels Over 2022

Reporting Period	Bore ID	Location	WMP Lithology	Outside pH Trigger Levels	Above EC Trigger Level
Q1	BZ2A(1)	Cheshunt	Mt Arthur Seam	✓	
	BZ3-3	Cheshunt	Mt Arthur Seam	✓	
	BZ4A(2)	Cheshunt	Mt Arthur Seam	✓	
	CFW55R	Carrington	Alluvium		✓
Q2	BZ2A(1)	Cheshunt	Mt Arthur Seam	✓	
	BZ3-3	Cheshunt	Mt Arthur Seam	✓	
	BZ4A(2)	Cheshunt	Mt Arthur Seam	✓	
	C630(BFS)	Lemington South	Bowfield Seam	✓	
	CFW55R	Carrington	Alluvium		✓
	GW-106	Carrington West Wing	Alluvium	✓	
	NPz2	West Pit	Sandstone/siltstone		✓
Q3	4116P	North Pit	Spoil		✓
	BZ2A(1)	Cheshunt	Mt Arthur Seam	✓	
	BZ3-3	Cheshunt	Mt Arthur Seam	✓	

Reporting Period	Bore ID	Location	WMP Lithology	Outside pH Trigger Levels	Above EC Trigger Level
	CGW51a	Carrington	Interburden	✓	
	CGW53	Carrington	Broonie Seam	✓	
	DM3	North Pit	Spoil	✓	
	GW-106	Carrington West Wing	Alluvium	✓	
	Hobdens Well	Cheshunt/North Pit	Alluvium	✓	
	NPz2	West Pit	Sandstone/siltstone		✓
	PB01(ALL)	Lemington South	Alluvium	✓	
Q4	B631(BFS)	Lemington South	Bowfield Seam	✓	
	BZ3-3	Cheshunt	Mt Arthur Seam	✓	
	C130(ALL)	Lemington South	Interburden	✓	
	CGW46	Carrington West Wing	Bayswater Seam	✓	
	CGW49	Carrington West Wing	Alluvium	✓	
	CGW51a	Carrington	Interburden	✓	
	CGW53	Carrington	Broonie Seam	✓	
	D010(BFS)	Lemington South	Bowfield Seam	✓	
	D214(BFS)	Lemington South	Bowfield Seam	✓	
	D510(BFS)	Lemington South	Bowfield Seam	✓	
	NPz2	West Pit	Sandstone/siltstone		✓
	PB01(ALL)	Lemington South	Alluvium	✓	

Table 6.2 Groundwater Level Trigger Exceedances

Bore ID	Exceedance	Location	Screened Lithology	Comment	Actions
CFW55R	Eight consecutive water level readings above the 95th percentile trigger level of 59.41 mAHD since April 2022	Carrington Billabong area, 80 m west of NV TSF and ~500 m northeast of the Hunter River	Carrington Alluvium	The purpose of bore CFW55R is monitoring of the groundwater response to mining/recovery in Carrington and the NV TSF. Groundwater levels in bore CFW55R have gradually increased since February 2020 with a sharp increase between September 2021 and September 2022 in response to above average rainfall and is not related to mining activities.	The trigger level within the current WMP has been superseded by triggers developed for monitoring the NV TSF seepage and have been updated in the draft WMP which is with DPE for approval. The revised triggers were not exceeded over 2022. No further action required.
CFW57	Thirteen consecutive water level readings above the 95th percentile trigger level of 59.24 mAHD since December 2021	Carrington Billabong area, ~520 m west of NV TSF and ~80 m northeast of the Hunter River	Carrington Alluvium	The purpose of bore CFW57 is monitoring of the groundwater response to mining/recovery in Carrington and the NV TSF. Groundwater levels in bore CFW57 have gradually increased since February 2020 with a sharp increase between September 2021 and September 2022 in response to above average rainfall and is not related to mining activities.	The trigger level within the current WMP has been superseded by triggers developed for monitoring the NV TSF seepage. Water level readings over 2022 were above the revised triggers; however, levels were in line with expected water level rise in response to climate trends. With no adverse trend in water quality, the change is related to climate trends. Therefore, the response protocol for the revised triggers does not require any further action. No further action required.
CGW53a	Seven consecutive water level readings above the 95th percentile trigger level of 59.19 mAHD since June 2021	Carrington Billabong area, ~1000 m west of NV TSF and ~100 m northeast of the Hunter River	Carrington Alluvium	The purpose of bore CGW53a is monitoring of the groundwater response to mining/recovery in Carrington and the NV TSF. Groundwater levels in bore CGW53a have gradually increased since December 2019 with a sharp increase between September 2021 and September 2022 in response to above average rainfall and is not related to mining activities.	The trigger level within the current WMP has been superseded by triggers developed for monitoring the NV TSF seepage and have been updated in the draft WMP which is with DPE for approval. The revised triggers were not exceeded over 2022. No further action required.

Bore ID	Exceedance	Location	Screened Lithology	Comment	Actions
CGW55a	Five consecutive water level readings above the 95th percentile trigger level of 58.43 mAHD since December 2021	Carrington Billabong area, ~850 m west of NV TSF and ~350 m northeast of the Hunter River	Carrington Alluvium	The purpose of bore CGW55a is monitoring of the groundwater response to mining/recovery in Carrington and the NV TSF. Groundwater levels in bore CGW55a have gradually increased since March 2020 with a sharp increase between September 2021 and September 2022 in response to above average rainfall and is not related to mining activities.	The trigger level within the current WMP has been superseded by triggers developed for monitoring the NV TSF seepage and have been updated in the draft WMP which is with DPE for approval. The revised triggers were not exceeded over 2022. No further action required.

Table 6.3 Groundwater Quality Trigger Exceedances

Bore ID	Exceedance	Location	Screened Lithology	Comment/Trend	Actions
BZ2A(1)	pH – ten consecutive readings below the lower pH trigger level of 6.5 between November 2019 and August 2022	Cheshunt	Mt Arthur Seam	The pH readings in bore BZ2A(1) have fluctuated over time ranging between 6.2 and 7.3. There has been a declining trend from 6.8 in August 2017 to 6.2 in February 2022, with a slight increase measured in November 2022 of 6.5. The 2019 Groundwater Annual Review (SLR, 2020) recommended further investigation of the bore condition and construction to confirm the geology being monitored in all of the 'BZ' bores in the Cheshunt area to understand the cause of the variability in the trends between the bores.	It is noted that the bore has already been removed from the compliance monitoring network in version 3.4 of the WMP which is currently with DPE for approval. No further action is required.
BZ3-3	pH – ten consecutive readings below the lower pH trigger level of 6.5 since November 2019	Cheshunt	Mt Arthur Seam	Bore BZ3-3, located between Cheshunt Pit and the Hunter River, and had an increasing pH trend between September 2004 (6.1) and August 2012 (7.1) followed by a decreasing trend between December 2012 (7.1) and November 2022 (6.1). The 2022 reading of 6.1 is within the historical range. The 2019 Groundwater Annual Review (SLR, 2020) recommended further investigation of the bore condition and construction to confirm the geology being monitored in all of the 'BZ' bores in the Cheshunt area to understand the cause of the variability in the trends between the bores.	It is noted that the bore has already been removed from the compliance monitoring network in version 3.4 of the WMP which is currently with DPE for approval. No further action is required.

Bore ID	Exceedance	Location	Screened Lithology	Comment/Trend	Actions
				The 2021 Groundwater Annual Review (EMM, 2022b) noted that field observations of BZ3-3 include an odour of hydrogen sulphide often associated with the oxidation of acid forming sulphides.	
BZ4A(2)	pH – seven consecutive readings below the lower pH trigger level of 6.5 between May 2020 and June 2022	Cheshunt	Mt Arthur Seam	With the exception of one anomalous reading (7.4) in November 2018, pH readings have been recorded below the lower pH trigger level of 6.5 since July 2011, ranging from 6.2 to 6.4. Groundwater levels have been at or below the base of the screen since September 2010. Water quality samples collected since September 2010 are therefore not representative of the Mt Arthur Seam and should be disregarded. The 2019 Groundwater Network Review (SLR, 2019a) noted that the bore is continuously dry in response to mining at Cheshunt but could be used for ongoing monitoring of groundwater recovery post mining. The 2019 Groundwater Annual Review (SLR, 2020) recommended further investigation of the bore condition and construction to confirm the geology being monitored in all of the 'BZ' bores in the Cheshunt area to understand the cause of the variability in the trends between the bores. The 2021 Groundwater Annual Review (EMM, 2022b) noted that as groundwater levels are below the base of the screen the water quality samples collected are not representative of the Mt Arthur Seam and recommended that the bore be removed from the revised WMP.	Verify the depth of the base of screen and total depth. If current bore details are correct the bore should be removed from the WMP but kept as part of the operational monitoring network for ongoing monitoring of groundwater recovery post mining. Water quality samples should not be collected if the groundwater level is below the base of the screen. Do not collect water quality samples if the water level is below the base of the screen.
C630(BFS)	pH – six consecutive readings above the upper pH trigger level of 7.9 between November 2018 and June 2022	Lemington South	Bowfield Seam	Bore C630(BFS) is located between Lemington South Pit and LUG Bore and intersects the Bowfield Seam. The purpose of the more is to monitor cumulative groundwater trends and the response to abstraction at LUG Bore. pH had an increasing trend between 2000 and 2009, followed by a relatively stable period between 2009 and 2017 followed by a slightly increasing trend until 2019. Levels have remained stable to slightly declining from 2019 to 2022. Levels have ranged between 7.1 (May 2000) to 8.3 (June 2001).	Revise the proposed pH trigger levels before finalising version 3.4 of the WMP which is currently with DPE for approval or revise in a subsequent version.

Bore ID	Exceedance	Location	Screened Lithology	Comment/Trend	Actions
				The 2021 Groundwater Annual Review (EMM, 2022b) noted the pH trigger level should be reviewed as historical data suggests that levels are likely to continue to exceed the trigger level. The data has been reviewed against the existing and proposed trigger level and it is recommended that the proposed trigger level is revised before finalising version 3.4 of the WMP.	
CFW55R	EC – consecutive readings above the trigger level of 6,154 µS/cm between May 2015 and April 2022	Carrington	Alluvium	The purpose of bore CFW55R is to monitor the groundwater response to mining/recovery in Carrington and North Void Tailings Facility (NV TSF). Bore CFW55R, located approximately 50 m north of the Carrington Billabong and 80 m west of NV TSF, recorded EC declining from 10,840 µS/cm (November 2008) to 1,760 µS/cm in March 2010. EC then increased to 10,230 µS/cm in September 2018. This trend was previously identified as being caused by seepage through spoil between NV TSF and the alluvium. The seepage was reported, and management measures put in place from 2018. Since 2018, EC has fluctuated but shows a decline to 5,610 µS/cm in June 2022. Although above the trigger level of 6,154 µS/cm until April 2022, readings have remained below the highest historical reading of 10,840 µS/cm recorded in November 2008. In addition, there is a declining trend since December 2021 corresponding to increased water levels which are a response to above average rainfall over the same period. EC levels have remained below the trigger level since May 2022.	It is noted that the trigger level has already been reviewed and updated to 11,510 µS/cm in version 3.4 of the WMP which is currently with DPE for approval. Current EC readings will be below the revised trigger level. No further action is required.
GW-106	pH – four consecutive readings below the lower trigger level of 6.8 between December 2021 and September 2022	Carrington West Wing	Alluvium	Bore GW-106 intersects a remnant patch of palaeochannel alluvium between West Pit and Carrington Pit (SLR, 2020). pH has fluctuated since monitoring began in 2013, ranging from 6.6 (March 2018) to 7.0 (March 2019). The four readings below the trigger level since December 2021 have all been within the historical range. The 2019 Groundwater Network Review (SLR, 2019a) recommended removal from the compliance network but continue monitoring as part of the operational network to collect background groundwater levels to monitor the change in levels in the palaeochannel north of the Carrington void for potential future works.	It is noted that the bore has already been removed from the compliance monitoring network in version 3.4 of the WMP which is currently with DPE for approval. No further action is required.

Bore ID	Exceedance	Location	Screened Lithology	Comment/Trend	Actions
NPz2	EC – ten consecutive readings above the trigger level of 13,428 µS/cm between September 2019 and May 2022	West Pit	Sandstone/Siltstone	Bore NPz2 is located northwest of West Pit beyond the outcrop of coal seams mined at West Pit and intersects Interburden sequences beneath the coal seams. EC readings range from 12,590 µS/cm (December 2014) and 19,400 µS/cm (December 2009). The 2022 readings are consistent with historical concentrations. The 2019 Groundwater Network Review (SLR, 2019a) noted that the bore is unlikely to detect relevant site impacts and recommended removal from the compliance monitoring network but kept in operational monitoring network for future work.	It is noted that the bore has already been removed from the compliance monitoring network in version 3.4 of the WMP which is currently with DPE for approval. No further action is required.

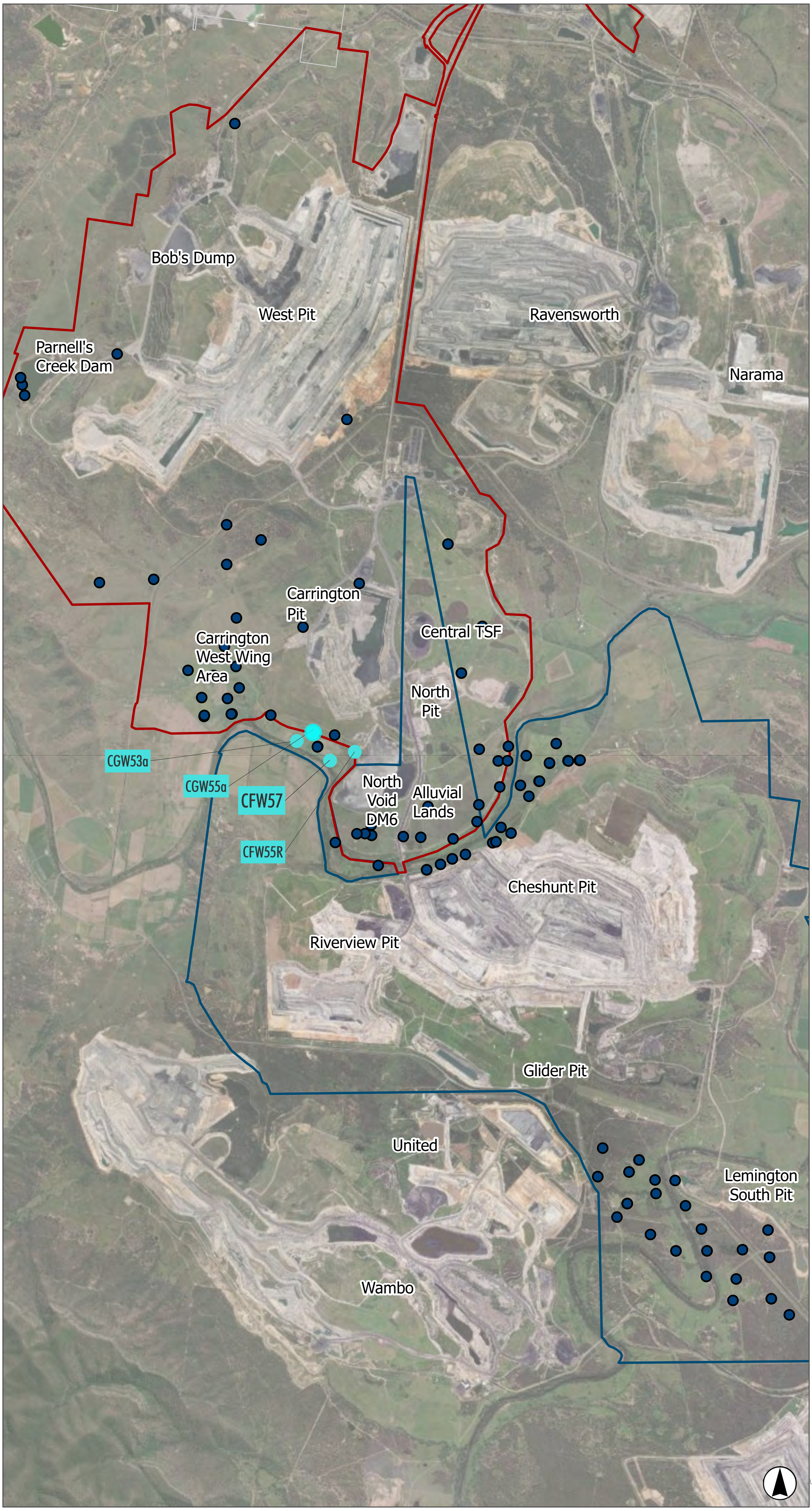


FIGURE 6.1

Groundwater Level Exceedence

Legend

- Groundwater Level Exceedence
- Groundwater No Exceedence
- HVO North Development Consent Boundary
- HVO South Development Consent Boundary

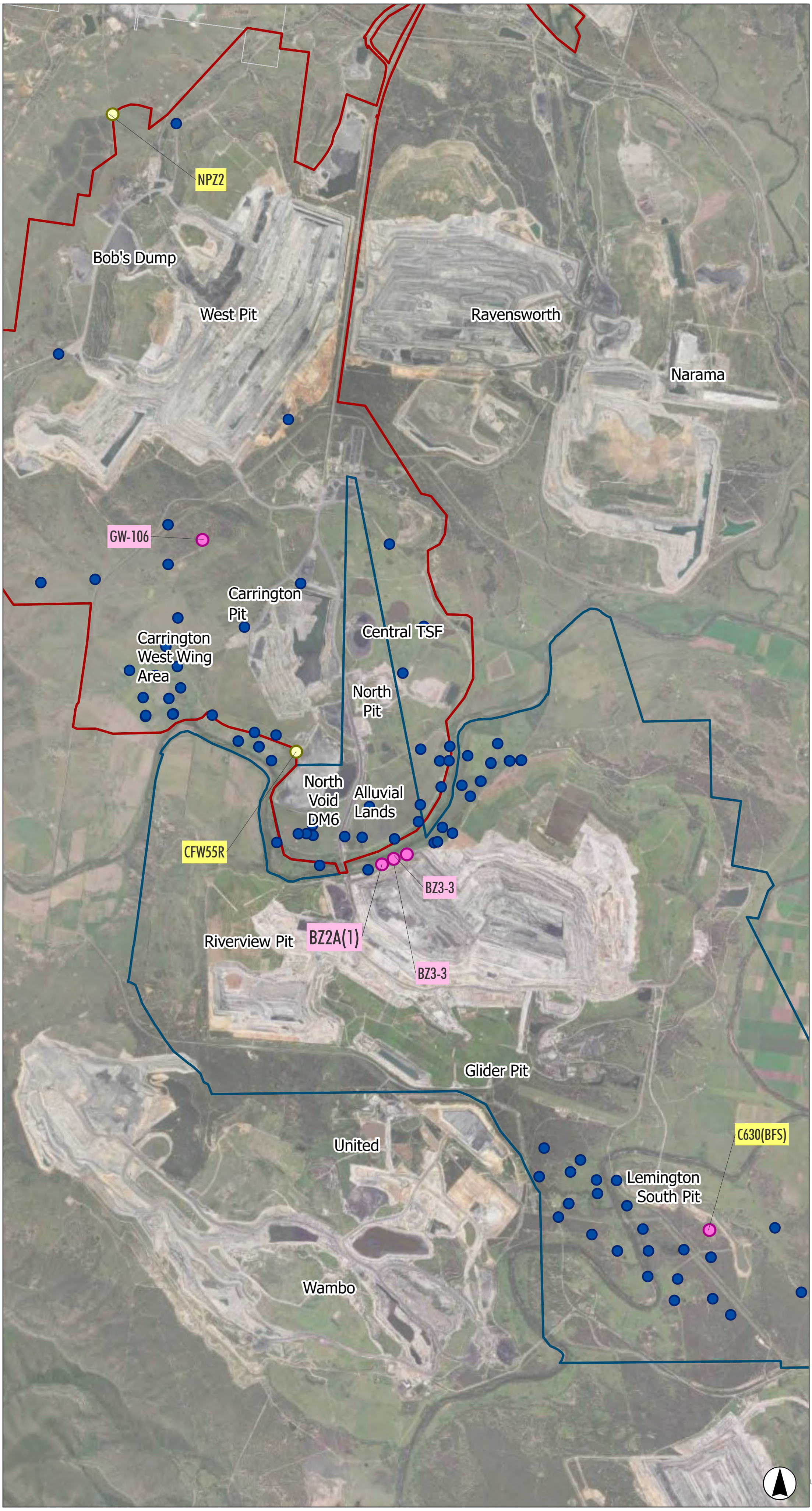
0 1 2
Kilometres

Scale 1:80,000 at A4
GDA 1994 MGA Zone 56

Image Source: ESRI Basemap (2022) **Data source:** NSW DFSI (2022)

FIGURE 6.2

Groundwater Quality Exceedence



Legend

Exceedance Type

- EC Exceedance
- pH Exceedance
- Groundwater Monitoring Bore
- HVO North Development Consent Boundary
- HVO South Development Consent Boundary

0 1 2
Kilometres

Scale 1:80,000 at A4
GDA 1994 MGA Zone 56

Image Source: ESRI Basemap (2022) **Data source:** NSW DFSI (2022)

7.0 Groundwater Take

The direct or indirect take of all groundwater is required to be accounted for under the Water Management Act 2000. At HVO the take of water occurs via:

- Direct take:
  - Incidental take – water intercepted within mine workings and extracted for safety.
  - Consumptive take – water pumped directly from water supply bores (i.e., LUG bore).
- Indirect take – depressurisation of Permian coal measures inducing inter-formation flows. Indirect take includes loss of baseflow, reduced upward seepage from Permian to alluvium and additional seepage from alluvium to underlying Permian.

Each activity is discussed below, and the estimated groundwater take for the various water sources summarised in **Section 7.3**.

7.1 Groundwater Inflows to Mine Operations (Incidental and Indirect Take)

A numerical groundwater model was developed for the HVO Continuation Project Groundwater Impact Assessment (AGE, 2022). The model was provided to Umwelt to undertake the model verification (refer **Appendix G**). The review identified that the model including mining in Carrington West Wing and Lemington South Pit 2. Following discussion with HVO, Umwelt updated the drain and time variant materials packages to remove Carrington West Wing and Lemington South Pit 2 from the model; no other changes were made.

The model was calibrated up to December 2020 and replicates mine progression on a quarterly basis to the year 2056. Results representing 2022 were extracted from the model representing predicted groundwater conditions and take for the 2022 reporting period for inclusion in this report.

Loss of baseflow is required to be assessed as specified in the WMP. Loss of baseflow includes reduction in contributions to the river from connected alluvium and additional leakage of streamflow into the connected alluvium. Baseflow is not measurable, and therefore can only be quantified and reported on from the groundwater model with results provided as indirect take. This process is illustrated in **Figure 7.2** below.

Baseflow loss from the Hunter River is accounted for in the indirect take under the Hunter Regulated River Water Source WSP (Hunter River management zone). Baseflow loss in Wollombi Brook is accounted for in the indirect take under the Hunter Unregulated River and Alluvial Water Source WSP (Lower Wollombi Brook Water Source management zone). Indirect take, inclusive of baseflow, is reported in **Table 7.1**.

As shown in the figure, the system is connected, and indirect take also includes reduced upward seepage from Permian to alluvium and additional seepage from alluvium to underlying Permian. Therefore, water loss in the alluvium in turn induces water loss from the surface water system. Consistent with the approach undertaken for previous approvals, and as reported by AGE (2016), to exclude double accounting in this connected system the maximum indirect take from any one source (alluvium or surface water) is applied.

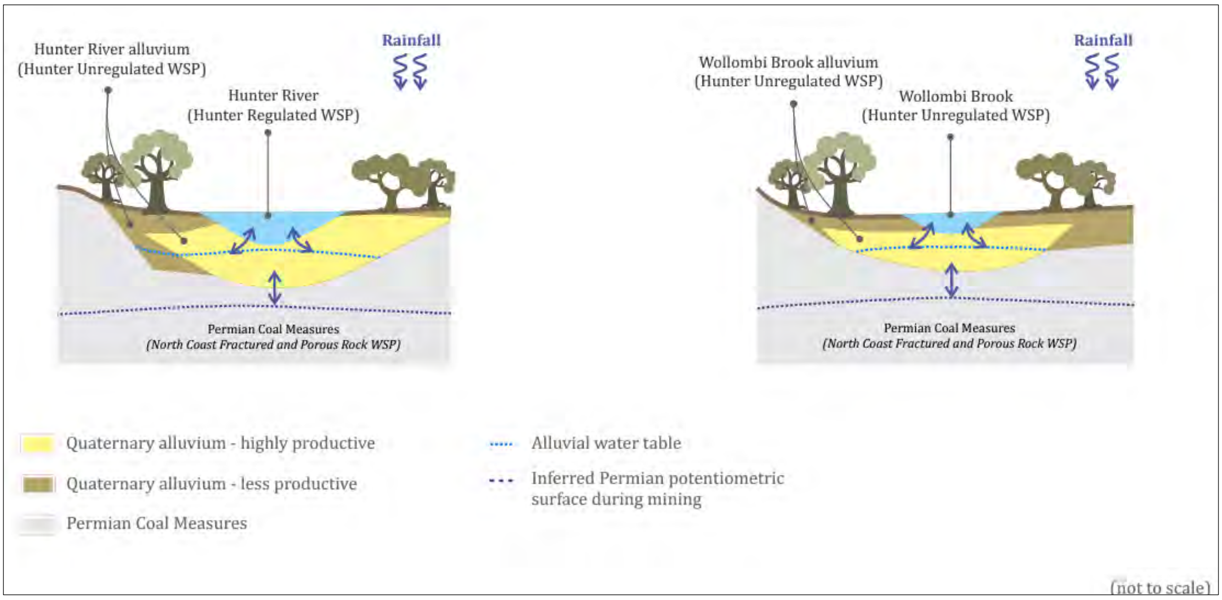


Figure 7.1 Schematic Showing Baseflow Licensing (Source: AGE, 2016)

7.2 Bore Abstraction (Consumptive Take)

Lemington Underground (LUG) bore is an abstraction bore constructed into the abandoned LUG mine void underlying HVO. The bore is licensed to take up to 1,800 ML of water from the North Coast Fractured and Porous Rock aquifer (20BL173392) per water year. The bore is equipped with a flow meter, with total monthly abstraction documented. Based on the flow volumes recorded, from July 2021 to June 2022 (water year) 41.5 ML of water was abstracted from the LUG bore, which is within the licensed allocation of 1,800 ML/year. From June 2022 to December 2022 water was abstracted in December totalling 54 ML.

As the bore intersects LUG that mined the Permian coal measures, groundwater levels within bores intersecting the coal measures around the bore have been reviewed to identify the extent of groundwater drawdown. As discussed in **Section 5.2.4.1**, groundwater levels within the Bowfield Seam of the Permian coal measures around Lemington South have declined by up to 12.2 m in bores over 2.4 km to the northwest of the LUG Bore. However, groundwater levels in bores within the Bowfield Seam within 1.7 km of LUG Bore increased by up to 7 m over 2022 in response to the cessation of the abstraction from LUG Bore for most of 2021 and 2022.

LUG Bore groundwater levels and daily abstraction volumes since January February 2018 are shown in **Figure 7.1**. Between January 2021 and December 2022, dewatering only occurred between June to December 2021 and in December 2022.

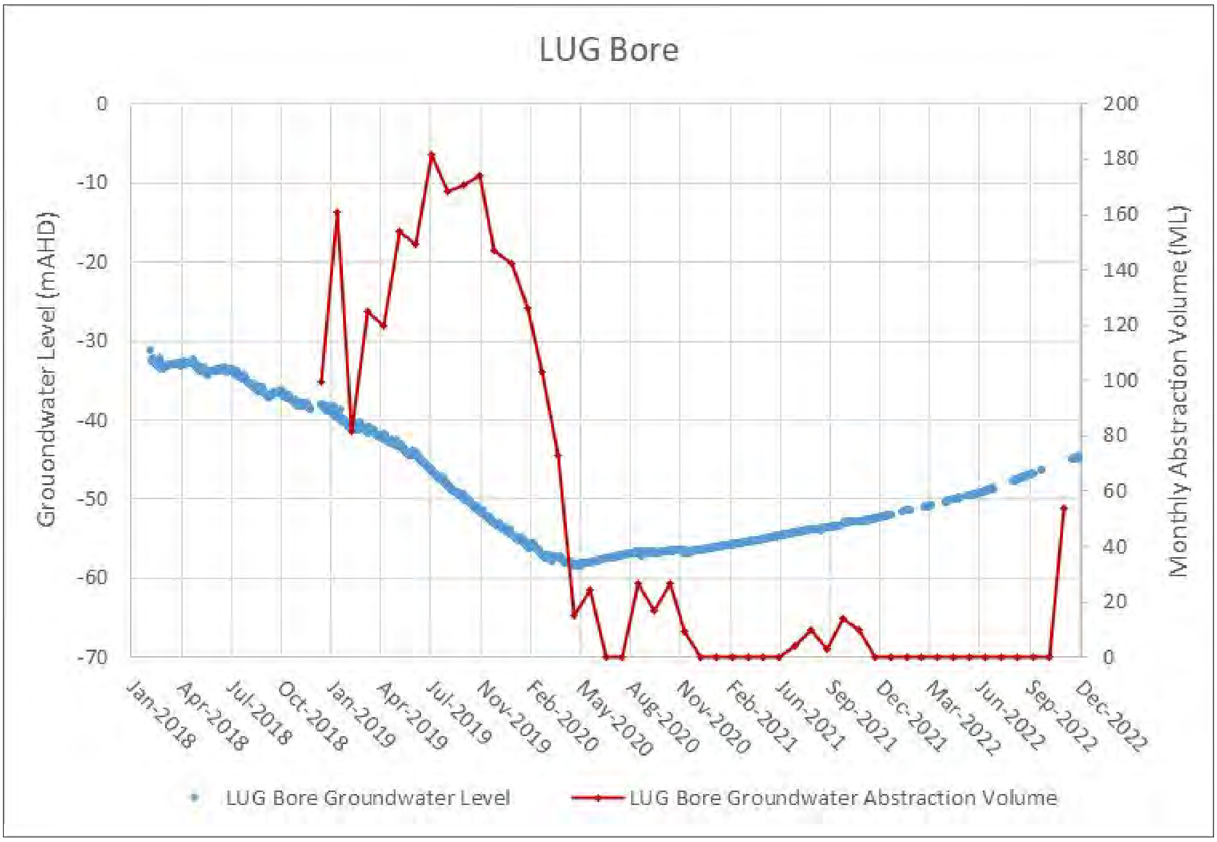


Figure 7.2 Groundwater Level and Monthly Abstraction Volume – LUG Bore

7.3 Summary of Groundwater Take

The predicted take of groundwater from the various groundwater sources associated with HVO and are summarised in **Table 7.1**. Over the 2022 reporting year the total take under the Hunter Regulated water source was estimated at 21 ML, total take from Hunter Unregulated water source was estimated at 346 ML, and 1,816.5 ML from the North Coast Fractured and Porous Rock water source.

Table 7.1 2022 Predicted Groundwater Take

Groundwater Take	Hunter Regulated River WSP (ML)	Hunter Unregulated River and Alluvial Water Sources WSP (ML)	North Coast Fractured and Porous Rock WSP (ML)
HVO Mine Operations (incidental and indirect take) *	21	346	1,775.0
LUG Bore Abstraction (consumptive take) ^	-	-	41.5
Total	**21**	**346**	**1,816.5**

*Note: * HVO Continuation Project (2022). ^ Take over water year (July 2021 to June 2022).*

8.0 Verification of Model Predictions

In accordance with Schedule 4 Condition 27 (c) under DA 450-10-2003 (HVO North) and Schedule 3 Condition 27 (c) under PA 06_0261 (HVO South), the WMP includes requirements to validate and recalibrate (if necessary) the groundwater model for the development. This includes an independent review of the model every three years, and comparison of monitoring results with modelled predictions. The latest numerical groundwater model that replicates all approved operations across HVO (north and south) was developed by AGE in 2022 as part of the HVO Continuation Project Groundwater Impact Assessment.

The three yearly independent review of the HVO Continuation Project numerical groundwater model to verify model predictions, undertaken by Umwelt (2023b), is presented in **Appendix G**. A review of the model design representing the approved operations scenario for the review period, from 2019 to 2022 was undertaken. This included the modelled and actual mine progression, rainfall trends and streamflow. Comparison between modelled and observed groundwater levels was also undertaken.

The overall match between observed and measured levels in the transient calibration to 2020 is considered reasonable. However, in some areas of the model domain (i.e., Carrington West Wing area and Lemington Pit) the match between observed and simulated heads is poor, with the model predicting more impact than captured by observed water levels. This is likely due to the discrepancies between the actual mine progression and modelled progression and the model not being able to represent these mining activities adequately.

The review of the model files also showed the simplification of modelled river stage heights between 2019 and present day compared to daily observations. The rainfall recharge was also represented in the predictive model based on quarterly averages, which is very different from the observed rainfall from 2020 to 2022. As a result, the model under-predicts groundwater levels in several shallow bores, and conservatively over-predicts drawdown in response to mining in some areas.

The hydrogeological description, conceptualisation of the groundwater system, numerical model design and the numerical model calibration are considered still fit for purpose. Given the scale of the discrepancies comparing to the regional scale of the model, updates to the model to remove the discrepancies will result in minor changes to the overall model predictions. However, groundwater models should periodically be evolved, updated and assessed when new data is available. The following updates to the groundwater model are recommended:

- Update to Drain Package (DRN) and Time-Variant Materials (TVM) to reflect the actual MOP to provide predictions that reflect actual site activities for compliance reporting and operational use. Update to ensure modelled and actual mine progressions match for approved operations from the end of 2020.
- Review TVM package changes for spoil emplacement. Spoil specific yield of 0.1% is considered too low. This causes a very fast recovery.
- Update recharge package based on the seasonal rainfall after 2020.
- Update recharge package to apply enhanced recharge rate over spoil.

9.0 Summary and Recommendations

9.1 Summary

This annual groundwater review covers data collected from 1 January to 31 December 2022 and was completed in compliance with:

- Condition 27 of Development Consent DA 450 10 2003 for HVO North.
- Condition 28 of the Project Approval PA 06 0261 24 for HVO South.
- Individual bore license conditions (20BL173587-89, 20BL173847 and 20BL173392).
- Conditions of Environment Protection Licence 640.

Over 2022 operations across HVO included active mining at Cheshunt Pit, Riverview Pit and West Pit, including pre-strip of Wilton and Mitchell Pits. Only one TSF (Carrington Pit TSF) was used during the year on HVO land. Cumnock Void TSF was also used on Ravensworth land. Groundwater was abstracted from LUG Bore in December 2022.

Review of climate data indicates the region generally experienced above average rainfall over 2022. Similar trends are reflected in stream levels for the Hunter River and Wollombi Brook from the HITS stations and site monitoring locations (WL03, WL05, WL10 and WL14). Stream flows in the Hunter River and Wollombi Brook peaked at the start of July following above average rainfall towards the end of June. Following the peak in July levels reduced but were followed by several high flow events following above average rainfall over 2022.

Groundwater monitoring was largely conducted in accordance with the Groundwater Monitoring Programme outlined within the WMP (HVO, 2018). However, water level and water quality readings were not taken in all required bores due to a range of factors such as dry, blocked bore conditions and access restrictions due to flooding. It is noted that monitoring was not undertaken on a large number of bores in Q1 due to extensive flooding in the HVO area. An additional monitoring round at the start of Q2 was undertaken to fulfill monitoring requirements.

Review of groundwater level trends indicates that where saturated, water levels within the alluvium increased in response to rainfall and stream flow trends following above average rainfall over the reporting period.

Four alluvium bores (CFW55R, CFW57, CGW53a and CGW55a) recorded groundwater level exceedances, attributable to increased rainfall and streamflow. It is noted that the trigger level for the four alluvium bores has been superseded triggers developed for monitoring NV TSF seepage and these triggers have either not been exceeded or do not require action in accordance with the trigger response protocol applied. The trigger levels have been revised in the draft WMP which is with DPE for approval. Groundwater within the Permian coal measures remained relatively stable over 2022.

Review of water quality results and comparison to trigger levels for EC and pH identified several trigger exceedances over 2022. It was identified that several bores exceeded triggers for EC and pH; however, 2022 readings were generally in line with historical trends for these bores.

Quantification of groundwater take was undertaken based on reported volumes estimated for approved operations as part of the HVO Continuation Project Groundwater Impact Assessment (AGE, 2022) and metered abstraction volumes from LUG Bore. Based on this, over the 2022 reporting year the total take under the Hunter Regulated water source was estimated at 21 ML, total take from Hunter Unregulated water source was estimated at 346 ML and around 1,817 ML from the North Coast Fractured and Porous Rock water source. These volumes are within the licensed take for each groundwater source.

In accordance with Schedule 4 Condition 27 (c) under DA 450-10-2003 (HVO North) and Schedule 3 Condition 27 (c) under PA 06_0261 (HVO South), the WMP includes requirements to validate and recalibrate the groundwater model for the development. This includes an independent review of the model every three years, and comparison of monitoring results with modelled predictions. The latest numerical groundwater model that replicates all approved operations across HVO (north and south) was developed by AGE in 2022 as part of the HVO Continuation Project Groundwater Impact Assessment. Umwelt

The three yearly independent review of the HVO Continuation Project numerical groundwater model to verify model predictions, undertaken by Umwelt (2023b). A review of the model design representing the approved operations scenario for the review period, from 2019 to 2022 was undertaken. This included the modelled and actual mine progression, rainfall trends and streamflow. Comparison between modelled and observed groundwater levels was also undertaken.

The hydrogeological description, conceptualisation of the groundwater system, numerical model design and the numerical model calibration are considered still fit for purpose.

9.2 Recommendations

Based on review of the available data for 2022, recommendations are summarised in **Table 9.1**.

Table 9.1 Summary of Recommendations

Bore ID	Recommendation
4051C	Bore is blocked. Recommend the condition of the bore is checked with a downhole camera and if bore is irreparable, it should be removed from the WMP.
B425(WD)	Verify the depth of the base of screen and total depth. If current bore details are correct the bore should be removed from the WMP, and ongoing monitoring be conducted at nearby bore C130(WDH). Groundwater levels have been below the base of the screen at B425(WDH) since 2017.
BZ2A(1)	Water quality exceedance during the reporting period. Recommend the bore condition and construction details are checked and the pH trigger levels be reviewed. Comprehensive water quality analysis should be undertaken to help determine the cause of the declining pH trend. It is noted that the bore has already been removed from the compliance monitoring network in version 3.4 of the WMP which is currently with DPE for approval.
BZ3-1	Bore blocked in June 2022. Check condition of bore and casing with a downhole camera. If unable to be remediated, remove from the WMP.
BZ3-3	Water quality exceedance during the reporting period. Recommend the bore condition and construction details are checked and the pH trigger levels be reviewed. Comprehensive water quality analysis should be undertaken to help determine the cause of the declining pH trend. It is noted that the bore has already been removed from the compliance monitoring network in version 3.4 of the WMP which is currently with DPE for approval.

Bore ID	Recommendation
BZ4A(2)	Water quality exceedance during the reporting period. Recommend that the depth of the base of screen and total depth be verified. If current bore details are correct the bore should be removed from the WMP but kept as part of the operational monitoring network for ongoing monitoring of groundwater recovery post mining. Water quality samples should not be collected if the groundwater level is below the base of the screen.
C130(WDH)	Revise EC and pH trigger levels in the draft WMP as water quality data trends indicate the trigger will continue to exceed the trigger levels in the draft WMP which is currently with DPE for approval.
C630(BFS)	Water quality exceedance during the reporting period. Recommend that the proposed pH and EC trigger levels are revised before finalising version 3.4 of the WMP which is currently with DPE for approval.
CFW55R	Groundwater level trigger exceedance during the reporting period. Revised water level trigger level already updated in version 3.4 of the WMP, which is currently with DPE for approval.
CFW55R	Water quality exceedance during the reporting period. It is noted that the trigger level has already been reviewed and updated to 11,510 µS/cm in version 3.4 of the WMP which is currently with DPE for approval. Current EC readings will be below the revised trigger level.
CFW57	Groundwater level trigger exceedance during the reporting period. Revised water level trigger level already updated in version 3.4 of the WMP, which is currently with DPE for approval.
CGW39	Check the condition and location of the bore and confirm if it is screened within alluvium or spoil.
CGW45	Bore has been blocked and unable to be monitored since 2018. Bore has been checked and an extension has been added to increase the height of the casing above the ground surface to avoid further blockages. Work is continuing to clear the existing blockage and reinstating the bore.
CGW51a	Bore CGW51a should be decommissioned to minimise potential mixing due to the construction of the bore and a new bore be installed within the spoil material to replace CGW51a. It is noted that bore CGW51a has been removed from the draft WMP which is awaiting approval.
CGW53a	Groundwater level trigger exceedance during the reporting period. Revised water level trigger level already updated in version 3.4 of the WMP, which is currently with DPE for approval.
CGW55a	Groundwater level trigger exceedance during the reporting period. Revised water level trigger level already updated in version 3.4 of the WMP, which is currently with DPE for approval.
D510(AFS)	Bore blocked in May 2022. Check condition of bore and casing with a downhole camera. If unable to be remediated, remove from the WMP.
G1	The condition of bore G1 is checked to determine the cause of the water quality fluctuations.
GW-103	The sensors have been checked and are irreparable. The VWP will be removed from the draft WMP.
GW-105	Check the VWP sensors as the deepest sensor has failed and is no longer recording data.
GW-106	Water quality exceedance during the reporting period. It is noted that the bore has already been removed in version 3.4 of the WMP, which is currently with DPE for approval.
GW-109	Check the VWP sensors as the deepest sensor (VW3) has failed and no longer recording data. Local site conditions and the condition of the GW-109 should be reviewed, and groundwater conditions within the spoil in Carrington Pit continue to be monitored to determine if the difference between sensors VW1 and VW2 is due to sensor drift or an additional source of recharge to the shallow stratigraphy.
GW-110	Calibration data from VWP installation required, if available, to convert raw data to water levels.
NPz2	Water quality exceedance during the reporting period. It is noted that the bore has already been removed from the compliance monitoring network in version 3.4 of the WMP which is currently with DPE for approval. Bores NPz2 and NPz3 remain in the monitoring program to assist with future assessments and assessment of post closure groundwater conditions.

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APPENDIX A

Groundwater Monitoring Network and Programme

Bore ID	WMP Geology	Easting (m)	Northing (m)	Ground Level (mAHD)	Screen Base (mAHD)	Screened Interval / Sensor Depth (mbgl)	Groundwater Monitoring Programme				
							Water Level	EC	pH	Comprehensive Analysis	Alk/ Acidity
4032P	Carrington West Wing Alluvium	308609	6402945	69.35	56.89	6.46–12.46	Q	Q	Q	6M	
4034P	Carrington West Wing Alluvium	308239	6402959	71.15	56.86	5.29–14.29	Q	Q	Q	6M	
4036C	Carrington Interburden	308272	6402688	70.7	37.68	32.02–33.02	Q	Q	Q		
4037P	Carrington West Wing Alluvium	308277	6402702	70.74	57.47	7.27–13.27	Q	Q	Q	6M	
4040P	Carrington West Wing Alluvium	308675	6402724	69.16	58.23	4.93–10.93	Q	Q	Q		
4051C	Carrington Interburden	308664	6402721	68.92	37.1	30.82–31.82	Q	Q	Q		
4116P	North Pit Spoil	310681	6400978	70.17	47.98	19.59–22.19	Q	Q	Q	6M	
4119P	North Pit Spoil	312501	6402048	63.51	47.24	13.67–16.27	Q	Q	Q	6M	
Appleyard Farm	Lemington South Alluvium	315491	6394639	43.4	34.2	6.20–9.20	M	Q	Q	A	
B334(BFS)	Lemington South Bowfield	316684	6394088	73.37	9.17	58.20–64.20	Q	6M	6M		
B425(WDH)	Lemington South Woodlands Hill	316010	6395024	57.88	22.69	31.19–35.19	Q	6M	6M	A	
B631(BFS)	Lemington South Bowfield	316425	6394319	72.11	-11.56	77.67–83.67	Q	6M	6M		
B631(WDH)	Lemington South Woodlands Hill	316424	6394319	71.98	39.95	29.53–32.03	6M	6M	6M		
B925(BFS)	Lemington South Bowfield	315921	6394604	62.45	-24.18	80.63–86.63	Q	6M	6M	A	
BC1a	Cheshunt Mt Arthur	312421	6400872	66.08	?	21.70– ?	Q	Q	Q		
BUNC45A	Cheshunt / North Pit Alluvium	313667	6402055	72.9	52.9	17.00–20.00	Q	Q	Q	6M	
BUNC45D	Cheshunt Mt Arthur Seam (Piercefield in WMP)	313677	6402060	73.36	44.82	25.54–28.54	Q	Q	Q	6M	
BZ1-1	Cheshunt / North Pit Interburden (Alluvium in WMP)	311472	6400483	71.39	47.79	20.60–23.60	Q	Q	Q	6M	
BZ1-3	Cheshunt Mt Arthur	311472	6400483	71.39	15.79	52.60–55.60	Q	Q	Q	6M	
BZ2A(1)	Cheshunt Mt Arthur	311671	6400561	71.17	19.62	48.55–51.55	Q	Q	Q		
BZ3-1	Cheshunt Interburden	311840	6400640	69.97	?	?	Q	Q	Q		
BZ3-3	Cheshunt Mt Arthur	311840	6400640	69.97	25.83	41.14–44.14	Q	Q	Q		
BZ4A(2)	Cheshunt Mt Arthur	312029	6400705	74.4	34	37.40–40.40	Q	Q	Q		
BZ8-2	Cheshunt Interburden	312685	6401010	67.8	46.8	18.00–21.00	Q	Q	Q	6M	

Bore ID	WMP Geology	Easting (m)	Northing	Ground	Screen Base	Screened Interval /	Groundwater Monitoring Programme				
C122(BFS)	Lemington South Bowfield	315501	6395007	58.2	?	?	Q	Q	Q		
C122(WDH)	Lemington South Woodlands Hill	315501	6395007	58.44	36.13	19.31–22.31	6M	6M	6M		
C130(AFS1)	Lemington South Arrowfield	316400	6394916	63.17	19.56	41.61–43.61	6M	6M	6M	A	
C130(ALL)	Lemington South Interburden	316400	6394916	63.17	46.55	14.62–16.62	Q	Q	Q	A	
C130(BFS)	Lemington South Bowfield	316400	6394916	62.98	-1.18	55.16–64.16	6M	6M	6M		
C130(WDH)	Lemington South Woodlands Hill	316400	6394916	63.14	42.02	18.62–21.12	6M	6M	6M		
C317(BFS)	Lemington South Bowfield	315054	6395007	60.38	-15.76	69.64–76.14	Q	6M	6M		
C317(WDH)	Lemington South Woodlands Hill	315054	6395007	60.12	26.83	30.79–33.29	Q	6M	6M		
C613(BFS)	Lemington South Bowfield	314688	6395243	63.64	-21.05	76.69–84.69	Q	6M	6M		
C621(BFS)	Lemington South Bowfield	315421	6395321	58.37	2.69	46.68–55.68	Q	6M	6M		
C630(BFS)	Lemington South Bowfield	316378	6395306	68.81	20.85	39.96–47.96	6M	6M	6M		
C809(GM/WDH)	Lemington South Woodlands Hill	314207	6395493	59.13	21.44	27.69–37.69	6M	6M	6M		
C919(ALL)	Lemington South Alluvium	315192	6395655	57.94	44.74	7.20–13.20	M	Q	Q	A	
CFW55R	Carrington Alluvium	310439	6402180	69.78	53.88	8.90–15.90	Q	Q	Q	6M	
CFW57	Carrington Alluvium	310084	6402053	70.05	55.35	7.70–14.70	Q	Q	Q	6M	
CGW32	Carrington West Wing Flood Plain	308598	6404872	78.48	56.06	13.42–22.42	Q	Q	Q		
CGW39	Carrington West Wing Flood Plain Alluvium?	308566	6403694	70.31	56.84	4.47–13.47	Q	Q	Q	6M	
CGW45	Carrington West Wing Bayswater Seam (LBL in WMP)	308042	6403349	71.83	?	28.3– ?	Q	Q	Q		
CGW46	Carrington West Wing Bayswater	308413	6403276	71.95	?	13.60– ?	Q	Q	Q	6M	
CGW47a	Carrington West Wing Broonie Seam (Flood Plain in WMP)	308731	6403405	70.39	?	16.03– ?	Q	Q	Q	6M	
CGW49	Carrington West Wing Bayswater Seam (Alluvium in WMP)	308778	6403098	69.05	?	12.78– ?	Q	Q	Q		
CGW51a	Carrington Interburden	310149	6402419	70.04	54.21	12.83–15.83	Q	Q	Q		
CGW52	Carrington Broonie	309906	6402255	70.7	28.8	38.90–41.90	Q	Q	Q		
CGW52a	Carrington Alluvium	309902	6402249	70.61	53.36	14.25–17.25	Q	Q	Q		
CGW53	Carrington Broonie	309606	6402333	69.87	28.98	37.89–40.89	Q	Q	Q		

Bore ID	WMP Geology	Easting (m)	Northing	Ground	Screen Base	Screened Interval /	Groundwater Monitoring Programme				
CGW53a	Carrington Alluvium	309606	6402333	69.83	55.83	11.00–14.00	Q	Q	Q		
CGW55a	Carrington Alluvium	309840	6402457	70.56	55.24	12.32–15.32	Q	Q	Q		
CHPZ10A	Cheshunt / North Pit Alluvium	313334	6402297	62.57	50.77	8.70–11.80	Q	Q	Q	6M	
CHPZ12A	Cheshunt / North Pit Alluvium	313238	6402013	63.13	51.93	9.20–11.20	Q	Q	Q	6M	
CHPZ12D	Cheshunt Mt Arthur	313236	6402019	63.26	51.51	?–11.75	Q	Q	Q	6M	
CHPZ1A	Cheshunt / North Pit Alluvium	312820	6401697	65.9	48.2	14.00–17.70	Q	Q	Q	6M*	
CHPZ2A	Cheshunt / North Pit Alluvium	312941	6401539	65.14	48.88	13.06–16.26	Q	Q	Q	6M	
CHPZ3A	Cheshunt / North Pit Alluvium	313086	6401756	63.18	52.36	13.82–10.82	Q	Q	Q	6M	
CHPZ3D	Cheshunt Mt Arthur	313094	6401756	62.96	40	19.86–22.96	Q	Q	Q	6M	
CHPZ4A	Cheshunt / North Pit Alluvium	312904	6402123	65.45	51.99	10.16–13.46	Q	Q	Q	6M	
CHPZ8A	Cheshunt / North Pit Alluvium	313503	6402051	60.05	54.85	3.20–5.20	Q	Q	Q	6M	
CHPZ8D	Cheshunt Mt Arthur	313508	6402047	59.89	51.6	4.79–8.29	Q	Q	Q	6M	
D010(BFS)	Lemington South Bowfield	314355	6395687	55.94	-10.17	59.61–66.11	6M	6M	6M		
D010(GM)	Lemington South Glen Munro	314355	6395687	55.95	39.26	12.19–16.69	6M	6M	6M	A	
D010(WDH)	Lemington South Woodlands Hill	314355	6395687	55.93	33.76	19.17–22.17	6M	6M	6M		
D214(BFS)	Lemington South Bowfield	314768	6395831	56.67	4.5	42.67–52.17	Q	6*M	6*M		
D317(BFS)	Lemington South Bowfield	315043	6396019	59.64	15.77	38.67–43.87	Q	6M	6M		
D406(AFS)	Lemington South Arrowfield	313931	6396074	57.41	30.23	23.68–27.18	6M	6M	6M		
D406(BFS)	Lemington South Bowfield	313931	6396074	57.36	0.68	50.68–56.68	6M	6M	6M		
D510(AFS)	Lemington South Arrowfield	314380	6396141	54.99	24.81	25.18–30.18	6M	6M	6M		
D510(BFS)	Lemington South Bowfield	314380	6396141	54.98	17.28	33.70–37.70	6M	6M	6M		
D612(AFS)	Lemington South Arrowfield	314524	6396314	62.16	?	23.62– ?	6M	6M	6M		
D612(BFS)	Lemington South Bowfield	314524	6396314	62.1	?	28.81– ?	6M	6M	6M		
D807(BFS)	Lemington South Bowfield	314002	6396484	59.94	19.29	35.65–40.65	6M	6M	6M		
DM1	North Pit Spoil	311778	6405164	102.73	?	28.83– ?	Q	Q	Q	A	Q
DM3	North Pit Spoil	311971	6403310	94.14	?	40.67– ?	Q	Q	Q	A	Q

Bore ID	WMP Geology	Easting (m)	Northing	Ground	Screen Base	Screened Interval /	Groundwater Monitoring Programme				
DM4	North Pit Spoil	312222	6401418	64.85	?	54.16– ?	Q	Q	Q	A	Q
DM7	North Pit Spoil	311136	6400961	69.26	?	30.87– ?	Q	Q	Q	A	Q
G1	West Pit Alluvium	305694	6407301	110	?	<10.00– ?	Q	Q	Q	A	
G2	West Pit Alluvium	305660	6407451	110.6	?	3.04– ?	Q	Q	Q	A	
G3	West Pit Alluvium	305636	6407556	108.6	?	<10.00– ?	Q	Q	Q	A	
GA3	Cheshunt / North Pit Coal (Alluvium in WMP)	310159	6400876	67.02	?	12.00– ?	Q	Q	Q		
GW-100	West Pit Alluvium	303729	6406436	89.6	84.6	4.40–5.00	Q	Q	Q	A	
GW-100a (VWP)	Carrington Barrett Seam and Interburden	303722	6406445	89.4	-	51.00	Q*				
GW-101	West Pit Alluvium	304374	6406728	100.5	88.5	9.00–12.00	Q	Q	Q	A	
GW-101a (VWP)	Carrington Interburden (Siltstone/Sandstone)	304362	6406721	100.5	-	51.00	Q*				
GW-102 (VWP)	Carrington Interburden (Sandstone with minor coal)	305280	6406668	114.6	-	60.50	Q*				
GW-103 (VWP)	Carrington Coal – undifferentiated and weathered	306769	6404610	103.2	-	25.50	Q*				
	Carrington Siltstone and coal				-	64.50					
	Carrington Sandstone – mg, fresh				-	119.50					
GW-104 (VWP)	Carrington Lower Pikes Gully Seam	307549	6404657	86.7	-	59.00	Q*				
	Carrington Sandstone IB (near Upper Liddell Seam)				-	107.00					
	Carrington Sandstone (above Barret)				-	135.00					
GW-105 (VWP)	Carrington Coal – undifferentiated	308597	6405442	93.1	-	33.00	Q*				
	Carrington Coal – tuffaceous				-	103.50					
	Carrington Coal				-	154.00					
GW-106	Carrington West Wing Alluvium	309092	6405224	82.3	56.1	23.20–26.20	Q	Q	Q	A	
GW-107	Carrington Spoil	308738	6404103	73.5	46.3	24.20–27.20	Q	Q	Q	A	
GW-108	Carrington Spoil	309695	6403971	84.4	25.9	52.50–58.50	Q	Q	Q	A	
GW-109 (VWP)	Carrington Coal – slightly weathered	309232	6402706	85.2	-	31.50	Q*				
	Carrington Coal – tuffaceous				-	65.00					
	Carrington Bayswater Seam				-	89.50					

Bore ID	WMP Geology	Easting (m)	Northing	Ground	Screen Base	Screened Interval /	Groundwater Monitoring Programme				
GW-110 (VWP)	Carrington Sandstone – fresh	310503	6404598	124.6	-	38.00	Q*				
	Carrington Sandstone				-	63.00					
	Carrington Bayswater Seam				-	93.00					
GW-114	North Pit Spoil	312272	6403981	98.2	68.2	27.00–30.00	Q	Q	Q	A	
GW-115	North Pit Spoil	312227	6402216	68.3	40.1	22.20–28.20	Q	Q	Q	A	
HG2	Cheshunt Interburden	312469	6400886	67.4	51.03	10.37–16.37	Q	Q	Q		
HG2a	Cheshunt Mt Arthur	312469	6400886	66.82	39.07	25.75–27.75	Q	Q	Q		
Hobdens Well	Cheshunt / North Pit Alluvium	312540	6401093	71	?	?	Q	Q	Q	A	
HV3(2)	Cheshunt / North Pit Alluvium	310776	6400546	68.06	51.94	? –16.12	Q	Q	Q		
LUG Bore	Lemington South Mt Arthur	315874	6394295	?	?	?	M	Q	Q	A	
MB14HVO01	North Pit Spoil	310587	6401003	71.3	-18.7	? –90.00	Q	Q	Q	A	
MB14HVO02	North Pit Spoil	310469	6401001	70.9	61.9	? –90.00	Q	Q	Q	A	
MB14HVO03	North Pit Spoil	311387	6400950	67.1	-12.9	? –80.00	Q	Q	Q	A	
MB14HVO04	North Pit Spoil	311491	6401392	67.1	12.1	? –55.00	Q	Q	Q	A	
MB14HVO05	North Pit Spoil	310675	6401127	71.7	-13.3	? –85.00	Q	Q	Q	A	
NPz2	West Pit Sandstone/Siltstone	307800	6411340	190.48	131.08	56.40–59.40	Q	Q	Q	A	
NPz3	West Pit Sandstone/Siltstone	306305	6409131	148.4	?	93.30–96.60	Q	Q	Q	A	
NPz5	West Pit Sandstone/Siltstone	310730	6406550	113.76	71.49	39.27–42.27	Q	Q	Q	A	
PB01(ALL)	Lemington South Alluvium	314754	6396026	54.37	42.11	9.26–12.26	M	Q	Q	A	
PZ1CH200	Cheshunt / North Pit Alluvium	312646	6402256	62.06	51.06	>8.90–11.00	Q	Q	Q		
PZ2CH400	Cheshunt / North Pit Alluvium	312635	6402051	62.53	51.43	>9.90–11.10	Q	Q	Q	6M*	
PZ3CH800	Cheshunt / North Pit Alluvium	312522	6401674	64.16	?	10.47– ?	Q	Q	Q	6M*	
PZ4CH1380	Cheshunt / North Pit Alluvium	312196	6401176	64.93	?	14.48– ?	Q	Q	Q		
PZ5CH1800	Cheshunt / North Pit Alluvium	311852	6400928	66.1	?	14.90– ?	Q	Q	Q		
SR001	Southern Coal	319146	6394094	58.44	?	59.18– ?	6M	6M	6M		
SR002	Southern Bayswater Seam	319079	6394620	56.99	16.38	37.61–40.61	6M	6M	6M		

Bore ID	WMP Geology	Easting (m)	Northing	Ground	Screen Base	Screened Interval /	Groundwater Monitoring Programme				
SR003	Southern Bayswater Seam	318863	6394864	61.33	?	63.88– ?	6M	6M	6M		
SR004	Southern Bayswater Seam	318994	6395506	78.15	?	39.87– ?	6M	6M	6M		
SR005	Southern Bayswater Seam	318831	6396128	65.36	?	26.39– ?	6M	6M	6M		
SR006	Southern Bayswater Seam	318555	6395732	83.31	?	91.44– ?	6M	6M	6M		
SR007	Southern Overburden and Vaux Seam	318772	6394373	60.9	23.4	31.50–37.50	6M	6M	6M	A	
SR008	Southern Siltstone/sandstone below Lemington Seam	319290	6395111	56.8	26.4	24.40–30.40	6M	6M	6M	A	
SR009	Southern Lemington Seam	319338	6394746	56.1	19.7	30.40–36.40	6M	6M	6M	A	
SR010	Southern Conglomerate and Warkworth Seam	317319	6395338	57.5	26.9	24.60–30.60	6M	6M	6M	A	
SR011	Southern Mt Arthur Seam and underburden	317699	6394412	88.2	40.8	41.40–47.40	6M	6M	6M	A	
SR012	Southern Overburden – conglomerate and sandstone	316354	6393926	76.2	46.8	23.40–29.40	6M	6M	6M	A	

Comprehensive analysis includes major ions TDS, Al, As, B, Ca, Cd, Cl, (CO3), Cu, Hg, K, Mg, Na, Ni, Pb, Se, SO4 (or S), Zn, Total Alkalinity, Bicarbonate Alkalinity, Carbonate Alkalinity, Hydroxide Alkalinity.

**TDS, Al, As, B, Be, Ca, Cd, Cl, CO3, Co, Cu, F, Fe, Hg, K, Mg, Mn, Na, Ni, NH3, NO2, NO3, P, Pb, Rb, Sb, Se, SO4 (or S), SiO2, Sr, Zn, Total Alkalinity, Bicarbonate Alkalinity, Carbonate Alkalinity, Hydroxide Alkalinity.*

Notes: *Q* – Data downloaded quarterly*

M – Monthly

Q – Quarterly

6M – Six Monthly

A – Annual

APPENDIX B

Groundwater Level Data

Table B.1 Groundwater Level Data – Alluvium

Bore ID	WMP Location and Geology	Base of Screen (mAHD)	Trigger Level (mAHD)		Q1 SWL (mAHD)			Q2 SWL (mAHD)			Q3 SWL (mAHD)			Q4 SWL (mAHD)		
			95th Percentile	5th Percentile	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4032P	Carrington West Wing	56.89	-	-	No Access			-	61.14	-	61.54	-	61.72	-	-	61.90
4034P	Carrington West Wing Alluvium	56.86	-	-	No Access			-	60.51	-	60.71	-	-	-	-	61.23
4037P	Carrington West Wing Alluvium	57.47	-	-	No Access			-	61.42	-	61.72	-	-	-	-	62.11
4040P	Carrington West Wing Alluvium	58.23	-	-	No Access			-	61.21	-	61.78	-	61.96	-	-	61.78
CGW49	Carrington West Wing Alluvium	?	-	-	No Access			-	61.14	-	61.42	-	-	-	-	61.86
GW-106	Carrington West Wing Alluvium	56.10	-	-	-	-	59.66	No Access			59.62	-	59.67	-	-	59.66
CGW32	Carrington West Wing Flood Plain	56.06	-	-	-	-	59.52	No Access			59.50	-	-	-	-	59.51
CGW39	Carrington West Wing Flood Plain	56.84	-	-	Dry			-	60.04	-	60.28	-	-	-	-	60.73
CGW47a	Carrington West Wing Flood Plain	?	-	-	No Access			-	60.91	-	61.03	-	61.35	-	-	61.65
CFW55R	Carrington Alluvium	53.88	59.41	57.06	59.12	59.19	59.26	59.43	59.60	59.56	59.57	59.66	59.72	No Access	60.06	60.00
CFW57	Carrington Alluvium	55.35	59.24	58.24	59.88	59.83	60.00	59.86	59.80	59.87	60.26	60.20	60.30	60.70	60.65	60.36
CGW52a	Carrington Alluvium	53.36	60.52	58.23	No Access			-	60.16	-	60.37	-	60.54	-	-	60.76
CGW53a	Carrington Alluvium	55.83	59.19	58.33	No Access			-	60.30	-	60.58	-	60.73	-	-	60.85
CGW55a	Carrington Alluvium	55.24	58.43	57.49	No Access			-	59.32	-	59.54	-	59.78	-	-	60.21
BUNC45A	Cheshunt / North Pit Alluvium	52.90	-	-	-	53.22	-	-	53.62	-	-	53.76	-	-	53.75	-
BZ1-1	Cheshunt / North Pit Alluvium	47.79	-	-	-	54.84	-	-	-	54.60	-	55.72	-	-	56.38	-
CHPZ10A	Cheshunt / North Pit Alluvium	50.77	-	-	-	56.41	-	-	56.31	-	-	56.66	-	-	57.13	-
CHPZ12A	Cheshunt / North Pit Alluvium	51.93	-	-	-	56.62	-	-	56.50	-	-	56.75	-	-	57.12	-
CHPZ1A	Cheshunt / North Pit Alluvium	48.20	-	-	-	57.55	-	-	57.47	-	-	57.87	-	-	58.42	-
CHPZ2A	Cheshunt / North Pit Alluvium	48.88	-	-	-	56.57	-	-	56.51	-	-	57.03	-	-	57.18	-
CHPZ3A	Cheshunt / North Pit Alluvium	52.36	-	-	-	56.66	-	-	56.55	-	-	56.84	-	-	57.28	-
CHPZ4A	Cheshunt / North Pit Alluvium	51.99	-	-	-	56.46	-	-	56.36	-	-	56.76	-	-	57.26	-
CHPZ8A	Cheshunt / North Pit Alluvium	54.85	-	-	-	56.80	-	-	56.82	-	-	56.95	-	-	57.48	-
GA3	Cheshunt / North Pit Alluvium	?	-	-	No Access			-	58.12	-	No Access			-	-	58.58
Hobdens Well	Cheshunt / North Pit Alluvium	?	-	-	-	60.96	-	-	60.91	-	-	61.74	-	-	62.70	-
HV3(2)	Cheshunt / North Pit Alluvium	51.94	-	-	No Access			-	56.65	-	No Access			-	-	59.02
PZ1CH200	Cheshunt / North Pit Alluvium	51.06	-	-	-	55.67	-	-	-	55.70	-	56.72	-	-	57.60	-

Bore ID	WMP Location and Geology	Base of	Trigger Level (mAHD)		Q1 SWL (mAHD)			Q2 SWL (mAHD)			Q3 SWL (mAHD)			Q4 SWL (mAHD)		
PZ2CH400	Cheshunt / North Pit Alluvium	51.43	-	-	-	54.90	-	-	-	54.69	-	55.97	-	-	56.71	-
PZ3CH800	Cheshunt / North Pit Alluvium	?	-	-	-	55.76	-	-	-	55.69	-	56.90	-	-	57.96	-
PZ4CH1380	Cheshunt / North Pit Alluvium	?	-	-	-	56.01	-	-	-	56.02	-	57.09	-	-	58.11	-
PZ5CH1800	Cheshunt / North Pit Alluvium	?	-	-	-	56.30	-	-	-	56.24	-	57.53	-	-	58.45	-
Appleyard Farm	Lemington South Alluvium	34.20	-	-	38.13	38.30	37.58	39.46	-	38.59	40.82	39.05	38.74	39.08	38.58	38.29
C919(ALL)	Lemington South Alluvium	44.74	-	-	47.70	47.84	47.89	48.52	-	48.69	49.51	49.62	49.78	50.00	-	50.05
PB01(ALL)	Lemington South Alluvium	42.11	-	-	47.16	46.87	47.05	48.75	47.73	47.64	51.52	49.40	48.23	48.27	47.83	47.62
G1	West Pit Alluvium	?	-	-	108.31	108.20	108.08	108.64	108.84	108.59	108.80	108.28	109.30	108.36	108.15	108.14
G2	West Pit Alluvium	?	-	-	109.33	109.15	109.06	109.52	109.68	109.59	109.58	109.18	109.27	109.26	109.02	109.12
G3	West Pit Alluvium	?	-	-	107.00	106.75	106.82	107.15	107.38	107.27	107.20	106.93	106.98	106.95	106.69	-
GW-100	West Pit Alluvium	84.60	-	-	No Access			-	85.74	-	85.90	-	85.99	-	-	86.04
GW-101	West Pit Alluvium	88.50	-	-	No Access			Dry			Dry			Dry		

Table B.2 Groundwater Level Data – Permian Coal Measures

Bore ID	WMP Location and Geology	Base of Screen (mAHD)	Trigger Level (mAHD)		Q1 SWL (mAHD)			Q2 SWL (mAHD)			Q3 SWL (mAHD)			Q4 SWL (mAHD)		
			95th Percentile	5th Percentile	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CGW45	Carrington West Wing LBL	?	-	-	Blocked			Blocked			72.03	-	-	Blocked		
CGW46	Carrington West Wing Bayswater	?	-	-	No Access			-	61.05	-	61.21	-	-	-	-	52.61
CGW51a	Carrington Alluvium	54.21	-	-	No Access			-	57.08	-	57.42	-	57.92	-	-	58.65
CGW52	Carrington Broonie	28.80	-	-	No Access			-	35.95	-	35.06	-	36.43	-	-	37.11
CGW53	Carrington Broonie	28.98	-	-	No Access			-	35.29	-	34.56	-	35.62	-	-	36.19
4036C	Carrington Interburden	37.68	-	-	No Access			-	39.62	-	40.16	-	-	Blocked		
4051C	Carrington Interburden	37.10	-	-	No Access			Blocked			Blocked			Blocked		
CGW51a	Carrington Interburden	54.21	-	-	No Access			-	57.08	-	57.42	-	57.92	-	-	58.65
BZ3-1	Cheshunt Interburden	?	-	-	-	53.67	-	-	-	53.93	Blocked			Blocked		
BZ8-2	Cheshunt Interburden	46.80	-	-	No Access			No Access			No Access			No Access		
HG2	Cheshunt Interburden	51.03	-	-	-	56.78	-	-	56.91	-	-	57.51	-	-	58.41	-
BC1a	Cheshunt Mt Arthur	?	-	-	-	49.08	-	-	49.03	-	-	49.12	-	-	49.25	-

Bore ID	WMP Location and Geology	Base of	Trigger Level (mAHD)		Q1 SWL (mAHD)			Q2 SWL (mAHD)			Q3 SWL (mAHD)			Q4 SWL (mAHD)		
BZ1-3	Cheshunt Mt Arthur	15.79	-	-	-	24.79	-	-	-	24.42	-	25.24	-	-	24.62	-
BZ2A(1)	Cheshunt Mt Arthur	19.62	-	-	-	25.78	-	-	-	25.74	-	25.83	-	-	25.94	-
BZ3-3	Cheshunt Mt Arthur	25.83	-	-	-	27.88	-	-	-	27.90	-	28.45	-	-	28.84	-
BZ4A(2)	Cheshunt Mt Arthur	34.00	-	-	-	33.93	-	-	-	34.03	-	34.03	-	-	34.06	-
CHPZ12D	Cheshunt Mt Arthur	51.51	-	-	-	56.45	-	-	56.33	-	-	56.62	-	-	57.00	-
CHPZ3D	Cheshunt Mt Arthur	40.00	-	-	-	55.17	-	-	55.11	-	-	55.61	-	-	56.10	-
CHPZ8D	Cheshunt Mt Arthur	51.60	-	-	-	56.80	-	-	56.73	-	-	57.10	-	-	57.60	-
HG2a	Cheshunt Mt Arthur	39.07	-	-	-	41.40	-	-	41.44	-	-	41.31	-	-	41.58	-
BUNC45D	Cheshunt Piercefield	44.82	-	-	-	48.74	-	-	48.78	-	-	48.97	-	-	48.84	-
C130(AFS1)	Lemington South Arrowfield	19.56	-	-	nr (6m)			-	45.20	-	nr (6m)			-	45.73	-
D406(AFS)	Lemington South Arrowfield	30.23	-	-	nr (6m)			-	39.02	-	nr (6m)			-	39.05	-
D510(AFS)	Lemington South Arrowfield	24.81	-	-	nr (6m)			**Blocked**			nr (6m)			**Blocked**		
D612(AFS)	Lemington South Arrowfield	?	-	-	nr (6m)			-	40.00	-	nr (6m)			-	39.95	-
B334(BFS)	Lemington South Bowfield	9.17	-	-	-	20.61	-	-	-	20.07	-	19.93	-	-	19.71	-
B631(BFS)	Lemington South Bowfield	-11.56	-	-	-	23.05	-	-	-	25.08	-	27.53	-	-	28.57	-
B925(BFS)	Lemington South Bowfield	-24.18	-	-	-	2.77	-	-	-	5.42	-	6.97	-	-	8.37	-
C122(BFS)	Lemington South Bowfield	?	-	-	-	-0.60	-	-	-	-0.05	-	-0.38	-	-	-0.46	-
C130(BFS)	Lemington South Bowfield	-1.18	-	-	-	10.32	-	-	12.82	-	-	14.33	-	-	14.42	-
C317(BFS)	Lemington South Bowfield	-15.76	-	-	-	8.13	-	-	11.66	-	-	14.77	-	-	15.21	-
C613(BFS)	Lemington South Bowfield	-21.05	-	-	-	37.48	-	-	39.61	-	-	41.49	-	-	41.97	-
C621(BFS)	Lemington South Bowfield	2.69	-	-	-	14.82	-	-	-	15.80	**No Access**			-	17.07	-
C630(BFS)	Lemington South Bowfield	20.85	-	-	nr (6m)			-	23.53	-	nr (6m)			-	23.64	-
D010(BFS)	Lemington South Bowfield	-10.17	-	-	nr (6m)			-	30.77	-	nr (6m)			-	27.78	-
D214(BFS)	Lemington South Bowfield	4.50	-	-	-	30.20	-	-	31.47	-	-	32.86	-	-	14.95	-
D317(BFS)	Lemington South Bowfield	15.77	-	-	-	28.75	-	-	-	29.92	-	31.30	-	-	31.87	-
D406(BFS)	Lemington South Bowfield	0.68	-	-	nr (6m)			-	26.59	-	nr (6m)			-	24.03	-
D510(BFS)	Lemington South Bowfield	17.28	-	-	nr (6m)			-	33.32	-	nr (6m)			--	29.84	--
D612(BFS)	Lemington South Bowfield	?	-	-	nr (6m)			-	33.43	-	nr (6m)			-	29.90	-
D807(BFS)	Lemington South Bowfield	19.29	-	-	nr (6m)			-	29.55	-	nr (6m)			-	24.27	-
D010(GM)	Lemington South Glen Munro	39.26	-	-	nr (6m)			-	50.10	-	nr (6m)			-	43.66	-

Bore ID	WMP Location and Geology	Base of	Trigger Level (mAHD)		Q1 SWL (mAHD)			Q2 SWL (mAHD)			Q3 SWL (mAHD)			Q4 SWL (mAHD)		
C130(ALL)	Lemington South Interburden	46.55	-	-	47.44	47.35	47.44	47.43	47.32	47.43	47.43	47.42	47.42	47.45	47.35	47.45
B425(WDH)	Lemington South Woodlands Hill	22.69	-	-	-	22.55	-	**Water level below base of screen**			-	22.84	-	**No Access**		
B631(WDH)	Lemington South Woodlands Hill	39.95	-	-	nr (6m)			-	-	45.95	nr (6m)			-	46.05	-
C122(WDH)	Lemington South Woodlands Hill	36.13	-	-	nr (6m)			-	-	47.54	nr (6m)			-	47.63	-
C130(WDH)	Lemington South Woodlands Hill	42.02	-	-	nr (6m)			-	45.18	-	nr (6m)			-	47.20	-
C317(WDH)	Lemington South Woodlands Hill	26.83	-	-	-	46.91	-	-	47.89	-	-	48.49	-	-	15.21	-
C809(GM/WDH)	Lemington South Woodlands Hill	21.44	-	-	nr (6m)			-	47.93	-	nr (6m)			-	49.86	-
D010(WDH)	Lemington South Woodlands Hill	33.76	-	-	nr (6m)			-	47.57	-	nr (6m)			-	43.66	-
LUG Bore	Lemington South Mt Arthur	?	-	-	Not required (Sealed Headworks)											
NPz2	West Pit Sandstone/Siltstone	131.08	-	-	No Access			-	161.00	-	161.15	-	160.94	-	-	154.86
NPz3	West Pit Sandstone/Siltstone	?	-	-	No Access			-	124.39	-	124.37	-	124.53	-	-	124.66
NPz5	West Pit Sandstone/Siltstone	71.49	-	-	**Mined Through, No Longer Exists**											
SR001	Southern Coal	?	-	-	nr (6m)			-	-	47.87	nr (6m)			-	-	47.95
SR002	Southern Bayswater Seam	16.38	-	-	nr (6m)			-	-	42.41	nr (6m)			-	-	42.83
SR003	Southern Bayswater Seam	?	-	-	nr (6m)			-	-	42.92	nr (6m)			-	-	43.33
SR004	Southern Bayswater Seam	?	-	-	nr (6m)			-	-	42.91	nr (6m)			-	-	43.34
SR005	Southern Bayswater Seam	?	-	-	nr (6m)			-	-	43.86	nr (6m)			-	-	44.63
SR006	Southern Bayswater Seam	?	-	-	nr (6m)			-	-	43.79	43.79	-	-	-	-	44.61
SR007	Southern Overburden and Vaux Seam	23.40	-	-	-	-	26.35	-	-	26.78	-	-	27.20	-	-	27.32
SR008	Southern Siltstone/sandstone below Lemington Seam	26.40	-	-	-	-	47.42	-	-	47.61	-	-	47.88	-	-	48.06
SR009	Southern Lemington Seam	19.70	-	-	-	-	49.32	-	-	49.51	-	-	49.82	-	-	50.00
SR010	Southern Conglomerate and Warkworth Seam	26.90	-	-	-	-	46.80	-	-	47.13	-	-	47.29	-	-	47.44
SR011	Southern Mt Arthur Seam and underburden	40.80	-	-	-	-	52.86	-	-	53.01	-	-	53.15	-	-	53.32
SR012	Southern Overburden - conglomerate and sandstone	46.80	-	-	-	-	49.58	-	-	49.57	-	-	49.95	-	-	50.88

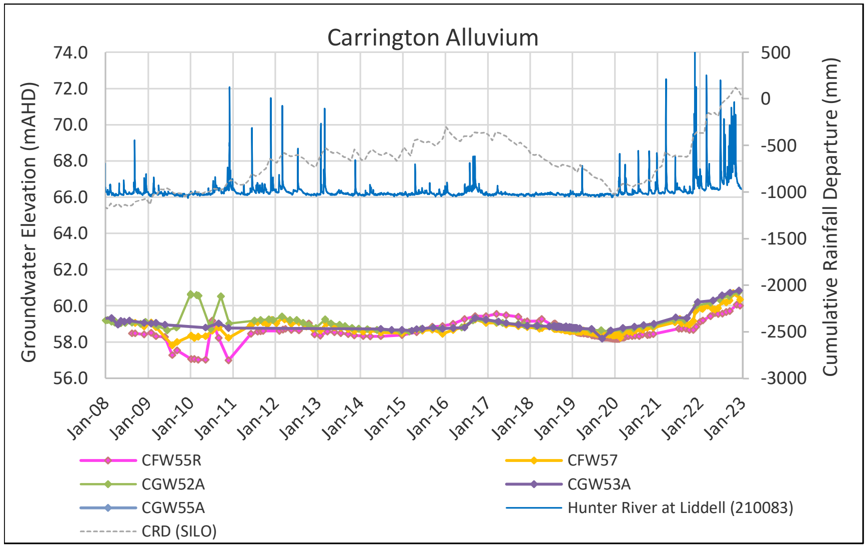
Note: nr (6m) - not required as six monthly monitoring only.

Table B.3 Groundwater Level Data – Spoil

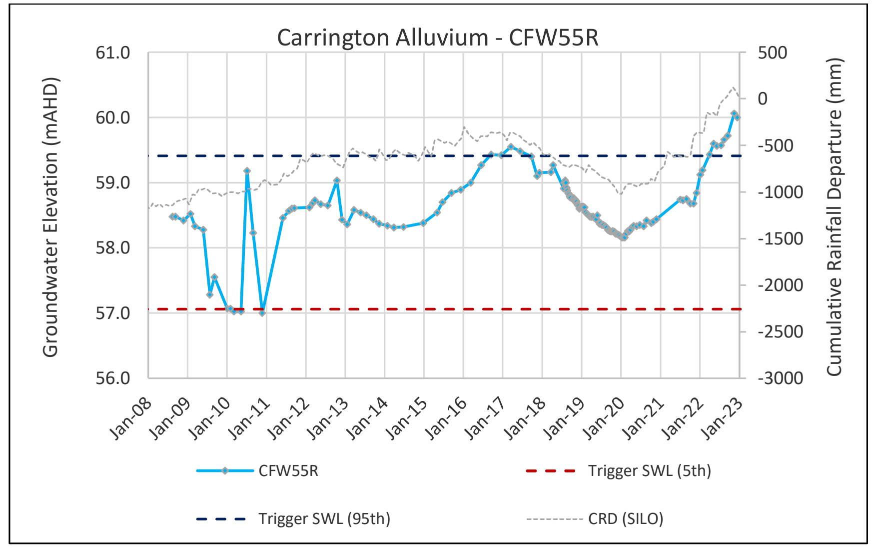
Bore ID	WMP Location and Geology	Base of Screen (mAHD)	Trigger Level (mAHD)		Q1 SWL (mAHD)			Q2 SWL (mAHD)			Q3 SWL (mAHD)			Q4 SWL (mAHD)		
			95^{th} Percentile	5^{th} Percentile	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
GW-107	Carrington Spoil	46.30	-	-	No Access			-	44.15	-	44.17	-	-	Dry		
GW-108	Carrington Spoil	25.90	-	-	No Access			-	23.71	-	No Access			Blocked		
4116P	North Pit Spoil	47.98	-	-	No Access			No Access			49.46	-	49.51	-	-	49.54
4119P	North Pit Spoil	47.24	-	-	No Access			-	56.49	-	No Access			No Access		
DM1	North Pit Spoil	?	-	-	No Access			-	78.10	-	78.35	-	78.68	-	-	78.96
DM3	North Pit Spoil	?	-	-	No Access			-	64.46	-	64.55	-	64.81	Blocked		
DM4	North Pit Spoil	?	-	-	No Access			-	49.07	-	49.72	-	50.50	-	-	51.26
DM7	North Pit Spoil	?	-	-	No Access			-	38.81	-	39.34	-	40.19	-	-	41.35
GW-114	North Pit Spoil	68.20	-	-	No Access			-	66.41	-	66.52	-	66.89	-	-	67.30
GW-115	North Pit Spoil	40.10	-	-	No Access			-	55.80	-	56.62	-	57.10	-	-	57.72
MB14HVO01	North Pit Spoil	-18.70	-	-	No Access			No Access			39.46	-	40.00	-	-	41.22
MB14HVO02	North Pit Spoil	-19.10	-	-	No Access			No Access			39.43	-	39.96	-	-	41.20
MB14HVO03	North Pit Spoil	-12.90	-	-	No Access			-	34.99	-	35.56	-	37.18	-	-	37.19
MB14HVO04	North Pit Spoil	12.10	-	-	No Access			-	39.38	-	No Access			-	-	41.86
MB14HVO05	North Pit Spoil	-13.30	-	-	No Access			No Access			39.55	-	40.13	-	-	41.35

APPENDIX C

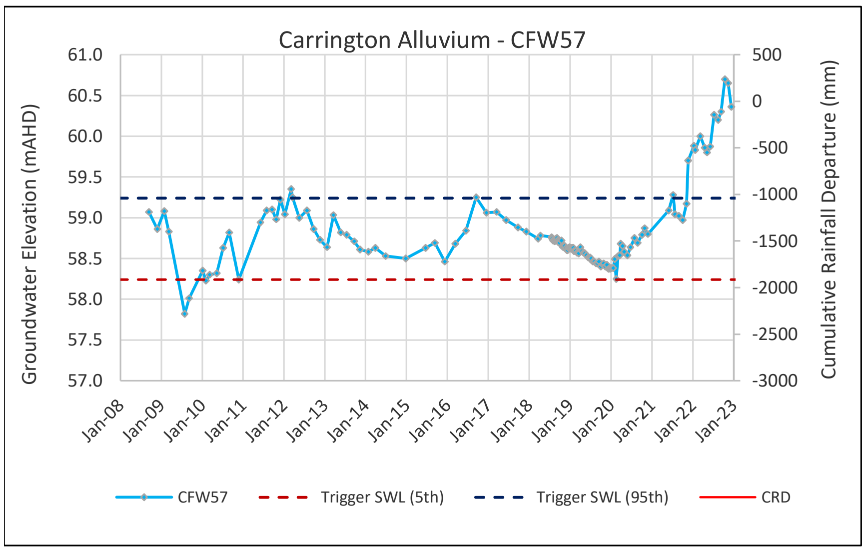
Groundwater Level Graphs



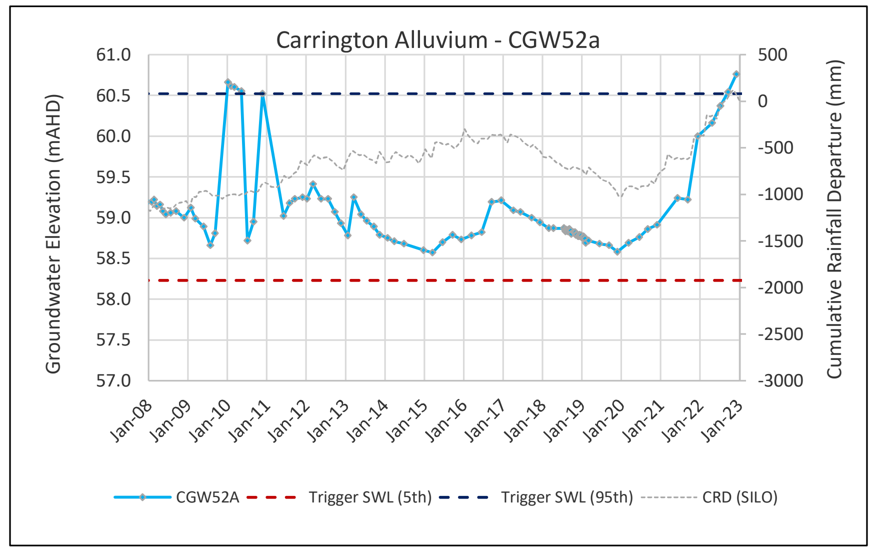
Carrington Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
CFW55R
CFW57
CGW52A
CGW53A
CGW55A
Hunter River at Liddell (210083)
CRD (SILO)



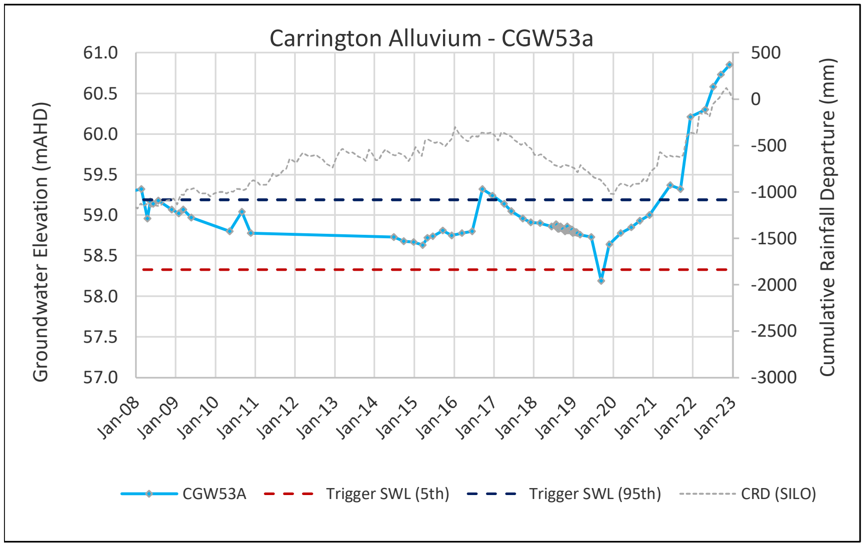
Carrington Alluvium - CFW55R
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
CFW55R
Trigger SWL (5th)
Trigger SWL (95th)
CRD (SILO)

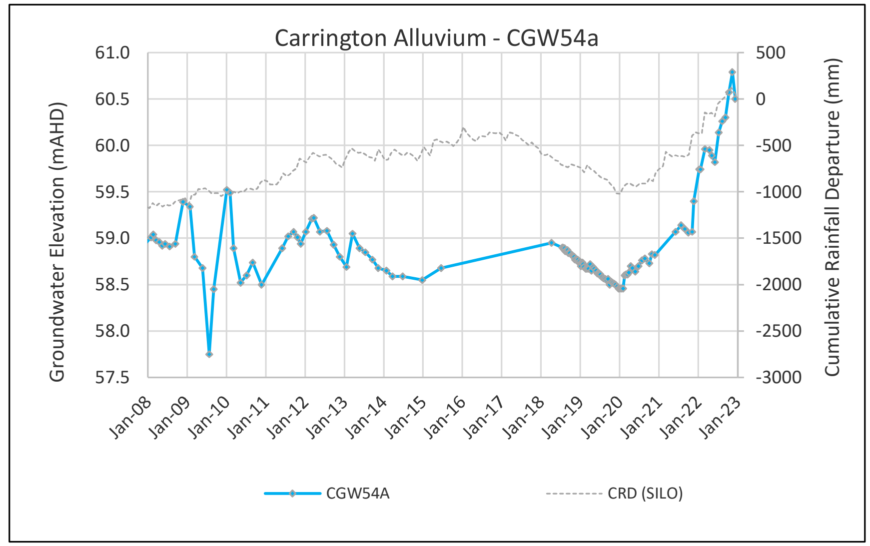


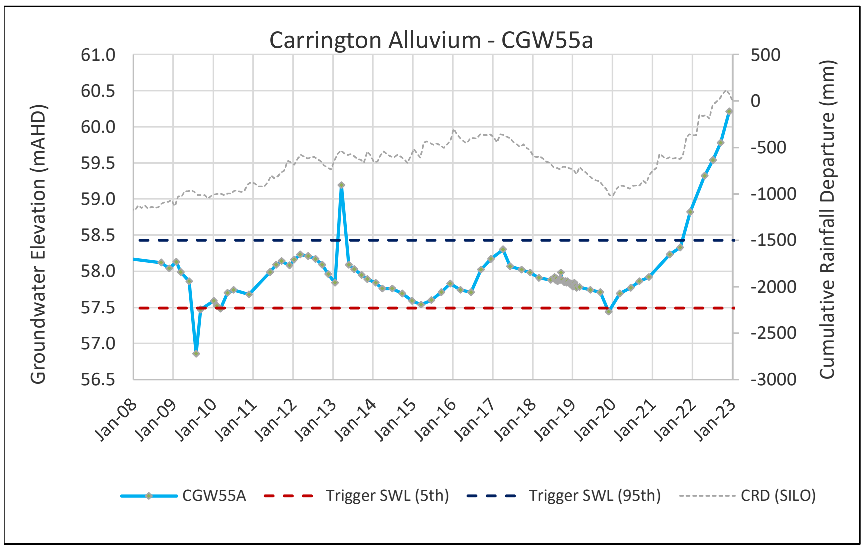
Carrington Alluvium - CFW57
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
CFW57
Trigger SWL (5th)
Trigger SWL (95th)
CRD

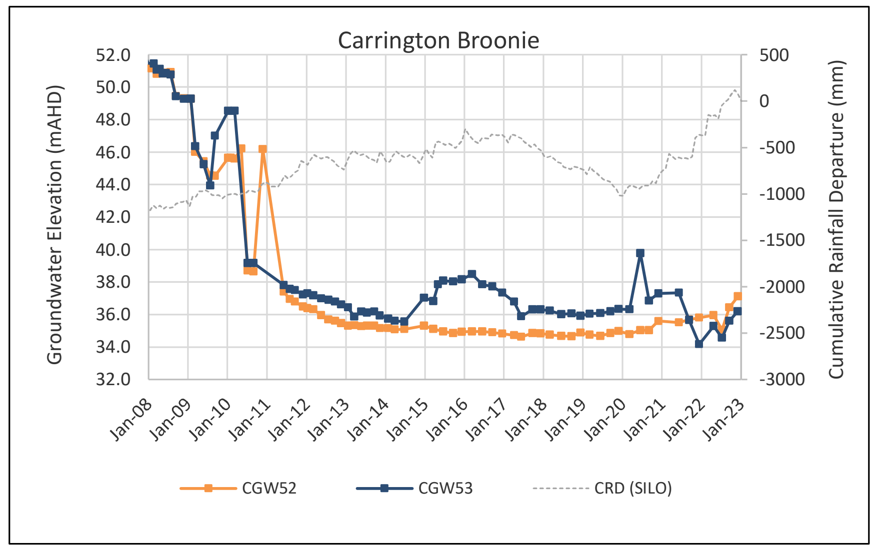


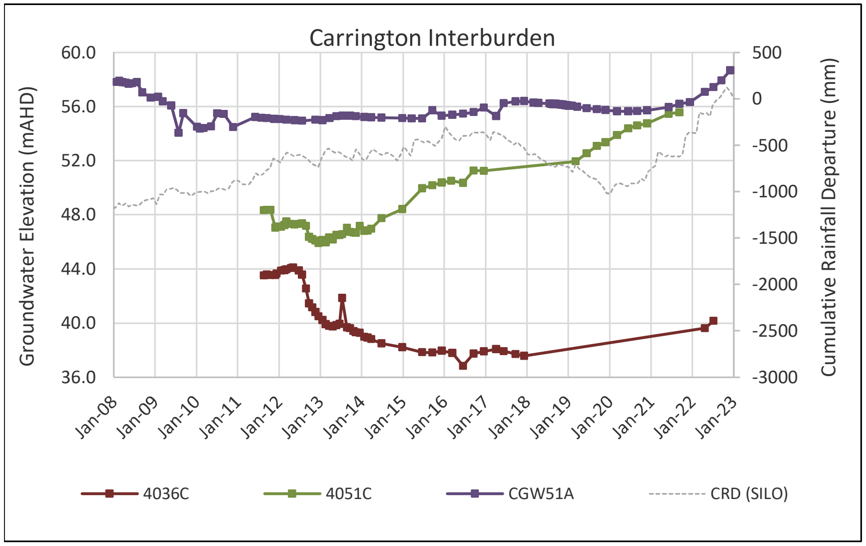
Carrington Alluvium - CGW52a
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
CGW52A
Trigger SWL (5th)
Trigger SWL (95th)
CRD (SILO)

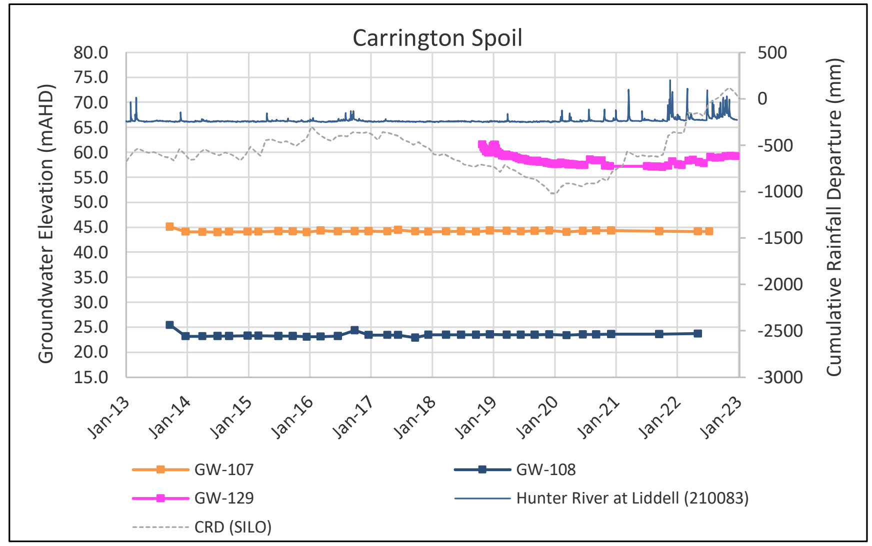

Carrington Alluvium - CGW53a
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
CGW53A
Trigger SWL (5th)
Trigger SWL (95th)
CRD (SILO)

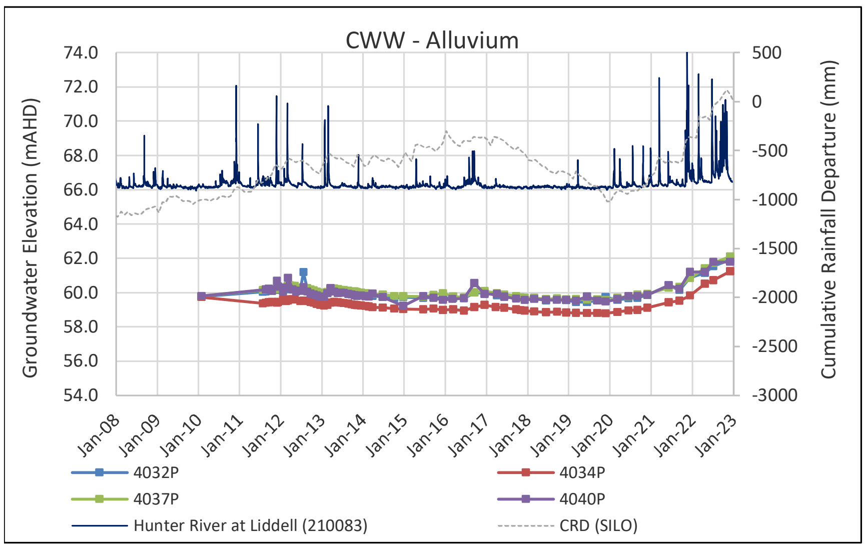

Carrington Alluvium - CGW54a
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
CGW54A
CRD (SILO)

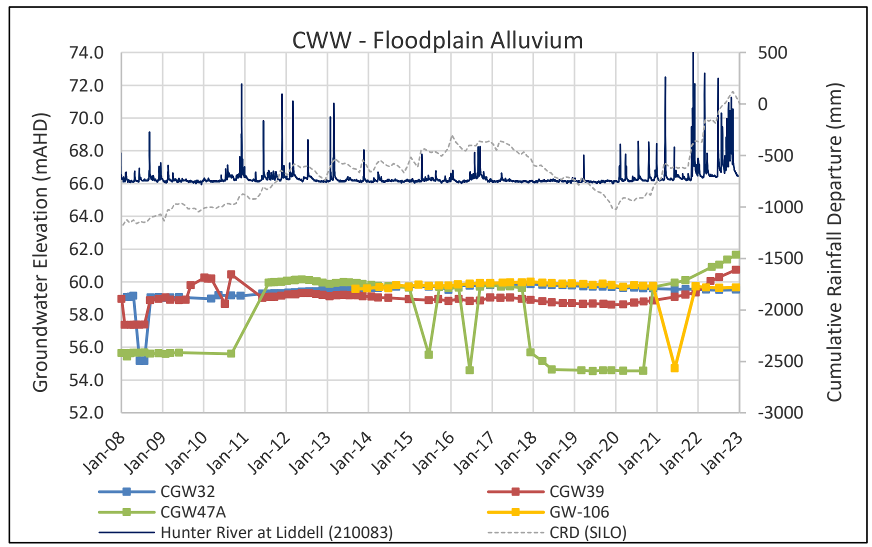

Carrington Alluvium - CGW55a
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
CGW55A
Trigger SWL (5th)
Trigger SWL (95th)
CRD (SILO)

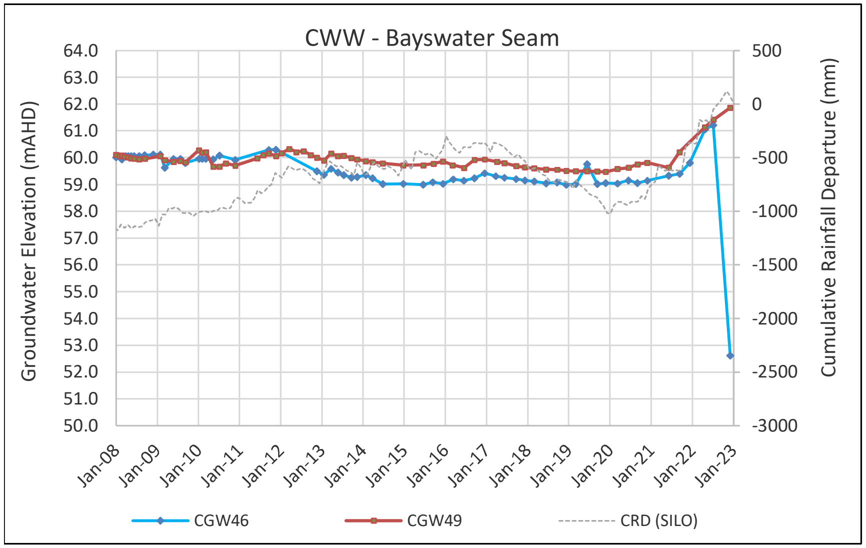

Carrington Broonie
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
CGW52
CGW53
CRD (SILO)

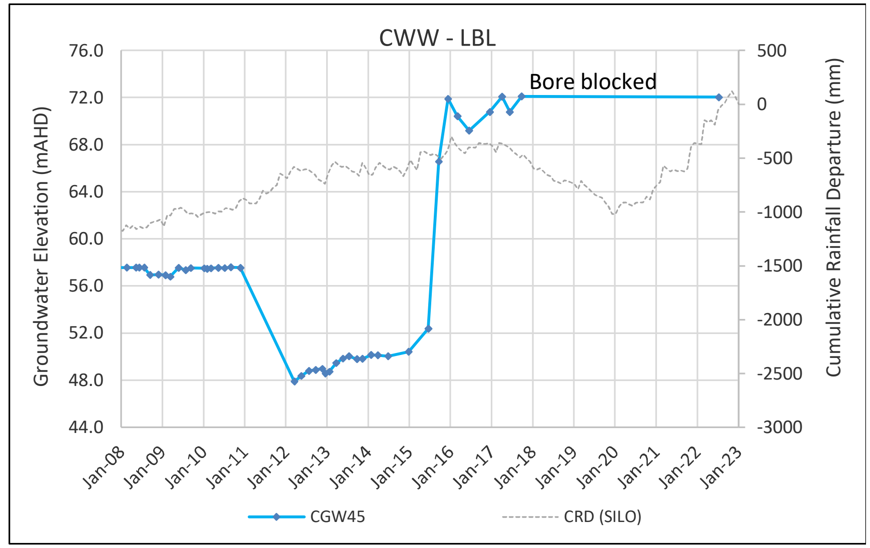

Carrington Interburden
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
60.0
56.0
52.0
48.0
44.0
40.0
36.0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
4036C
4051C
CGW51A
CRD (SILO)

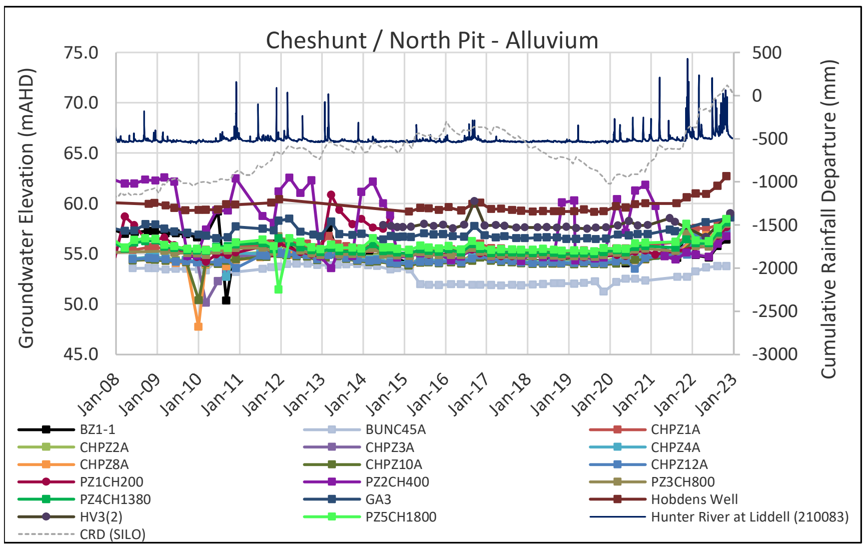

Carrington Spoil
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
GW-107
GW-108
GW-129
Hunter River at Liddell (210083)
CRD (SILO)

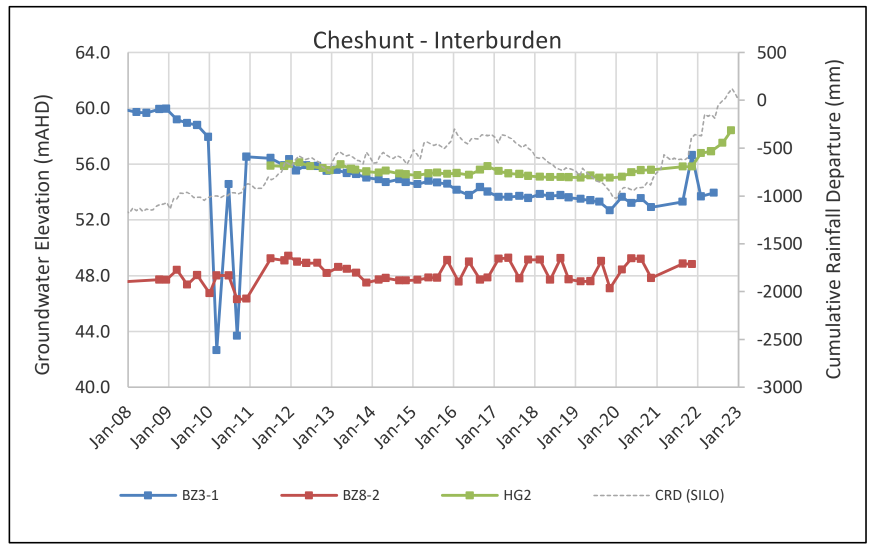

CWW - Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
74.0
72.0
70.0
68.0
66.0
64.0
62.0
60.0
58.0
56.0
54.0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
4032P
4034P
4037P
4040P
Hunter River at Liddell (210083)
CRD (SILO)

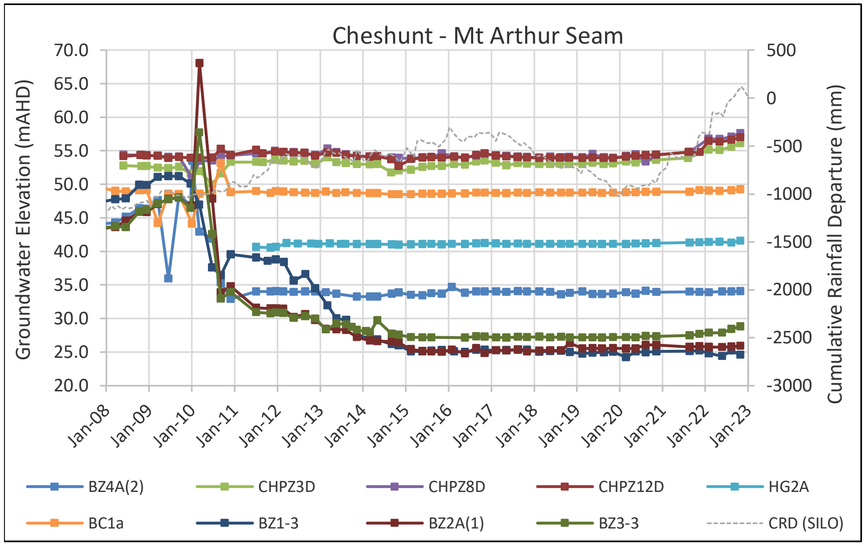

CWW - Floodplain Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
74.0
72.0
70.0
68.0
66.0
64.0
62.0
60.0
58.0
56.0
54.0
52.0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
CGW32
CGW39
CGW47A
GW-106
Hunter River at Liddell (210083)
CRD (SILO)

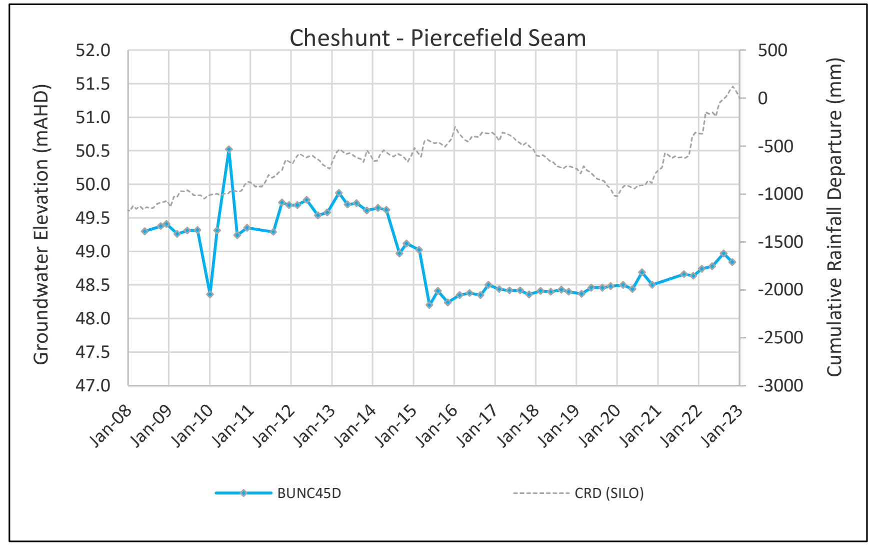

CWW - Bayswater Seam
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
CGW46
CGW49
CRD (SILO)

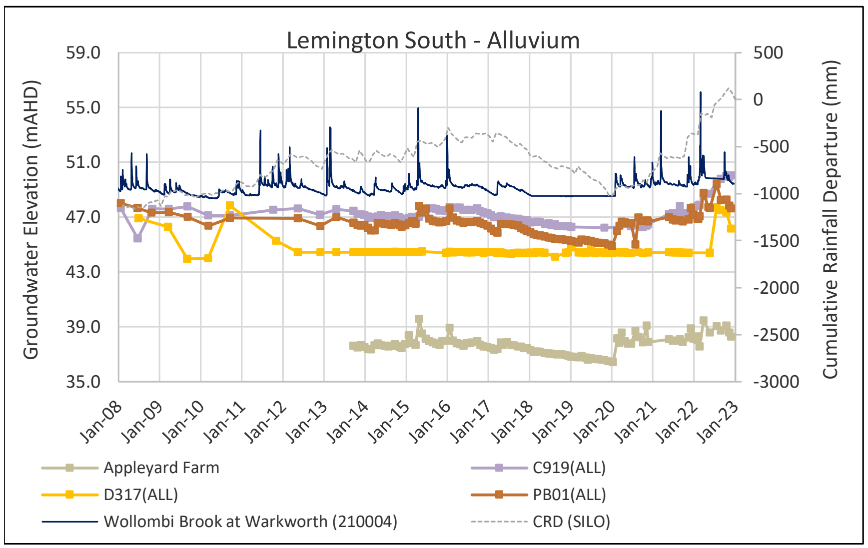

CWW - LBL
Bore blocked
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
CGW45
CRD (SILO)

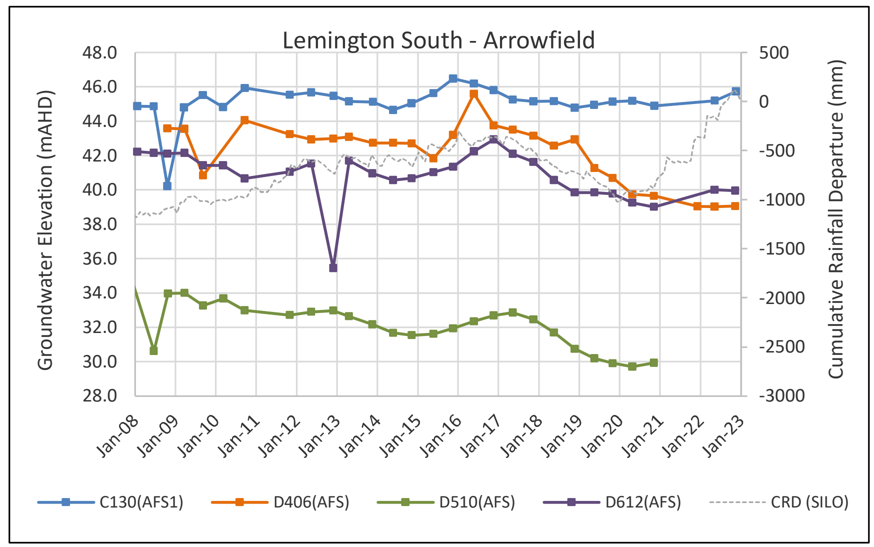

Cheshunt / North Pit - Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
BZ1-1
BUNC45A
CHPZ1A
CHPZ2A
CHPZ3A
CHPZ4A
CHPZ8A
CHPZ10A
CHPZ12A
PZ1CH200
PZ2CH400
PZ3CH800
PZ4CH1380
GA3
Hobdens Well
HV3(2)
PZ5CH1800
Hunter River at Liddell (210083)
CRD (SILO)

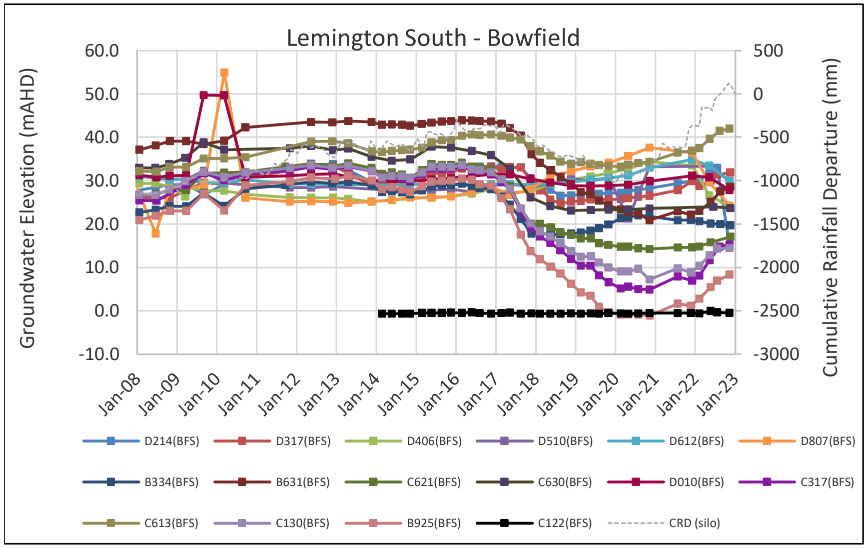

Cheshunt - Interburden
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
BZ3-1
BZ8-2
HG2
CRD (SILO)

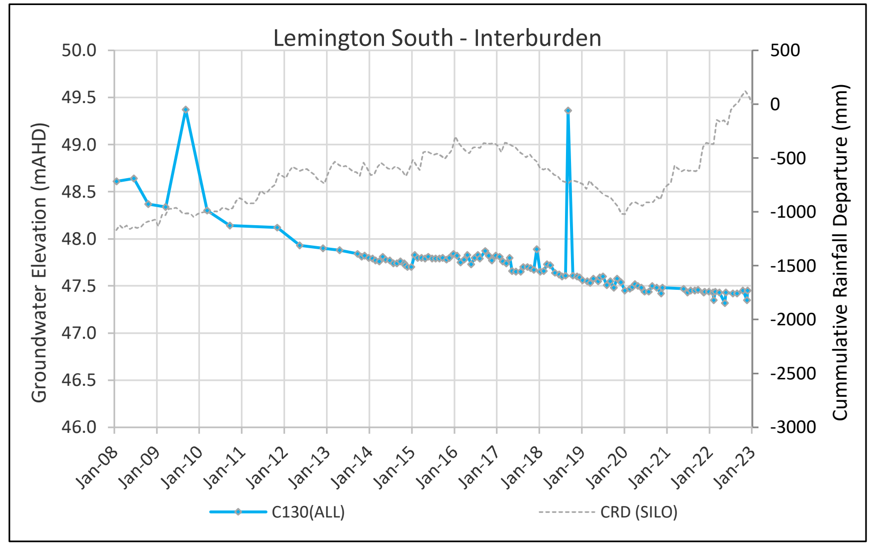

Cheshunt - Mt Arthur Seam
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
BZ4A(2)
CHPZ3D
CHPZ8D
CHPZ12D
HG2A
BC1a
BZ1-3
BZ2A(1)
BZ3-3
CRD (SILO)

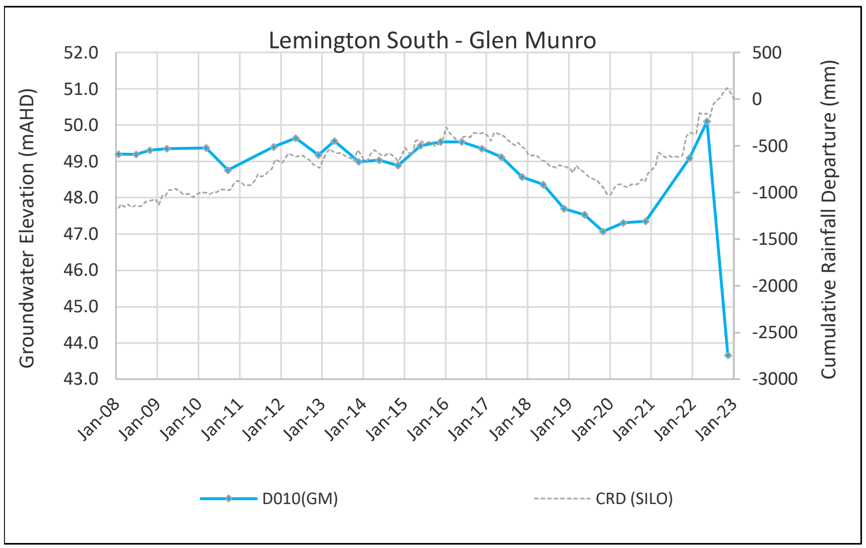

Cheshunt - Piercefield Seam
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
BUNC45D
CRD (SILO)

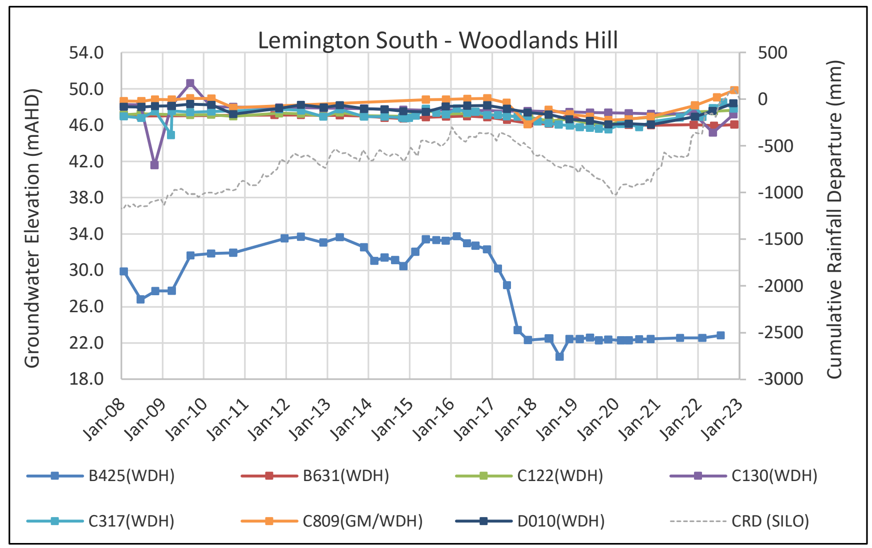

Lemington South - Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
Appleyard Farm
C919(ALL)
D317(ALL)
PB01(ALL)
Wollombi Brook at Warkworth (210004)
CRD (SILO)

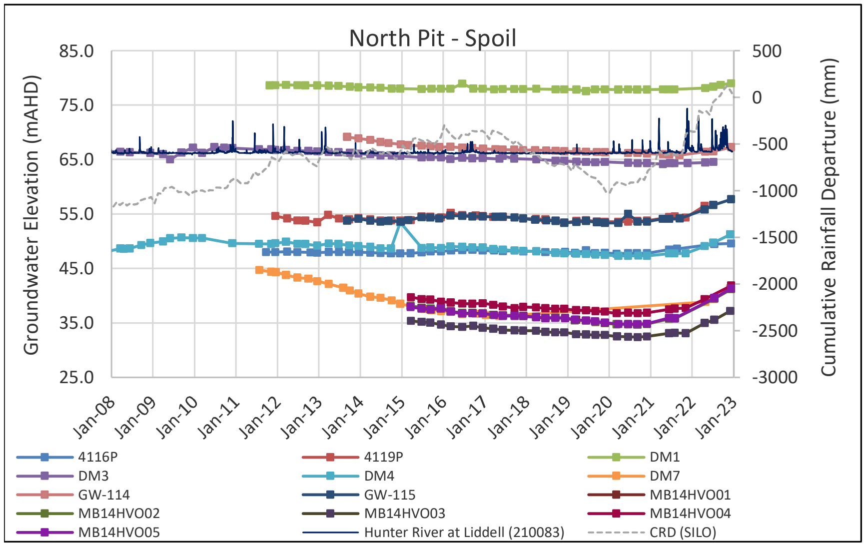

Lemington South - Arrowfield
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
C130(AFS1)
D406(AFS)
D510(AFS)
D612(AFS)
CRD (SILO)

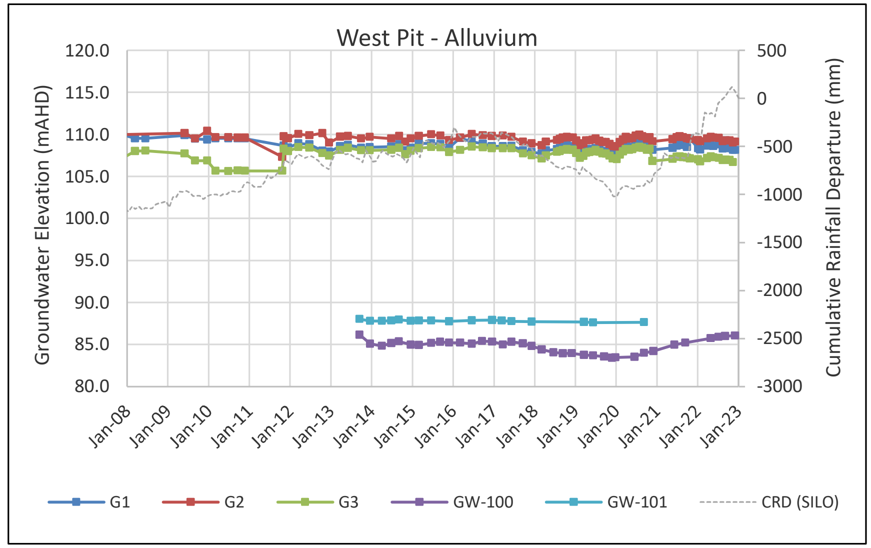

Lemington South - Bowfield
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
D214(BFS)
D317(BFS)
D406(BFS)
D510(BFS)
D612(BFS)
D807(BFS)
B334(BFS)
B631(BFS)
C621(BFS)
C630(BFS)
D010(BFS)
C317(BFS)
C613(BFS)
C130(BFS)
B925(BFS)
C122(BFS)
CRD (silo)

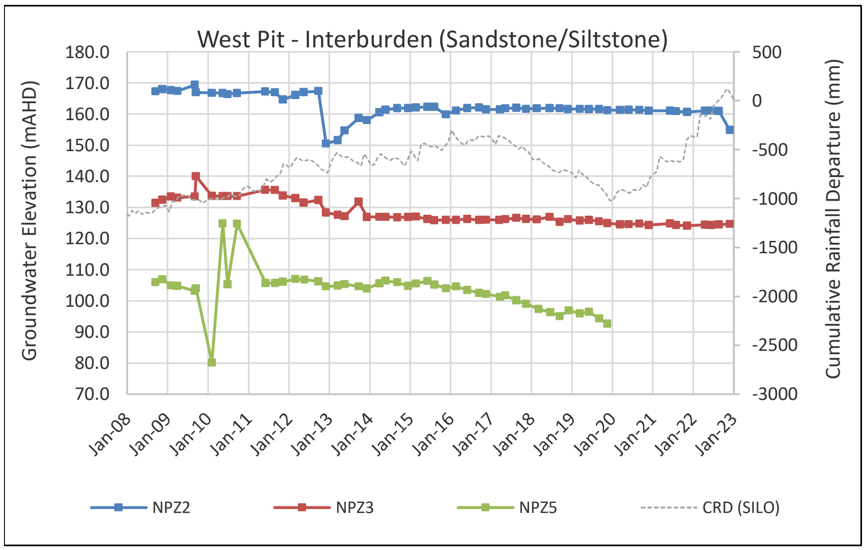

Lemington South - Interburden
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
C130(ALL)
CRD (SILO)

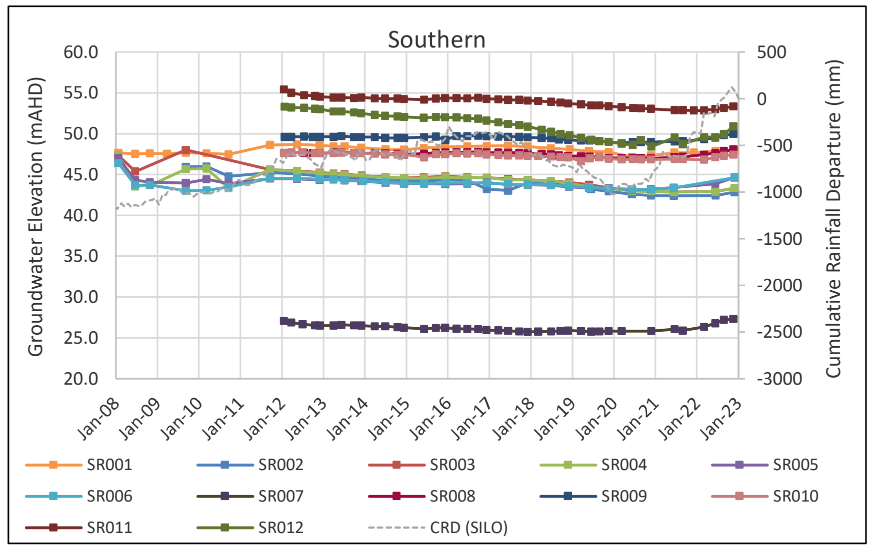

Lemington South - Glen Munro
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
D010(GM)
CRD (SILO)


Lemington South - Woodlands Hill
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
B425(WDH)
B631(WDH)
C122(WDH)
C130(WDH)
C317(WDH)
C809(GM/WDH)
D010(WDH)
CRD (SILO)


North Pit - Spoil
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
85.0
75.0
65.0
55.0
45.0
35.0
25.0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21 Jan-22 Jan-23
4116P
4119P
DM1
DM3
DM4
DM7
GW-114
GW-115
MB14HVO01
MB14HVO02
MB14HVO03
MB14HVO04
MB14HVO05
Hunter River at Liddell (210083)
CRD (SILO)


West Pit - Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
120.0
115.0
110.0
105.0
100.0
95.0
90.0
85.0
80.0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21 Jan-22 Jan-23
G1
G2
G3
GW-100
GW-101
CRD (SILO)


West Pit - Interburden (Sandstone/Siltstone)
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21 Jan-22 Jan-23
NPZ2
NPZ3
NPZ5
CRD (SILO)


Southern
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21 Jan-22 Jan-23
SR001
SR002
SR003
SR004
SR005
SR006
SR007
SR008
SR009
SR010
SR011
SR012
CRD (SILO)

APPENDIX D

Groundwater Quality Data

Table D.1 Groundwater Quality Data – Alluvium

Bore ID	WMP Location and Geology	pH Trigger		Q1			Q2			Q3			Q4			EC Trigger (µS/cm)	Q1			Q2			Q3			Q4		
		(5th Percentile)	(95th Percentile)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CFW55R	Carrington Alluvium	7	8	7.2	7	7	7	7.2	7.2	7.1	7.2	7.1	-	7.2	7.1	6154	8960	8100	7550	6880	5950	5610	5760	4770	4160	nm	3540	3570
CFW57	Carrington Alluvium	7	8	7.2	7.1	7.2	7.2	7.4	7.5	7.2	7	7.2	7.2	7.1	7.4	6154	5010	4820	4020	4830	2790	2010	4140	4360	4640	3900	4360	2140
CGW52a	Carrington Alluvium	7	8	No Access			-	7.8	-	7.7	-	7.7	-	-	7.8	6154	No Access			-	1610	-	1220	-	1312	-	-	1389
CGW53a	Carrington Alluvium	7	8	No Access			-	7.2	-	7	-	7.1	-	-	7.5	6154	No Access			-	1249	-	847	-	854	-	-	888
CGW55a	Carrington Alluvium	7	8	No Access			-	7	-	7.5	-	7.2	-	-	7.6	6154	No Access			-	1625	-	548	-	645	-	-	860
4032P	Carrington West Wing Alluvium	7	7.5	No Access			-	7.4	-	7.3	-	7.3	-	-	7.4	2775	No Access			-	1218	-	1378	-	1137	-	-	1169
4034P	Carrington West Wing Alluvium	7	7.5	No Access			-	7.4	-	7.4	-	-	-	-	7.4	2775	No Access			-	1234	-	1255	-	-	-	-	1273
4037P	Carrington West Wing Alluvium	7	7.5	No Access			-	7.3	-	7.3	-	-	-	-	7.3	2775	No Access			-	1009	-	993	-	-	-	-	1304
4040P	Carrington West Wing Alluvium	7	7.5	No Access			-	7.2	-	7.3	-	7.2	-	-	7.2	2775	No Access			-	1650	-	1227	-	1348	-	-	1289
CGW49	Carrington West Wing Alluvium	7	7.5	No Access			-	7.4	-	7.4	-	-	-	-	7.6	2775	No Access			-	2010	-	1905	-	-	-	-	1638
GW-106	Carrington West Wing Alluvium	6.8	7.8	-	-	6.7	No Access			6.7	-	6.7	-	-	6.8	9280	-	-	5500	No Access			7990	-	8560	-	-	7220
CGW32	Carrington West Wing Flood Plain	6.8	7.8	-	-	7.2	No Access			7.2	-	7.1	-	-	7.1	9280	-	-	8850	No Access			8970	-	8590	-	-	8530
CGW39	Carrington West Wing Flood Plain	6.8	7.8	Dry			-	7.3	-	7.5	-	-	-	-	7.4	9280	Dry			-	5400	-	5270	-	-	-	-	4880
CGW47a	Carrington West Wing Flood Plain	6.8	7.8	No Access			-	7.6	-	7.6	-	7.4	-	-	7.4	9280	No Access			-	5080	-	5420	-	5900	-	-	6070
BUNC45A	Cheshunt / North Pit Alluvium	6.6	7.5	-	6.6	-	-	6.6	-	-	6.6	-	-	6.6	-	4462	-	2500	-	-	2500	-	-	3000	-	-	2780	-
BZ1-1	Cheshunt / North Pit Alluvium	6.6	7.5	-	7.4	-	-	-	7.5	-	7.3	-	-	7.5	-	4462	-	2480	-	-	-	2460	-	3590	-	-	2770	-
CHPZ10A	Cheshunt / North Pit Alluvium	6.6	7.5	-	6.7	-	-	7	-	-	6.8	-	-	7.1	-	4462	-	1185	-	-	664	-	-	1619	-	-	1169	-
CHPZ12A	Cheshunt / North Pit Alluvium	6.6	7.5	-	6.8	-	-	7	-	-	6.9	-	-	7.4	-	4462	-	1125	-	-	873	-	-	1129	-	-	966	-
CHPZ1A	Cheshunt / North Pit Alluvium	6.6	7.5	-	7.1	-	-	6.9	-	-	7.1	-	-	7	-	4462	-	696	-	-	690	-	-	691	-	-	711	-
CHPZ2A	Cheshunt / North Pit Alluvium	6.6	7.5	-	7	-	-	7.2	-	-	7.1	-	-	7.1	-	4462	-	880	-	-	896	-	-	858	-	-	1178	-
CHPZ3A	Cheshunt / North Pit Alluvium	6.6	7.5	-	6.8	-	-	7.1	-	-	6.9	-	-	7.1	-	4462	-	885	-	-	798	-	-	851	-	-	813	-
CHPZ4A	Cheshunt / North Pit Alluvium	6.6	7.5	-	6.9	-	-	6.9	-	-	7	-	-	7	-	4462	-	786	-	-	837	-	-	925	-	-	921	-
CHPZ8A	Cheshunt / North Pit Alluvium	6.6	7.5	-	7.1	-	-	7.3	-	-	7.2	-	-	7.2	-	4462	-	1131	-	-	757	-	-	966	-	-	988	-
GA3	Cheshunt / North Pit Alluvium	6.6	7.5	No Access			-	6.9	-	No Access			-	-	6.9	4462	No Access			-	576	-	No Access			-	-	676
Hobdens Well	Cheshunt / North Pit Alluvium	6.6	7.5	-	7.3	-	-	7.7	-	-	7.7	-	-	7.2	-	4462	-	1134	-	-	1107	-	-	1036	-	-	1035	-
HV3(2)	Cheshunt / North Pit Alluvium	6.6	7.5	No Access			-	6.9	-	No Access			-	-	7	4462	No Access			-	777	-	No Access			-	-	763
PZ1CH200	Cheshunt / North Pit Alluvium	6.6	7.5	-	7.2	-	-	-	7.3	-	7.4	-	-	7.1	-	4462	-	958	-	-	-	980	-	994	-	-	1048	-
PZ2CH400	Cheshunt / North Pit Alluvium	6.6	7.5	-	7	-	-	-	6.8	-	6.9	-	-	6.9	-	4462	-	793	-	-	-	745	-	1025	-	-	1002	-
PZ3CH800	Cheshunt / North Pit Alluvium	6.6	7.5	-	7.1	-	-	-	7	-	6.9	-	-	6.8	-	4462	-	906	-	-	-	894	-	1132	-	-	1084	-
PZ4CH1380	Cheshunt / North Pit Alluvium	6.6	7.5	-	7	-	-	-	6.8	-	7.1	-	-	6.7	-	4462	-	740	-	-	-	747	-	745	-	-	710	-
PZ5CH1800	Cheshunt / North Pit Alluvium	6.6	7.5	-	7	-	-	-	6.8	-	6.7	-	-	6.8	-	4462	-	193	-	-	-	159	-	85	-	-	128	-
Appleyard Farm	Lemington South Alluvium	6.6	7.7	-	6.62	-	-	-	6.9	-	6.7	-	-	6.7	-	3938	-	426	-	-	-	468	-	361	-	-	377	-
C919(ALL)	Lemington South Alluvium	6.6	7.7	-	7.4	-	-	-	7.5	-	7.6	-	-	7.6	-	3938	-	793	-	-	-	766	-	743	-	-	719	-
PB01(ALL)	Lemington South Alluvium	6.6	7.7	-	6.9	-	-	6.6	-	-	6.1	-	-	6.5	-	3938	-	2910	-	-	364	-	-	205	-	-	1604	-
G1	West Pit Alluvium	7.1	8.6	7.2	7.2	7.2	7.2	7.5	7.6	7.5	7.5	7.3	7.2	7.1	7.4	10751	3170	4510	4650	975	2080	1828	870	1527	1538	1723	2250	2430
G2	West Pit Alluvium	7.1	8.6	7.4	7.4	7.4	7.4	7.5	7.6	7.6	7.5	7.4	7.6	7.5	7.4	10751	6100	5920	5960	6020	6010	5840	5860	5920	5800	5800	5770	5830
G3	West Pit Alluvium	7.1	8.6	7.4	7.5	7.4	7.5	7.5	7.6	7.5	7.6	7.5	7.5	7.4	-	10751	5780	5530	5550	5680	5720	5630	5770	5620	5510	5510	5740	nm
GW-100	West Pit Alluvium	7.1	8.6	No Access			-	7.4	-	7.5	-	7.4	-	-	7.4	10751	No Access			-	10450	-	9920	-	10330			10100
GW-101	West Pit Alluvium	7.1	8.6	No Access			Dry			Dry			Dry			10751	No Access			Dry			Dry			Dry		

Table D.2 Groundwater Quality Data – Permian Coal Measures

Bore ID	WMP Geology	pH Trigger		Q1			Q2			Q3			Q4			EC Trigger (µS/cm)	Q1			Q2			Q3			Q4		
		(5th Percentile)	(95th Percentile)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CGW51a	Carrington Interburden	6.7	7.4	No Access			-	7.4	-	7.4	-	7.6	-	-	7.6	10824	No Access			-	5800	-	6100	-	5640	-	-	7160
CGW52	Carrington Broonie	6.8	7.1	No Access			-	6.8	-	7	-	6.8	-	-	6.9	8628	No Access			-	8240	-	7870	-	7590	-	-	7650
CGW53	Carrington Broonie	6.8	7.1	No Access			-	6.8	-	6.8	-	6.6	-	-	6.7	8628	No Access			-	7500	-	6810	-	6000	-	-	6440
4036C	Carrington Interburden	6.7	7.4	No Access			-	6.9	-	6.8	-	-	Blocked			10824	No Access			-	3880	-	3350	-	-	Blocked		
4051C	Carrington Interburden	6.7	7.4	No Access			Blocked			Blocked			Blocked			10824	No Access			Blocked			Blocked			Blocked		
CGW46	Carrington West Wing Bayswater	7.3	7.6	No Access			-	7.3	-	7.3	-	-	-	-	7.1	3531	No Access			-	788	-	761	-	-	-	-	824
CGW45	Carrington West Wing LBL	6.5	7.2	Blocked												1894	Blocked											
BZ3-1	Cheshunt Interburden	6.9	7.7	-	7.7	-	Blocked			Blocked			Blocked			6213	-	1558	-	Blocked			Blocked			Blocked		
BZ8-2	Cheshunt Interburden	6.9	7.7	No Access			No Access			No Access			No Access			6213	No Access			No Access			No Access			No Access		
HG2	Cheshunt Interburden	6.9	7.7	-	7.4	-	-	7.4	-	-	7.5	-	-	7.4	-	6213	-	3740	-	-	3640	-	-	3640	-	-	3640	-
BC1a	Cheshunt Mt Arthur	6.5	7.6	-	6.9	-	-	6.9	-	-	7	-	-	7	-	3350	-	1002	-	-	998	-	-	937	-	-	933	-
BZ1-3	Cheshunt Mt Arthur	6.5	7.6	-	6.9	-	-	-	7.3	-	7.3	-	-	6.9	-	3350	-	950	-	-	-	546	-	974	-	-	984	-
BZ2A(1)	Cheshunt Mt Arthur	6.5	7.6	-	6.2	-	-	-	6.4	-	6.4	-	-	6.5	-	3350	-	1143	-	-	-	1165	-	1237	-	-	1421	-
BZ3-3	Cheshunt Mt Arthur	6.5	7.6	-	6.1	-	-	-	6.2	-	6.1	-	-	6.1	-	3350	-	1019	-	-	-	1102	-	1141	-	-	1171	-
BZ4A(2)	Cheshunt Mt Arthur	6.5	7.6	-	6.3	-	-	-	6.3	Insufficient Water			Insufficient Water			3350	-	1956	-	-	-	1268	Insufficient Water			Insufficient Water		
CHPZ12D	Cheshunt Mt Arthur	6.5	7.6	-	6.7	-	-	6.8	-	-	6.8	-	-	7.1	-	3350	-	1286	-	-	1303	-	-	1284	-	-	1402	-
CHPZ3D	Cheshunt Mt Arthur	6.5	7.6	-	6.5	-	-	6.6	-	-	6.5	-	-	6.6	-	3350	-	983	-	-	369	-	-	957	-	-	1010	-
CHPZ8D	Cheshunt Mt Arthur	6.5	7.6	-	7.2	-	-	7.1	-	-	7	-	-	7.1	-	3350	-	994	-	-	203	-	-	960	-	-	1000	-
HG2a	Cheshunt Mt Arthur	6.5	7.6	-	7.1	-	-	7.2	-	-	7.4	-	-	7.3	-	3350	-	1823	-	-	2010	-	-	2180	-	-	2370	-
BUNC45D	Cheshunt Piercefield	6.4	6.8	-	6.8	-	-	6.7	-	-	6.7	-	-	6.5	-	2596	-	2430	-	-	2260	-	-	2400	-	-	2350	-
C130(AFS1)	Lemington South Arrowfield	6.8	7.5	NR (6M)			-	7.1	-	NR (6M)			-	7.3	-	15324	NR (6M)			-	12820	-	NR (6M)			-	12740	-
D406(AFS)	Lemington South Arrowfield	6.8	7.5	NR (6M)			-	6.8	-	NR (6M)			-	6.9	-	15324	NR (6M)			-	11320	-	NR (6M)			-	11230	-
D510(AFS)	Lemington South Arrowfield	6.8	7.5	NR (6M)			Blocked			NR (6M)			Blocked			NR (6M)	NR (6M)			Blocked			NR (6M)			Blocked		
D612(AFS)	Lemington South Arrowfield	6.8	7.5	NR (6M)			-	6.8	-	NR (6M)			-	6.8	-	15324	NR (6M)			-	14700	-	NR (6M)			-	13350	-
B334(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	-	7.2	NR (6M)			-	7.2	-	12440	NR (6M)			-	-	7100	NR (6M)			-	7040	-
B631(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	-	6.7	NR (6M)			-	6.6	-	12440	NR (6M)			-	-	12020	NR (6M)			-	12330	-
B925(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	-	7	NR (6M)			-	7	-	12440	NR (6M)			-	-	4380	NR (6M)			-	5490	-
C122(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	-	10	NR (6M)			Insufficient Water			12440	NR (6M)			-	-	707	MR (6M)			Insufficient Water		
C130(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	7.2	-	NR (6M)			-	7	-	12440	NR (6M)			-	4960	-	NR (6M)			-	4570	-
C317(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	7	-	NR (6M)			-	7	-	12440	NR (6M)			-	10150	-	NR (6M)			-	10340	-
C613(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	7	-	NR (6M)			-	7	-	12440	NR (6M)			-	8690	-	NR (6M)			-	8820	-
C621(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	-	7.3	NR (6M)			-	7.1	-	12440	NR (6M)			-	-	7310	NR (6M)			-	7406	-
C630(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	8.0	-	NR (6M)			-	7.7	-	12440	NR (6M)			-	4610	-	NR (6M)			-	4670	-
D010(BFS)	Lemington South Bowfield	6.7	7.1	NR (6M)			-	7.2	-	NR (6M)			-	7.2	-	11408	NR (6M)			-	9840	-	NR (6M)			-	8600	-
D214(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	7.7	-	NR (6M)			-	5.7	-	12440	NR (6M)			-	7650	-	NR (6M)			-	123	-
D317(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	-	6.8	NR (6M)			-	6.8	-	12440	NR (6M)			-	-	2570	NR (6M)			-	2600	-
D406(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	7.4	-	NR (6M)			-	7.3	-	12440	NR (6M)			-	7100	-	NR (6M)			-	7080	-
D510(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	7.1	-	NR (6M)			-	6.2	-	12440	NR (6M)			-	10590	-	NR (6M)			-	362	-
D612(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	6.8	-	NR (6M)			-	6.8	-	12440	NR (6M)			-	11300	-	NR (6M)			-	11380	-
D807(BFS)	Lemington South Bowfield	6.7	7.9	NR (6M)			-	6.9	-	NR (6M)			-	6.8	-	12440	NR (6M)			-	9470	-	NR (6M)			-	10660	-
D010(GM)	Lemington South Glen Munro	6.7	7.1	NR (6M)			-	6.8	-	NR (6M)			-	6.8	-	11408	NR (6M)			-	10700	-	NR (6M)			-	10370	-
C130(ALL)	Lemington South Interburden	6.8	7.0	-	6.8	-	-	7	-	-	7	-	-	7.2	-	22700	-	20800	-	-	19250	-	-	19180	-	-	18670	-
LUG Bore	Lemington South Mt Arthur	No Trigger		-	8.6	-	-	-	8.5	-	8.7	-	-	8.9	-	No Trigger	-	8600	-	-	-	8100	-	8190	-	-	8490	-
B425(WDH)	Lemington South Woodlands Hill	6.6	7.6	NR (6M)			Dry			NR (6M)			No Access			20240	NR (6M)			Dry			NR (6M)			No Access		
B631(WDH)	Lemington South Woodlands Hill	6.6	7.6	NR (6M)			-	-	6.8	NR (6M)			-	6.8	-	20240	NR (6M)			-	-	11850	NR (6M)			-	11920	-

Bore ID	WMP Geology	pH Trigger		Q1			Q2			Q3			Q4			EC Trigger	Q1			Q2			Q3			Q4		
C122(WDH)	Lemington South Woodlands Hill	6.6	7.6	NR (6M)			-	-	7.4	NR (6M)			-	7.4	-	20240	NR (6M)			-	-	13260	NR (6M)			-	14430	-
C130(WDH)	Lemington South Woodlands Hill	6.6	7.6	NR (6M)			-	6.6	-	NR (6M)			-	6.6	-	20240	NR (6M)			-	19890	-	NR (6M)			-	2020	-
C317(WDH)	Lemington South Woodlands Hill	6.6	7.6	NR (6M)			-	7.4	-	NR (6M)			-	7.3	-	20240	NR (6M)			-	6260	-	NR (6M)			-	5190	-
C809(GM/WDH)	Lemington South Woodlands Hill	6.6	7.6	NR (6M)			-	7.0	-	NR (6M)			-	7.1	-	20240	NR (6M)			-	9980	-	NR (6M)			-	9630	-
D010(WDH)	Lemington South Woodlands Hill	6.6	7.6	NR (6M)			-	7.2	-	NR (6M)			-	7.3	-	20240	NR (6M)			-	9340	-	NR (6M)			-	288	-
SR002	Southern Bayswater Seam	No Trigger		NR (6M)			-	-	6.8	NR (6M)			-	-	6.8	No Trigger	NR (6M)			-	-	15260	NR (6M)			-	-	14500
SR003	Southern Bayswater Seam	No Trigger		NR (6M)			-	-	6.9	NR (6M)			-	-	6.9	No Trigger	NR (6M)			-	-	9650	NR (6M)			-	-	9600
SR004	Southern Bayswater Seam	No Trigger		NR (6M)			-	-	6.8	NR (6M)			-	-	6.8	No Trigger	NR (6M)			-	-	12760	NR (6M)			-	-	12290
SR005	Southern Bayswater Seam	No Trigger		NR (6M)			-	-	6.3	NR (6M)			-	-	6.3	No Trigger	NR (6M)			-	-	3830	NR (6M)			-	-	5430
SR006	Southern Bayswater Seam	No Trigger		NR (6M)			-	-	6.8	6.8	-	-	-	-	7	No Trigger	NR (6M)			-	-	11850	11850	-	-	-	-	11300
SR001	Southern Coal	No Trigger		NR (6M)			-	-	6.7				-	-	6.7	No Trigger	NR (6M)			-	-	17830				-	-	15420
SR010	Southern Conglomerate and Warkworth Seam	No Trigger		-	-	7	-	-	7	-	-	7	-	-	7	No Trigger	-	-	5850	-	-	5950	-	-	6340	-	-	5950
SR009	Southern Lemington Seam	No Trigger		-	-	7.4	-	-	7.4	-	-	7.4	-	-	7.3	No Trigger	-	-	5900	-	-	5990	-	-	5780	-	-	6000
SR011	Southern Mt Arthur Seam and underburden	No Trigger		-	-	6.6	-	-	6.5	-	-	6.6	-	-	6.5	No Trigger	-	-	14850	-	-	16350	-	-	14000	-	-	15110
SR012	Southern Overburden - conglomerate and sandstone	No Trigger		-	-	7.1	-	-	7	-	-	6.9	-	-	6.8	No Trigger	-	-	11010	-	-	8220	-	-	11190	-	-	12880
SR007	Southern Overburden and Vaux Seam	No Trigger		-	-	6.7	-	-	6.6	-	-	6.6	-	-	6.6	No Trigger	-	-	5200	-	-	4610	-	-	4660	-	-	4170
SR008	Southern Siltstone/sandstone below Lemington Seam	No Trigger		-	-	6.9	-	-	6.8	-	-	6.9	-	-	6.8	No Trigger	-	-	9250	-	-	13070	-	-	12430	-	-	12650
NPz2	West Pit Sandstone/Siltstone	6.9	8	No Access			-	7.6	-	7	-	7.1	-	-	7.2	13428	No Access			-	15410	-	13160	-	13800	-	-	13550
NPz3	West Pit Sandstone/Siltstone	6.9	8	No Access			-	7.8	-	7.6	-	7.8	Blocked			13428	No Access			-	12880	-	12320	-	12680	Blocked		
NPz5	West Pit Sandstone/Siltstone	6.9	8	Mined Through, No Longer Exists												13428	Mined Through, No Longer Exists											

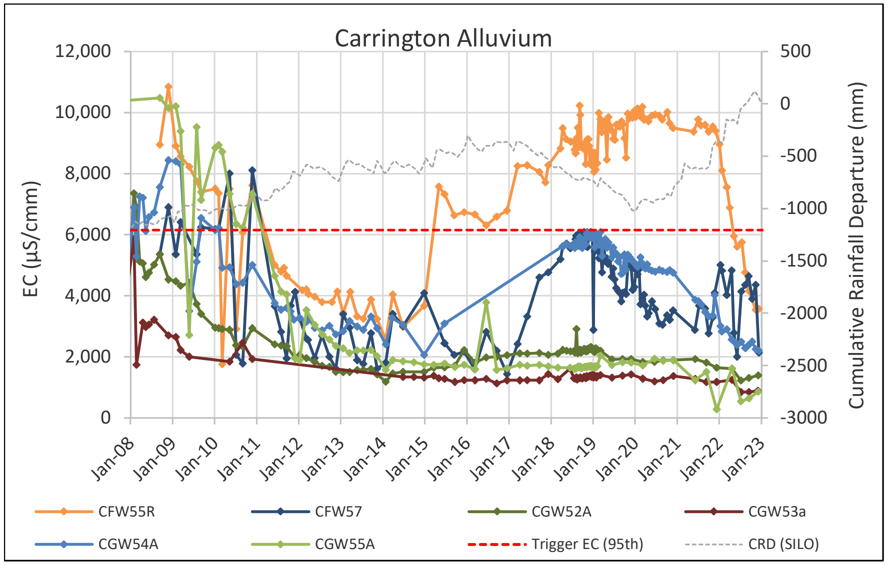
Note: NR (6M) – not required as six monthly monitoring only.

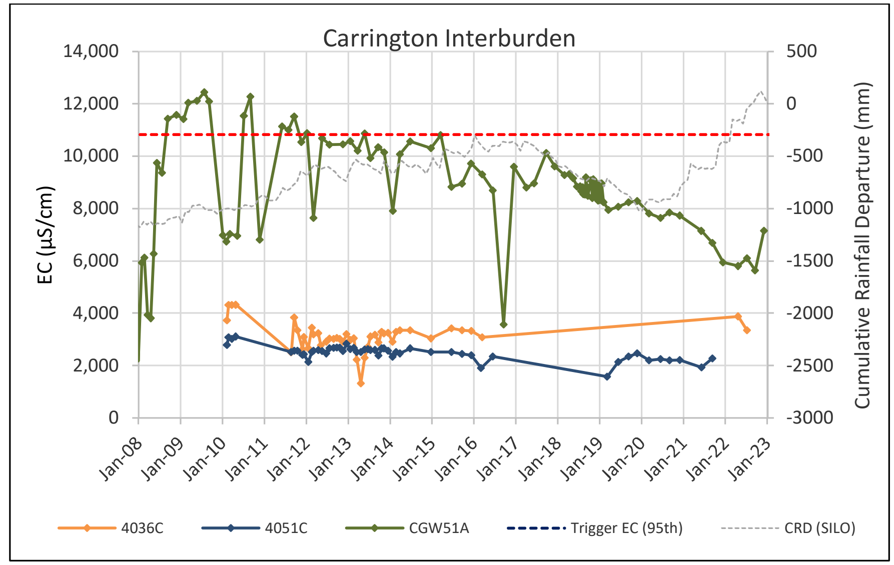
Table D.3 Groundwater Quality Data – Spoil

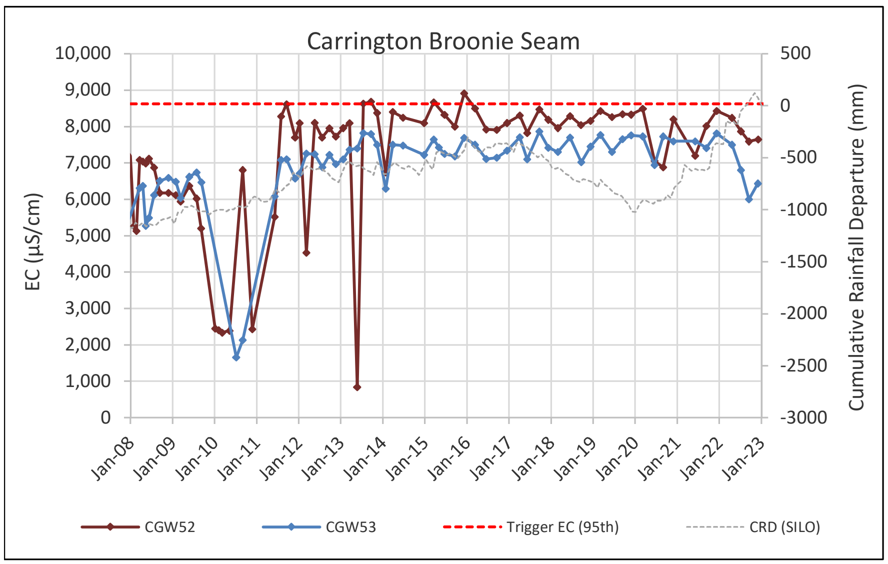
Bore ID	WMP Geology	pH Trigger		Q1			Q2			Q3			Q4			EC Trigger (µS/cm)	Q1			Q2			Q3			Q4		
		(5th Percentile)	(95th Percentile)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
GW-107	Carrington Spoil	No Trigger		No Access			Insufficient Water			Insufficient Water			Dry			No Trigger	No Access			Insufficient Water			Insufficient Water			Dry		
GW-108	Carrington Spoil	No Trigger		No Access			Insufficient Water			No Access			Blocked			No Trigger	No Access			Insufficient Water			No Access			Blocked		
4116P	North Pit Spoil	6.5	7.8	No Access			-	-	-	7.1	-	7	-	-	6.9	12460	No Access			-	-	-	12820	-	11850	-	-	11520
4119P	North Pit Spoil	6.5	7.8	No Access			-	7	-	No Access			No Access			12460	No Access			-	2780	-	No Access			No Access		
DM1	North Pit Spoil	6.5	7.8	No Access			-	6.6	-	6.8	-	6.6	-	-	6.6	12460	No Access			-	10020	-	9560	-	7790	-	-	8300
DM3	North Pit Spoil	6.5	7.8	No Access			-	6.4	-	6.6	-	6.4	Blocked			12460	No Access			-	9480	-	9330	-	9320	Blocked		
DM4	North Pit Spoil	6.5	7.8	No Access			-	6.8	-	6.9	-	6.9	-	-	7	12460	No Access			-	6270	-	5830	-	5770	-	-	5930
DM7	North Pit Spoil	6.5	7.8	No Access			-	7.1	-	7.2	-	7.2	-	-	7.4	12460	No Access			-	8590	-	7810	-	7270	-	-	7250
GW-114	North Pit Spoil	6.5	7.8	No Access			-	6.6	-	6.6	-	6.5	-	-	6.6	12460	No Access			-	8480	-	8050	-	8530	-	-	7530
GW-115	North Pit Spoil	6.5	7.8	No Access			-	6.8	-	6.8	-	6.8	-	-	6.8	12460	No Access			-	7080	-	6150	-	6810	-	-	3750
MB14HVO01	North Pit Spoil	6.5	7.8	No Access			-	-	-	6.9	-	6.8	-	-	7	12460	No Access			-	-	-	6740	-	7200	-	-	5720
MB14HVO02	North Pit Spoil	6.5	7.8	No Access			-	-	-	6.9	-	6.8	-	-	6.8	12460	No Access			-	-	-	6780	-	6940	-	-	6530
MB14HVO03	North Pit Spoil	6.5	7.8	No Access			-	6.9	-	7	-	6.9	-	-	7	12460	No Access			-	6000	-	4690	-	4430	-	-	3990
MB14HVO04	North Pit Spoil	6.5	7.8	No Access			-	6.8	-	No Access			-	-	6.9	12460	No Access			-	6120	-	No Access			-	-	5820
MB14HVO05	North Pit Spoil	6.5	7.8	No Access			-	-	-	6.8	-	6.9	-	-	6.7	12460	No Access			-	-	-	7380	-	7270	-	-	7190

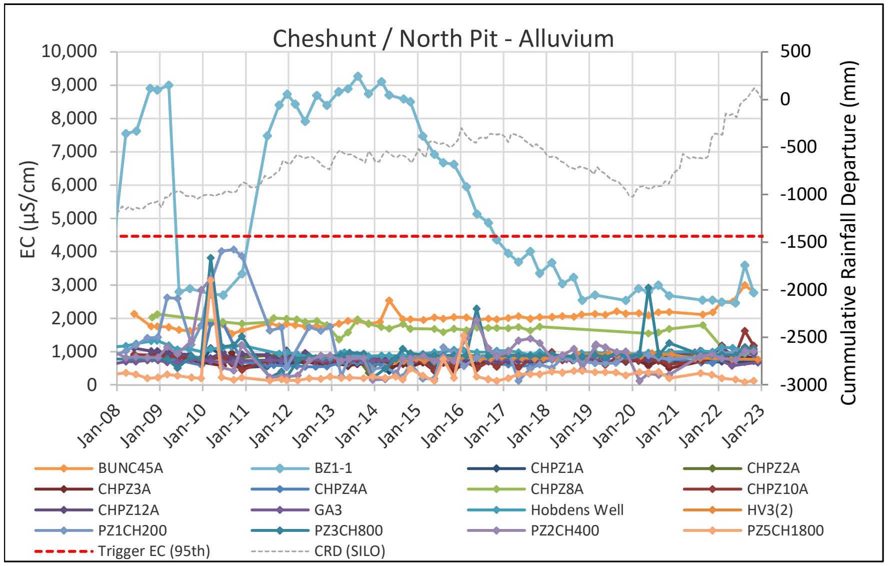
APPENDIX E

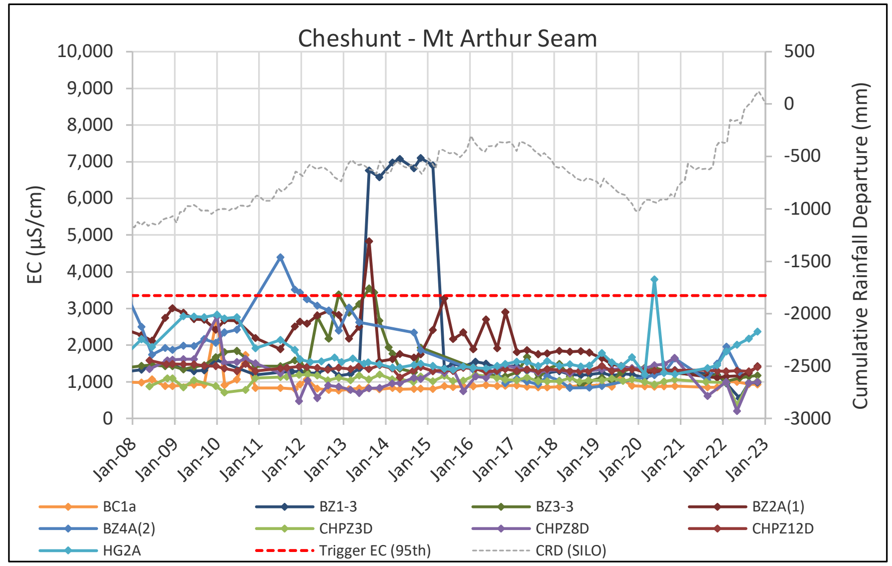
Groundwater Quality Graphs

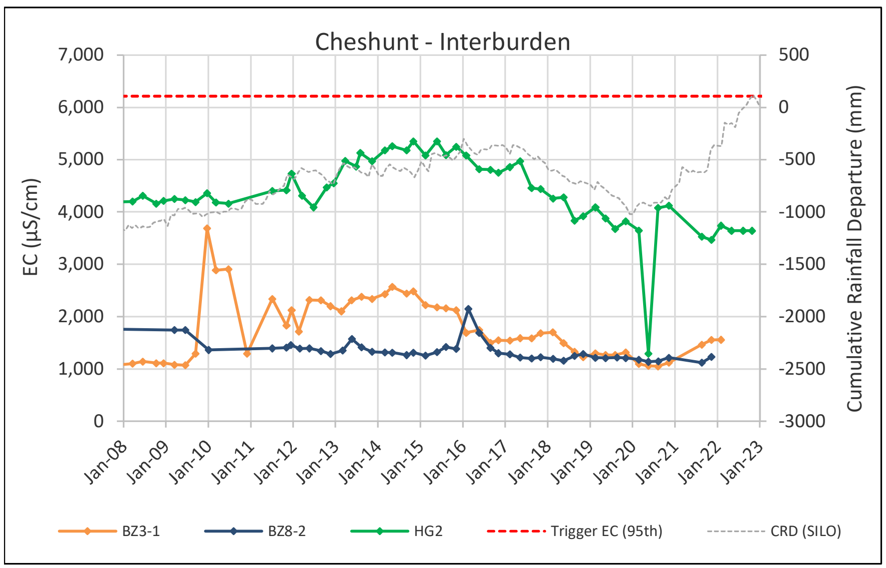

Carrington Alluvium
EC (µS/cmm)
Cumulative Rainfall Departure (mm)
12,000
10,000
8,000
6,000
4,000
2,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
CFW55R
CFW57
CGW52A
CGW53a
CGW54A
CGW55A
Trigger EC (95th)
CRD (SILO)

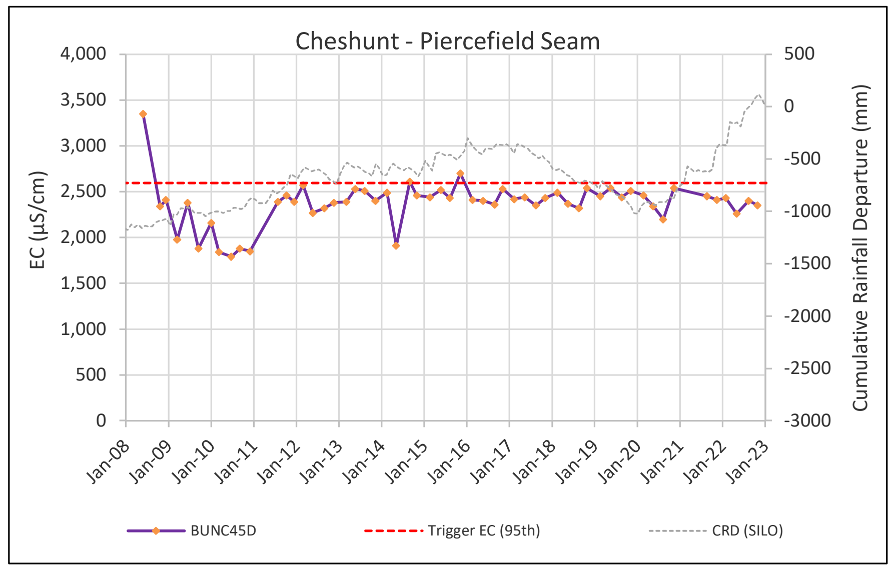

Carrington Interburden
EC (µS/cm)
Cumulative Rainfall Departure (mm)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
4036C
4051C
CGW51A
Trigger EC (95th)
CRD (SILO)

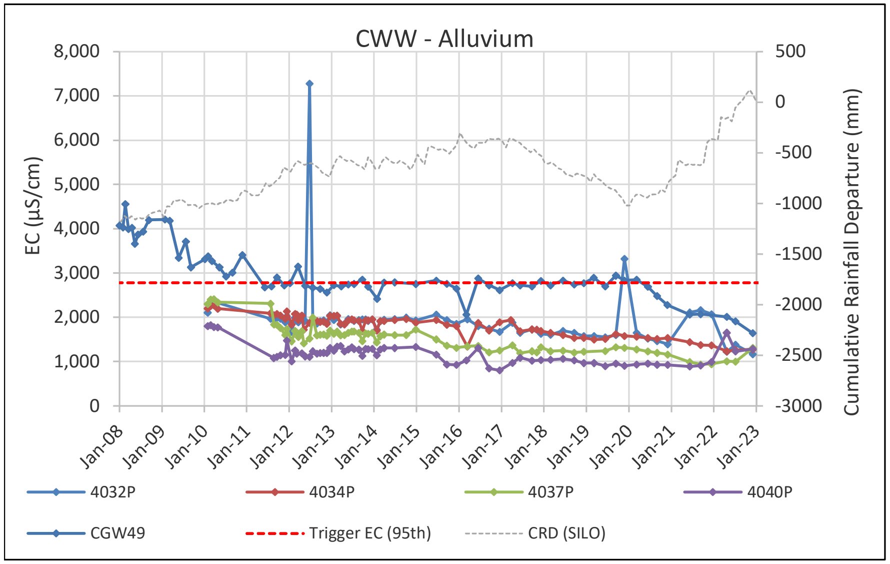

Carrington Broonie Seam
EC (µS/cm)
Cumulative Rainfall Departure (mm)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
CGW52
CGW53
Trigger EC (95th)
CRD (SILO)


Cheshunt / North Pit - Alluvium
EC (µS/cm)
Cummulative Rainfall Departure (mm)
BUNC45A
BZ1-1
CHPZ1A
CHPZ2A
CHPZ3A
CHPZ4A
CHPZ8A
CHPZ10A
CHPZ12A
GA3
Hobdens Well
HV3(2)
PZ1CH200
PZ3CH800
PZ2CH400
PZ5CH1800
Trigger EC (95th)
CRD (SILO)

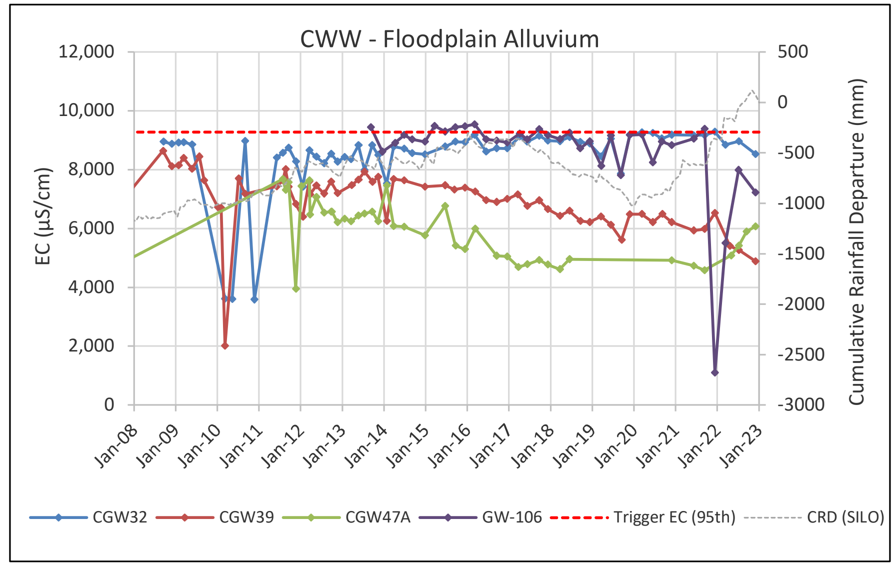

Cheshunt - Mt Arthur Seam
EC (µS/cm)
Cumulative Rainfall Departure (mm)
BC1a
BZ1-3
BZ3-3
BZ2A(1)
BZ4A(2)
CHPZ3D
CHPZ8D
CHPZ12D
HG2A
Trigger EC (95th)
CRD (SILO)


Cheshunt - Interburden
EC (µS/cm)
Cumulative Rainfall Departure (mm)
BZ3-1
BZ8-2
HG2
Trigger EC (95th)
CRD (SILO)

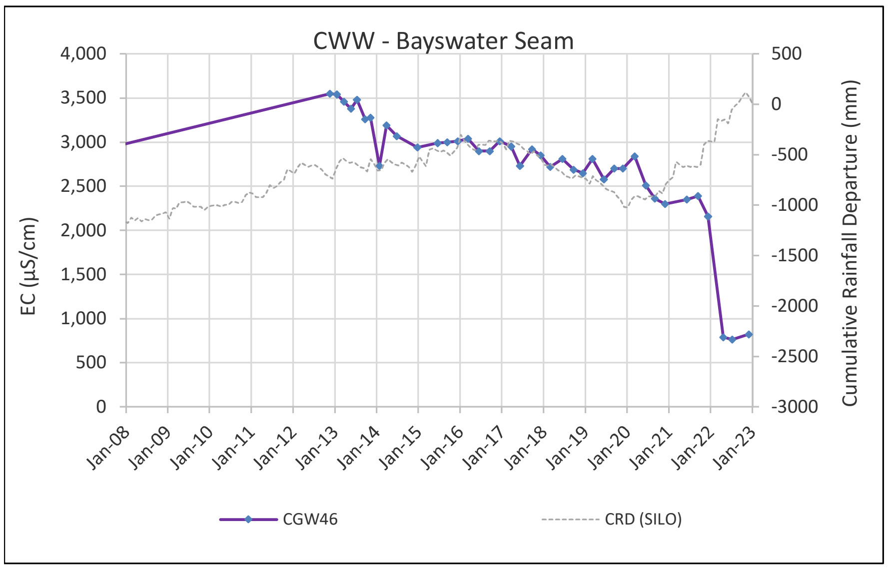

Cheshunt - Piercefield Seam
EC (µS/cm)
Cumulative Rainfall Departure (mm)
BUNC45D
Trigger EC (95th)
CRD (SILO)



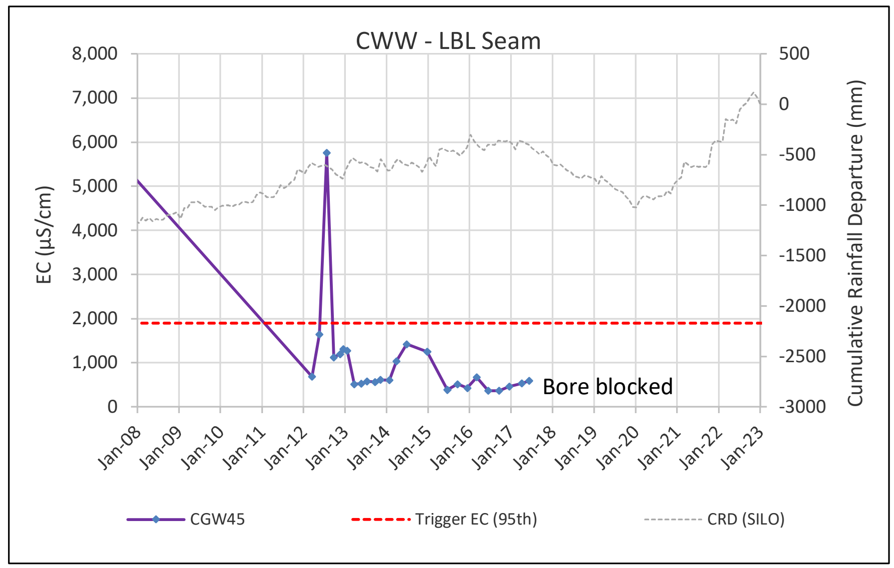
CWW - Alluvium
EC (µS/cm)
Cumulative Rainfall Departure (mm)
4032P
4034P
4037P
4040P
CGW49
Trigger EC (95th)
CRD (SILO)



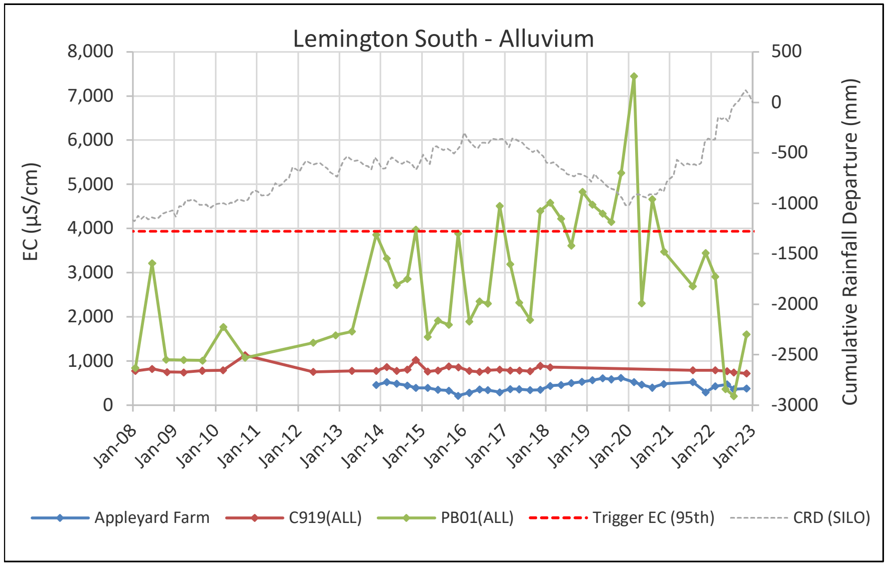
CWW - Floodplain Alluvium
EC (µS/cm)
Cumulative Rainfall Departure (mm)
CGW32
CGW39
CGW47A
GW-106
Trigger EC (95th)
CRD (SILO)

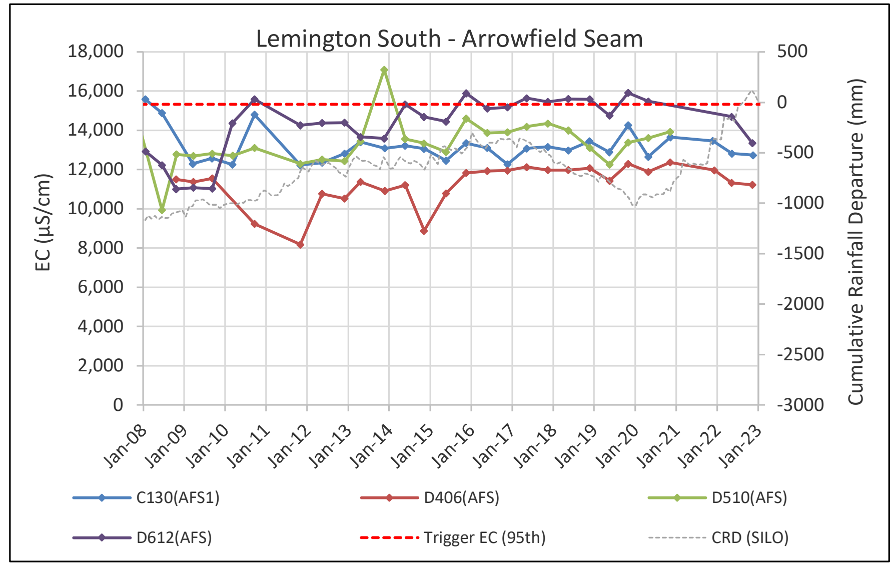


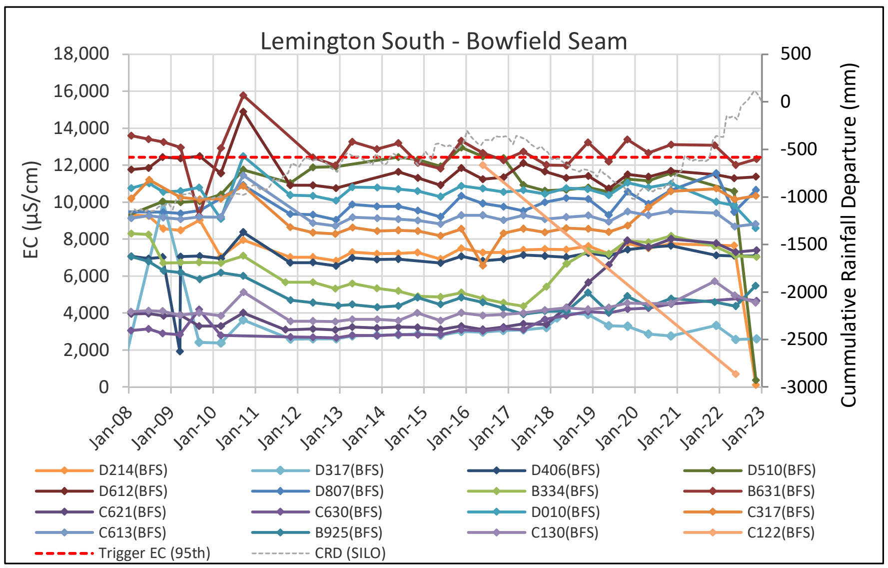
CWW - Bayswater Seam
EC (µS/cm)
Cumulative Rainfall Departure (mm)
CGW46
CRD (SILO)

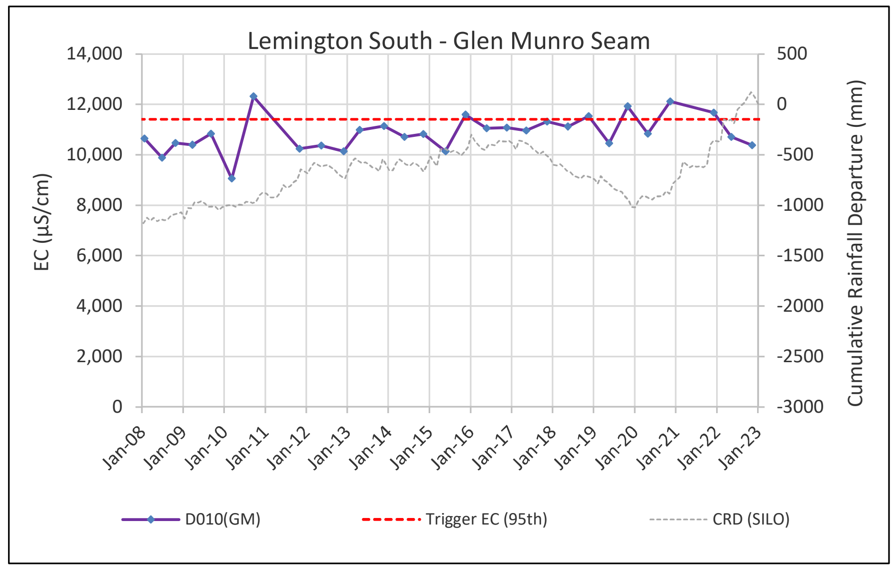


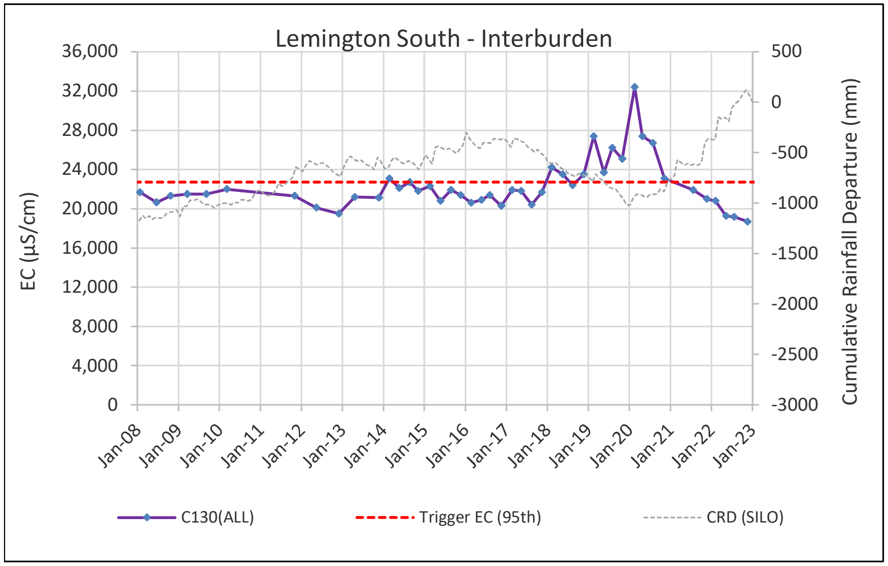
CWW - LBL Seam
EC (µS/cm)
Cumulative Rainfall Departure (mm)
Bore blocked
CGW45
Trigger EC (95th)
CRD (SILO)

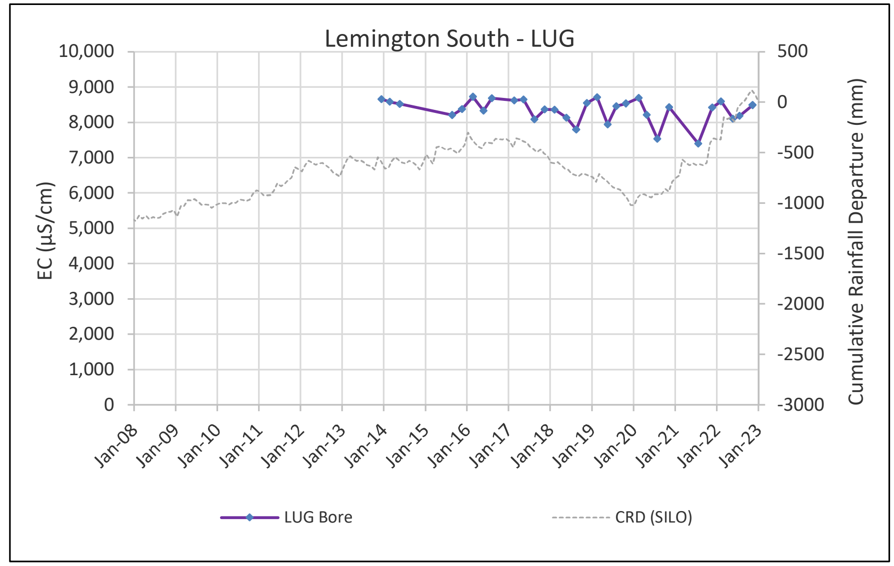

Lemington South - Alluvium
EC (µS/cm)
Cumulative Rainfall Departure (mm)
Appleyard Farm
C919(ALL)
PB01(ALL)
Trigger EC (95th)
CRD (SILO)

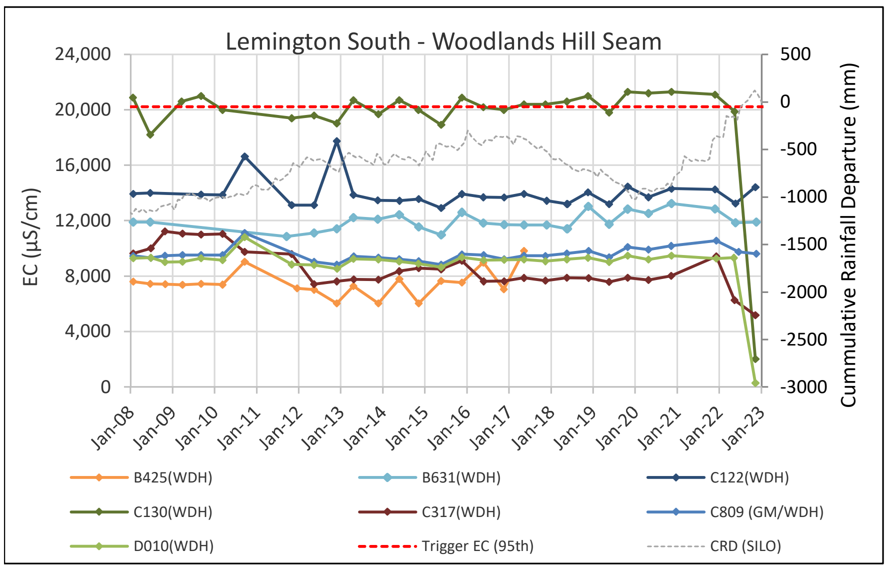

Lemington South - Arrowfield Seam
EC (µS/cm)
Cumulative Rainfall Departure (mm)
C130(AFS1)
D406(AFS)
D510(AFS)
D612(AFS)
Trigger EC (95th)
CRD (SILO)

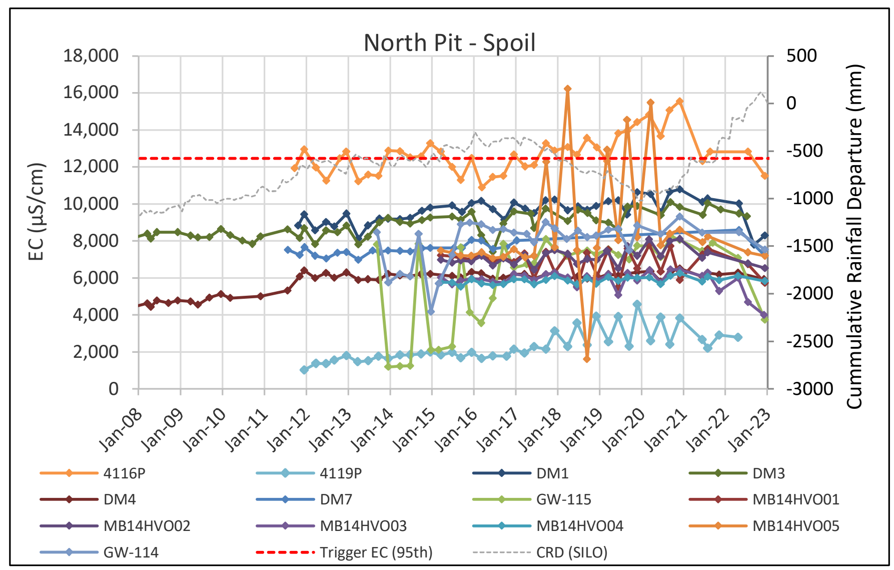

Lemington South - Bowfield Seam
EC (µS/cm)
Cummulative Rainfall Departure (mm)
D214(BFS)
D317(BFS)
D406(BFS)
D510(BFS)
D612(BFS)
D807(BFS)
B334(BFS)
B631(BFS)
C621(BFS)
C630(BFS)
D010(BFS)
C317(BFS)
C613(BFS)
B925(BFS)
C130(BFS)
C122(BFS)
Trigger EC (95th)
CRD (SILO)

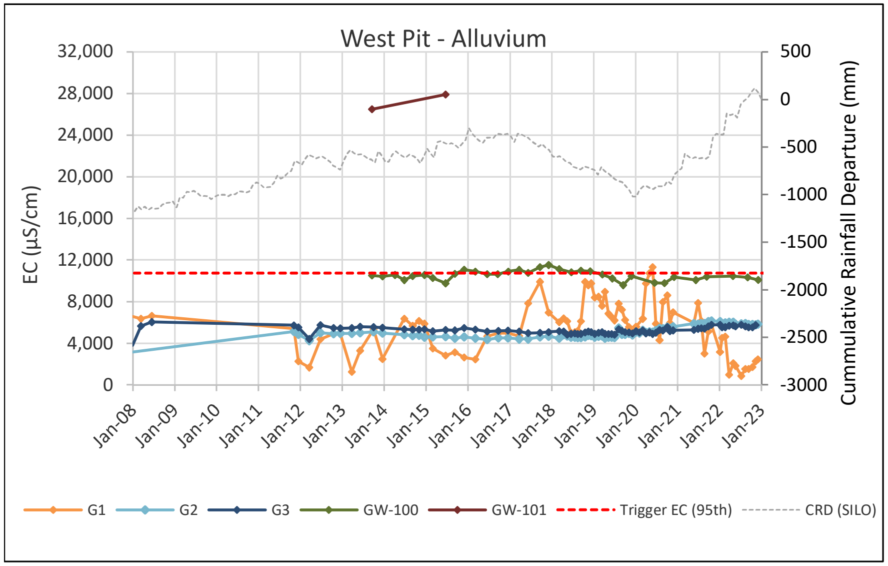

Lemington South - Glen Munro Seam
EC (µS/cm)
Cumulative Rainfall Departure (mm)
D010(GM)
Trigger EC (95th)
CRD (SILO)

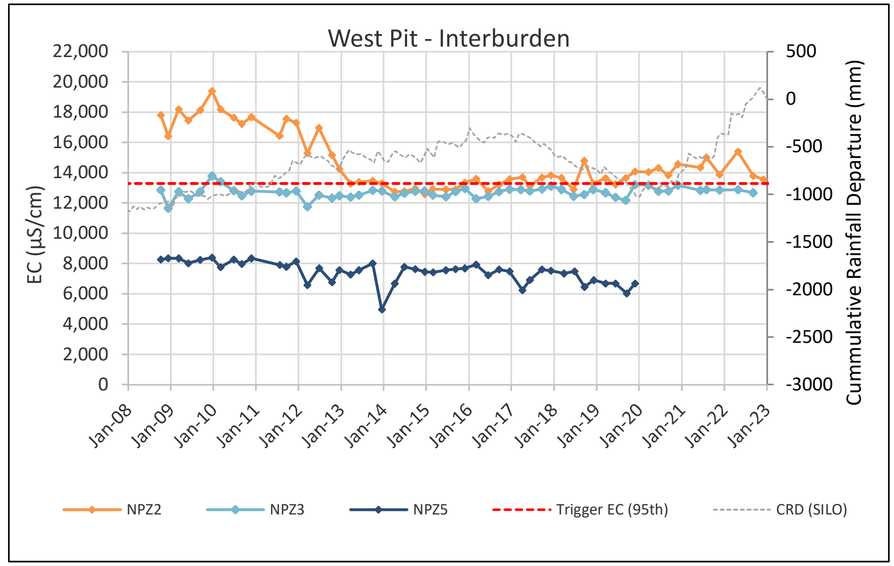

Lemington South - Interburden
EC (µS/cm)
Cumulative Rainfall Departure (mm)
C130(ALL)
Trigger EC (95th)
CRD (SILO)

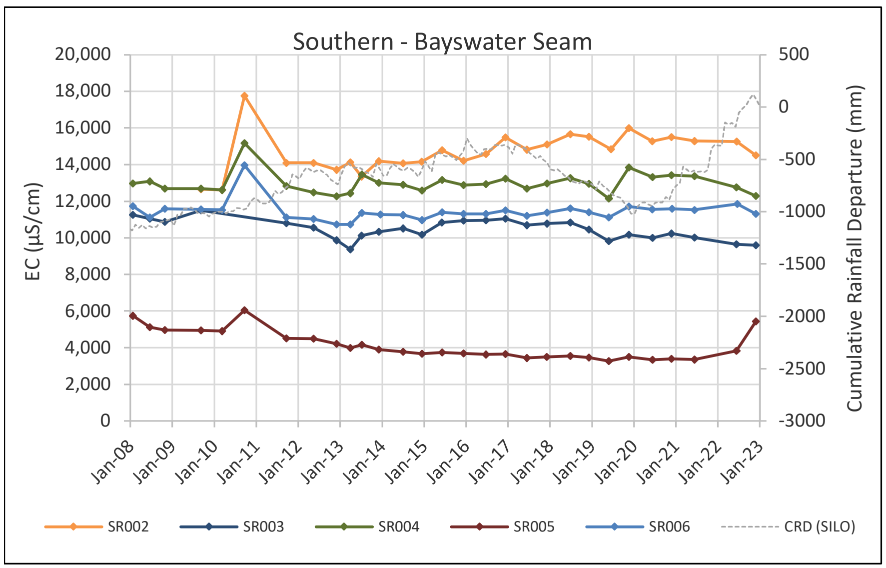

Lemington South - LUG
EC (µS/cm)
Cumulative Rainfall Departure (mm)
LUG Bore
CRD (SILO)

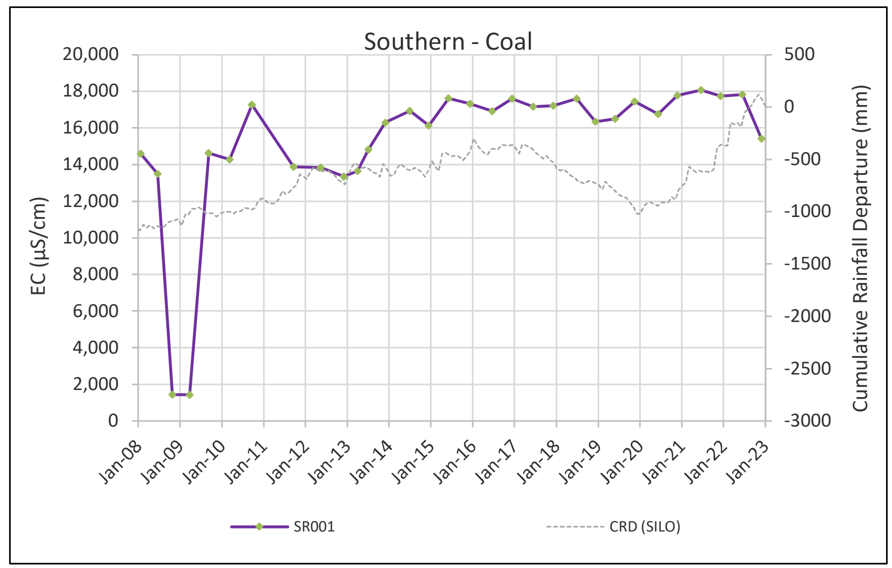

Lemington South - Woodlands Hill Seam
EC (µS/cm)
Cummulative Rainfall Departure (mm)
B425(WDH)
B631(WDH)
C122(WDH)
C130(WDH)
C317(WDH)
C809 (GM/WDH)
D010(WDH)
Trigger EC (95th)
CRD (SILO)

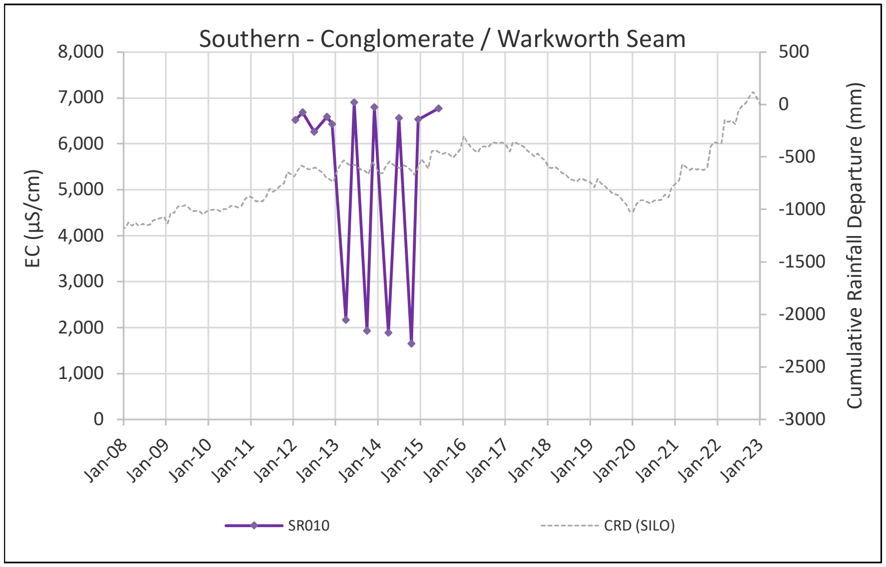

North Pit - Spoil
EC (µS/cm)
Cummulative Rainfall Departure (mm)
4116P
4119P
DM1
DM3
DM4
DM7
GW-115
MB14HVO01
MB14HVO02
MB14HVO03
MB14HVO04
MB14HVO05
GW-114
Trigger EC (95th)
CRD (SILO)

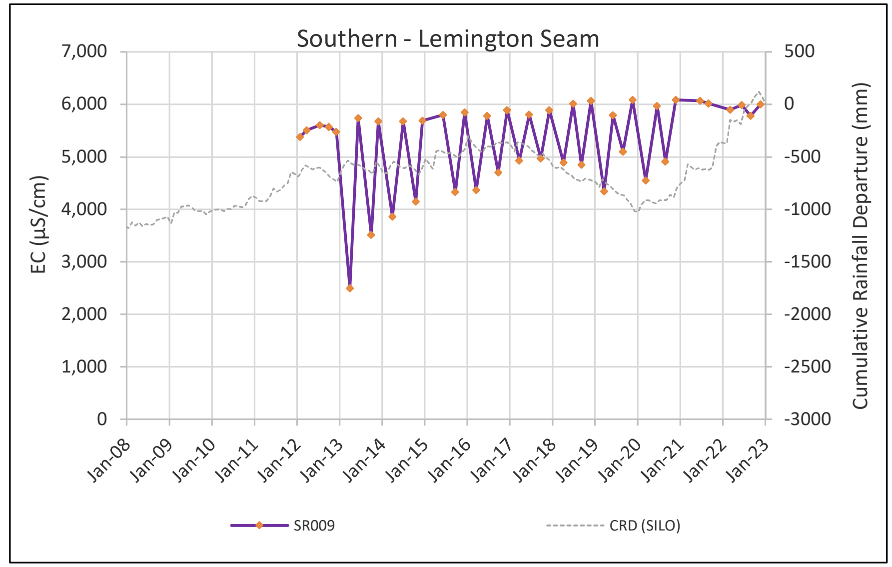

West Pit - Alluvium
EC (µS/cm)
Cummulative Rainfall Departure (mm)
32,000
28,000
24,000
20,000
16,000
12,000
8,000
4,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
G1
G2
G3
GW-100
GW-101
Trigger EC (95th)
CRD (SILO)

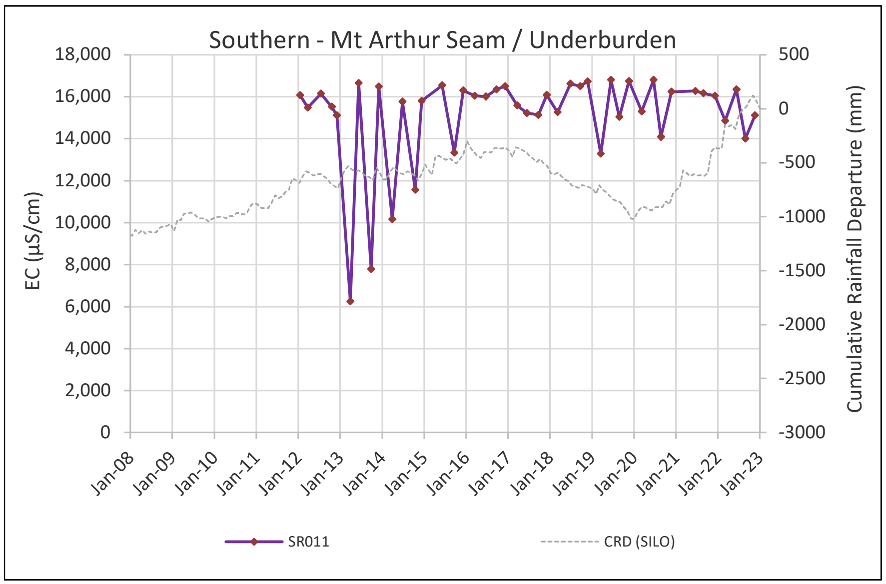

West Pit - Interburden
EC (µS/cm)
Cummulative Rainfall Departure (mm)
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
NPZ2
NPZ3
NPZ5
Trigger EC (95th)
CRD (SILO)

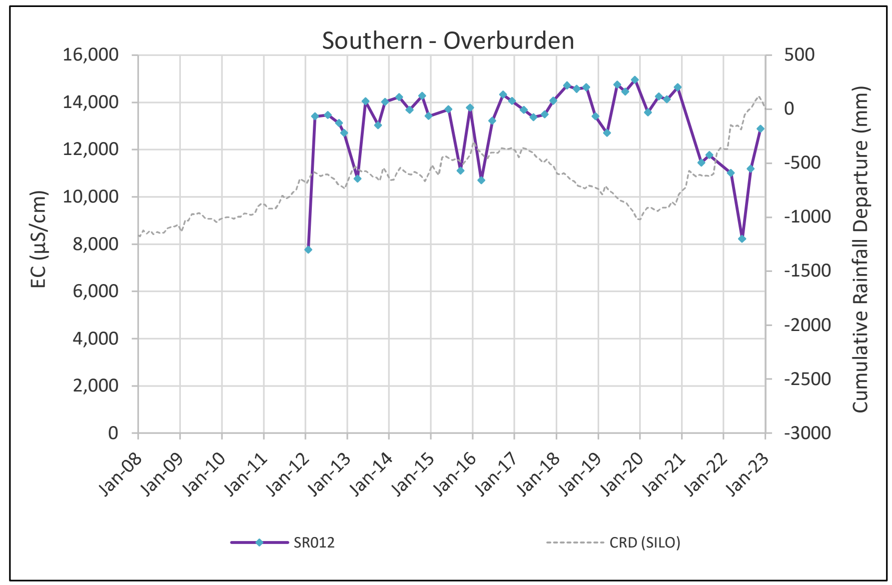

Southern - Bayswater Seam
EC (µS/cm)
Cumulative Rainfall Departure (mm)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
SR002
SR003
SR004
SR005
SR006
CRD (SILO)

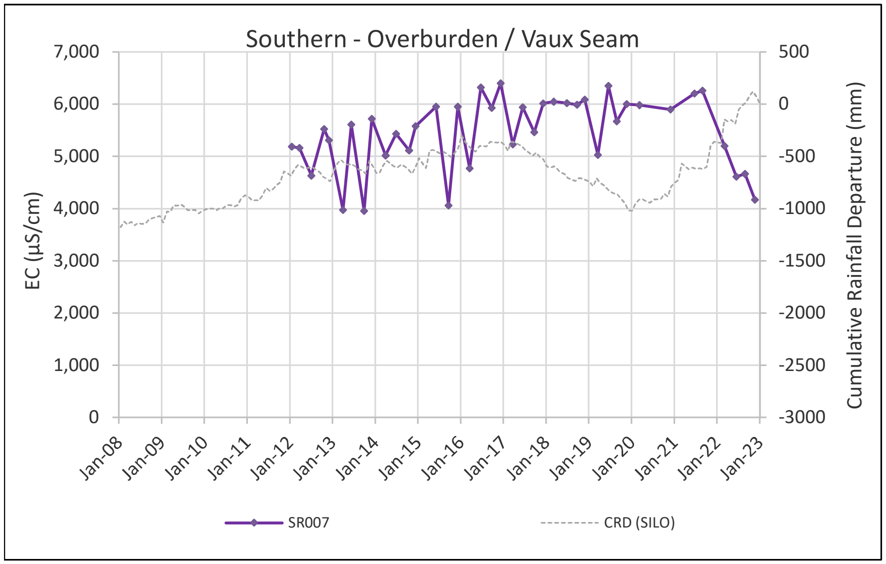

Southern - Coal
EC (µS/cm)
Cumulative Rainfall Departure (mm)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
SR001
CRD (SILO)

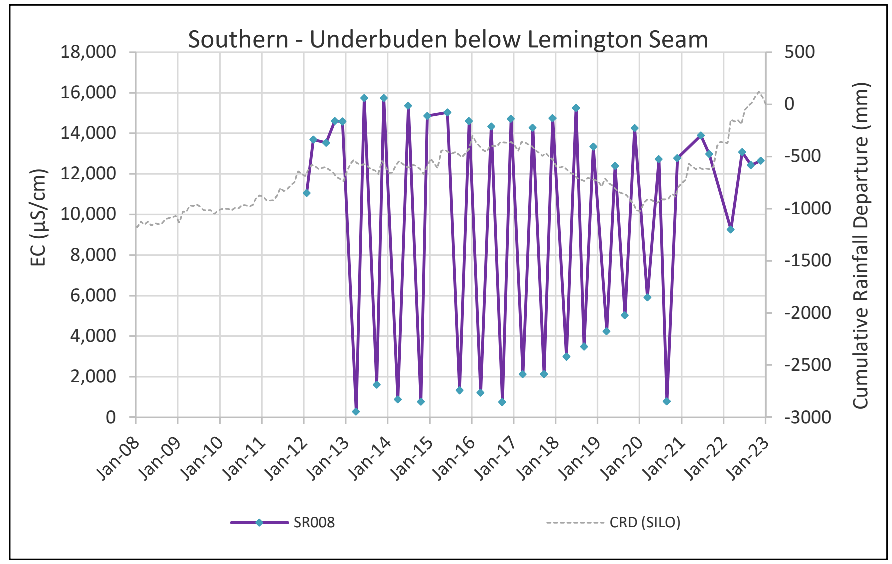

Southern - Conglomerate / Warkworth Seam
EC (µS/cm)
Cumulative Rainfall Departure (mm)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21 Jan-22 Jan-23
SR010
CRD (SILO)

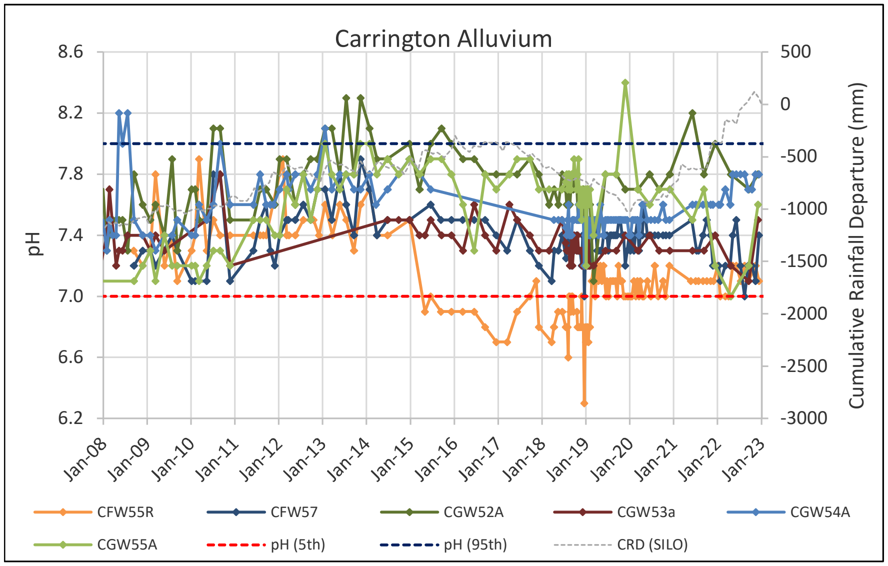

Southern - Lemington Seam
EC (µS/cm)
Cumulative Rainfall Departure (mm)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21 Jan-22 Jan-23
SR009
CRD (SILO)

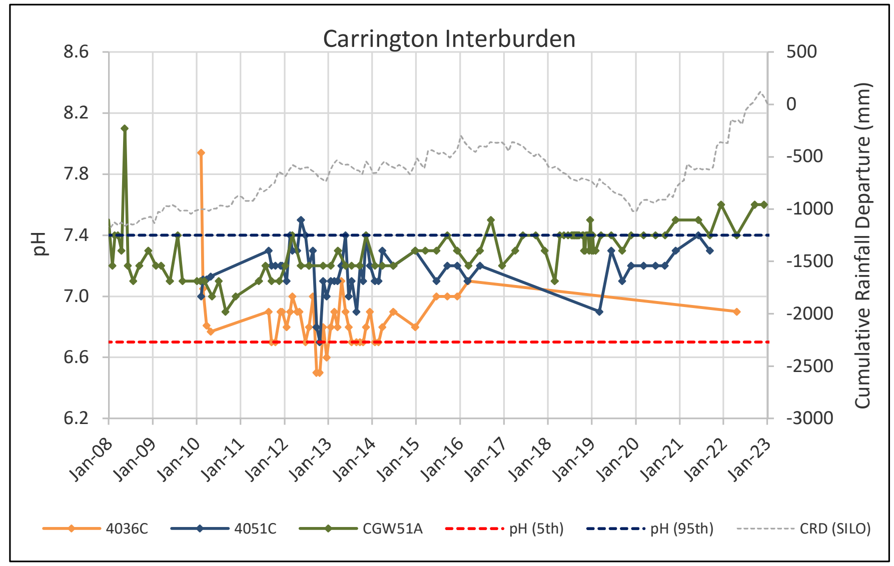

Southern - Mt Arthur Seam / Underburden
EC (µS/cm)
Cumulative Rainfall Departure (mm)
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21 Jan-22 Jan-23
SR011
CRD (SILO)

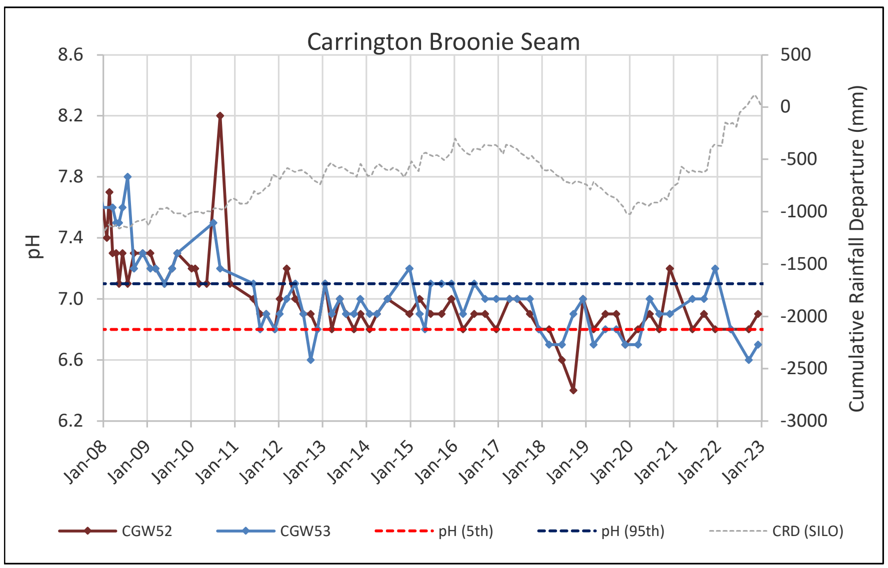

Southern - Overburden
EC (µS/cm)
Cumulative Rainfall Departure (mm)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21 Jan-22 Jan-23
SR012
CRD (SILO)

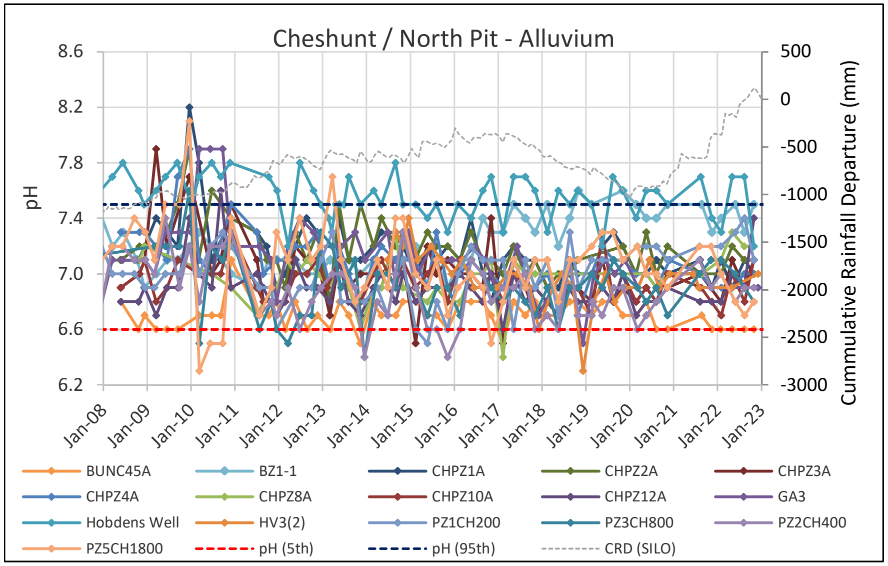

Southern - Overburden / Vaux Seam
EC (µS/cm)
Cumulative Rainfall Departure (mm)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21 Jan-22 Jan-23
SR007
CRD (SILO)

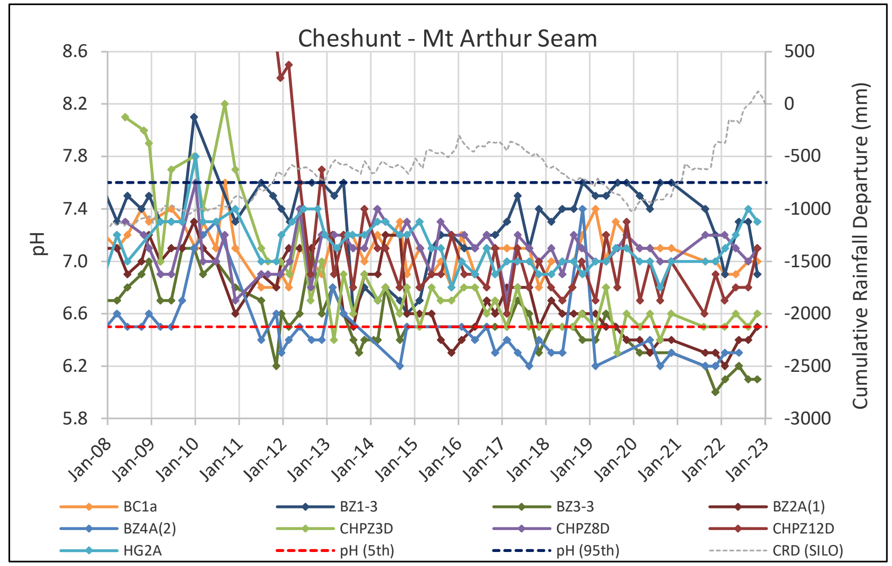

Southern - Underbuden below Lemington Seam
EC (µS/cm)
Cumulative Rainfall Departure (mm)
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21 Jan-22 Jan-23
SR008
CRD (SILO)

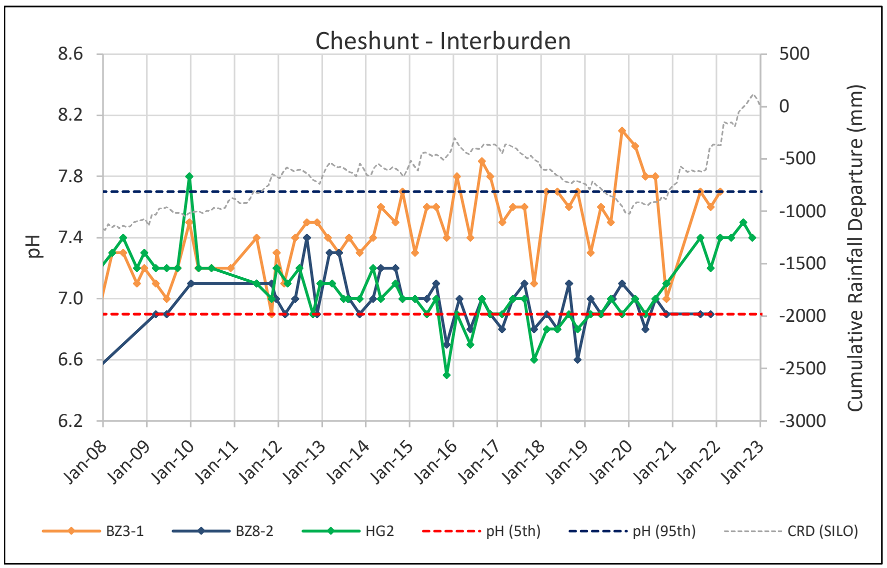

Carrington Alluvium
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
CFW55R
CFW57
CGW52A
CGW53a
CGW54A
CGW55A
pH (5th)
pH (95th)
CRD (SILO)

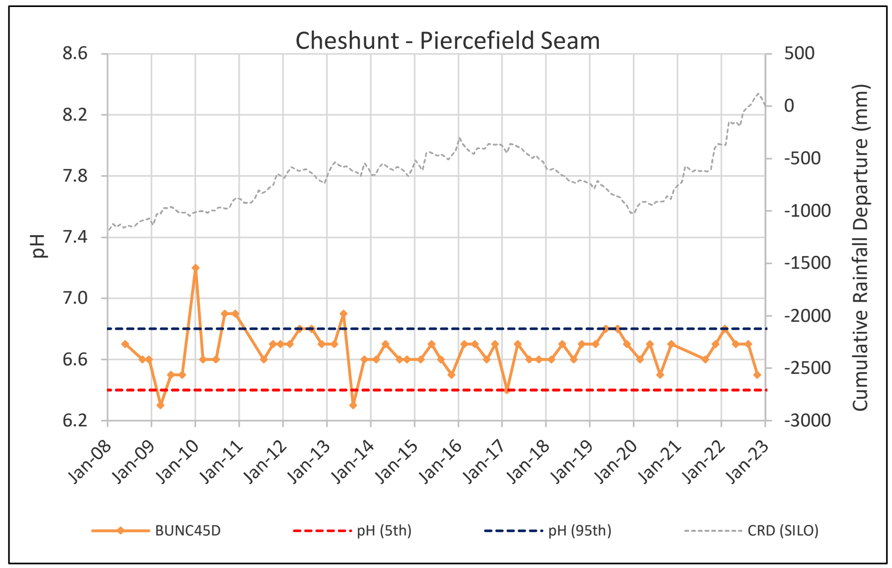

Carrington Interburden
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
4036C
4051C
CGW51A
pH (5th)
pH (95th)
CRD (SILO)

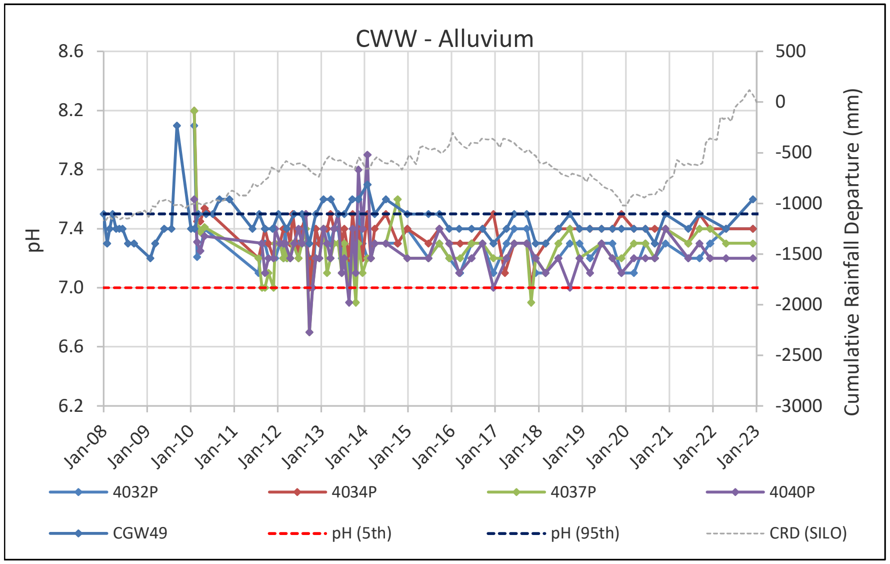

Carrington Broonie Seam
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
CGW52
CGW53
pH (5th)
pH (95th)
CRD (SILO)

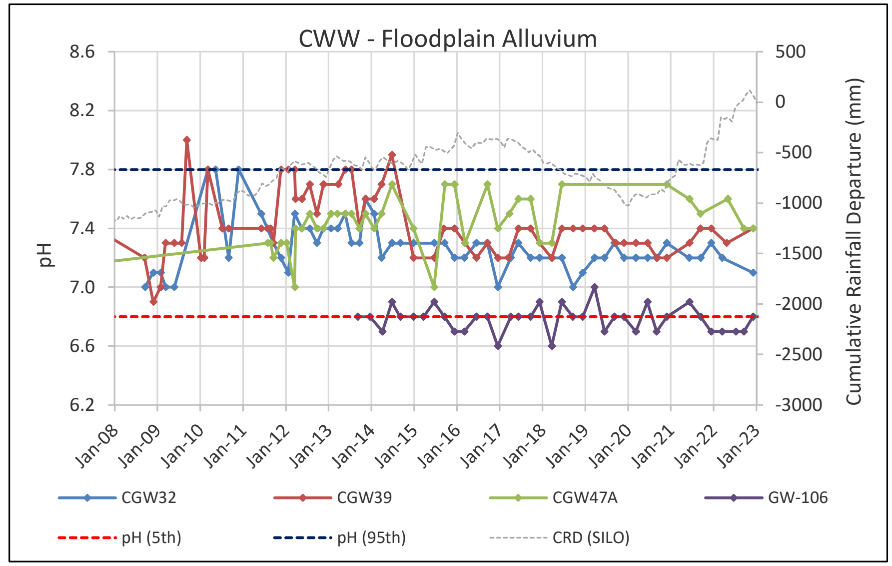

Cheshunt / North Pit - Alluvium
pH
Cummulative Rainfall Departure (mm)
BUNC45A
BZ1-1
CHPZ1A
CHPZ2A
CHPZ3A
CHPZ4A
CHPZ8A
CHPZ10A
CHPZ12A
GA3
Hobdens Well
HV3(2)
PZ1CH200
PZ3CH800
PZ2CH400
PZ5CH1800
pH (5th)
pH (95th)
CRD (SILO)

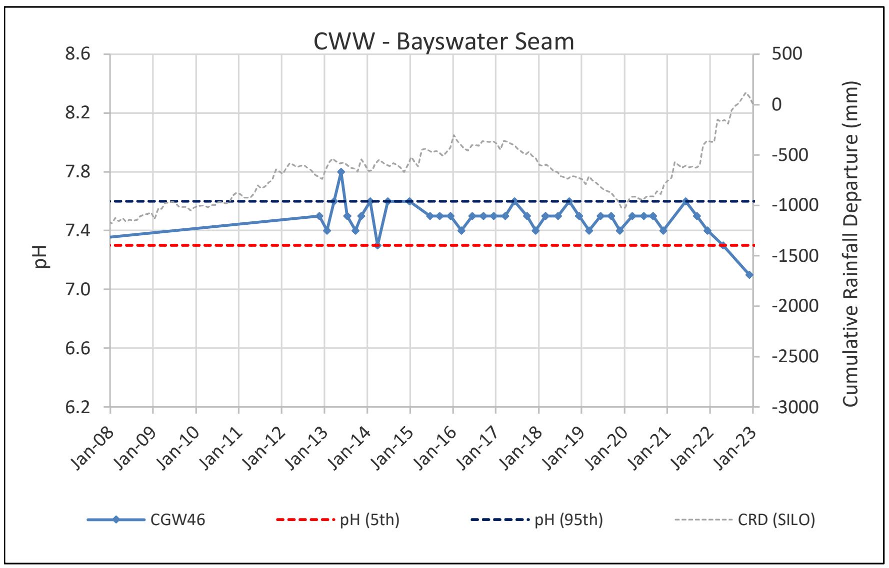

Cheshunt - Mt Arthur Seam
pH
Cumulative Rainfall Departure (mm)
BC1a
BZ1-3
BZ3-3
BZ2A(1)
BZ4A(2)
CHPZ3D
CHPZ8D
CHPZ12D
HG2A
pH (5th)
pH (95th)
CRD (SILO)

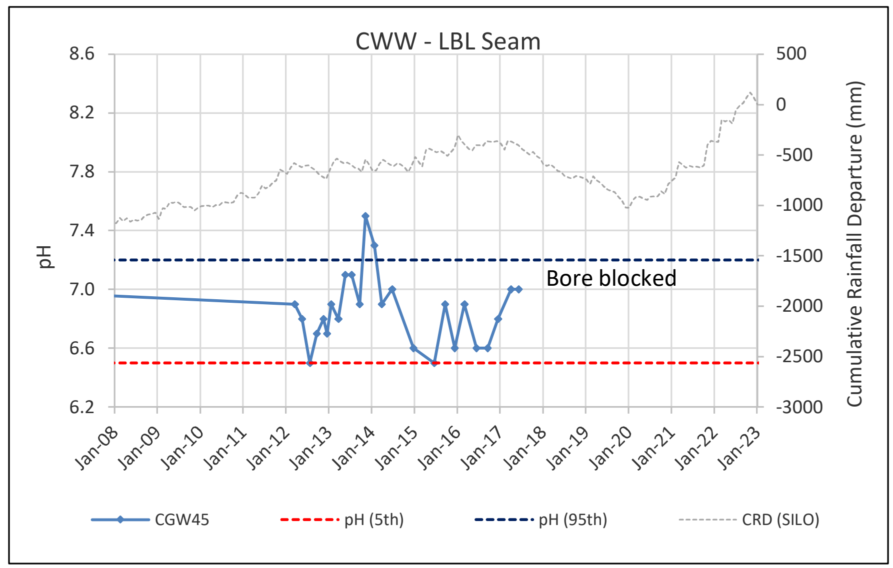

Cheshunt - Interburden
pH
Cumulative Rainfall Departure (mm)
BZ3-1
BZ8-2
HG2
pH (5th)
pH (95th)
CRD (SILO)

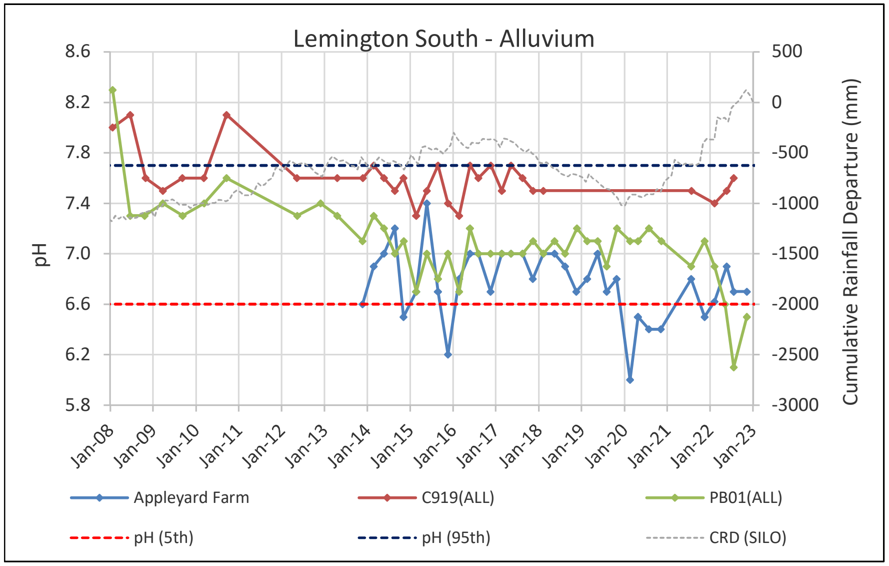

Cheshunt - Piercefield Seam
pH
Cumulative Rainfall Departure (mm)
BUNC45D
pH (5th)
pH (95th)
CRD (SILO)

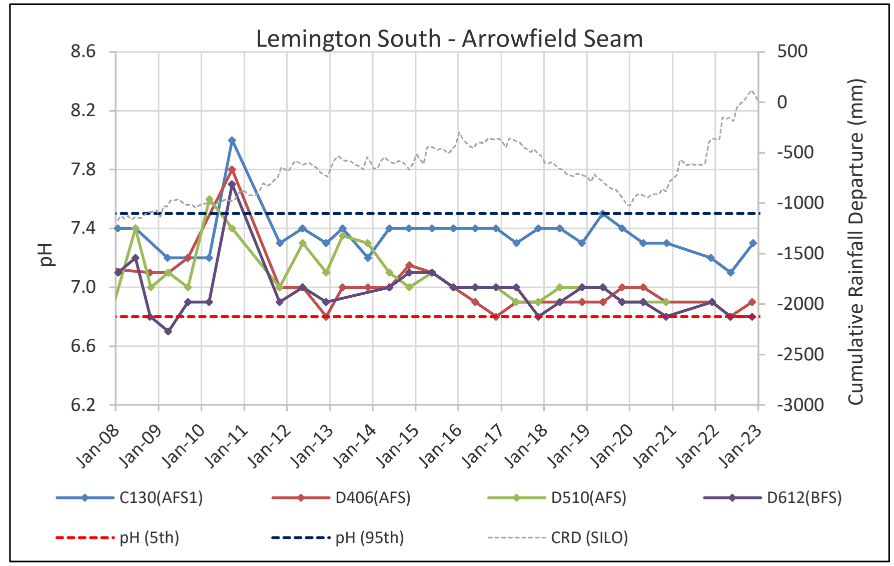

CWW - Alluvium
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
4032P
4034P
4037P
4040P
CGW49
pH (5th)
pH (95th)
CRD (SILO)

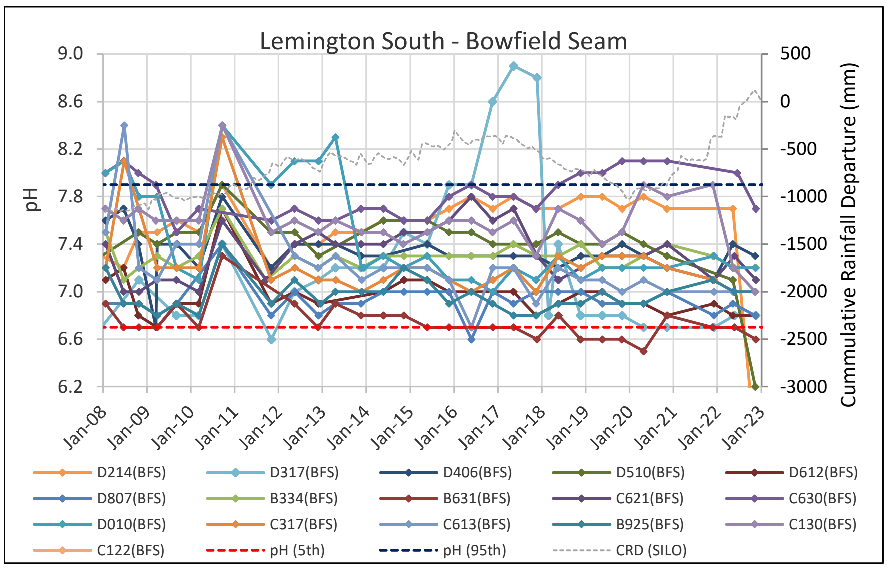

CWW - Floodplain Alluvium
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
CGW32
CGW39
CGW47A
GW-106
pH (5th)
pH (95th)
CRD (SILO)

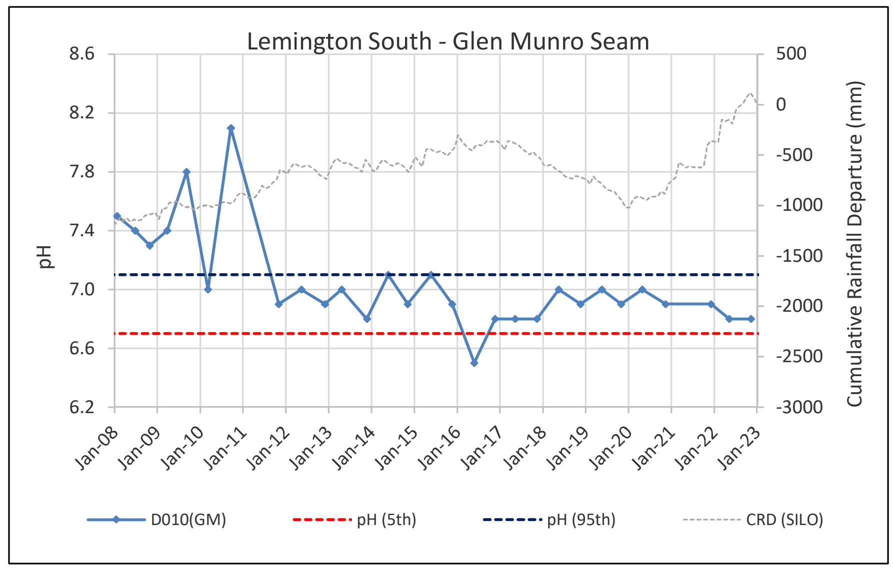

CWW - Bayswater Seam
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
CGW46
pH (5th)
pH (95th)
CRD (SILO)

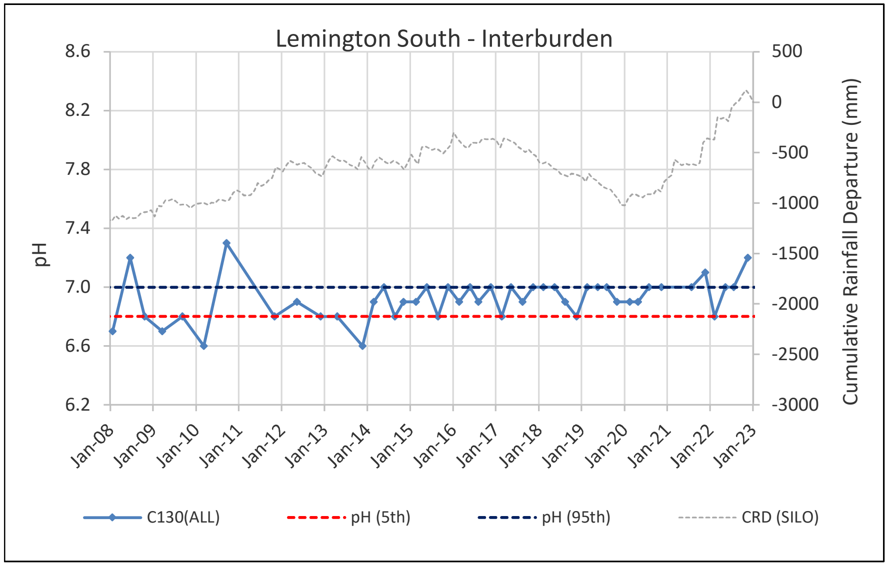

CWW - LBL Seam
pH
Cumulative Rainfall Departure (mm)
Bore blocked
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
CGW45
pH (5th)
pH (95th)
CRD (SILO)

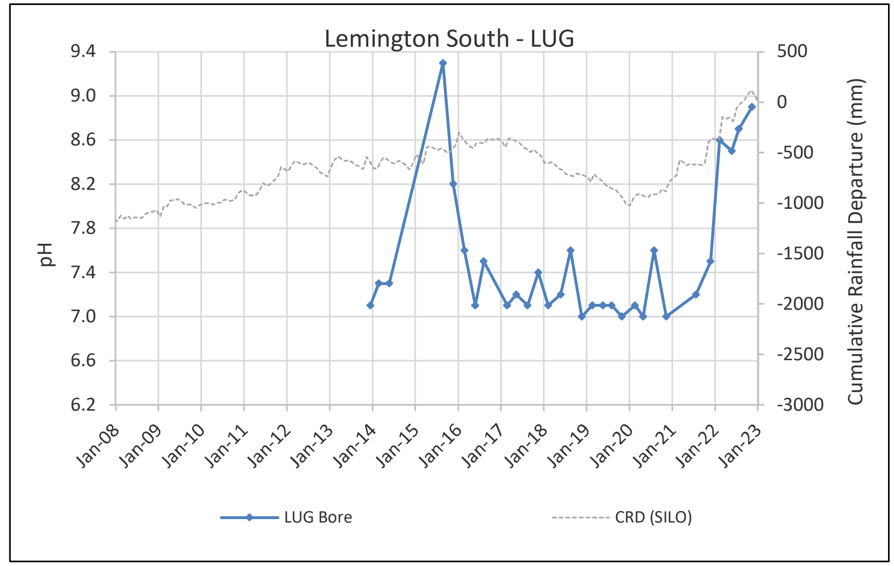

Lemington South - Alluvium
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
5.8
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Appleyard Farm
C919(ALL)
PB01(ALL)
pH (5th)
pH (95th)
CRD (SILO)

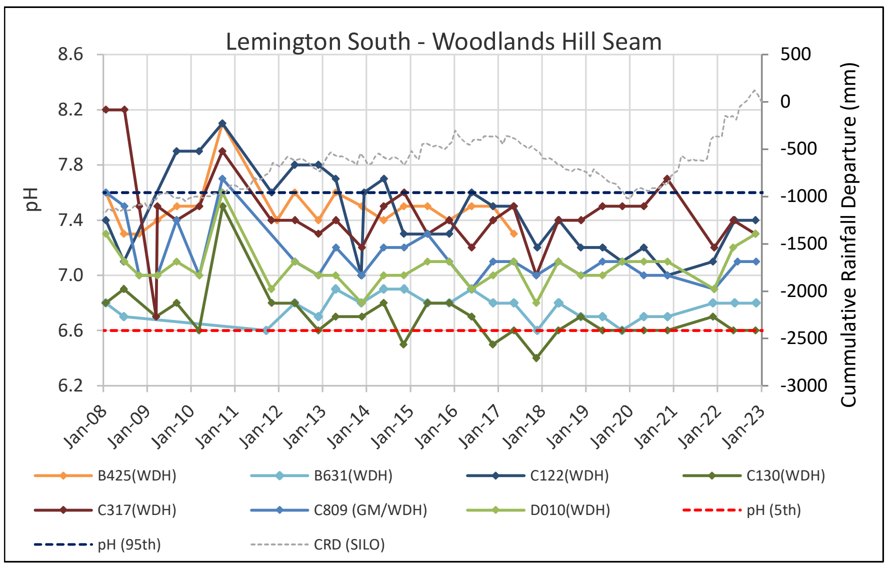

Lemington South - Arrowfield Seam
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
C130(AFS1)
D406(AFS)
D510(AFS)
D612(BFS)
pH (5th)
pH (95th)
CRD (SILO)

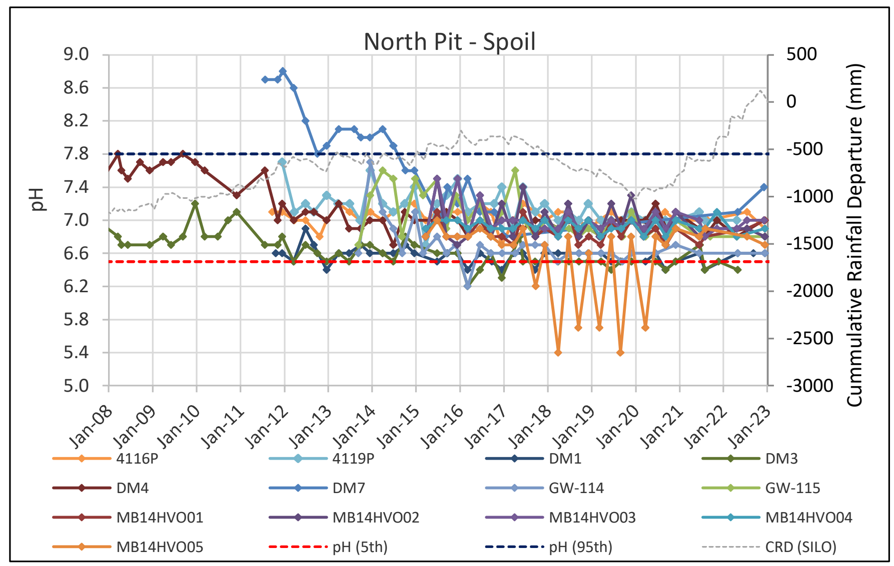

Lemington South - Bowfield Seam
pH
Cummulative Rainfall Departure (mm)
9.0
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
D214(BFS)
D317(BFS)
D406(BFS)
D510(BFS)
D612(BFS)
D807(BFS)
B334(BFS)
B631(BFS)
C621(BFS)
C630(BFS)
D010(BFS)
C317(BFS)
C613(BFS)
B925(BFS)
C130(BFS)
C122(BFS)
pH (5th)
pH (95th)
CRD (SILO)

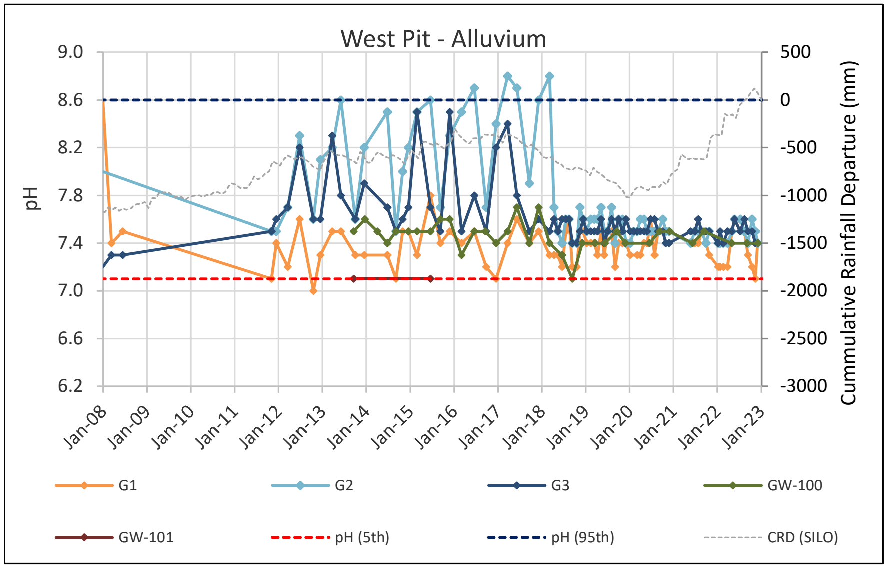

Lemington South - Glen Munro Seam
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
D010(GM)
pH (5th)
pH (95th)
CRD (SILO)

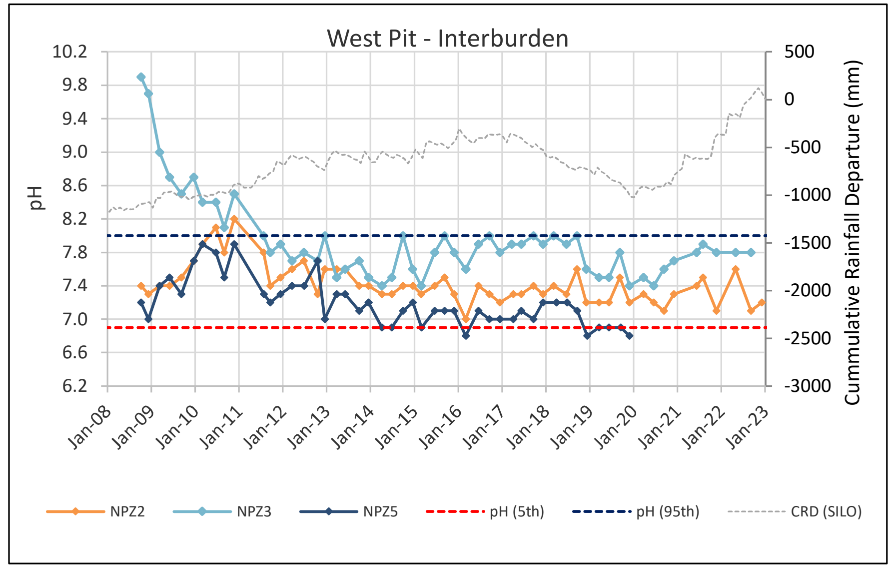

Lemington South - Interburden
pH
Cumulative Rainfall Departure (mm)
C130(ALL)
pH (5th)
pH (95th)
CRD (SILO)

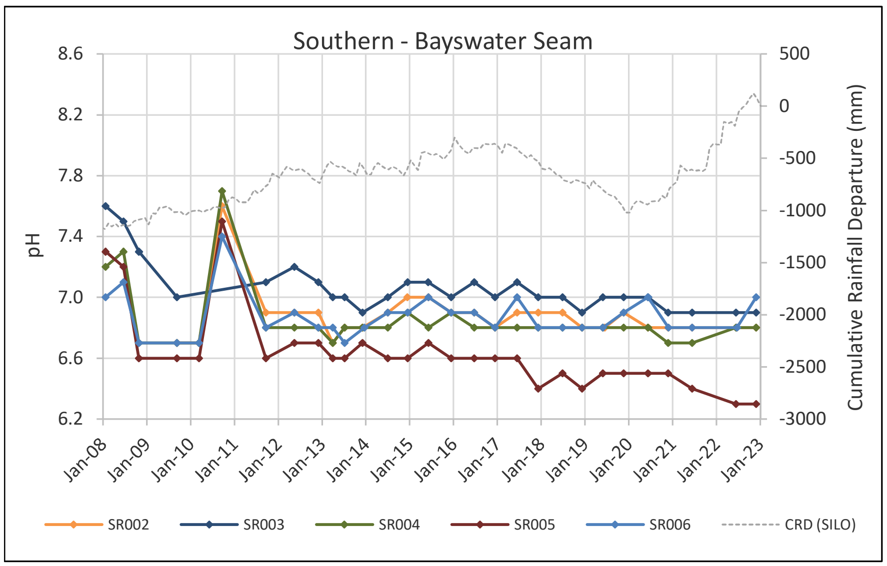

Lemington South - LUG
pH
Cumulative Rainfall Departure (mm)
LUG Bore
CRD (SILO)

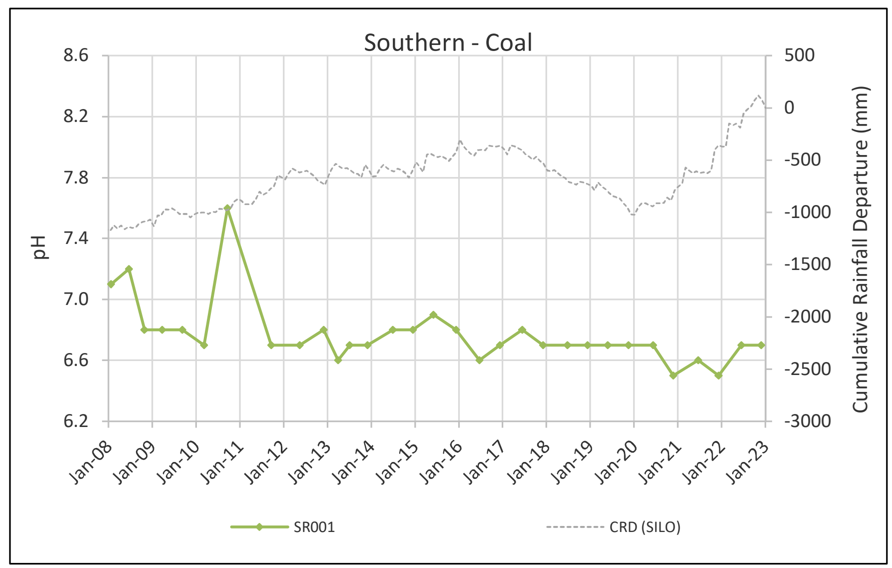

Lemington South - Woodlands Hill Seam
pH
Cummulative Rainfall Departure (mm)
B425(WDH)
B631(WDH)
C122(WDH)
C130(WDH)
C317(WDH)
C809 (GM/WDH)
D010(WDH)
pH (5th)
pH (95th)
CRD (SILO)

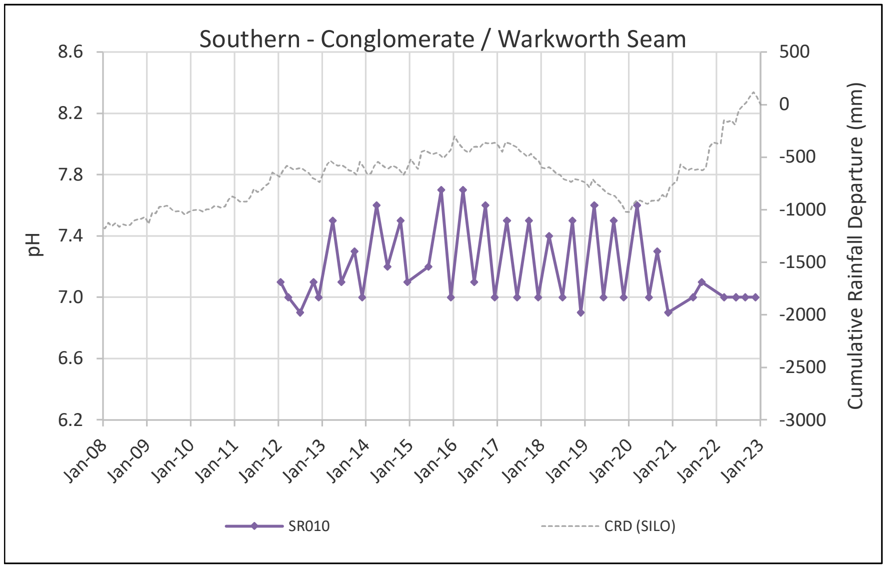

North Pit - Spoil
pH
Cummulative Rainfall Departure (mm)
4116P
4119P
DM1
DM3
DM4
DM7
GW-114
GW-115
MB14HVO01
MB14HVO02
MB14HVO03
MB14HVO04
MB14HVO05
pH (5th)
pH (95th)
CRD (SILO)

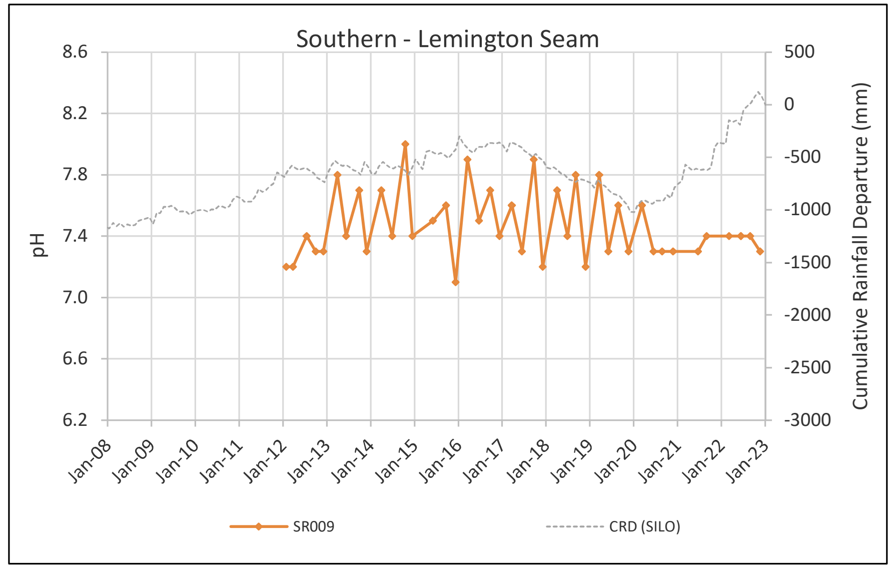

West Pit - Alluvium
pH
Cummulative Rainfall Departure (mm)
G1
G2
G3
GW-100
GW-101
pH (5th)
pH (95th)
CRD (SILO)

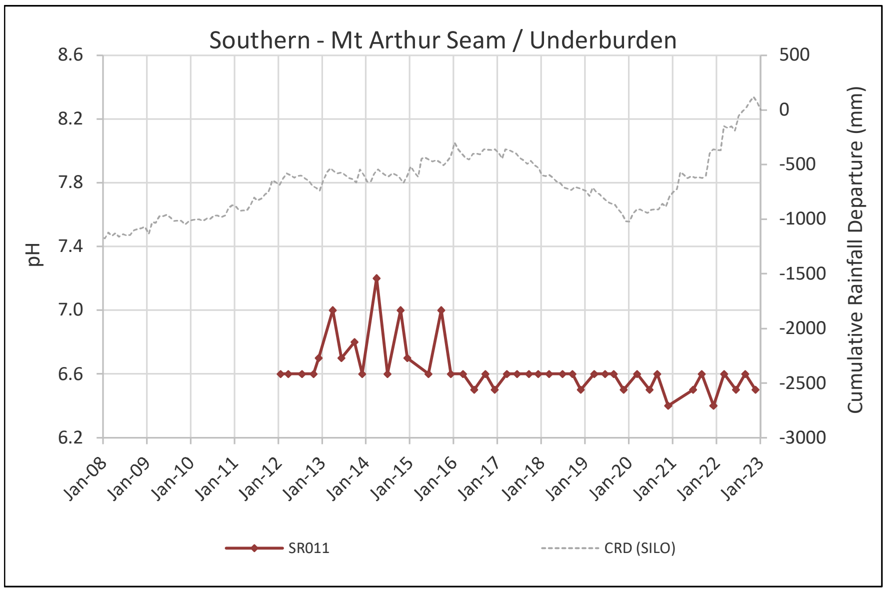

West Pit - Interburden
pH
Cummulative Rainfall Departure (mm)
NPZ2
NPZ3
NPZ5
pH (5th)
pH (95th)
CRD (SILO)

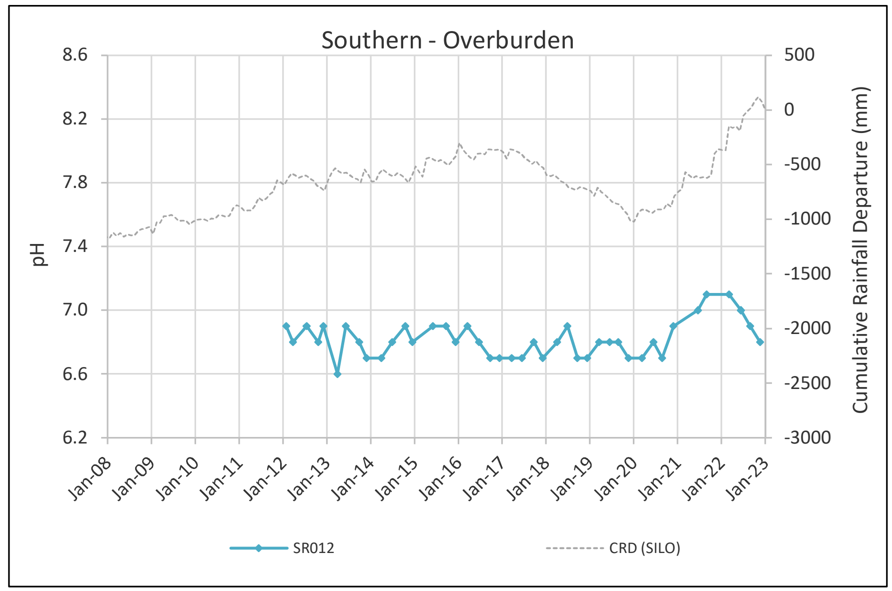

Southern - Bayswater Seam
pH
Cumulative Rainfall Departure (mm)
SR002
SR003
SR004
SR005
SR006
CRD (SILO)

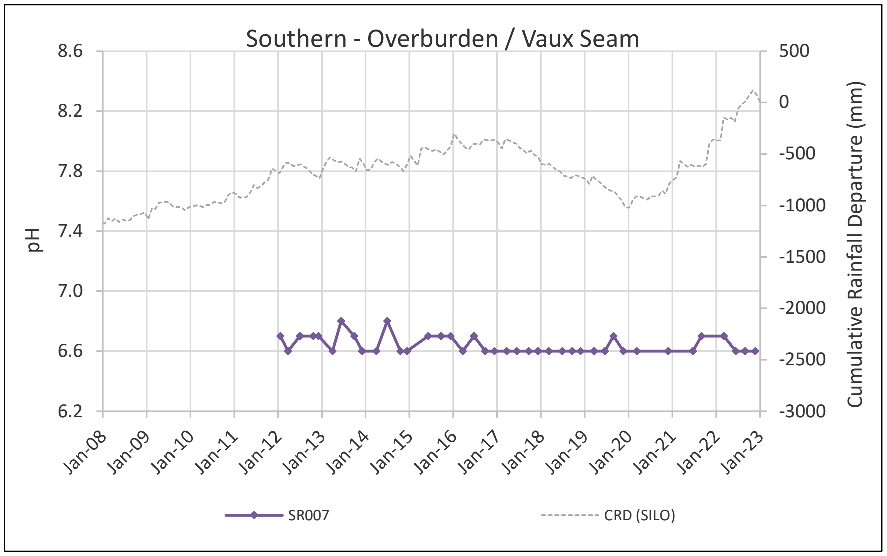

Southern - Coal
pH
Cumulative Rainfall Departure (mm)
SR001
CRD (SILO)

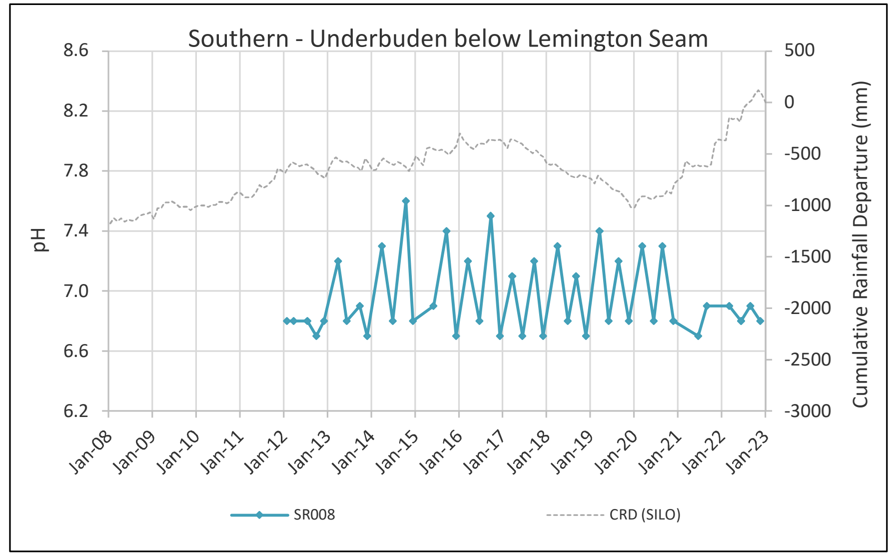

Southern - Conglomerate / Warkworth Seam
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
SR010
CRD (SILO)


Southern - Lemington Seam
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
SR009
CRD (SILO)


Southern - Mt Arthur Seam / Underburden
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
SR011
CRD (SILO)


Southern - Overburden
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
SR012
CRD (SILO)


Southern - Overburden / Vaux Seam
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
SR007
CRD (SILO)


Southern - Underbuden below Lemington Seam
pH
Cumulative Rainfall Departure (mm)
8.6
8.2
7.8
7.4
7.0
6.6
6.2
500
0
-500
-1000
-1500
-2000
-2500
-3000
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
SR008
CRD (SILO)

APPENDIX F

Comprehensive Groundwater Quality Results

Bore ID	Date	Geology	Depth to Water from Stand Pipe (mbToC)	Field pH (pH unit)	Field Electrical Conductivity (uS/cm)	Field Dissolved Oxygen (mg/L)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Carbonate Alkalinity as CaCO3 (mg/L)	Hydroxide Alkalinity as CaCO3 (mg/L)	Bicarbonate Alkalinity as CaCO3 (mg/L)	Total Alkalinity as CaCO3 (mg/L)	Sulfate as SO4 (mg/L)	Sulfate/ Chloride Ratio	Total Calcium (mg/L)	Total Magnesium (mg/L)	Total Potassium (mg/L)	Total Sodium (mg/L)	Total Aluminium (mg/L)	Total Cadmium (mg/L)	Total Caesium (mg/L)	Total Chromium (mg/L)	Total Cobalt (mg/L)	Total Copper (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Lithium (mg/L)	Total Manganese (mg/L)	Total Mercury (mg/L)	Total Nickel (mg/L)	Total Phosphorus as P (mg/L)	Total Rubidium (mg/L)
4032P	24/03/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4036C	24/03/2022	Carrington_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4037P	24/03/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4040P	24/03/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4051C	24/03/2022	Carrington_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4116P	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4119P	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Appleyard Farm	7/01/2022	Lemington South_Alluvium	6.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Appleyard Farm	18/02/2022	Lemington South_Alluvium	5.90	6.62	426	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Appleyard Farm	3/03/2022	Lemington South_Alluvium	6.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B334(BFS)	18/02/2022	Lemington South_Bowfield	53.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B425(WDH)	18/02/2022	Lemington South_Woodlands Hill	35.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B631(BFS)	18/02/2022	Lemington South_Bowfield	49.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B925(BFS)	18/02/2022	Lemington South_Bowfield	60.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BC1a	11/02/2022	Cheshunt_Mt Arthur	17.28	6.90	1002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUNC45A	7/02/2022	Cheshunt / North Pit_Alluvium	19.98	6.60	2500	-	1360	-	-	<1	531.00	531.00	7.00	0.01	67.00	47.00	6.00	396.00	0.10	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	0.02	-	-
BUNC45D	9/02/2022	Cheshunt_Piercefield	24.98	6.80	2430	-	1450	-	-	<1	811.00	811.00	1.00	-	76.00	56.00	10.00	407.00	0.32	<0.0001	-	-	-	-	-	-	-	-	<0.0001	0.01	-	-
BZ1-1	10/02/2022	Cheshunt / North Pit_Alluvium	16.95	7.40	2480	-	1510	-	-	<1	590.00	590.00	72.00	0.12	14.00	33.00	9.00	486.00	2.51	<0.0001	-	-	-	0.05	-	0.01	-	-	<0.0001	0.01	-	-
BZ1-3	10/02/2022	Cheshunt_Mt Arthur	47.00	6.90	950	-	607	-	-	<1	343.00	343.00	32.00	0.19	14.00	23.00	10.00	202.00	0.49	-	-	-	-	0.01	-	-	-	-	<0.0001	0.02	-	-
BZ2A(1)	10/02/2022	Cheshunt_Mt Arthur	45.94	6.20	1143	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ3-1	11/02/2022	Cheshunt_Interburden	16.62	7.70	1558	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ3-3	11/02/2022	Cheshunt_Mt Arthur	42.45	6.10	1019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ4A(2)	10/02/2022	Cheshunt_Mt Arthur	41.07	6.30	1956	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ8-2	10/02/2022	Cheshunt_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C122(BFS)	18/02/2022	Lemington South_Bowfield	58.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(ALL)	7/01/2022	Lemington South_Interburden	16.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(ALL)	18/02/2022	Lemington South_Interburden	16.20	6.80	20800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(ALL)	3/03/2022	Lemington South_Interburden	16.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(BFS)	18/02/2022	Lemington South_Bowfield	53.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C317(BFS)	18/02/2022	Lemington South_Bowfield	52.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C317(WDH)	18/02/2022	Lemington South_Woodlands Hill	13.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C613(BFS)	18/02/2022	Lemington South_Bowfield	26.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C621(BFS)	18/02/2022	Lemington South_Bowfield	43.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C919(ALL)	7/01/2022	Lemington South_Alluvium	10.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C919(ALL)	18/02/2022	Lemington South_Alluvium	10.40	7.40	793	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C919(ALL)	3/03/2022	Lemington South_Alluvium	10.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CFW55R	13/01/2022	Carrington_Alluvium	11.16	7.20	8960	3	5870	<5	<1	<1	747.00	747.00	1900.00	0.88	101.00	215.00	28.00	1610.00	0.07	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	0.01	-	-
CFW55R	4/02/2022	Carrington_Alluvium	11.09	7.00	8100	2	5470	<5	<1	<1	855.00	855.00	1500.00	0.79	97.00	194.00	26.00	1540.00	0.05	<0.0001	-	-	-	0.03	-	-	-	-	<0.0001	0.01	-	-
CFW55R	17/03/2022	Carrington_Alluvium	11.02	7.00	7550	2	4890	<5	<1	<1	836.00	836.00	1260.00	0.66	86.00	168.00	26.00	1390.00	0.09	<0.0001	-	-	-	-	-	<0.001	-	-	<0.0001	0.03	-	-
CFW57	21/01/2022	Carrington_Alluvium	10.87	7.20	5010	1	3140	<5	<1	<1	705.00	705.00	261.00	0.16	124.00	163.00	8.00	644.00	0.06	<0.0001	-	-	-	-	-	<0.001	-	-	<0.0001	0.01	-	-
CFW57	3/02/2022	Carrington_Alluvium	10.92	7.10	4820	1	2840	11	<1	<1	698.00	698.00	255.00	0.18	110.00	149.00	6.00	687.00	0.34	<0.0001	-	-	-	-	-	<0.001	-	-	<0.0001	0.02	-	-
CFW57	18/03/2022	Carrington_Alluvium	10.75	7.20	4020	1	2300	<5	<1	<1	647.00	647.00	235.00	0.20	96.00	139.00	5.00	581.00	0.03	<0.0001	-	-	-	0.02	-	<0.001	-	-	<0.0001	-	-	-
CGW32	24/03/2022	Carrington West Wing_Flood Plain	19.54	7.20	8850	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW39	24/03/2022	Carrington West Wing_Flood Plain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW45	24/03/2022	Carrington West Wing_LBL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW46	24/03/2022	Carrington West Wing_Bayswater	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW47a	24/03/2022	Carrington West Wing_Flood Plain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW49	24/03/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW51a	24/03/2022	Carrington_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW52	24/03/2022	Carrington_Broonie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW52a	24/03/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW53	24/03/2022	Carrington_Broonie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW53a	24/03/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW55a	24/03/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ10A	10/02/2022	Cheshunt / North Pit_Alluvium	6.96	6.70	1185	-	634	-	<1	<1	347.00	347.00	71.00	0.38	103.00	61.00	4.00	56.00	0.10	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	0.01	-	-
CHPZ12A	8/02/2022	Cheshunt / North Pit_Alluvium	6.81	6.80	1125	-	770	-	<1	<1	303.00	303.00	66.00	0.33	92.00	58.00	1.00	57.00	0.06	<0.0001	-	-	-	-	-	<0.001	-	-	<0.0001	-	-	-
CHPZ12D	8/02/2022	Cheshunt_Mt Arthur	7.06	6.70	1286	-	854	-	<1	<1	548.00	548.00	<1	-	14.00	12.00	7.00	277.00	<0.01	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	<0.001	-	-
CHPZ1A	9/02/2022	Cheshunt / North Pit_Alluvium	9.35	7.10	696	-	421	-	<1	<1	251.00	251.00	30.00	0.33	47.00	30.00	3.00	58.00	<0.01	<0.0001	-	-	-	<0.001	<0.05	<0.001	<0.001	0.01	<0.0001	<0.001	0.08	<0.001
CHPZ2A	9/02/2022	Cheshunt / North Pit_Alluvium	9.21	7.00	880	-	536	-	<1	<1	245.00	245.00	41.00	0.24	45.00	37.00	<1	83.00	0.01	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
CHPZ3A	8/02/2022	Cheshunt / North Pit_Alluvium	7.20	6.80	885	-	572	-	<1	<1	223.00	223.00	56.00	0.30	53.00	40.00	1.00	63.00	1.12	<0.0001	-	-	-	0.02	-	<0.001	-	-	<0.0001	0.02	-	-
CHPZ3D	8/02/2022	Cheshunt_Mt Arthur	8.43	6.50	983	-	558	-	<1	<1	411.00	411.00	<1	-	11.00	10.00	6.00	199.00	0.26	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
CHPZ4A	10/02/2022	Cheshunt / North Pit_Alluvium	9.73	6.90	786	-	462	-	<1	<1	240.00	240.00	39.00	0.40	60.00	36.00	2.00	54.00	0.01	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
CHPZ8A	7/02/2022	Cheshunt / North Pit_Alluvium	4.05	7.10	1131	-	748	-	<1	<1	427.00	427.00	99.00	1.16	122.00	65.00	<1	36.00	<0.01	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
CHPZ8D	8/02/2022	Cheshunt_Mt Arthur	4.30	7.20	994	-	660	-	<1	<1	375.00	375.00	26.00	0.17	93.00	50.00	2.00	38.00	1.39	<0.0001	-	-	-	0.01	-	<0.001	-	-	<0.0001	0.01	-	-
D214(BFS)	18/02/2022	Lemington South_Bowfield	26.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D317(BFS)	18/02/2022	Lemington South_Bowfield	31.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM1	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM3	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM4	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM7	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G1	17/01/2022	West Pit_Alluvium	1.69	7.20	3170	-	1720	-	<1	<1	92.00	92.00	472.00	0.77	47.00	42.00	2.00	409.00	0.14	<0.0001	-	-	-	-	-	<0.001	-	-	<0.0001	0.01	-	-
G1	3/02/2022	West Pit_Alluvium	1.80	7.20	4510	-	2280	-	<1	<1	442.00	442.00	572.00	0.63	91.00	88.00	3.00	697.00	0.20	<0.0001	-	-	-	0.02	-	-	-	-	<0.0001	0.01	-	-
G1	2/03/2022	West Pit_Alluvium	1.92	7.20	4650	-	2580	-	<1	<1	467.00	467.00	685.00	0.61	107.00	106.00	4.00	785.00	0.22	<0.0001	-	-	-	0.01	-	-	-	-	<0.0001	0.01	-	-
G2	17/01/2022	West Pit_Alluvium	1.27	7.40	6100	-	3940	-	<1	<1	98.00	98.00	918.00	0.60	61.00	151.00	6.00	1040.00	0.10	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
G2	3/02/2022	West Pit_Alluvium	1.45	7.40	5920	-	3910	-	<1	<1	666.00	666.00	913.00	0.56	77.00	151.00	6.00	1000.00	0.06	<0.0001	-	-	-	-	-	<0.001	-	-	<0.0001	-	-	-
G2	2/03/2022	West Pit_Alluvium	1.54	7.40	5960	-	4120	-	<1	<1	653.00	653.00	951.00	0.57	90.00	160.00	7.00	1060.00	0.03	<0.0001	-	-	-	-	-	<0.001	-	-	<0.0001	-	-	-
G3	17/01/2022	West Pit_Alluvium	1.60	7.40	5780	-	3390	-	<1	<1	101.00	101.00	670.00	0.47	45.00	98.00	4.00	1030.00	0.02	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
G3	3/02/2022	West Pit_Alluvium	1.85	7.50	5530	-	3570	-	<1	<1	714.00	714.00	737.00	0.48	47.00	99.00	4.00	1040.00	0.02	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	0.01	-	-
G3	2/03/2022	West Pit_Alluvium	1.78	7.40	5550	-	3590	-	<1	<1	711.00	711.00	774.00	0.49	53.00	103.00	4.00	1060.00	0.03	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
GA3	24/03/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-100	24/03/2022	West Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-101	24/03/2022	West Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-106	24/03/2022	Carrington West Wing_Alluvium	23.44	6.70	5500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-107	24/03/2022	Carrington_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-108	24/03/2022	Carrington_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-114	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-115	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HG2	11/02/2022	Cheshunt_Interburden	11.25	7.40	3740	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HG2a	11/02/2022	Cheshunt_Mt Arthur	25.47	7.10	1823	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hobdens Well	10/02/2022	Cheshunt / North Pit_Alluvium	10.74	7.30	1134	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HV3(2)	24/03/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LUG Bore	18/02/2022	Lemington South Mt Arthur	-	8.60	8600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO01	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO02	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO03	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO04	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO05	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPz2	24/03/2022	West Pit_Sandstone/Siltstone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPz3	24/03/2022	West Pit_Sandstone/Siltstone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB01(ALL)	7/01/2022	Lemington South_Alluvium	7.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB01(ALL)	18/02/2022	Lemington South_Alluvium	7.74	6.90	2910	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB01(ALL)	3/03/2022	Lemington South_Alluvium	7.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ1CH200	9/02/2022	Cheshunt / North Pit_Alluvium	6.49	7.20	958	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ2CH400	9/02/2022	Cheshunt / North Pit_Alluvium	7.73	7.00	793	-	491	-	<1	<1	258.00	258.00	36.00	0.28	49.00	29.00	4.00	68.00	2.30	<0.0001	-	-	-	0.01	5.34	-	-	0.44	<0.0001	0.01	1.35	-
PZ3CH800	9/02/2022	Cheshunt / North Pit_Alluvium	8.40	7.10	906	-	589	-	<1	<1	278.00	278.00	50.00	0.28	72.00	42.00	2.00	54.00	0.88	<0.0001	-	-	-	0.01	<0.05	-	<0.001	0.04	<0.0001	0.01	0.27	<0.001
PZ4CH1380	9/02/2022	Cheshunt / North Pit_Alluvium	9.02	7.00	740	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ5CH1800	9/02/2022	Cheshunt / North Pit_Alluvium	9.90	7.00	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR007	16/03/2022	Southern_Overburden and Vaux Seam coal	34.55	6.70	5200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR008	16/03/2022	Southern_Siltstone/sandstone below Lemington Seam	9.38	6.90	9250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR009	16/03/2022	Southern_Lemington Seam	6.78	7.40	5900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR010	16/03/2022	Southern_Conglomerate and Warkworth Seam	10.70	7.00	5850	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR011	16/03/2022	Southern_Mt Arthur Seam and underburden	35.34	6.60	14850	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR012	16/03/2022	Southern_Overburden - conglomerate and sandstone	26.62	7.10	11010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Bore Id	Date	Geology	Total Selenium (mg/L)	Total Silicon (mg/L)	Total Strontium (mg/L)	Total Zinc (mg/L)	Dissolved Chloride (mg/L)	Dissolved Calcium (mg/L)	Dissolved Magnesium (mg/L)	Dissolved Potassium (mg/L)	Dissolved Sodium (mg/L)	Dissolved Aluminium (µg/L)	Dissolved Antimony (µg/L)	Dissolved Arsenic (µg/L)	Dissolved Barium (µg/L)	Dissolved Berrylium (µg/L)	Dissolved Boron (µg/L)	Dissolved Boron (mg/L)	Dissolved Cadmium (µg/L)	Dissolved Chromium (µg/L)	Dissolved Copper (µg/L)	Dissolved Iron (µg/L)	Dissolved Lead (µg/L)	Dissolved Lithium (µg/L)	Dissolved Manganese (µg/L)	Dissolved Mercury (µg/L)	Dissolved Molybdenum (µg/L)	Dissolved Nickel (µg/L)	Dissolved Rubidium (µg/L)	Dissolved Selenium (µg/L)	Dissolved Silver (µg/L)	Dissolved Strontium (µg/L)	Dissolved Zinc (µg/L)
4032P	24/03/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4036C	24/03/2022	Carrington_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4037P	24/03/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4040P	24/03/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4051C	24/03/2022	Carrington_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4116P	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4119P	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Appleyard Farm	7/01/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Appleyard Farm	18/02/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Appleyard Farm	3/03/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B334(BFS)	18/02/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B425(WDH)	18/02/2022	Lemington South_Woodlands Hill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B631(BFS)	18/02/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B925(BFS)	18/02/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BC1a	11/02/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUNC45A	7/02/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	<0.005	530.00	67.00	47.00	6.00	396.00	<10.0000	-	<1.0000	-	-	100.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	<5.0000
BUNC45D	9/02/2022	Cheshunt_Piercefield	<0.01	-	-	0.02	413.00	76.00	56.00	10.00	407.00	<10.0000	-	2.00	-	-	120.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	4.00	-	<10.0000	-	-	16.00
BZ1-1	10/02/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	0.05	452.00	14.00	33.00	9.00	486.00	<10.0000	-	<1.0000	-	-	70.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	7.00
BZ1-3	10/02/2022	Cheshunt_Mt Arthur	<0.01	-	-	0.03	125.00	14.00	23.00	10.00	202.00	<10.0000	-	<1.0000	-	-	70.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	18.00	-	<10.0000	-	-	16.00
BZ2A(1)	10/02/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ3-1	11/02/2022	Cheshunt_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ3-3	11/02/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ4A(2)	10/02/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ8-2	10/02/2022	Cheshunt_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C122(BFS)	18/02/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(ALL)	7/01/2022	Lemington South_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(ALL)	18/02/2022	Lemington South_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(ALL)	3/03/2022	Lemington South_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(BFS)	18/02/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C317(BFS)	18/02/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C317(WDH)	18/02/2022	Lemington South_Woodlands Hill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C613(BFS)	18/02/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C621(BFS)	18/02/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C919(ALL)	7/01/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C919(ALL)	18/02/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C919(ALL)	3/03/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CFW55R	13/01/2022	Carrington_Alluvium	<0.01	-	-	<0.005	1600.00	101.00	215.00	28.00	1610.00	<10.0000	-	<1.0000	-	-	90.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	5.00	-	<10.0000	-	-	<5.0000
CFW55R	4/02/2022	Carrington_Alluvium	<0.01	-	-	0.02	1400.00	97.00	194.00	26.00	1540.00	<10.0000	-	<1.0000	-	-	90.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	3.00	-	<10.0000	-	-	<5.0000
CFW55R	17/03/2022	Carrington_Alluvium	<0.01	-	-	0.01	1410.00	-	-	-	-	<10	-	<1	-	-	80.00	-	<0.1	-	<1	-	<1	-	-	<0.1	-	4.00	-	<10	-	-	6.00
CFW57	21/01/2022	Carrington_Alluvium	<0.01	-	-	<0.005	1240.00	124.00	163.00	8.00	644.00	<10.0000	-	<1.0000	-	-	70.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	<5.0000
CFW57	3/02/2022	Carrington_Alluvium	<0.01	-	-	0.04	1070.00	110.00	149.00	6.00	687.00	<10.0000	-	<1.0000	-	-	70.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	<5.0000
CFW57	18/03/2022	Carrington_Alluvium	<0.01	-	-	0.01	884.00	96.00	139.00	5.00	581.00	<10.0000	-	<1.0000	-	-	80.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
CGW32	24/03/2022	Carrington West Wing_Flood Plain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW39	24/03/2022	Carrington West Wing_Flood Plain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW45	24/03/2022	Carrington West Wing_LBL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW46	24/03/2022	Carrington West Wing_Bayswater	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW47a	24/03/2022	Carrington West Wing_Flood Plain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW49	24/03/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW51a	24/03/2022	Carrington_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW52	24/03/2022	Carrington_Broonie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW52a	24/03/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW53	24/03/2022	Carrington_Broonie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW53a	24/03/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW55a	24/03/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ10A	10/02/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	<0.005	140.00	103.00	61.00	4.00	56.00	10.00	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	4.00	-	<10.0000	-	-	8.00
CHPZ12A	8/02/2022	Cheshunt / North Pit_Alluvium	0.02	-	-	<0.005	148.00	92.00	58.00	1.00	57.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.1	-	3.00	-	10.00	-	-	6.00
CHPZ12D	8/02/2022	Cheshunt_Mt Arthur	<0.01	-	-	<0.005	134.00	14.00	12.00	7.00	277.00	<10.0000	-	<1.0000	-	-	90.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.1	-	<1.0000	-	<10.0000	-	-	<5.0000
CHPZ1A	9/02/2022	Cheshunt / North Pit_Alluvium	<0.01	-	0.34	<0.005	68.00	47.00	30.00	3.00	58.00	<10.0000	<1.0000	<1.0000	-	<1.0000	<50.0000	-	<0.1000	-	<1.0000	<50	<1.0000	<1	15.00	<0.0001	-	<1.0000	<1	<10.0000	-	367.00	<5.0000
CHPZ2A	9/02/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	<0.005	128.00	45.00	37.00	<1	83.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	1.00	-	<10.0000	-	-	7.00
CHPZ3A	8/02/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	0.04	140.00	53.00	40.00	1.00	63.00	<10.0000	-	2.00	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.1	-	2.00	-	<10.0000	-	-	<5.0000
CHPZ3D	8/02/2022	Cheshunt_Mt Arthur	<0.01	-	-	<0.005	92.00	11.00	10.00	6.00	199.00	<10.0000	-	<1.0000	-	-	100.00	-	<0.1000	-	2.00	-	<1.0000	-	-	<0.1	-	1.00	-	<10.0000	-	-	5.00
CHPZ4A	10/02/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	<0.005	73.00	60.00	36.00	2.00	54.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
CHPZ8A	7/02/2022	Cheshunt / North Pit_Alluvium	0.01	-	-	<0.005	63.00	122.00	65.00	<1	36.00	<10.0000	-	<1.0000	-	-	70.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	10.00	-	-	<5.0000
CHPZ8D	8/02/2022	Cheshunt_Mt Arthur	<0.01	-	-	0.03	116.00	93.00	50.00	2.00	38.00	<10.0000	-	2.00	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.1	-	2.00	-	<10.0000	-	-	9.00
D214(BFS)	18/02/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D317(BFS)	18/02/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM1	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM3	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM4	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM7	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G1	17/01/2022	West Pit_Alluvium	<0.01	-	-	0.02	451.00	47.00	42.00	2.00	409.00	<10.0000	-	<1.0000	-	-	110.00	-	<0.1000	-	1.00	-	<1.0000	-	-	<0.0001	-	5.00	-	<10.0000	-	-	10.00
G1	3/02/2022	West Pit_Alluvium	<0.01	-	-	0.05	672.00	91.00	88.00	3.00	697.00	<10.0000	-	<1.0000	-	-	140.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	6.00	-	<10.0000	-	-	19.00
G1	2/03/2022	West Pit_Alluvium	<0.01	-	-	0.04	831.00	-	-	-	-	<10	-	<1	-	-	190.00	-	<0.1	-	<1	-	<1	-	-	<0.1	-	9.00	-	<10	-	-	24.00
G2	17/01/2022	West Pit_Alluvium	<0.01	-	-	<0.005	1130.00	61.00	151.00	6.00	1040.00	40.00	-	<1.0000	-	-	300.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
G2	3/02/2022	West Pit_Alluvium	<0.01	-	-	0.01	1210.00	77.00	151.00	6.00	1000.00	30.00	-	<1.0000	-	-	250.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	3.00	-	<10.0000	-	-	<5.0000
G2	2/03/2022	West Pit_Alluvium	<0.01	-	-	<0.005	1230.00	-	-	-	-	20.00	-	<1	-	-	330.00	-	<0.1	-	1.00	-	<1	-	-	<0.1	-	1.00	-	<10	-	-	<5
G3	17/01/2022	West Pit_Alluvium	<0.01	-	-	<0.005	1050.00	45.00	98.00	4.00	1030.00	<10.0000	-	<1.0000	-	-	290.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	<5.0000
G3	3/02/2022	West Pit_Alluvium	<0.01	-	-	0.01	1130.00	47.00	99.00	4.00	1040.00	<10.0000	-	<1.0000	-	-	230.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	6.00	-	<10.0000	-	-	<5.0000
G3	2/03/2022	West Pit_Alluvium	<0.01	-	-	<0.005	1160.00	-	-	-	-	<10	-	<1	-	-	310.00	-	<0.1	-	<1	-	<1	-	-	<0.1	-	2.00	-	<10	-	-	<5
GA3	24/03/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-100	24/03/2022	West Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-101	24/03/2022	West Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-106	24/03/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-107	24/03/2022	Carrington_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-108	24/03/2022	Carrington_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-114	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-115	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HG2	11/02/2022	Cheshunt_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HG2a	11/02/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hobdens Well	10/02/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HV3(2)	24/03/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LUG Bore	18/02/2022	Lemington South Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO01	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO02	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO03	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO04	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO05	24/03/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPz2	24/03/2022	West Pit_Sandstone/Siltstone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPz3	24/03/2022	West Pit_Sandstone/Siltstone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB01(ALL)	7/01/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB01(ALL)	18/02/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB01(ALL)	3/03/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ1CH200	9/02/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ2CH400	9/02/2022	Cheshunt / North Pit_Alluvium	<0.01	-	0.40	0.03	96.00	49.00	29.00	4.00	68.00	<10.0000	<1.0000	2.00	-	<1.0000	<50.0000	-	<0.1000	-	<1.0000	5340.00	<1.0000	1.00	420.00	<0.0001	-	4.00	1.00	<10.0000	-	406.00	9.00
PZ3CH800	9/02/2022	Cheshunt / North Pit_Alluvium	<0.01	-	0.55	0.03	131.00	72.00	42.00	2.00	54.00	<10.0000	<1.0000	<1.0000	-	<1.0000	<50.0000	-	<0.1000	-	1.00	<50	<1.0000	<1	27.00	<0.0001	-	6.00	<1	<10.0000	-	532.00	11.00
PZ4CH1380	9/02/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ5CH1800	9/02/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR007	16/03/2022	Southern_Overburden and Vaux Seam coal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR008	16/03/2022	Southern_Siltstone/sandstone below Lemington Seam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR009	16/03/2022	Southern_Lemington Seam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR010	16/03/2022	Southern_Conglomerate and Warkworth Seam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR011	16/03/2022	Southern_Mt Arthur Seam and underburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR012	16/03/2022	Southern_Overburden - conglomerate and sandstone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Bore ID	Date	Location/Geology	Depth to Water (mbToC)	SWL (mAHD)	Field pH (pH unit)	Field Electrical Conductivity (µS/cm)	Field Water Temperature (°C)	Lab pH (pH unit)	Lab Electrical Conductivity (µS/cm)	Field Dissolved Oxygen (mg/L)	Redox Potential (mV)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Total Alkalinity as CaCO3 (mg/L)	Bicarbonate Alkalinity as CaCO3 (mg/L)	Carbonate Alkalinity as CaCO3 (mg/L)	Hydroxide Alkalinity as CaCO3 (mg/L)	Sulfate as SO4 (mg/L)	Dissolved Chloride (mg/L)	Sulfate/Chloride Ratio	Dissolved Calcium (mg/L)	Dissolved Magnesium (mg/L)	Dissolved Potassium (mg/L)	Dissolved Sodium (mg/L)	Dissolved Aluminium (µg/L)	Dissolved Arsenic (µg/L)	Dissolved Boron (µg/L)
4032P	3/05/2022	Carrington West Wing_Alluvium	9.15	61.14	7.40	1218	20.70	-	-	-	-	678	-	395	395.00	<1	<1	34.0	156.0	0.16	40.00	48.000	1.00	146.00	<10.0000	<1.0000	<50.0000
4034P	3/05/2022	Carrington West Wing_Alluvium	10.95	60.51	7.40	1234	19.50	-	-	-	-	710	-	374	374.00	<1	<1	38.0	178.0	0.16	36.00	54.000	2.00	149.00	<10.0000	2.000	<50.0000
4037P	3/05/2022	Carrington West Wing_Alluvium	10.35	61.42	7.30	1009	20.10	-	-	-	-	568	-	270	270.00	<1	<1	33.0	154.0	0.16	42.00	43.000	<1	97.00	<10.0000	<1.0000	<50.0000
4119P	2/05/2022	North Pit_Spoil	8.25	56.49	7.00	2780	21.90	-	-	-	-	1670	-	540	540.00	<1	<1	324.0	433.0	0.55	88.00	74.000	14.00	384.00	<10.0000	61.000	<50.0000
CFW55R	12/04/2022	Carrington_Alluvium	10.85	59.43	7.00	6880	22.50	7.18	6990	-	151.0	4400	<5	851	851.00	<1	<1	1060.0	1240.0	0.63	68.00	148.000	25.00	1330.00	<10.0000	<1.0000	100.00
CFW55R	19/05/2022	Carrington_Alluvium	10.68	59.60	7.20	5950	21.90	7.22	6140	-	130.0	3930	<5	819	819.00	<1	<1	964.0	1000.0	0.71	54.00	115.000	21.00	1110.00	<10.0000	<1.0000	60.00
CFW55R	17/06/2022	Carrington_Alluvium	10.72	59.56	7.20	5610	21.60	7.28	5730	-	186.0	3620	<5	740	740.00	<1	<1	778.0	966.0	0.60	44.00	96.000	20.00	1040.00	<10.0000	<1.0000	90.00
CFW57	27/04/2022	Carrington_Alluvium	10.89	59.86	7.20	4830	20.90	7.30	5000	-	118.0	2760	<5	699	699.00	<1	<1	270.0	1160.0	0.17	109.00	151.000	6.00	725.00	<10.0000	<1.0000	90.00
CFW57	18/05/2022	Carrington_Alluvium	10.95	59.80	7.40	2790	21.20	7.50	2700	-	132.0	1500	27	540	540.00	<1	<1	132.0	490.0	0.20	36.00	55.000	3.00	453.00	<10.0000	<1.0000	80.00
CFW57	16/06/2022	Carrington_Alluvium	10.88	59.87	7.50	2010	21.30	7.60	1920	-	234.0	1070	<5	440	440.00	<1	<1	84.0	329.0	0.19	24.00	32.000	4.00	344.00	<10.0000	<1.0000	70.00
CGW39	3/05/2022	Carrington West Wing_Flood Plain	10.80	60.04	7.30	5400	19.70	-	-	-	-	3130	-	868	868.00	<1	<1	207.0	1200.0	0.13	88.00	155.000	6.00	851.00	<10.0000	<1.0000	50.00
CGW46	3/05/2022	Carrington West Wing_Bayswater	10.90	61.05	7.30	788	21.20	-	-	-	-	605	-	295	295.00	<1	<1	<10	53.0	-	42.00	26.000	90.00	18.00	<10.0000	4.000	<50.0000
CGW47A	13/05/2022	Carrington West Wing_Flood Plain	9.92	60.91	7.60	5080	19.50	-	-	-	-	3250	-	666	666.00	<1	<1	158.0	1130.0	0.10	111.00	188.000	6.00	775.00	<10.0000	1.000	70.00
CGW54A	27/04/2022	Carrington_Alluvium	10.05	59.95	7.60	2570	21.30	7.82	2260	-	174.0	1470	<5	553	553.00	<1	<1	146.0	473.0	0.23	14.00	29.000	4.00	487.00	<10.0000	1.000	120.00
CGW54A	18/05/2022	Carrington_Alluvium	10.11	59.89	7.80	2510	21.00	7.85	2490	-	143.0	1470	16	550	550.00	<1	<1	130.0	406.0	0.24	12.00	28.000	4.00	490.00	<10.0000	1.000	110.00
CGW54A	16/06/2022	Carrington_Alluvium	10.18	59.82	7.80	2390	20.60	7.86	2360	-	259.0	1370	<5	502	502.00	<1	<1	147.0	412.0	0.26	11.00	25.000	5.00	451.00	<10.0000	2.000	100.00
G1	6/04/2022	West Pit_Alluvium	1.36	108.64	7.20	975	23.00	-	-	-	-	538	-	267	267.00	<1	<1	104.0	85.0	0.90	17.00	16.000	1.00	174.00	20.00	<1.0000	80.00
G1	11/05/2022	West Pit_Alluvium	1.16	108.84	7.50	2080	19.30	-	-	-	-	1340	-	450	450.00	<1	<1	263.0	240.0	0.81	32.00	30.000	2.00	401.00	<10.0000	<1.0000	100.00
G1	2/06/2022	West Pit_Alluvium	1.41	108.59	7.60	1828	17.00	-	-	-	-	1040	-	482	482.00	<1	<1	198.0	178.0	0.82	23.00	25.000	2.00	336.00	<10.0000	<1.0000	120.00
G2	6/04/2022	West Pit_Alluvium	1.08	109.52	7.40	6020	22.60	-	-	-	-	3790	-	666	666.00	<1	<1	928.0	1200.0	0.57	79.00	156.000	7.00	1060.00	30.00	<1.0000	320.00
G2	11/05/2022	West Pit_Alluvium	0.92	109.68	7.50	6010	20.00	-	-	-	-	3990	-	583	583.00	<1	<1	976.0	1000.0	0.72	73.00	146.000	6.00	983.00	<10.0000	<1.0000	280.00
G2	2/06/2022	West Pit_Alluvium	1.01	109.59	7.60	5840	16.10	-	-	-	-	3780	-	637	637.00	<1	<1	960.0	1030.0	0.69	50.00	149.000	6.00	985.00	30.00	<1.0000	290.00
G3	6/04/2022	West Pit_Alluvium	1.45	107.15	7.50	5680	21.40	-	-	-	-	3420	-	708	708.00	<1	<1	757.0	1140.0	0.49	48.00	102.000	4.00	1070.00	<10.0000	<1.0000	320.00
G3	11/05/2022	West Pit_Alluvium	1.22	107.38	7.50	5720	18.90	-	-	-	-	3550	-	606	606.00	<1	<1	643.0	1010.0	0.47	49.00	110.000	4.00	1100.00	<10.0000	<1.0000	230.00
G3	2/06/2022	West Pit_Alluvium	1.33	107.27	7.60	5630	15.30	-	-	-	-	3600	-	712	712.00	<1	<1	776.0	1000.0	0.57	39.00	101.000	4.00	1010.00	<10.0000	<1.0000	250.00
GW-120	12/04/2022	North Void_Alluvium	11.13	59.59	7.10	8320	22.20	7.22	8360	-	162.0	5640	<5	811	811.00	<1	<1	1520.0	1550.0	0.73	102.00	233.000	28.00	1540.00	<10.0000	<1.0000	80.00
GW-120	19/05/2022	North Void_Alluvium	11.10	59.62	7.20	7810	21.50	7.22	7960	-	166.0	5420	<5	792	792.00	<1	<1	1360.0	1400.0	0.72	94.00	202.000	28.00	1380.00	<10.0000	<1.0000	<50.0000
GW-120	17/06/2022	North Void_Alluvium	11.10	59.62	7.10	7640	21.60	7.28	7580	-	172.0	5060	<5	737	737.00	<1	<1	1590.0	1360.0	0.86	84.00	189.000	27.00	1340.00	<10.0000	<1.0000	80.00
GW-122	16/06/2022	North Void_Permian	10.36	59.35	7.30	4870	20.60	7.48	4940	-	192.0	2780	<5	617	617.00	<1	<1	349.0	1050.0	0.25	101.00	132.000	6.00	703.00	<10.0000	8.000	80.00
GW-123	17/06/2022	North Void_Alluvium	10.08	59.93	7.50	3680	19.70	7.65	3660	-	-67.0	2120	<5	615	615.00	<1	<1	261.0	719.0	0.27	29.00	65.000	8.00	637.00	<10.0000	<1.0000	100.00
GW-124	17/06/2022	North Void_Alluvium	9.80	59.81	7.60	2650	20.30	7.72	2640	-	203.0	1510	<5	556	556.00	<1	<1	142.0	476.0	0.22	13.00	32.000	4.00	506.00	<10.0000	<1.0000	100.00
GW-125	12/04/2022	North Void_Alluvium	8.89	60.23	7.50	2030	21.10	7.70	2000	2.1	183.0	1190	<5	702	702.00	<1	<1	83.0	264.0	0.23	93.00	65.000	18.00	273.00	<10.0000	2.000	130.00
GW-125	18/05/2022	North Void_Alluvium	9.03	60.09	7.70	2870	20.80	7.79	2800	2.4	167.0	1650	<5	626	626.00	<1	<1	96.0	488.0	0.15	44.00	37.000	13.00	487.00	<10.0000	2.000	120.00
GW-125	16/06/2022	North Void_Alluvium	9.11	60.01	7.70	2950	20.70	7.79	2840	1.9	230.0	1600	<5	589	589.00	<1	<1	118.0	534.0	0.16	35.00	34.000	14.00	522.00	<10.0000	2.000	120.00
GW-126	27/04/2022	North Void_Alluvium	11.06	60.18	7.70	1726	20.60	7.79	1720	7.6	165.0	946	<5	456	456.00	<1	<1	51.0	313.0	0.12	12.00	21.000	3.00	340.00	<10.0000	1.000	80.00
GW-126	18/05/2022	North Void_Alluvium	11.11	60.13	7.70	1824	20.60	7.77	1810	6.5	129.0	1140	<5	449	449.00	<1	<1	46.0	292.0	0.12	12.00	22.000	3.00	344.00	<10.0000	1.000	90.00
GW-126	16/06/2022	North Void_Alluvium	11.19	60.05	7.70	1905	20.50	7.79	1880	5.2	227.0	1060	<5	427	427.00	<1	<1	52.0	340.0	0.11	12.00	24.000	3.00	348.00	<10.0000	<1.0000	90.00
GW-127	27/04/2022	North Void_Alluvium	9.46	60.19	7.20	1280	20.50	7.34	1260	2.6	13.0	690	<5	419	419.00	<1	<1	42.0	157.0	0.20	33.00	33.000	2.00	205.00	<10.0000	<1.0000	60.00
GW-127	18/05/2022	North Void_Alluvium	9.52	60.13	7.20	1342	20.70	7.27	1350	1.9	105.0	802	<5	429	429.00	<1	<1	44.0	154.0	0.21	29.00	33.000	3.00	213.00	<10.0000	<1.0000	50.00
GW-127	16/06/2022	North Void_Alluvium	9.62	60.03	7.20	1472	20.60	7.33	1460	2.4	206.0	837	<5	414	414.00	<1	<1	52.0	203.0	0.19	32.00	36.000	2.00	225.00	<10.0000	<1.0000	50.00
GW-128	12/04/2022	North Void_Alluvium	12.07	58.67	7.20	8320	21.20	7.28	8330	5.2	39.0	5160	<5	1040	1040.00	<1	<1	1060.0	1680.0	0.47	81.00	246.000	25.00	1480.00	<10.0000	<1.0000	160.00
GW-128	18/05/2022	North Void_Alluvium	11.03	59.71	7.20	8190	20.60	7.32	8280	5.5	89.0	5310	15	1020	1020.00	<1	<1	1010.0	1530.0	0.49	74.00	237.000	21.00	1430.00	<10.0000	<1.0000	150.00
GW-128	16/06/2022	North Void_Alluvium	11.04	59.70	7.20	8270	19.60	7.38	8180	3.2	62.0	5160	<5	964	964.00	<1	<1	937.0	1600.0	0.43					<10	<1	160.00
GW-129	12/04/2022	Carrington_Spoil	14.54	58.49	6.90	8590	23.60	6.96	8680	1.7	194.0	6170	14	854	854.00	<1	<1	2170.0	1420.0	1.13	173.00	334.000	32.00	1460.00	<10.0000	4.000	90.00
GW-129	19/05/2022	Carrington_Spoil	15.01	58.02	7.00	9000	22.70	7.09	9350	2.0	153.0	6230	<5	816	816.00	<1	<1	1760.0	1590.0	0.82	147.00	255.000	33.00	1600.00	<10.0000	4.000	60.00
GW-129	17/06/2022	Carrington_Spoil	15.22	57.81	7.00	9020	22.80	7.13	9300	1.9	139.0	6130	<5	752	752.00	<1	<1	2550.0	1580.0	1.19	148.00	264.000	33.00	1540.00	<10.0000	2.000	80.00
LUG001	27/06/2022	Lemington South	86.00	#N/A	7.00	6270	21.60	-	-	-	-	3960	-	1540	1540.00	<1	<1	<10	1370.0	-	53.00	44.000	23.00	1340.00	<10.0000	84.000	180.00
MB14HVO03	2/05/2022	North Pit_Spoil	32.11	34.99	6.90	6000	23.60	-	-	-	-	3870	-	736	736.00	<1	<1	955.0	1060.0	0.67	146.00	164.000	23.00	953.00	<10.0000	171.000	90.00
MB14HVO04	2/05/2022	North Pit_Spoil	27.72	39.38	6.80	6120	23.90	-	-	-	-	4300	-	745	745.00	<1	<1	1140.0	1060.0	0.80	275.00	232.000	21.00	800.00	<10.0000	89.000	80.00
SR001	27/06/2022	Southern_Coal	11.39	47.87	6.70	17830	21.90	-	-	-	-	12000	-	1150	1150.00	<1	<1	777.0	6050.0	0.09	178.00	476.000	29.00	3200.00	<10.0000	<1.0000	80.00
SR002	27/06/2022	Southern_Bayswater Seam	14.97	42.41	6.80	15260	20.40	-	-	-	-	9820	-	929	929.00	<1	<1	258.0	5300.0	0.04	184.00	310.000	27.00	2720.00	<10.0000	<1.0000	60.00
SR003	24/06/2022	Southern_Bayswater Seam	18.97	42.92	6.90	9650	22.20	-	-	-	-	5790	-	1150	1150.00	<1	<1	199.0	2520.0	0.06	76.00	117.000	13.00	2020.00	<10.0000	<1.0000	100.00
SR004	24/06/2022	Southern_Bayswater Seam	36.01	42.91	6.80	12760	22.10	-	-	-	-	7920	-	1070	1070.00	<1	<1	386.0	3600.0	0.08	204.00	275.000	27.00	2400.00	10.00	<1.0000	90.00
SR005	24/06/2022	Southern_Bayswater Seam	22.19	43.86	6.30	3830	20.50	-	-	-	-	2550	-	255	255.00	<1	<1	615.0	761.0	0.60	130.00	200.000	6.00	354.00	270.00	1.000	<50.0000
SR006	1/07/2022	Southern_Bayswater Seam	40.33	43.79	6.80	11850	22.00	-	-	-	-	7180	-	2020	2020.00	<1	<1	<1	3280.0	-	80.00	82.000	23.00	2500.00	<10.0000	<1.0000	110.00
SR007	24/06/2022	Southern_Overburden and Vaux Seam coal	34.12	26.78	6.60	4610	21.60	-	-	-	-	2770	-	626	626.00	<1	<1	150.0	1050.0	0.11	121.00	218.000	11.00	530.00	<10.0000	<1.0000	<50.0000
SR008	23/06/2022	Southern_Siltstone/sandstone below Lemington Seam	9.19	47.61	6.80	13070	19.60	-	-	-	-	7570	-	964	964.00	<1	<1	278.0	3640.0	0.06	113.00	251.000	14.00	2440.00	<10.0000	<1.0000	60.00
SR009	23/06/2022	Southern_Lemington Seam	6.59	49.51	7.40	5990	19.90	-	-	-	-	3360	-	772	772.00	<1	<1	91.0	1370.0	0.05	31.00	54.000	6.00	1220.00	<10.0000	<1.0000	70.00
SR010	23/06/2022	Southern_Conglomerate and Warkworth Seam	10.37	47.13	7.00	5950	20.10	-	-	-	-	3410	-	587	587.00	<1	<1	246.0	1420.0	0.13	105.00	161.000	11.00	961.00	<10.0000	<1.0000	<50.0000
SR011	24/06/2022	Southern_Mt Arthur Seam and underburden	35.19	53.01	6.50	16350	20.50	-	-	-	-	10900	-	772	772.00	<1	<1	678.0	4840.0	0.10	509.00	614.000	33.00	2390.00	<10.0000	<1.0000	60.00
SR012	23/06/2022	Southern_Overburden - conglomerate and sandstone	26.63	49.57	7.00	8220	19.00	-	-	-	-	6930	-	1130	1130.00	<1	<1	985.0	3270.0	0.22	117.00	458.000	40.00	1880.00	<10.0000	<1.0000	<50.0000

Bore ID	Date	Location/Geology	Dissolved Cadmium (µg/L)	Dissolved Copper (µg/L)	Dissolved Lead (µg/L)	Dissolved Mercury (µg/L)	Dissolved Nickel (µg/L)	Dissolved Selenium (µg/L)	Dissolved Zinc (µg/L)	Total Calcium (mg/L)	Total Magnesium (mg/L)	Total Potassium (mg/L)	Total Sodium (mg/L)	Total Aluminium (mg/L)	Total Arsenic (mg/L)	Total Boron (mg/L)	Total Cadmium (mg/L)	Total Copper (mg/L)	Total Lead (mg/L)	Total Mercury (mg/L)	Total Nickel (mg/L)	Total Selenium (mg/L)	Total Zinc (mg/L)	Total Anions (meq/L)	Total Cations (meq/L)	Ionic Balance (%)
4032P	3/05/2022	Carrington West Wing_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	40.0	48.0	1.0	146.0	3.25	-	<0.05	<0.0001	0.01	-	<0.0001	0.01	<0.01	0.08	13.00	12.30	2.68
4034P	3/05/2022	Carrington West Wing_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	1.000	<10.0000	5.000	36.0	54.0	2.0	149.0	1.01	-	<0.05	<0.0001	0.03	-	<0.0001	0.01	<0.01	0.07	13.30	12.80	1.96
4037P	3/05/2022	Carrington West Wing_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	42.0	43.0	<1	97.0	1.36	-	<0.05	<0.0001	0.02	-	<0.0001	-	<0.01	0.02	10.40	9.85	2.82
4119P	2/05/2022	North Pit_Spoil	<0.1000	<1.0000	<1.0000	<0.0001	11.000	<10.0000	<5.0000	88.0	74.0	14.0	384.0	0.87	0.08	0.08	-	-	-	<0.0001	0.05	<0.01	0.32	29.70	27.50	3.85
CFW55R	12/04/2022	Carrington_Alluvium	<0.1000	1.000	<1.0000	<0.0001	2.000	<10.0000	22.000	68.0	148.0	25.0	1330.0	0.02	<0.001	0.09	<0.0001	<0.001	<0.001	<0.0001	-	<0.01	<0.005	74.00	74.10	<0.01
CFW55R	19/05/2022	Carrington_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	4.000	<10.0000	6.000	54.0	115.0	21.0	1110.0	0.17	<0.001	0.10	<0.0001	-	<0.001	<0.0001	0.01	<0.01	<0.005	64.60	61.00	2.92
CFW55R	17/06/2022	Carrington_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	44.0	96.0	20.0	1040.0	0.22	<0.001	0.10	<0.0001	-	<0.001	<0.0001	-	<0.01	<0.005	58.20	55.80	2.09
CFW57	27/04/2022	Carrington_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	2.000	<10.0000	<5.0000	109.0	151.0	6.0	725.0	0.05	<0.001	0.09	<0.0001	<0.001	<0.001	<0.0001	0.02	<0.01	0.01	52.30	49.60	2.70
CFW57	18/05/2022	Carrington_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	2.000	<10.0000	<5.0000	36.0	55.0	3.0	453.0	0.04	<0.001	0.09	<0.0001	<0.001	<0.001	<0.0001	0.01	<0.01	<0.005	27.40	26.10	2.35
CFW57	16/06/2022	Carrington_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	24.0	32.0	4.0	344.0	0.06	<0.001	0.07	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	19.80	18.90	2.39
CGW39	3/05/2022	Carrington West Wing_Flood Plain	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	88.0	155.0	6.0	851.0	9.84	-	<0.05	<0.0001	0.01	-	<0.0001	0.02	0.010	0.07	55.50	54.30	1.08
CGW46	3/05/2022	Carrington West Wing_Bayswater	<0.1000	<1.0000	<1.0000	<0.0001	17.000	<10.0000	6.000	42.0	26.0	90.0	18.0	12.00	0.01	<0.05	<0.0001	0.02	0.01	<0.0001	0.05	<0.01	0.15	7.39	7.32	0.47
CGW47A	13/05/2022	Carrington West Wing_Flood Plain	<0.1000	2.000	<1.0000	<0.0001	1.000	20.000	11.000	111.0	188.0	6.0	775.0	1.22	-	0.07	<0.0001	<0.001	<0.001	<0.0001	-	0.010	0.03	48.50	54.90	6.20
CGW54A	27/04/2022	Carrington_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	14.0	29.0	4.0	487.0	0.05	-	0.11	<0.0001	<0.001	<0.001	<0.0001	-	<0.01	<0.005	27.40	24.40	5.91
CGW54A	18/05/2022	Carrington_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	12.0	28.0	4.0	490.0	0.02	-	0.10	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	25.10	24.30	1.68
CGW54A	16/06/2022	Carrington_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	11.0	25.0	5.0	451.0	0.20	-	0.11	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	24.70	22.40	5.02
G1	6/04/2022	West Pit_Alluvium	<0.1000	2.000	<1.0000	<0.0001	4.000	<10.0000	6.000	17.0	16.0	1.0	174.0	0.61	<0.001	0.10	<0.0001	-	-	<0.0001	0.01	<0.01	0.02	9.90	9.76	0.70
G1	11/05/2022	West Pit_Alluvium	<0.1000	2.000	<1.0000	<0.0001	4.000	<10.0000	8.000	32.0	30.0	2.0	401.0	0.16	<0.001	0.13	<0.0001	-	-	<0.0001	0.01	<0.01	0.01	21.20	21.60	0.75
G1	2/06/2022	West Pit_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	4.000	<10.0000	<5.0000	23.0	25.0	2.0	336.0	0.15	<0.001	0.10	<0.0001	-	<0.001	<0.0001	0.01	<0.01	0.01	18.80	17.90	2.46
G2	6/04/2022	West Pit_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	3.000	<10.0000	<5.0000	79.0	156.0	7.0	1060.0	0.18	<0.001	0.34	<0.0001	-	-	<0.0001	-	<0.01	<0.005	66.50	63.10	2.63
G2	11/05/2022	West Pit_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	2.000	<10.0000	<5.0000	73.0	146.0	6.0	983.0	0.74	-	<0.05	-	-	<0.001	<0.0001	-	<0.01	<0.005	60.20	58.60	1.35
G2	2/06/2022	West Pit_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	3.000	<10.0000	<5.0000	50.0	149.0	6.0	985.0	0.07	<0.001	0.28	<0.0001	<0.001	<0.001	<0.0001	-	<0.01	<0.005	61.80	57.80	3.36
G3	6/04/2022	West Pit_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	5.000	<10.0000	<5.0000	48.0	102.0	4.0	1070.0	0.04	<0.001	0.32	<0.0001	-	<0.001	<0.0001	0.01	<0.01	<0.005	62.10	57.40	3.87
G3	11/05/2022	West Pit_Alluvium	<0.1000	3.000	<1.0000	<0.0001	3.000	<10.0000	<5.0000	49.0	110.0	4.0	1100.0	0.18	<0.001	0.27	-	-	<0.001	<0.0001	0.01	<0.01	0.01	54.00	59.40	4.81
G3	2/06/2022	West Pit_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	3.000	<10.0000	<5.0000	39.0	101.0	4.0	1010.0	0.08	<0.001	0.26	<0.0001	<0.001	<0.001	<0.0001	-	<0.01	<0.005	58.60	54.30	3.81
GW-120	12/04/2022	North Void_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	3.000	<10.0000	8.000	102.0	233.0	28.0	1540.0	<0.01	<0.001	0.08	<0.0001	<0.001	<0.001	<0.0001	0.01	<0.01	0.01	91.60	92.00	0.21
GW-120	19/05/2022	North Void_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	5.000	<10.0000	8.000	94.0	202.0	28.0	1380.0	<0.01	<0.001	0.09	<0.0001	-	<0.001	<0.0001	0.02	<0.01	<0.005	83.60	82.00	0.95
GW-120	17/06/2022	North Void_Alluvium	<0.1000	2.000	<1.0000	<0.0001	4.000	<10.0000	9.000	84.0	189.0	27.0	1340.0	0.01	<0.001	0.08	<0.0001	<0.001	<0.001	<0.0001	-	<0.01	<0.005	86.20	78.70	4.53
GW-122	16/06/2022	North Void_Permian	<0.1000	2.000	<1.0000	<0.0001	4.000	20.000	14.000	101.0	132.0	6.0	703.0	0.03	0.01	0.08	<0.0001	-	<0.001	<0.0001	-	0.020	0.01	49.20	46.60	2.69
GW-123	17/06/2022	North Void_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	29.0	65.0	8.0	637.0	0.03	-	0.10	<0.0001	-	<0.001	<0.0001	<0.001	<0.01	<0.005	38.00	34.70	4.53
GW-124	17/06/2022	North Void_Alluvium	<0.1000	4.000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	13.0	32.0	4.0	506.0	<0.01	-	0.10	<0.0001	-	<0.001	<0.0001	<0.001	<0.01	<0.005	27.50	25.40	3.97
GW-125	12/04/2022	North Void_Alluvium	<0.1000	21.000	<1.0000	<0.0001	6.000	<10.0000	5.000	93.0	65.0	18.0	273.0	0.02	-	0.14	<0.0001	0.02	<0.001	<0.0001	0.01	<0.01	<0.005	23.20	22.30	1.92
GW-125	18/05/2022	North Void_Alluvium	<0.1000	6.000	<1.0000	<0.0001	2.000	<10.0000	<5.0000	44.0	37.0	13.0	487.0	0.06	<0.001	0.13	<0.0001	0.01	<0.001	<0.0001	-	<0.01	<0.005	28.30	26.80	2.75
GW-125	16/06/2022	North Void_Alluvium	<0.1000	4.000	<1.0000	<0.0001	1.000	<10.0000	<5.0000	35.0	34.0	14.0	522.0	0.10	-	0.13	<0.0001	0.01	<0.001	<0.0001	-	<0.01	<0.005	29.30	27.60	2.95
GW-126	27/04/2022	North Void_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	12.0	21.0	3.0	340.0	<0.01	-	0.09	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	19.00	17.20	5.00
GW-126	18/05/2022	North Void_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	12.0	22.0	3.0	344.0	<0.01	<0.001	0.09	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	18.20	17.40	2.01
GW-126	16/06/2022	North Void_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	12.0	24.0	3.0	348.0	<0.01	-	0.09	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	19.20	17.80	3.83
GW-127	27/04/2022	North Void_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	2.000	<10.0000	<5.0000	33.0	33.0	2.0	205.0	<0.01	<0.001	0.05	<0.0001	<0.001	<0.001	<0.0001	-	<0.01	<0.005	13.70	13.30	1.27
GW-127	18/05/2022	North Void_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	2.000	<10.0000	<5.0000	29.0	33.0	3.0	213.0	<0.01	<0.001	0.05	<0.0001	<0.001	<0.001	<0.0001	-	<0.01	<0.005	13.80	13.50	1.20
GW-127	16/06/2022	North Void_Alluvium	<0.1000	<1.0000	<1.0000	<0.0001	5.000	<10.0000	<5.0000	32.0	36.0	2.0	225.0	<0.01	<0.001	0.06	<0.0001	<0.001	<0.001	<0.0001	-	<0.01	<0.005	15.10	14.40	2.32
GW-128	12/04/2022	North Void_Alluvium	<0.1000	14.000	<1.0000	<0.0001	15.000	<10.0000	55.000	81.0	246.0	25.0	1480.0	0.02	<0.001	0.16	<0.0001	0.02	<0.001	<0.0001	0.02	<0.01	0.05	90.20	89.30	0.52
GW-128	18/05/2022	North Void_Alluvium	<0.1000	2.000	<1.0000	<0.0001	10.000	<10.0000	14.000	74.0	237.0	21.0	1430.0	0.05	<0.001	0.17	<0.0001	0.04	<0.001	<0.0001	0.02	<0.01	0.05	84.60	85.90	0.80
GW-128	16/06/2022	North Void_Alluvium	<0.1	5.000	<1	<0.1	15.000	<10	37.000	72.0	220.0	22.0	1360.0	0.36	<0.001	0.17	<0.0001	0.03	<0.001	<0.0001	0.02	<0.01	0.06	83.90	81.40	
GW-129	12/04/2022	Carrington_Spoil	0.200	2.000	<1.0000	<0.0001	46.000	<10.0000	85.000	173.0	334.0	32.0	1460.0	0.17	0.01	0.10	-	-	<0.001	<0.0001	0.06	<0.01	0.10	102.00	100.00	0.91
GW-129	19/05/2022	Carrington_Spoil	0.100	<1.0000	<1.0000	<0.0001	43.000	<10.0000	64.000	147.0	255.0	33.0	1600.0	0.06	-	0.09	-	-	<0.001	<0.0001	0.06	<0.01	0.07	97.80	98.80	0.49
GW-129	17/06/2022	Carrington_Spoil	<0.1000	<1.0000	<1.0000	<0.0001	42.000	<10.0000	59.000	148.0	264.0	33.0	1540.0	0.20	-	0.09	<0.0001	-	<0.001	<0.0001	0.05	<0.01	0.07	113.00	96.90	7.51
LUG001	27/06/2022	Lemington South	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	53.0	44.0	23.0	1340.0	0.06	0.09	0.17	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	0.02	69.40	65.10	3.18
MB14HVO03	2/05/2022	North Pit_Spoil	<0.1000	<1.0000	<1.0000	<0.0001	3.000	<10.0000	<5.0000	146.0	164.0	23.0	953.0	0.03	0.18	0.08	<0.0001	<0.001	<0.001	<0.0001	0.01	<0.01	0.01	64.50	62.80	1.31
MB14HVO04	2/05/2022	North Pit_Spoil	<0.1000	<1.0000	<1.0000	<0.0001	24.000	<10.0000	12.000	275.0	232.0	21.0	800.0	0.56	0.10	0.07	<0.0001	-	<0.001	<0.0001	0.06	<0.01	0.04	68.50	68.20	0.27
SR001	27/06/2022	Southern_Coal	<0.1000	<1.0000	<1.0000	<0.0001	1.000	<10.0000	<5.0000	178.0	476.0	29.0	3200.0	0.02	<0.001	0.08	<0.0001	-	<0.001	<0.0001	-	<0.01	<0.005	210.00	188.00	5.49
SR002	27/06/2022	Southern_Bayswater Seam	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	184.0	310.0	27.0	2720.0	0.01	<0.001	0.06	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	173.00	154.00	6.03
SR003	24/06/2022	Southern_Bayswater Seam	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	76.0	117.0	13.0	2020.0	0.02	<0.001	0.07	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	98.20	102.00	1.71
SR004	24/06/2022	Southern_Bayswater Seam	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	6.000	204.0	275.0	27.0	2400.0	0.05	<0.001	0.08	<0.0001	<0.001	<0.001	<0.0001	-	<0.01	<0.005	131.00	138.00	2.58
SR005	24/06/2022	Southern_Bayswater Seam	0.100	<1.0000	<1.0000	<0.0001	24.000	<10.0000	737.000	130.0	200.0	6.0	354.0	1.14	-	<0.05	-	-	<0.001	<0.0001	0.03	<0.01	0.71	39.40	38.50	1.11
SR006	1/07/2022	Southern_Bayswater Seam	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	14.000	80.0	82.0	23.0	2500.0	0.07	<0.001	0.15	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	0.02	133.00	120.00	5.06
SR007	24/06/2022	Southern_Overburden and Vaux Seam coal	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	121.0	218.0	11.0	530.0	0.03	<0.001	<0.05	<0.0001	<0.001	<0.001	<0.0001	-	<0.01	<0.005	45.20	47.30	2.23
SR008	23/06/2022	Southern_Siltstone/sandstone below Lemington Seam	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	113.0	251.0	14.0	2440.0	0.04	<0.001	0.06	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	128.00	133.00	1.94
SR009	23/06/2022	Southern_Lemington Seam	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	31.0	54.0	6.0	1220.0	0.14	<0.001	0.07	<0.0001	-	<0.001	<0.0001	-	<0.01	<0.005	56.00	59.20	2.82
SR010	23/06/2022	Southern_Conglomerate and Warkworth Seam	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	105.0	161.0	11.0	961.0	<0.01	<0.001	<0.05	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	56.90	60.60	3.12
SR011	24/06/2022	Southern_Mt Arthur Seam and underburden	<0.1000	<1.0000	<1.0000	<0.0001	<1.0000	<10.0000	<5.0000	509.0	614.0	33.0	2390.0	<0.01	<0.001	0.06	<0.0001	<0.001	<0.001	<0.0001	-	<0.01	<0.005	166.00	181.00	4.23
SR012	23/06/2022	Southern_Overburden - conglomerate and sandstone	<0.1000	<1.0000	<1.0000	<0.0001	22.000	<10.0000	<5.0000	117.0	458.0	40.0	1880.0	10.70	0.01	<0.05	-	0.04	0.02	<0.0001	0.16	<0.01	0.10	135.00	126.00	3.44

Bore ID	Date	Geology	Depth to Water from Stand Pipe (mbToC)	Field pH (pH unit)	Field Electrical Conductivity (uS/cm)	Field Dissolved Oxygen (mg/L)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Carbonate Alkalinity as CaCO3 (mg/L)	Hydroxide Alkalinity as CaCO3 (mg/L)	Bicarbonate Alkalinity as CaCO3 (mg/L)	Total Alkalinity as CaCO3 (mg/L)	Sulfate as SO4 (mg/L)	Sulfate/ Chloride Ratio	Total Calcium (mg/L)	Total Magnesium (mg/L)	Total Potassium (mg/L)	Total Sodium (mg/L)	Total Aluminium (mg/L)	Total Cadmium (mg/L)	Total Caesium (mg/L)	Total Chromium (mg/L)	Total Cobalt (mg/L)	Total Copper (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Lithium (mg/L)	Total Manganese (mg/L)	Total Mercury (mg/L)	Total Nickel (mg/L)	Total Phosphorus as P (mg/L)	Total Rubidium (mg/L)
4032P	19/07/2022	Carrington West Wing_Alluvium	8.75	7.3	1378	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4034P	19/07/2022	Carrington West Wing_Alluvium	10.75	7.4	1255	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4036C	19/07/2022	Carrington_Interburden	31.62	6.8	3350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4037P	19/07/2022	Carrington West Wing_Alluvium	10.05	7.3	993	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4040P	19/07/2022	Carrington West Wing_Alluvium	8.35	7.3	1227	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4116P	27/07/2022	North Pit_Spoil	22.02	7.1	12820	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Appleyard Farr	12/07/2022	Lemington South_Alluvium	3.38	6.7	361	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B334(BFS)	30/08/2022	Lemington South_Bowfield	53.74	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B425(WDH)	2/08/2022	Lemington South_Woodlands Hill	35.35	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B631(BFS)	30/08/2022	Lemington South_Bowfield	44.91	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B925(BFS)	2/08/2022	Lemington South_Bowfield	55.85	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BC1a	23/08/2022	Cheshunt_Mt Arthur	17.24	7.0	937	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUNC45A	23/08/2022	Cheshunt / North Pit_Alluvium	19.44	6.6	3000	-	1520	-	<1	<1	465.00	465.00	17.00	<1	90.00	59.00	8.00	426.00	0.13	<0.0001	-	-	-	-	-	<0.001	-	-	<0.0001	0.02	-	-
BUNC45D	23/08/2022	Cheshunt_Piercefield	24.75	6.7	2400	-	1250	-	<1	<1	723.00	723.00	<1	<1	78.00	56.00	10.00	349.00	0.30	<0.0001	-	-	-	-	-	-	-	-	<0.0001	0.01	-	-
BZ1-1	23/08/2022	Cheshunt / North Pit_Alluvium	16.07	7.3	3590	-	1800	-	<1	<1	575.00	575.00	96.00	<1	28.00	64.00	10.00	577.00	0.68	<0.0001	-	-	-	0.01	-	-	-	-	<0.0001	0.01	-	-
BZ1-3	23/08/2022	Cheshunt_Mt Arthur	46.55	7.3	974	-	465	-	<1	<1	286.00	286.00	30.00	<1	12.00	19.00	8.00	160.00	0.44	<0.0001	-	-	-	0.02	-	<0.001	-	-	<0.0001	0.13	-	-
BZ2A(1)	23/08/2022	Cheshunt_Mt Arthur	45.89	6.4	1237	-	-	-	<1	<1	448.00	448.00	26.00	<1	18.00	19.00	12.00	231.00	0.33	<0.0001	-	-	<0.001	0.31	-	<0.001	-	-	<0.0001	0.01	-	-
BZ3-3	23/08/2022	Cheshunt_Mt Arthur	41.88	6.1	1141	-	-	-	<1	<1	424.00	424.00	<1	<1	15.00	17.00	10.00	228.00	0.18	<0.0001	-	-	<0.001	0.01	-	<0.001	-	-	<0.0001	-	-	-
BZ4A(2)	23/08/2022	Cheshunt_Mt Arthur	40.97	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C122(BFS)	2/08/2022	Lemington South_Bowfield	58.58	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(ALL)	12/07/2022	Lemington South_Interburden	16.12	7.0	19180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(BFS)	2/08/2022	Lemington South_Bowfield	48.99	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C317(BFS)	23/08/2022	Lemington South_Bowfield	45.97	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C317(WDH)	23/08/2022	Lemington South_Woodlands Hill	11.84	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C613(BFS)	23/08/2022	Lemington South_Bowfield	22.46	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C919(ALL)	12/07/2022	Lemington South_Alluvium	8.73	7.6	743	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CFW55R	25/07/2022	Carrington_Alluvium	10.71	7.1	5760	-	3630	<5	<1	<1	770.00	770.00	695.00	<1	-	-	-	-	0.12	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	0.01	-	-
CFW57	22/07/2022	Carrington_Alluvium	10.49	7.2	4140	-	2420	<5	<1	<1	629.00	629.00	260.00	<1	-	-	-	-	0.02	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	<0.001	-	-
CGW32	19/07/2022	Carrington West Wing_Flood Plain	19.56	7.2	8970	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW39	19/07/2022	Carrington West Wing_Flood Plain	10.56	7.5	5270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW46	19/07/2022	Carrington West Wing_Bayswater	10.74	7.3	761	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW47a	19/07/2022	Carrington West Wing_Flood Plain	9.80	7.6	5420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW49	19/07/2022	Carrington West Wing_Alluvium	8.15	7.4	1905	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW51a	19/07/2022	Carrington_Interburden	12.79	7.4	6100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW52	19/07/2022	Carrington_Broonie	36.34	7.0	7870	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW52a	19/07/2022	Carrington_Alluvium	10.99	7.7	1220	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW53	19/07/2022	Carrington_Broonie	35.92	6.8	6810	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW53a	19/07/2022	Carrington_Alluvium	9.95	7.0	847	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW55a	19/07/2022	Carrington_Alluvium	11.50	7.5	548	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ10A	24/08/2022	Cheshunt / North Pit_Alluvium	6.71	6.8	1619	-	1080	-	<1	<1	434.00	434.00	148.00	<1	159.00	91.00	2.00	59.00	0.03	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	0.01	-	-
CHPZ12A	23/08/2022	Cheshunt / North Pit_Alluvium	6.68	6.9	1129	-	662	-	<1	<1	375.00	375.00	83.00	<1	109.00	65.00	1.00	48.00	<0.01	<0.0001	-	-	<0.001	-	-	<0.001	-	-	<0.0001	-	-	-
CHPZ12D	23/08/2022	Cheshunt_Mt Arthur	6.89	6.8	1284	-	720	-	<1	<1	532.00	532.00	<1	<1	18.00	12.00	8.00	264.00	0.04	<0.0001	-	-	<0.001	-	-	<0.001	-	-	<0.0001	-	-	-
CHPZ1A	24/08/2022	Cheshunt / North Pit_Alluvium	9.03	7.1	691	-	420	-	<1	<1	256.00	256.00	32.00	<1	48.00	31.00	2.00	55.00	0.07	<0.0001	-	-	<0.001	<0.001	<0.05	<0.001	<0.001	0.03	<0.0001	-	0.10	<0.001
CHPZ2A	23/08/2022	Cheshunt / North Pit_Alluvium	8.75	7.1	858	-	442	-	<1	<1	234.00	234.00	40.00	<1	50.00	38.00	1.00	78.00	<0.01	<0.0001	-	-	<0.001	<0.001	-	<0.001	-	-	<0.0001	-	-	-
CHPZ3A	23/08/2022	Cheshunt / North Pit_Alluvium	7.02	6.9	851	-	457	-	<1	<1	217.00	217.00	63.00	<1	58.00	42.00	<1	58.00	<0.01	<0.0001	-	-	<0.001	<0.001	-	<0.001	-	-	<0.0001	-	-	-
CHPZ3D	23/08/2022	Cheshunt_Mt Arthur	7.99	6.5	957	-	533	-	<1	<1	398.00	398.00	<1	<1	12.00	11.00	6.00	190.00	0.05	<0.0001	-	-	<0.001	<0.001	-	<0.001	-	-	<0.0001	-	-	-
CHPZ4A	23/08/2022	Cheshunt / North Pit_Alluvium	9.43	7.0	925	-	528	-	<1	<1	285.00	285.00	59.00	<1	77.00	44.00	2.00	59.00	0.01	<0.0001	-	-	<0.001	<0.001	-	<0.001	-	-	<0.0001	-	-	-
CHPZ8A	23/08/2022	Cheshunt / North Pit_Alluvium	3.90	7.2	966	-	582	-	<1	<1	462.00	462.00	36.00	<1	113.00	55.00	<1	34.00	1.06	<0.0001	-	-	<0.001	-	-	<0.001	-	-	<0.0001	-	-	-
CHPZ8D	23/08/2022	Cheshunt_Mt Arthur	4.00	7.0	960	-	566	-	<1	<1	330.00	330.00	34.00	<1	94.00	48.00	2.00	37.00	0.17	<0.0001	-	-	<0.001	<0.001	-	<0.001	-	-	<0.0001	-	-	-
D214(BFS)	2/08/2022	Lemington South_Bowfield	24.14	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D317(BFS)	2/08/2022	Lemington South_Bowfield	28.67	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM1	18/07/2022	North Pit_Spoil	24.70	6.8	9560	-	-	-	<1	<1	861.00	-	-	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM3	19/07/2022	North Pit_Spoil	30.42	6.6	9330	-	-	-	<1	<1	815.00	-	-	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM4	18/07/2022	North Pit_Spoil	15.97	6.9	5830	-	-	-	<1	<1	902.00	-	-	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM7	18/07/2022	North Pit_Spoil	31.05	7.2	7810	-	-	-	<1	<1	794.00	-	-	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G1	21/07/2022	West Pit_Alluvium	1.20	7.5	870	-	579	-	<1	<1	275.00	275.00	103.00	<1	-	-	-	-	1.83	<0.0001	-	-	-	-	-	-	-	-	<0.0001	-	-	-
G2	21/07/2022	West Pit_Alluvium	1.02	7.6	5860	-	3940	-	<1	<1	629.00	629.00	991.00	<1	-	-	-	-	0.11	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	0.01	-	-
G3	20/07/2022	West Pit_Alluvium	1.40	7.5	5770	-	3680	-	23.00	<1	669.00	692.00	734.00	<1	-	-	-	-	0.14	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	0.01	-	-
GW-100	18/07/2022	West Pit_Alluvium	3.70	7.5	9920	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-106	18/07/2022	Carrington West Wing_Alluvium	23.48	6.7	7990	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-107	19/07/2022	Carrington_Spoil	29.33	nm	nm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-114	18/07/2022	North Pit_Spoil	31.68	6.6	8050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-115	18/07/2022	North Pit_Spoil	11.68	6.8	6150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HG2	23/08/2022	Cheshunt_Interburden	10.52	7.5	3640	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HG2a	23/08/2022	Cheshunt_Mt Arthur	25.56	7.4	2180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hobdens Well	23/08/2022	Cheshunt / North Pit_Alluvium	9.96	7.7	1036	-	574	-	<1	<1	280.00	280.00	34.00	<1	42.00	38.00	2.00	136.00	0.03	<0.0001	-	-	<0.001	<0.001	-	<0.001	-	-	<0.0001	<0.001	-	-
LUG Bore	2/08/2022	Lemington South_Mt Arthur	nm	8.7	8190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO01	27/07/2022	North Pit_Spoil	31.84	6.9	6740	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO02	27/07/2022	North Pit_Spoil	31.47	6.9	6780	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO03	27/07/2022	North Pit_Spoil	31.54	7.0	4690	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO05	27/07/2022	North Pit_Spoil	32.15	6.8	7380	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPz2	18/07/2022	West Pit_Sandstone/Siltstone	29.93	7.0	13160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPz3	18/07/2022	West Pit_Sandstone/Siltstone	24.03	7.6	12320	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB01(ALL)	14/07/2022	Lemington South_Alluvium	3.09	6.1	205	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ1CH200	24/08/2022	Cheshunt / North Pit_Alluvium	5.44	7.4	994	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ2CH400	25/08/2022	Cheshunt / North Pit_Alluvium	6.66	6.9	1025	-	573	-	<1	<1	294.00	294.00	71.00	<1	78.00	44.00	4.00	70.00	0.86	<0.0001	-	-	-	-	3.46	<0.001	-	0.39	<0.0001	-	0.50	-
PZ3CH800	25/08/2022	Cheshunt / North Pit_Alluvium	7.26	6.9	1132	-	736	-	<1	<1	305.00	305.00	74.00	<1	99.00	54.00	3.00	61.00	0.49	<0.0001	-	-	<0.001	0.01	<0.05	-	<0.001	0.02	<0.0001	0.01	0.32	-
PZ4CH1380	24/08/2022	Cheshunt / North Pit_Alluvium	7.94	7.1	745	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ5CH1800	24/08/2022	Cheshunt / North Pit_Alluvium	8.67	6.7	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR006	1/07/2022	Southern_Bayswater Seam	40.33	6.8	11850	-	7180	-	<1	<1	2020.00	2020.00	<1	<1	80.00	82.00	23.00	2500.00	0.07	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	<0.001	-	-
SR007	8/09/2022	Southern_Overburden and Vaux Seam coal	33.70	6.6	4660	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR008	8/09/2022	Southern_Siltstone/sandstone below Lemington Seam	8.92	6.9	12430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR009	8/09/2022	Southern_Lemington Seam	6.28	7.4	5780	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR010	8/09/2022	Southern_Conglomerate and Warkworth Seam	10.21	7.0	6340	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR011	8/09/2022	Southern_Mt Arthur Seam and underburden	35.05	6.6	14000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR012	8/09/2022	Southern_Overburden - conglomerate and sandstone	26.25	6.9	11190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Bore ID	Date	Geology	Total Selenium (mg/L)	Total Silicon (mg/L)	Total Strontium (mg/L)	Total Zinc (mg/L)	Dissolved Chloride (mg/L)	Dissolved Calcium (mg/L)	Dissolved Magnesium (mg/L)	Dissolved Potassium (mg/L)	Dissolved Sodium (mg/L)	Dissolved Aluminium (µg/L)	Dissolved Antimony (µg/L)	Dissolved Arsenic (µg/L)	Dissolved Barium (µg/L)	Dissolved Berrylium (µg/L)	Dissolved Boron (µg/L)	Dissolved Boron (mg/L)	Dissolved Cadmium (µg/L)	Dissolved Chromium (µg/L)	Dissolved Copper (µg/L)	Dissolved Iron (µg/L)	Dissolved Lead (µg/L)	Dissolved Lithium (µg/L)	Dissolved Manganese (µg/L)	Dissolved Mercury (µg/L)	Dissolved Molybdenum (µg/L)	Dissolved Nickel (µg/L)	Dissolved Rubidium (µg/L)	Dissolved Selenium (µg/L)	Dissolved Silver (µg/L)	Dissolved Strontium (µg/L)	Dissolved Zinc (µg/L)
4032P	19/07/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4034P	19/07/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4036C	19/07/2022	Carrington_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4037P	19/07/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4040P	19/07/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4116P	27/07/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4119P	18/07/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Appleyard Farr	12/07/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B334(BFS)	30/08/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B425(WDH)	2/08/2022	Lemington South_Woodlands Hill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B631(BFS)	30/08/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B925(BFS)	2/08/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BC1a	23/08/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUNC45A	23/08/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	0.01	733.00	90.00	59.00	8.00	426.00	<10.0000	-	2.00	-	-	70.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	5.00	-	<10.0000	-	-	6.00
BUNC45D	23/08/2022	Cheshunt_Piercefield	<0.01	-	-	0.02	399.00	78.00	56.00	10.00	349.00	<10.0000	-	2.00	-	-	110.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	8.00	-	<10.0000	-	-	8.00
BZ1-1	23/08/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	0.03	753.00	28.00	64.00	10.00	577.00	<10.0000	-	<1.0000	-	-	50.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	3.00	-	<10.0000	-	-	13.00
BZ1-3	23/08/2022	Cheshunt_Mt Arthur	<0.01	-	-	0.04	114.00	12.00	19.00	8.00	160.00	20.00	-	<1.0000	-	-	50.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	78.00	-	<10.0000	-	-	44.00
BZ2A(1)	23/08/2022	Cheshunt_Mt Arthur	<0.01	-	-	0.03	138.00	18.00	19.00	12.00	231.00	40.00	-	<1.0000	-	-	90.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	4.00	-	<10.0000	-	-	33.00
BZ3-3	23/08/2022	Cheshunt_Mt Arthur	<0.01	-	-	0.02	119.00	15.00	17.00	10.00	228.00	<10.0000	-	<1.0000	-	-	130.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	1.00	-	<10.0000	-	-	10.00
BZ4A(2)	23/08/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C122(BFS)	2/08/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(ALL)	12/07/2022	Lemington South_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(BFS)	2/08/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C317(BFS)	23/08/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C613(BFS)	23/08/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C919(ALL)	12/07/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CFW55R	25/07/2022	Carrington_Alluvium	<0.01	-	-	<0.005	1030.00	54.00	109.00	18.00	1030.00	<10.0000	-	<1.0000	-	-	90.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	3.00	-	<10.0000	-	-	<5.0000
CFW57	22/07/2022	Carrington_Alluvium	<0.01	-	-	<0.005	902.00	98.00	132.00	5.00	598.00	<10.0000	-	<1.0000	-	-	70.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
CGW32	19/07/2022	Carrington West Wing_Flood Plain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW39	19/07/2022	Carrington West Wing_Flood Plain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW46	19/07/2022	Carrington West Wing_Bayswater	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW47a	19/07/2022	Carrington West Wing_Flood Plain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW49	19/07/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW51a	19/07/2022	Carrington_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW52	19/07/2022	Carrington_Broonie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW52a	19/07/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW53	19/07/2022	Carrington_Broonie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW53a	19/07/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW55a	19/07/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ10A	24/08/2022	Cheshunt / North Pit_Alluvium	0.02	-	-	<0.005	200.00	159.00	91.00	2.00	59.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	6.00	-	20.00	-	-	<5.0000
CHPZ12A	23/08/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	<0.005	105.00	109.00	65.00	1.00	48.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	4.00	-	1.00	-	-	<0.0001	-	2.00	-	10.00	-	-	<5.0000
CHPZ12D	23/08/2022	Cheshunt_Mt Arthur	<0.01	-	-	<0.005	129.00	18.00	12.00	8.00	264.00	<10.0000	-	<1.0000	-	-	90.00	-	<0.1000	-	2.00	-	<1.0000	-	-	<0.0001	-	3.00	-	<10.0000	-	-	<5.0000
CHPZ1A	24/08/2022	Cheshunt / North Pit_Alluvium	<0.01	-	0.38	<0.005	61.00	48.00	31.00	2.00	55.00	<10.0000	<1.0000	<1.0000	-	<1.0000	<50.0000	-	<0.1000	-	<1.0000	<50	<1.0000	<1	31.00	<0.0001	-	<1.0000	<1	<10.0000	-	386.00	<5.0000
CHPZ2A	23/08/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	<0.005	129.00	50.00	38.00	1.00	78.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	<5.0000
CHPZ3A	23/08/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	<0.005	125.00	58.00	42.00	<1	58.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	1.00	-	<10.0000	-	-	<5.0000
CHPZ3D	23/08/2022	Cheshunt_Mt Arthur	<0.01	-	-	<0.005	84.00	12.00	11.00	6.00	190.00	<10.0000	-	<1.0000	-	-	100.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
CHPZ4A	23/08/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	<0.005	81.00	77.00	44.00	2.00	59.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
CHPZ8A	23/08/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	0.01	44.00	113.00	55.00	<1	34.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	<5.0000
CHPZ8D	23/08/2022	Cheshunt_Mt Arthur	<0.01	-	-	0.01	120.00	94.00	48.00	2.00	37.00	<10.0000	-	3.00	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	8.00
D214(BFS)	2/08/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D317(BFS)	2/08/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM1	18/07/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM3	19/07/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM4	18/07/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM7	18/07/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G1	21/07/2022	West Pit_Alluvium	<0.01	-	-	0.01	63.00	12.00	12.00	1.00	166.00	80.00	-	<1.0000	-	-	50.00	-	<0.1000	-	2.00	-	<1.0000	-	-	<0.0001	-	3.00	-	<10.0000	-	-	<5.0000
G2	21/07/2022	West Pit_Alluvium	<0.01	-	-	<0.005	1150.00	51.00	147.00	5.00	986.00	20.00	-	<1.0000	-	-	240.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	<5.0000
G3	20/07/2022	West Pit_Alluvium	<0.01	-	-	<0.005	1150.00	40.00	103.00	3.00	988.00	<10.0000	-	<1.0000	-	-	200.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	<5.0000
GW-100	18/07/2022	West Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-101	18/07/2022	West Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-106	18/07/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-107	19/07/2022	Carrington_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-114	18/07/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-115	18/07/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HG2	23/08/2022	Cheshunt_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HG2a	23/08/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hobdens Well	23/08/2022	Cheshunt / North Pit_Alluvium	<0.01	-	-	0.02	144.00	42.00	38.00	2.00	136.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	16.00
HV3(2)	18/07/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LUG Bore	2/08/2022	Lemington South_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO01	27/07/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO02	27/07/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO03	27/07/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO05	27/07/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPz2	18/07/2022	West Pit_Sandstone/Siltstone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPz3	18/07/2022	West Pit_Sandstone/Siltstone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB01(ALL)	14/07/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ1CH200	24/08/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ2CH400	25/08/2022	Cheshunt / North Pit_Alluvium	<0.01	-	0.65	0.01	122.00	78.00	44.00	4.00	70.00	<10.0000	<1.0000	1.00	-	<1.0000	<50.0000	-	<0.1000	-	<1.0000	3460.00	<1.0000	1.00	367.00	<0.0001	-	3.00	1.00	<10.0000	-	629.00	<5.0000
PZ3CH800	25/08/2022	Cheshunt / North Pit_Alluvium	<0.01	-	0.72	0.01	152.00	99.00	54.00	3.00	61.00	<10.0000	<1.0000	<1.0000	-	<1.0000	<50.0000	-	<0.1000	-	<1.0000	<50	<1.0000	<1	10.00	<0.0001	-	4.00	<1	<10.0000	-	704.00	6.00
PZ4CH1380	24/08/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ5CH1800	24/08/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR006	1/07/2022	Southern_Bayswater Seam	<0.01	-	-	0.02	3280.00	80.00	82.00	23.00	2500.00	<10.0000	-	<1.0000	-	-	110.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	14.00
SR007	8/09/2022	Southern_Overburden and Vaux Seam coal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR008	8/09/2022	Southern_Siltstone/sandstone below Lemington Seam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR009	8/09/2022	Southern_Lemington Seam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR010	8/09/2022	Southern_Conglomerate and Warkworth Seam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR011	8/09/2022	Southern_Mt Arthur Seam and underburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR012	8/09/2022	Southern_Overburden - conglomerate and sandstone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Bore ID	Date	Geology	Depth to Water from Stand Pipe (mbToC)	Field pH (pH unit)	Field Electrical Conductivity (uS/cm)	Field Dissolved Oxygen (mg/L)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Carbonate Alkalinity as CaCO3 (mg/L)	Hydroxide Alkalinity as CaCO3 (mg/L)	Bicarbonate Alkalinity as CaCO3 (mg/L)	Total Alkalinity as CaCO3 (mg/L)	Sulfate as SO4 (mg/L)	Sulfate/ Chloride Ratio	Total Calcium (mg/L)	Total Magnesium (mg/L)	Total Potassium (mg/L)	Total Sodium (mg/L)	Total Aluminium (mg/L)	Total Cadmium (mg/L)	Total Caesium (mg/L)	Total Chromium (mg/L)	Total Cobalt (mg/L)	Total Copper (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Lithium (mg/L)	Total Manganese (mg/L)	Total Mercury (mg/L)	Total Nickel (mg/L)	Total Phosphorus as P (mg/L)	Total Rubidium (mg/L)
4032P	14/12/2022	Carrington West Wing_Alluvium	8.39	7.4	1169	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4034P	14/12/2022	Carrington West Wing_Alluvium	10.23	7.4	1273	-	668	-	<1	<1	376.00	376.00	37.00	<1	-	-	-	-	0.25	-	-	-	0.01	0.01	-	<0.001	-	-	<0.0001	0.01	-	-
4037P	14/12/2022	Carrington West Wing_Alluvium	9.66	7.3	1304	-	762	-	<1	<1	298.00	298.00	59.00	<1	66.00	61.00	1.00	110.00	1.21	<0.0001	-	-	-	0.01	-	-	-	-	<0.0001	0.01	-	-
4040P	14/12/2022	Carrington West Wing_Alluvium	8.35	7.2	1289	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
4116P	22/12/2022	North Pit_Spoil	21.94	6.9	11520	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
B334(BFS)	30/11/2022	Lemington South_Bowfield	53.96	7.2	7040	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
B631(BFS)	30/11/2022	Lemington South_Bowfield	43.87	6.6	12330	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
B631(WDH)	30/11/2022	Lemington South_Woodlands Hill	26.20	6.8	11920	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
B925(BFS)	22/11/2022	Lemington South_Bowfield	54.45	7.0	5490	-	3330	-	<1	<1	1210.00	1210.00	<1	<1	18.00	15.00	10.00	1140.00	0.22	<0.0001	-	-	-	0.01	-	-	-	-	<0.0001	-	-	-
BC1a	8/11/2022	Cheshunt_Mt Arthur	17.11	7.0	933	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
BUNC45A	8/11/2022	Cheshunt / North Pit_Alluvium	19.45	6.6	2780	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
BUNC45D	8/11/2022	Cheshunt_Piercefield	24.88	6.5	2350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
BZ1-1	8/11/2022	Cheshunt / North Pit_Alluvium	15.41	7.5	2770	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
BZ1-3	8/11/2022	Cheshunt_Mt Arthur	47.17	6.9	984	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
BZ2A(1)	8/11/2022	Cheshunt_Mt Arthur	45.78	6.5	1421	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
BZ3-3	8/11/2022	Cheshunt_Mt Arthur	41.49	6.1	1171	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
C122(WDH)	22/11/2022	Lemington South_Woodlands Hill	11.10	7.4	14430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
C130(AFS1)	30/11/2022	Lemington South_Arrowfield	17.83	7.3	12740	-	7960	-	<1	<1	769.00	769.00	2.00	<1	175.00	135.00	28.00	2520.00	0.01	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
C130(BFS)	22/11/2022	Lemington South_Bowfield	48.90	7.0	4570	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
C130(WDH)	22/11/2022	Lemington South_Woodlands Hill	16.32	6.6	2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
C317(BFS)	23/11/2022	Lemington South_Bowfield	45.53	7.0	10340	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
C317(WDH)	23/11/2022	Lemington South_Woodlands Hill	12.50	7.3	5190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
C613(BFS)	22/11/2022	Lemington South_Bowfield	21.98	7.0	8820	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
C621(BFS)	30/11/2022	Lemington South_Bowfield	41.62	7.1	7406	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
C630(BFS)	30/11/2022	Lemington South_Bowfield	45.51	7.7	4670	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
C809(GM/WDH	30/11/2022	Lemington South_Woodlands Hill	9.58	7.1	9630	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CFW57	25/10/2022	Carrington_Alluvium	10.05	7.2	3900	0.47	2150	<5	<1	<1	613.00	613.00	210.00	<1	108.00	126.00	7.00	556.00	0.02	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
CGW32	14/12/2022	Carrington West Wing_Flood Plain	19.55	7.1	8530	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CGW39	14/12/2022	Carrington West Wing_Flood Plain	10.11	7.4	4880	-	2730	-	<1	<1	827.00	827.00	188.00	<1	81.00	132.00	6.00	790.00	0.10	<0.0001	-	-	<0.001	<0.001	-	<0.001	-	-	<0.0001	0.01	-	-
CGW46	14/12/2022	Carrington West Wing_Bayswater	19.34	7.1	824	-	423	-	<1	<1	265.00	265.00	5.00	<1	35.00	22.00	71.00	26.00	23.60	-	-	-	0.03	0.05	-	0.01	-	-	<0.0001	0.08	-	-
CGW47a	14/12/2022	Carrington West Wing_Flood Plain	9.18	7.4	6070	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CGW49	14/12/2022	Carrington West Wing_Alluvium	7.71	7.6	1638	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CGW51a	15/12/2022	Carrington_Interburden	11.56	7.6	7160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CGW52	15/12/2022	Carrington_Broonie	34.29	6.9	7650	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CGW52a	15/12/2022	Carrington_Alluvium	10.60	7.8	1389	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CGW53	14/12/2022	Carrington_Broonie	34.29	6.7	6440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CGW53a	14/12/2022	Carrington_Alluvium	9.68	7.5	888	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CGW55a	15/12/2022	Carrington_Alluvium	10.83	7.6	860	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CHPZ10A	8/11/2022	Cheshunt / North Pit_Alluvium	6.24	7.1	1169	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CHPZ12A	8/11/2022	Cheshunt / North Pit_Alluvium	6.31	7.4	966	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CHPZ12D	8/11/2022	Cheshunt_Mt Arthur	6.51	7.1	1402	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CHPZ1A	8/11/2022	Cheshunt / North Pit_Alluvium	8.48	7.0	711	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CHPZ2A	8/11/2022	Cheshunt / North Pit_Alluvium	8.60	7.1	1178	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CHPZ3A	8/11/2022	Cheshunt / North Pit_Alluvium	6.58	7.1	813	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CHPZ3D	8/11/2022	Cheshunt_Mt Arthur	7.50	6.6	1010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CHPZ4A	8/11/2022	Cheshunt / North Pit_Alluvium	8.93	7.0	921	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CHPZ8A	8/11/2022	Cheshunt / North Pit_Alluvium	3.37	7.2	988	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
CHPZ8D	8/11/2022	Cheshunt_Mt Arthur	3.50	7.1	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
D010(BFS)	22/11/2022	Lemington South_Bowfield	28.55	7.2	8600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
D010(GM)	22/11/2022	Lemington South_Glen Munro	12.60	6.8	10370	-	6910	-	<1	<1	1100.00	1100.00	333.00	<1	113.00	304.00	28.00	1700.00	0.11	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
D010(WDH)	22/11/2022	Lemington South_Woodlands Hill	7.87	7.3	288	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
D214(BFS)	23/11/2022	Lemington South_Bowfield	42.05	5.7	123	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
D317(BFS)	30/11/2022	Lemington South_Bowfield	28.10	6.8	2600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
D406(AFS)	23/11/2022	Lemington South_Arrowfield	18.68	6.9	11230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
D510(BFS)	23/11/2022	Lemington South_Bowfield	25.44	6.2	362	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
D612(AFS)	23/11/2022	Lemington South_Arrowfield	22.60	6.8	13350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
D807(BFS)	23/11/2022	Lemington South_Bowfield	36.02	6.8	10660	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
DM1	22/12/2022	North Pit_Spoil	24.09	6.6	8300	-	-	-	<1	<1	930.00	930.00	-	<1	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
DM4	15/12/2022	North Pit_Spoil	14.43	7.0	5930	-	-	-	<1	<1	934.00	934.00	-	<1	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
DM7	15/12/2022	North Pit_Spoil	29.04	7.4	7250	-	-	-	<1	<1	822.00	822.00	-	<1	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
G1	28/10/2022	West Pit_Alluvium	1.64	7.2	1723	-	1020	-	<1	<1	451.00	451.00	280.00	<1	29.00	28.00	2.00	335.00	0.17	<0.0001	-	-	-		-	<0.001	-	-	<0.0001	0.01	-	-
G2	28/10/2022	West Pit_Alluvium	1.34	7.6	5800	-	3800	-	<1	<1	629.00	629.00	1080.00	<1	67.00	152.00	7.00	1040.00	0.07	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
G2	28/10/2022	West Pit_Alluvium	1.34	7.6	5800	-	3800	-	<1	<1	629.00	629.00	1080.00	<1	67.00	152.00	7.00	1040.00	0.07	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
G2	28/10/2022	West Pit_Alluvium	1.34	7.6	5800	-	3800	-	<1	<1	629.00	629.00	1080.00	<1	67.00	152.00	7.00	1040.00	0.07	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
G3	28/10/2022	West Pit_Alluvium	1.65	7.5	5510	-	3510	-	<1	<1	647.00	647.00	680.00	<1	48.00	102.00	4.00	1070.00	0.03	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	0.01	-	-
GA3	15/12/2022	Cheshunt / North Pit_Alluvium	8.44	6.9	676	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
GW-100	15/12/2022	West Pit_Alluvium	3.56	7.4	10100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
GW-106	14/12/2022	Carrington West Wing_Alluvium	23.44	6.8	7220	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
GW-114	22/12/2022	North Pit_Spoil	30.90	6.6	7530	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
GW-115	22/12/2022	North Pit_Spoil	10.58	6.8	3750	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
HG2	8/11/2022	Cheshunt_Interburden	9.62	7.4	3640	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
HG2a	8/11/2022	Cheshunt_Mt Arthur	25.29	7.3	2370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
Hobdens Well	8/11/2022	Cheshunt / North Pit_Alluvium	9.00	7.2	1035	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
HV3(2)	15/12/2022	Cheshunt / North Pit_Alluvium	9.62	7.0	763	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
LUG Bore	22/11/2022	Lemington South_Mt Arthur	0.00	8.9	8490	-	5170	-	324.00	<1	2030.00	2350.00	<1	<1	8.00	26.00	19.00	1920.00	<0.01	<0.0001	-	-	-	0.18	-	<0.001	-	-	<0.0001	-	-	-
MB14HVO01	22/12/2022	North Pit_Spoil	30.08	7.0	5720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
MB14HVO02	22/12/2022	North Pit_Spoil	29.70	6.8	6530	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
MB14HVO03	15/12/2022	North Pit_Spoil	29.91	7.0	3990	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
MB14HVO04	22/12/2022	North Pit_Spoil	25.24	6.9	5820	-	-	-	<1	<1	680.00	680.00	1250.00	<1	253.00	218.00	18.00	701.00	0.01	<0.0001	-	-	0.02	<0.001	-	<0.001	-	-	<0.0001	0.03	-	-
MB14HVO05	22/12/2022	North Pit_Spoil	30.35	6.7	7190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
NPz2	15/12/2022	West Pit_Sandstone/Siltstone	36.22	7.2	13550	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
PZ1CH200	8/11/2022	Cheshunt / North Pit_Alluvium	4.56	7.1	1048	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
PZ2CH400	8/11/2022	Cheshunt / North Pit_Alluvium	5.92	6.9	1002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
PZ3CH800	8/11/2022	Cheshunt / North Pit_Alluvium	6.20	6.8	1084	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
PZ4CH1380	8/11/2022	Cheshunt / North Pit_Alluvium	6.92	6.7	710	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
PZ5CH1800	8/11/2022	Cheshunt / North Pit_Alluvium	7.75	6.8	128	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
SR001	9/12/2022	Southern_Coal	11.31	6.7	15420	-	10200	-	<1	<1	1200.00	1200.00	760.00	<1	124.00	498.00	22.00	2840.00	0.12	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
SR002	9/12/2022	Southern_Bayswater Seam	14.55	6.8	14500	-	9190	-	<1	<1	1080.00	1080.00	236.00	<1	159.00	323.00	23.00	2760.00	<0.01	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
SR003	9/12/2022	Southern_Bayswater Seam	18.56	6.9	9600	-	5700	-	<1	<1	1220.00	1220.00	211.00	<1	72.00	112.00	15.00	2030.00	0.18	<0.0001	-	-	-		-	<0.001	-	-	<0.0001	<0.001	-	-
SR004	9/12/2022	Southern_Bayswater Seam	35.58	6.8	12290	-	7720	-	<1	<1	1150.00	1150.00	305.00	<1	183.00	252.00	25.00	2340.00	0.02	<0.0001	-	-	-	0.01	-	<0.001	-	-	<0.0001	0.20	-	-
SR005	9/12/2022	Southern_Bayswater Seam	21.42	6.3	5430	-	3600	-	<1	<1	331.00	331.00	478.00	<1	119.00	214.00	10.00	679.00	0.90	-	-	-	-	<0.001	-	<0.001	-	-	<0.0001	0.02	-	-
SR006	9/12/2022	Southern_Bayswater Seam	39.51	7.0	11300	-	6850	-	<1	<1	1960.00	1960.00	<1	<1	71.00	84.00	22.00	2510.00	0.07	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
SR007	1/12/2022	Southern_Overburden and Vaux Seam coal	33.58	6.6	4170	-	2600	-	<1	<1	530.00	530.00	128.00	<1	114.00	190.00	14.00	500.00	0.03	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	0.01	-	-
SR008	1/12/2022	Southern_Siltstone/sandstone below Lemington Seam	8.74	6.8	12650	-	7870	-	<1	<1	842.00	842.00	292.00	<1	120.00	248.00	18.00	2440.00	0.07	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	<0.001	-	-
SR009	1/12/2022	Southern_Lemington Seam	6.10	7.3	6000	-	3420	-	<1	<1	658.00	658.00	71.00	<1	34.00	55.00	8.00	1180.00	<0.01	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	<0.001	-	-
SR010	1/12/2022	Southern_Conglomerate and Warkworth Seam	10.06	7.0	5950	-	3560	-	<1	<1	509.00	509.00	256.00	<1	114.00	166.00	14.00	958.00	<0.01	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	-	-	-
SR011	1/12/2022	Southern_Mt Arthur Seam and underburden	34.88	6.5	15110	-	11800	-	<1	<1	656.00	656.00	709.00	<1	440.00	584.00	35.00	2290.00	0.01	<0.0001	-	-	-	<0.001	-	<0.001	-	-	<0.0001	<0.001	-	-
SR012	1/12/2022	Southern_Overburden - conglomerate and sandstone	25.32	6.8	12880	-	8790	-	<1	<1	853.00	853.00	739.00	<1	196.00	550.00	54.00	2040.00	0.49	<0.0001	-	-	-		-	<0.001	-	-	<0.0001	0.01	-	-

Bore ID	Date	Geology	Total Selenium (mg/L)	Total Silicon (mg/L)	Total Strontium (mg/L)	Total Zinc (mg/L)	Dissolved Chloride (mg/L)	Dissolved Calcium (mg/L)	Dissolved Magnesium (mg/L)	Dissolved Potassium (mg/L)	Dissolved Sodium (mg/L)	Dissolved Aluminium (µg/L)	Dissolved Antimony (µg/L)	Dissolved Arsenic (µg/L)	Dissolved Barium (µg/L)	Dissolved Berrylium (µg/L)	Dissolved Boron (µg/L)	Dissolved Boron (mg/L)	Dissolved Cadmium (µg/L)	Dissolved Chromium (µg/L)	Dissolved Copper (µg/L)	Dissolved Iron (µg/L)	Dissolved Lead (µg/L)	Dissolved Lithium (µg/L)	Dissolved Manganese (µg/L)	Dissolved Mercury (µg/L)	Dissolved Molybdenum (µg/L)	Dissolved Nickel (µg/L)	Dissolved Rubidium (µg/L)	Dissolved Selenium (µg/L)	Dissolved Silver (µg/L)	Dissolved Strontium (µg/L)	Dissolved Zinc (µg/L)
4032P	14/12/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4034P	14/12/2022	Carrington West Wing_Alluvium	<0.01	-	-	0.05	186.00	42.00	53.00	2.00	147.00	<10.0000	-	3.00	-	-	120.00	-	<0.1000	-	7.00	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
4037P	14/12/2022	Carrington West Wing_Alluvium	<0.01	-	-	0.07	218.00	66.00	61.00	1.00	110.00	<10.0000	-	<1.0000	-	-	60.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
4040P	14/12/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4051C	14/12/2022	Carrington_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4116P	22/12/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4119P	15/12/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B334(BFS)	30/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B425(WDH)	22/11/2022	Lemington South_Woodlands Hill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B631(BFS)	30/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B631(WDH)	30/11/2022	Lemington South_Woodlands Hill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B925(BFS)	22/11/2022	Lemington South_Bowfield	<0.01	-	-	0.03	1150.00	18.00	15.00	10.00	1140.00	<10.0000	-	<1.0000	-	-	130.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	5.00
BC1a	8/11/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUNC45A	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUNC45D	8/11/2022	Cheshunt_Piercefield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ1-1	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ1-3	8/11/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ2A(1)	8/11/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ2A(1)	8/11/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ3-1	8/11/2022	Cheshunt_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ3-3	8/11/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ4A(2)	8/11/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZ4A(2)	8/11/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C122(BFS)	22/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C122(WDH)	22/11/2022	Lemington South_Woodlands Hill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(AFS1)	30/11/2022	Lemington South_Arrowfield	<0.01	-	-	<0.005	4640.00	175.00	135.00	28.00	2520.00	<10.0000	-	2.00	-	-	110.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	3.00	-	<10.0000	-	-	7.00
C130(ALL)	27/10/2022	Lemington South_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(BFS)	22/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C130(WDH)	22/11/2022	Lemington South_Woodlands Hill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C317(BFS)	23/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C317(WDH)	23/11/2022	Lemington South_Woodlands Hill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C613(BFS)	22/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C621(BFS)	30/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C630(BFS)	30/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C809(GM/WDH	30/11/2022	Lemington South_Woodlands Hill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C919(ALL)	27/10/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CFW55R	24/10/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CFW57	25/10/2022	Carrington_Alluvium	<0.01	-	-	<0.005	821.00	108.00	126.00	7.00	556.00	<10.0000	-	<1.0000	-	-	70.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	1.00	-	<10.0000	-	-	<5.0000
CGW32	14/12/2022	Carrington West Wing_Flood Plain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW39	14/12/2022	Carrington West Wing_Flood Plain	0.02	-	-	<0.005	1070.00	81.00	132.00	6.00	790.00	<10.0000	-	<1.0000	-	-	90.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	10.00	-	-	<5.0000
CGW45	14/12/2022	Carrington West Wing_LBL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW46	14/12/2022	Carrington West Wing_Bayswater	<0.01	-	-	0.17	58.00	35.00	22.00	71.00	26.00	<10.0000	-	4.00	-	-	<50.0000	-	<0.1000	-	1.00	-	<1.0000	-	-	<0.0001	-	18.00	-	<10.0000	-	-	<5.0000
CGW47a	14/12/2022	Carrington West Wing_Flood Plain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW49	14/12/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW51a	15/12/2022	Carrington_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW52	15/12/2022	Carrington_Broonie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW52a	15/12/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW53	14/12/2022	Carrington_Broonie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW53a	14/12/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CGW55a	15/12/2022	Carrington_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ10A	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ12A	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ12D	8/11/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ1A	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ2A	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ3A	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ3D	8/11/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ4A	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ8A	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHPZ8D	8/11/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D010(BFS)	22/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D010(GM)	22/11/2022	Lemington South_Glen Munro	<0.01	-	-	<0.005	3210.00	113.00	304.00	28.00	1700.00	<10.0000	-	<1.0000	-	-	110.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
D010(WDH)	22/11/2022	Lemington South_Woodlands Hill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D214(BFS)	23/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D317(BFS)	30/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D406(AFS)	23/11/2022	Lemington South_Arrowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D510(BFS)	23/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D612(AFS)	23/11/2022	Lemington South_Arrowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D807(BFS)	23/11/2022	Lemington South_Bowfield	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM1	22/12/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM3	22/12/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM4	15/12/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM7	15/12/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G1	28/10/2022	West Pit_Alluvium	<0.01	-	-	0.02	156.00	29.00	28.00	2.00	335.00	<10.0000	-	<1.0000	-	-	70.00	-	<0.1000	-	1.00	-	<1.0000	-	-	<0.0001	-	4.00	-	<10.0000	-	-	13.00
G2	28/10/2022	West Pit_Alluvium	<0.01	-	-	<0.005	967.00	67.00	152.00	7.00	1040.00	30.00	-	<1.0000	-	-	260.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	<5.0000
G3	28/10/2022	West Pit_Alluvium	<0.01	-	-	<0.005	1000.00	48.00	102.00	4.00	1070.00	<10.0000	-	<1.0000	-	-	220.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	4.00	-	<10.0000	-	-	6.00
GA3	15/12/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-100	15/12/2022	West Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-106	14/12/2022	Carrington West Wing_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-114	22/12/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW-115	22/12/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HG2	8/11/2022	Cheshunt_Interburden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HG2a	8/11/2022	Cheshunt_Mt Arthur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hobdens Well	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HV3(2)	15/12/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LUG Bore	22/11/2022	Lemington South_Mt Arthur	<0.01	-	-	0.03	1530.00	8.00	26.00	19.00	1920.00	<10.0000	-	61.00	-	-	170.00	-	<0.1000	-	171.00	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	22.00
MB14HVO01	22/12/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO02	22/12/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO03	15/12/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MB14HVO04	22/12/2022	North Pit_Spoil	<0.01	-	-	0.02	1160.00	253.00	218.00	18.00	701.00	<10.0000	-	82.00	-	-	80.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	24.00	-	<10.0000	-	-	<5.0000
MB14HVO05	22/12/2022	North Pit_Spoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPz2	15/12/2022	West Pit_Sandstone/Siltstone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPz3	15/12/2022	West Pit_Sandstone/Siltstone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB01(ALL)	27/10/2022	Lemington South_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ1CH200	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ2CH400	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ3CH800	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ4CH1380	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ5CH1800	8/11/2022	Cheshunt / North Pit_Alluvium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SR001	9/12/2022	Southern_Coal	<0.01	-	-	<0.005	5060.00	124.00	498.00	22.00	2840.00	<10.0000	-	<1.0000	-	-	70.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	<5.0000
SR002	9/12/2022	Southern_Bayswater Seam	<0.01	-	-	<0.005	4970.00	159.00	323.00	23.00	2760.00	<10.0000	-	<1.0000	-	-	60.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
SR003	9/12/2022	Southern_Bayswater Seam	<0.01	-	-	0.01	2690.00	72.00	112.00	15.00	2030.00	<10.0000	-	<1.0000	-	-	90.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
SR004	9/12/2022	Southern_Bayswater Seam	<0.01	-	-	0.01	3980.00	183.00	252.00	25.00	2340.00	<10.0000	-	<1.0000	-	-	80.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	9.00	-	<10.0000	-	-	11.00
SR005	9/12/2022	Southern_Bayswater Seam	<0.01	-	-	0.63	1310.00	119.00	214.00	10.00	679.00	220.00	-	5.00	-	-	<50.0000	-	0.10	-	<1.0000	-	<1.0000	-	-	<0.0001	-	14.00	-	<10.0000	-	-	549.00
SR006	9/12/2022	Southern_Bayswater Seam	<0.01	-	-	0.01	3070.00	71.00	84.00	22.00	2510.00	<10.0000	-	<1.0000	-	-	120.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	10.00
SR007	1/12/2022	Southern_Overburden and Vaux Seam coal	<0.01	-	-	0.01	1110.00	114.00	190.00	14.00	500.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	1.00	-	<10.0000	-	-	<5.0000
SR008	1/12/2022	Southern_Siltstone/sandstone below Lemington Seam	<0.01	-	-	<0.005	4380.00	120.00	248.00	18.00	2440.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
SR009	1/12/2022	Southern_Lemington Seam	<0.01	-	-	<0.005	1570.00	34.00	55.00	8.00	1180.00	<10.0000	-	<1.0000	-	-	70.00	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
SR010	1/12/2022	Southern_Conglomerate and Warkworth Seam	<0.01	-	-	<0.005	1670.00	114.00	166.00	14.00	958.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	<5.0000
SR011	1/12/2022	Southern_Mt Arthur Seam and underburden	<0.01	-	-	<0.005	5800.00	440.00	584.00	35.00	2290.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	<1.0000	-	<1.0000	-	-	<0.0001	-	<1.0000	-	<10.0000	-	-	7.00
SR012	1/12/2022	Southern_Overburden - conglomerate and sandstone	<0.01	-	-	0.01	4480.00	196.00	550.00	54.00	2040.00	<10.0000	-	<1.0000	-	-	<50.0000	-	<0.1000	-	8.00	-	<1.0000	-	-	<0.0001	-	2.00	-	<10.0000	-	-	14.00

APPENDIX G

Groundwater Model Verification

Our Ref: 21188_R10_GWModelVerification_V2

20 March 2023

Andrew Speechly
Hunter Valley Operations Pty Ltd

Dear Andrew,

RE: Triennial Groundwater Model Review – HVO

1.0 Introduction

The Hunter Valley Operations (HVO) mining complex is located approximately 20 km north-west of Singleton and includes HVO North and HVO South. Under Schedule 3, Condition 27(c) of Development Consent 450-10-2003 and Schedule 3, Condition 27 of Project Approval 06_0261 an independent review of the numerical groundwater model is required on a three-yearly basis. The review is to include comparison between monitoring results and modelled predictions.

A numerical groundwater model was developed by AGE Consultants in 2022, which replicates the approved operations and the proposed modification as part of the HVO Continuation Project. This memo presents an independent review of the current AGE (2022) model results as they relate to the approved operations.

Umwelt conducted a review of the model design representing the approved operations scenario for the review period, from 2019 to 2022. This included the modelled and actual mine progression, rainfall trends and streamflow. Comparison between modelled and observed groundwater levels was also undertaken.

2.0 Model Review

2.1 Model Background

The HVO South numerical groundwater model replicates all approved operations across HVO (north and south) and was developed by AGE Consultants in 2022 as part of HVO Continuation Project. As part of the assessment process the model was independently peer reviewed.

The model was built around the conceptual groundwater model summarised in of AGE (2022). Development of the model was based on previous HVO groundwater models, with updates using data from HVO geological model as well as publicly available data (i.e. geological maps and groundwater studies for the surrounding region).

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The model uses MODFLOW-USG model code and comprises a total of 415,385 cells. The extent of the model was set up relatively large to capture all active mine operations surrounding HVO. The model includes the full extents of the existing HVO North and HVO South mines, as well as the full extent of Liddell Mine, Glendell Mine Ravensworth Operations, Ashton Open Cut and Underground Mine; and United and Wambo open cut mines. The model extends east to include the full lateral extent of the Wittingham Coal Measures.

The model domain was discretised and divided into 33 layers comprising up to 22,577 cell nodes in each layer. Model layers were created to separately represent Quaternary alluvium, surficial weathered Permian strata, coal seams; and non-coal, overburden and interburden strata that separate the coal seams. Only the topmost layer and the base layer are continuous. The other layers pinch-out.

RCH, CHD, and GHB packages of MODFLOW-USG were used to model recharge (as a fraction of rainfall), constant head boundary (representing Lake Liddell, Plashett Reservoir and the Bayswater Power Station ash lake) and general head boundary (representing groundwater exchange inside/outside of the model), respectively. Evapotranspiration from the water table was represented in the numerical model within the soil moisture balance calculation prepared to estimate the applied recharge. Therefore, the evapotranspiration package (EVT) of MODFLOW was not applied.

Groundwater interaction with surface drainage was simulated using either the stream package (STR), or the river package (RIV) of MODFLOW. Major streams systems, including the Hunter River, Bowmans Creek, Glennies Creek and Wollombi Brook were represented using the stream package, whereas minor drainage systems were represented using the river package.

The model is divided into two phases regarding timing and stress period. The Life of Mine (LOM) phase is divided to 169 stress periods of different lengths, starting in 1969 and ending in 2056. Quarterly stress periods were introduced to the model from 2009 to 2035 so that some seasonal variability in recharge and stream flows could be represented within this period. The recovery phase consists of 19 stress periods of different lengths, starting in 2051 and ending in 4000. Thus, in practice, the end of LOM phase is 2050.

Using a total of 377 monitoring points from 269 bores and 108 VWP sensors, the groundwater model calibration replicates steady state (to end of 1969) and transient groundwater levels (1970 to 2020).
The model was calibrated by adjusting aquifer parameters and stresses to produce the best match between the observed and simulated water levels and mine inflows. The transient calibration achieved a 9.2 per cent scaled root mean square (SRMS) error, which is within acceptable limits (i.e., 10 per cent), noted in the Australian groundwater modelling guidelines (Barnett et al 2012). Therefore, the model calibration was considered valid. Comparison of the observed and modelled groundwater trends is discussed later in this report for the review period, which cover the end of calibration and start of the predictive period.

The model simulated the currently approved mine plan at HVO South. The model represented mining using the drain (DRN) package. Drain cells were used to simulate the effect of the completed and approved future mining at HVO and other mines in the area. A high drain conductance of 100 m^2/day was applied to the drain cells and the drain elevation was set the base of the modelled layer. The drains were setup to remain active within the open cut mining areas for 3.5 years after mined, before being turned off. The progressive backfilling of the open cuts with spoils was represented by progressively changing the hydraulic properties of mined cells (Kh, Kv, Sy and Ss) behind the active open cut mining areas after the drains were removed.

Spoil properties in the AGE models are obtained through calibration and are applied uniformly. Calibrated horizontal hydraulic conductivity and vertical to horizontal hydraulic conductivity are 1.23 m/day and 0.1 m/day respectively. Enhanced recharge rates were applied to spoil heaps (2.9 mm/year, 0.45% of average rainfall) to simulate their enhanced recharge capacity, only in recovery phase.

For the prediction period, a constant recharge rate based on the long-term average annual rainfall was adopted (AGE, 2022). Similarly for the stream package, the average flow per gauging station between 2009 and 2019 was used as the water input for the Hunter River, Glennies Creek and Wollombi Brook.

Final voids represented in HVO North and South, Liddell Entrance Pit and South Cut, Ravensworth East, Mt Owen Glendell Operations, Ravensworth Narama, Ravensworth West Pit and United Mine. The recovery models are developed with input from a water balance model created by created by Engeny (2022) using the following steps:

1. the water balance model was used to assess the rate of net surface water flow in the final void from rainfall and runoff (minus evaporation), using groundwater inflow estimates from previous assessments.

2. the water level recovery curve predicted by the water balance model was then incorporated in the AGE recovery model and the net rate of groundwater inflow to the final void over time was calculated.

3. the calculated groundwater inflow to the final void was entered into the water balance model and the water level recovery curve recalculated; and

4. the updated water level recovery curve was incorporated in the groundwater model to allow prediction of long-term drawdown and water take (AGE, 2022).

The recovery simulation was run for 1,950 years and the final water balance model indicated the water level within the HVO final voids will slowly recover. After a period of 100 years (year 2150) their level will be -124.5 mAHD at HVO North and -96.6 mAHD at HVO South.

2.2 Model Design Review

The overall design of the model was briefly described above. This section presents a review of modelled and actual mine progression, rainfall, and streamflow for the review period, from 2019 to 2022.

2.2.1 Mine Progression

Actual mine activities conducted over the review period are summarised in **Table 2.1**. The actual mining details are based on the mine operations plan (2020). Note that the model design in the table is based on the time during which drain cells are active. **Figure 2.1** presents the modelled mine progression of when drain cells are turned on in the approved model scenario.

As mentioned in the table, the model design largely represents the existing approved operations; however, some discrepancies between the actual mine plan and the mine included in the model are noted. This includes additional mining in the model at Carrington West Wing and South Lemington Pit 2, which are not in the current RMP. This is because mining is approved in this location, and while it is not currently in operational planning the impact assessment should consider all approved and foreseeable mining. Therefore the model is considered overly conservative when applied for site operational purposes.

It is also noted that the model does not include the Mitchell Pit within the approved mine plan scenario but does include it for the proposed scenario. The approved scenario would therefore under-predict impacts and take in this area, but over-predict impacts due to the proposed project.

Table 2.1 Mine Areas

Mine Area	Actual Timing	Details	Model Design
West Pit	1949–2025	Mined down to the Bayswater and Hebden Seams. Approved to operate until 2025.	Replicated in the model with drain cells active until 2019.
Mitchell Pit	2022–2025	Mined down to the Hebden Seam. Approved to operate until end of June 2025.	Not included within the AGE (2022) model scenario for approved operations.
North Pit	1979–2003	Mined down to Piercefield, Vaux seams.	Drains are active from 1990 to 2003.
Carrington Pit	2000–2021	Mined down to Broonie, Bayswater seam.	Drains are active from 2003 to 2017 over the pit area.
Alluvial Lands	1993–2003	Mined down to Piercefield, Vaux seams. Rehabilitated.	Drains are active from 2000 to 2003 over the area.
Carrington West Wing	2023–2028	Included in the approved operations but not in the current RMP. Approved to be mined to the Bayswater Seam.	Included in the model – Approved to be mined, with drain cells active from 2023–September 2028.
Cheshunt Pit	2002–2030	Mined down to the Bayswater Seam. Currently actively mined and progressing to the south-west.	Drains are active from 1970 to 2030. 1970 and 1980 drains are in the easter edge of the pit.
Riverview Pit	1997–2030	Mined down to the Bayswater Seam. Currently actively mined and progressing to the south.	Drains in this area are active from 1990 to 2034. There is no boundary between this pit and Chestnut Pit.
South Lemington Pit 1	1998–2006 and 2019–2030	Previously mined down to the Bowfield Seam. Approved to be continued to be mined to the Warkworth Seam. No active mining over review period, used for water storage (LUG Bore water storage).	The drains are active from 2000 to 2002 and from 2023 to 2030.
South Lemington Pit 2	2023–2029	No active mining over review period. Approved to be mined, at State level – Not in current RMP.	Included in the model, with drain cells active from 2023 to 2029.
Glider Pit	2016–2017	Mined to the Vaux Seam. Rehabilitated.	The drains are active from 1990 to 2019.

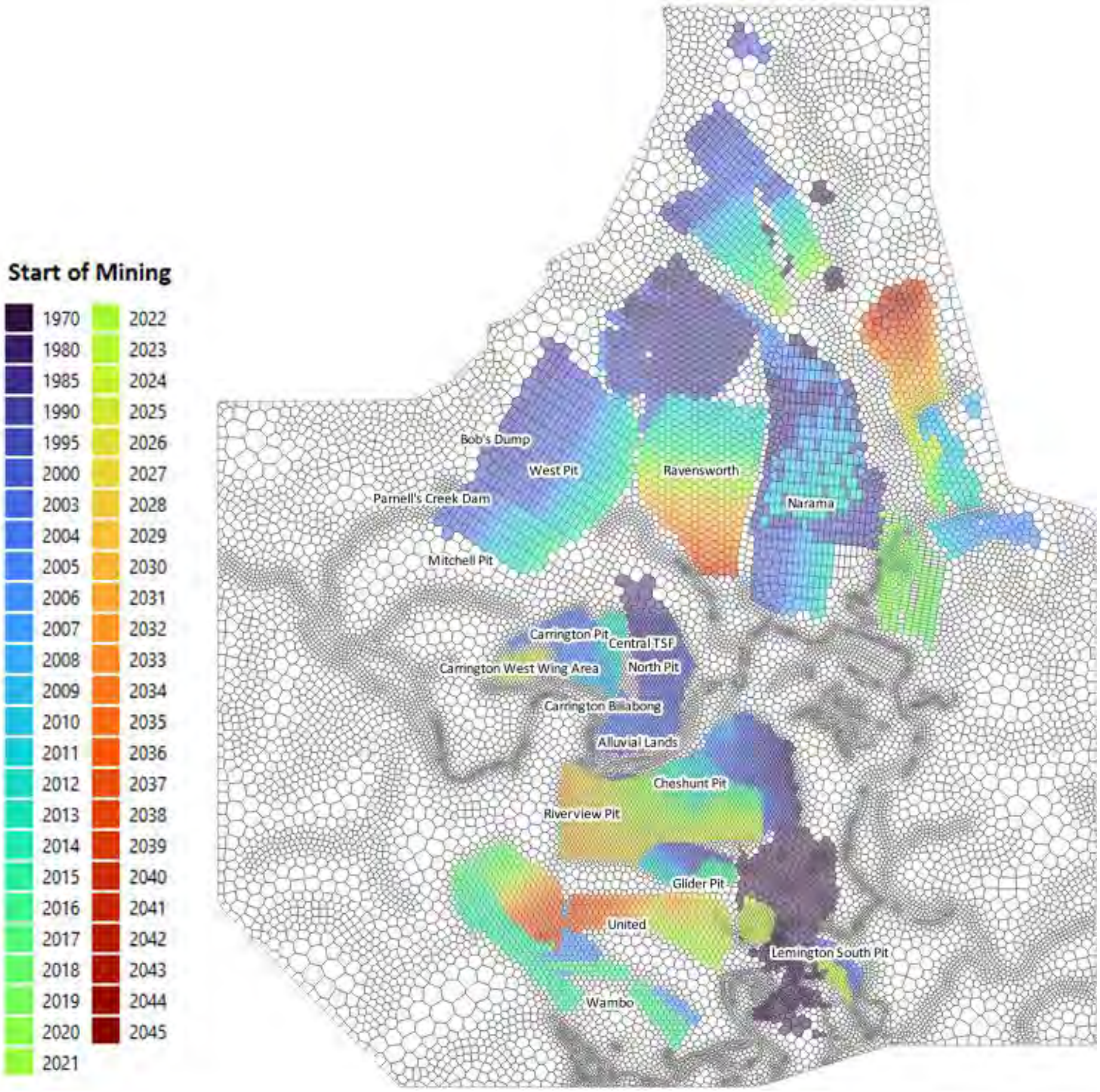

Figure 2.1 Mine Area

2.2.2 Rainfall

The reporting period is captured in the calibration model up to end of December 2019, and the start of the predictive model from January 2020 to December 2022. The stress periods in the model are set up as quarterly, from start of January to end of March, for years within 2009–2035. The AGE (2022) model replicates recharge using the RCH package.

Recharge is applied based on a proportion of observed rainfall over the stress period. The proportion of recharge varies based on zonation of layer 1 based on surface geology/land use. A summary of the different recharge zones and predictive model rates as reported by AGE 2022 is summarised in **Table 2.2**. To derive the recharge flux in the model, the model rainfall in converted to m/day and multiplied to the fractions reported in **Table 2.2** for each zone.

Table 2.2 Modelled Recharge Rates (Adapted from: AGE 2022)

Zone		Long Term Annual Average (mm/year)	% of Annual Rainfall
1, 2	Alluvium, low productivity area	57.49	10.396%
3	Subcrop: Overburden	0.27	0.049%
4	Subcrop: Newcastle, Whybrow Seams	0.06	0.012%
5	Subcrop: Interburden	0.10	0.018%
6	Subcrop: Wambo Seam	0.45	0.082%
7	Subcrop: Interburden	0.20	0.036%
8	Subcrop: Whynot Seam	0.26	0.046%
9	Subcrop: Interburden	0.33	0.059%
10	Subcrop: Blakefield, GlenMunro, WoodlandsHill Seams	0.06	0.012%
11	Subcrop: Interburden	0.39	0.070%
12	Subcrop: Arrowfield Seams	0.22	0.039%
13	Subcrop: Interburden	0.09	0.015%
14	Subcrop: Bowfield, BowfieldSplit Seams	0.13	0.023%
15	Subcrop: Interburden	0.30	0.054%
16	Subcrop: Warkworth Seam	0.39	0.071%
17	Subcrop: Interburden	0.65	0.117%
18	Subcrop: MtArthur Seam	0.30	0.053%
19	Subcrop: Interburden	0.06	0.012%
20	Subcrop: Piercefield, Vaux Seams	0.44	0.080%
21	Subcrop: Interburden	0.07	0.013%
22	Subcrop: Broonie, Bayswater Seams	0.10	0.017%
23	Subcrop: Interburden	0.29	0.052%
24	Subcrop: Interburden	0.44	0.080%
25	Subcrop: Lemington, PikesGully Seams	0.13	0.024%
26	Subcrop: Interburden	0.10	0.018%
27	Subcrop: Interburden	0.43	0.078%
28	Subcrop: Arties, Liddell Seams	0.13	0.023%
29	Subcrop: Interburden	0.45	0.081%
30	Subcrop: Barrett Seam	0.09	0.016%
31	Subcrop: Interburden	0.43	0.078%
32	Subcrop: Hebden Seam	0.25	0.046%
33	Subcrop: SaltwaterCkFm	0.38	0.069%
34	Water/Lakes	0.43	0.078%
36	Regolith – Narrabeen Group (SW)	0.03	0.006%
37	Regolith – Carboniferous tuff and ignimbrite (NE)	0.03	0.006%
39	Alluvium – Palaeochannel W	64.65	11.690%
41	Alluvium – Palaeochannel E	32.32	5.845%
43	Alluvium – Hunter, upstream from HVO (far)	64.65	11.690%
45	Alluvium – Hunter, upstream from HVO (near)	64.65	11.690%

Zone		Long Term Annual Average (mm/year)	% of Annual Rainfall
47	Alluvium – Hunter, downstream from HVO (near)	32.32	5.845%
49	Alluvium – Hunter, downstream from HVO (far)	50.84	9.193%
51	Alluvium – Wollombi	64.65	11.690%
53	Alluvium – Bowmans	64.65	11.690%
55	Alluvium – Glennies	43.64	7.892%
58	Alluvium – Bettys	43.64	7.892%
59	Alluvium – Hunter, near HVO (low productivity area)	28.18	5.095%
61	Alluvium – Wollombi (low productivity area)	41.61	7.524%
63	Alluvium – HVO Alluvial Lands	0	0%

During the calibration period the actual quarterly rainfall was applied. Based on the modelling report, a constant recharge rate based on the long-term annual average rainfall was adopted (AGE, 2022). The actual rate applied was not specified; however, assuming the rainfall is averaged from 1901, this is estimated to be 634.2 mm/year, evenly averaged to 158.55 mm/quarter. The assumed rainfall used to calculate recharge (model) versus the actual average rainfall (measured) is shown in **Figure 2.2**. As shown in the figure, during the predictive period from 2020 there is a relatively significant discrepancy between model and actual rainfall. This is due to the area experiencing above average rainfall from 2020 to 2022. This would likely reduce the model fit to observed seasonal trends for bores.

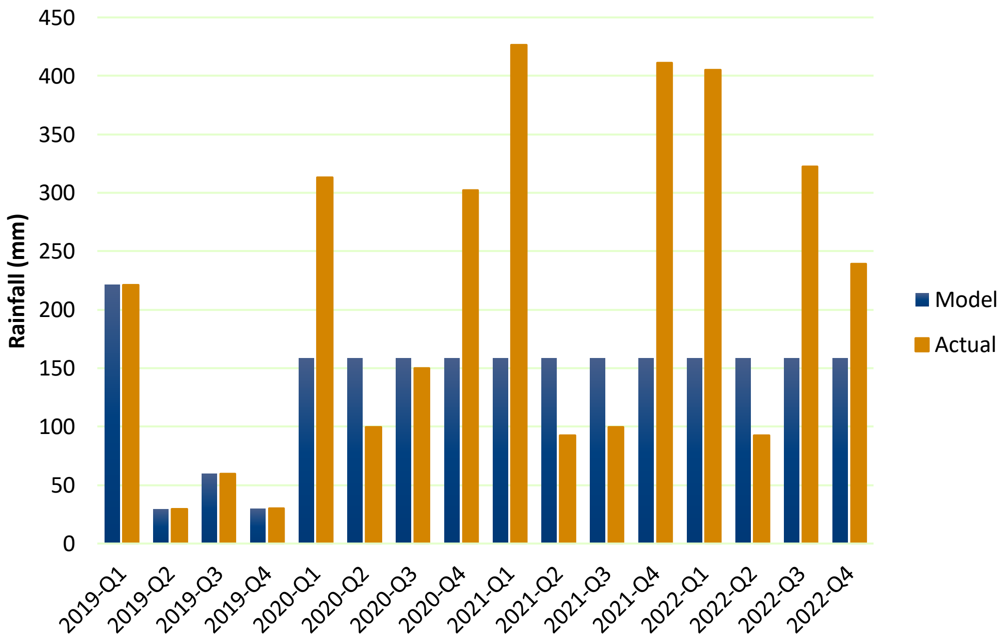

Figure 2.2 Modelled and Observed Rainfall

2.2.3 Streamflow

AGE (2022) used stream package for major rivers in the model based on data from nearby gauging stations. For Hunter River the measured streamflow for the BoM Station *at Liddell* (station number 210083) was used. For the predictive period, the average flow per gauging station between 2009 and 2019 was used as the water input.

The stream bed conductance was calculated from river width, length, riverbed thickness, and an estimated vertical hydraulic conductivity of the riverbed material. The vertical hydraulic conductivity of the stream bed was then adjusted during the calibration process. The stage height for rivers and creeks where flow "enters" the model (Hunter River, Glennies Creek and Wollombi Brook) was internally calculated by MODFLOW-USG.

Figure 2.3 shows a comparison between the model input elevation and recorded stage elevation for the Hunter River at Liddell. As shown in the figure, the model input stage elevations for Hunter River do not capture the fluctuations of daily stream levels.

Based on this comparison, it is expected that the model will reflect longer term seasonal trends. However, the modelled groundwater trends for shallow bores near watercourses are unlikely to replicate short term responses to peak flow events.

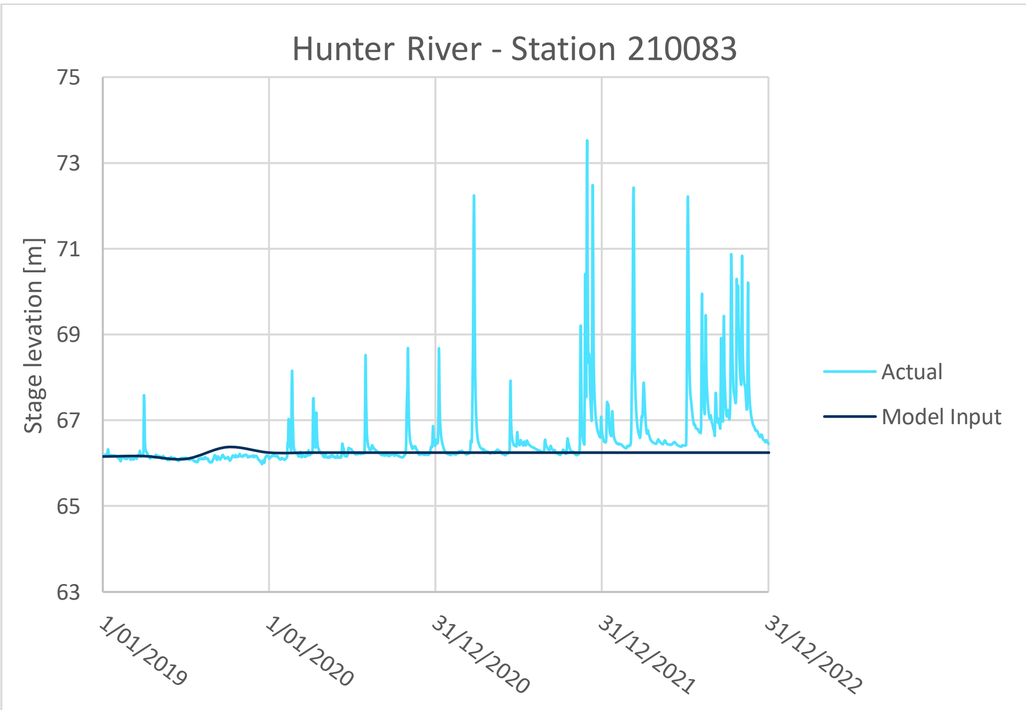

Figure 2.3 **Modelled and Observed River Discharge**

2.3 Model Predictions 2019 to 2022

2.3.1 Calibration Results

Table 2.3 presents the unweighted statistics for the transient calibration model. The RMS error calculated for the calibrated model was 16.8 m. The scaled unweighted RMS (SRMS) of 9.2% indicates a good match for the type of system being modelled.

Table 2.3 Statistical Analysis of Calibrated Model

Calibration Performance Measure	Unweighted Value (All)
SR – Sum of Residuals (m)	166481
MSR – Mean Sum of Residuals (m)	10.8
SMSR – Scaled Mean Sum of Residuals (%)	5.9
RMS – Root Mean Square (m)	16.8
SRMS – Scaled RMS (%)	9.2

Figure 2.4 and **Figure 2.5** show scattergrams of observed head versus modelled head of the calibration points of the AGE (2022) model. **Figure 2.5** presents the scattergram with bores from selected layers highlighted. **Figure 2.5** highlights that the model has a good fit to the shallower layers. The model fit for the Barrett Seam shows variability, potentially related to simplification of model layers compared to VWP sensor depths, and potential discrepancies in mine progression in localised areas.

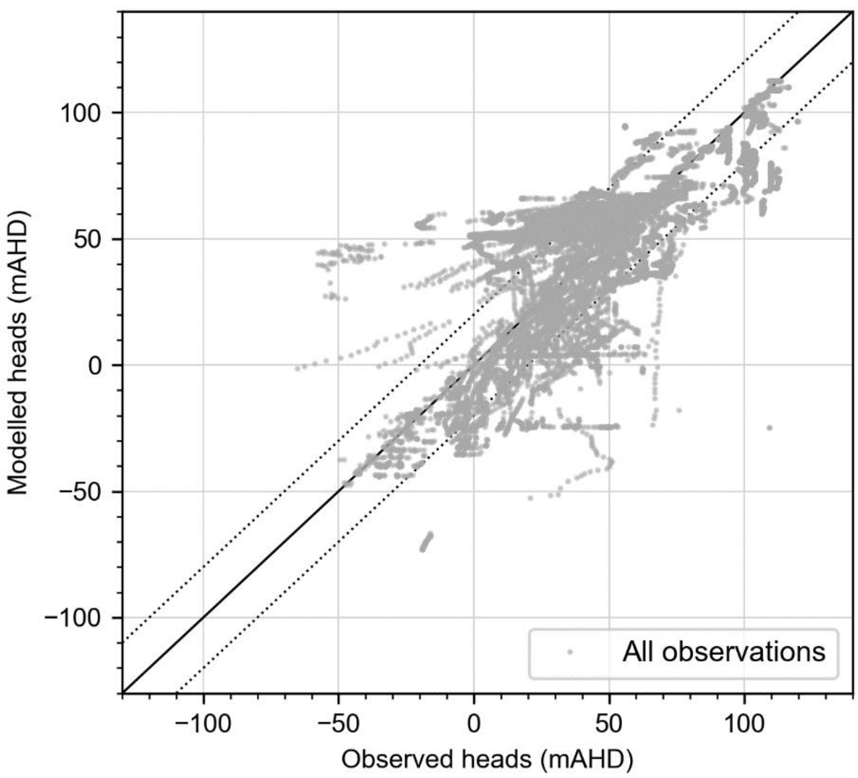

Figure 2.4 Observed versus Modelled head in AGE (2022) Model (Adapted from: AGE 2022)

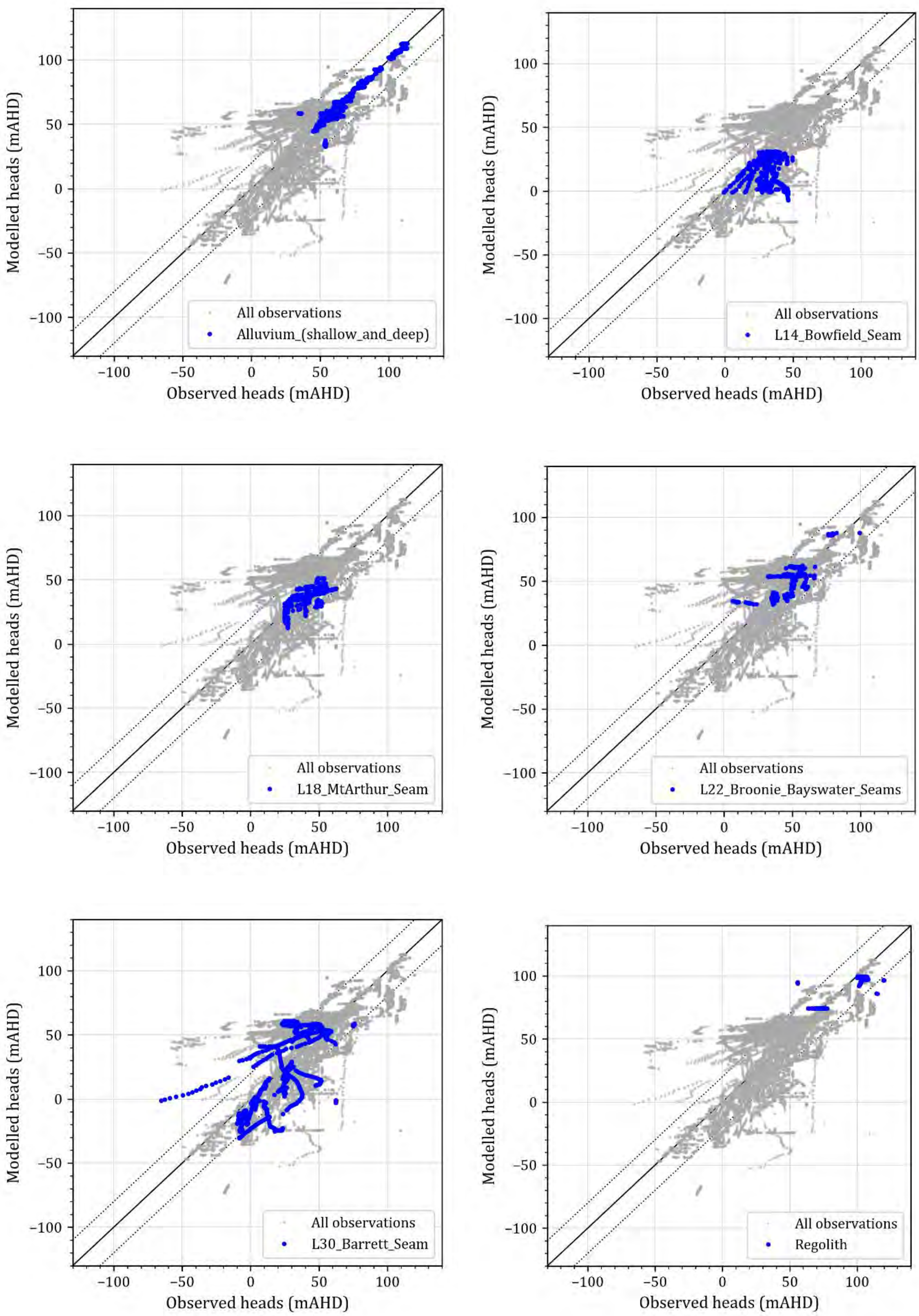

Figure 2.5 Observed head versus modelled head for different layers of AGE (2022) model (Adapted from: AGE 2022)

Overall, the model has been able to replicate the response of groundwater levels to the mining activities and seasonality from 2019 to the present day. The hydrographs for HVO bores show a general over prediction in water level drawdowns. In localised areas, this appears to relate to the modelled mine progression covering a bigger area in comparison to the actual mine progression, as discussed in **Section 2.2.1**.

The hydrographs of the alluvium and spoil bores show that the model is generally in a good match with the observed data over the calibration period to 2020. However, the observed groundwater levels in most alluvial and spoil bores rapidly increase from 2020 in response to significant rainfall and flooding. This observed trend is not replicated in the model, as average rainfall and streamflow is represented in the predictive model (refer **Section 2.2.2** and **Section 2.2.3**). Due to this, the model conservatively over-estimates drawdown in response to mining.

It is also noted that the predicted groundwater levels for bores around Carrington West Wing and within spoil show a rapid rise in water levels to above pre-mining levels. This potentially relates to the use of a low specific yield for spoil of 0.1%, which is considered quite low compared to findings by Mackie (2008).

3.0 Conclusions and Recommendations

The hydrogeological description, conceptualisation and model design of the AGE (2022) groundwater model were revisited and reviewed. As a part of the review process, the modelled recharge, stream stage heights and mine progression were compared against the actual observation data for 2019 to the end of 2022.

The overall match between observed and measured levels in the transient calibration to 2020 is considered reasonable. However, in some areas of the model domain (i.e., Carrington West Wing area and Lemington Pit) the match between observed and simulated heads is poor, with the model predicting more impact than captured by observed water levels. This is likely due to the discrepancies between the actual mine progression and modelled progression and the model not being able to represent these mining activities adequately.

The review of the model files also showed the simplification of modelled river stage heights between 2019 and present day compared to daily observations. The rainfall recharge was also represented in the predictive model based on quarterly averages, which is very different from the observed rainfall from 2020 to 2022. As a result, the model under-predicts groundwater levels in several shallow bores, and conservatively over-predicts drawdown in response to mining in some areas.

As an overall conclusion, this reviewer considers the hydrogeological description, the conceptualisation of the groundwater system and the numerical model design and the numerical model calibration are still fit for purpose. Given the scale of the discrepancies comparing to the regional scale of the model, the reviewer believes updates to the model to remove the discrepancies will result in minor changes to the overall model predictions. However, groundwater models should periodically be evolved, updated and assessed when new data is available. Therefore, the reviewer recommends the following updates to the groundwater model:

Update to Drain Package (DRN) and Time-Variant Materials (TVM) to reflect the actual RMP to provide predictions that reflect actual site activities for compliance reporting and operational use. Update to ensure modelled and actual mine progressions match for approved operations from the end of 2020.

- Review TVM package changes for spoil emplacement. Spoil specific yield of 0.1% is considered too low. This causes a very fast recovery.

- Update recharge package based on the seasonal rainfall after 2020.

- Update recharge package to apply enhanced recharge rate over spoil.

We trust this information meets with your current requirements. Please do not hesitate to contact the undersigned on 1300 793 267 should you require clarification or further information.

Yours sincerely

Mohammad Sedaghat
Senior Groundwater Modeller

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4.0 References

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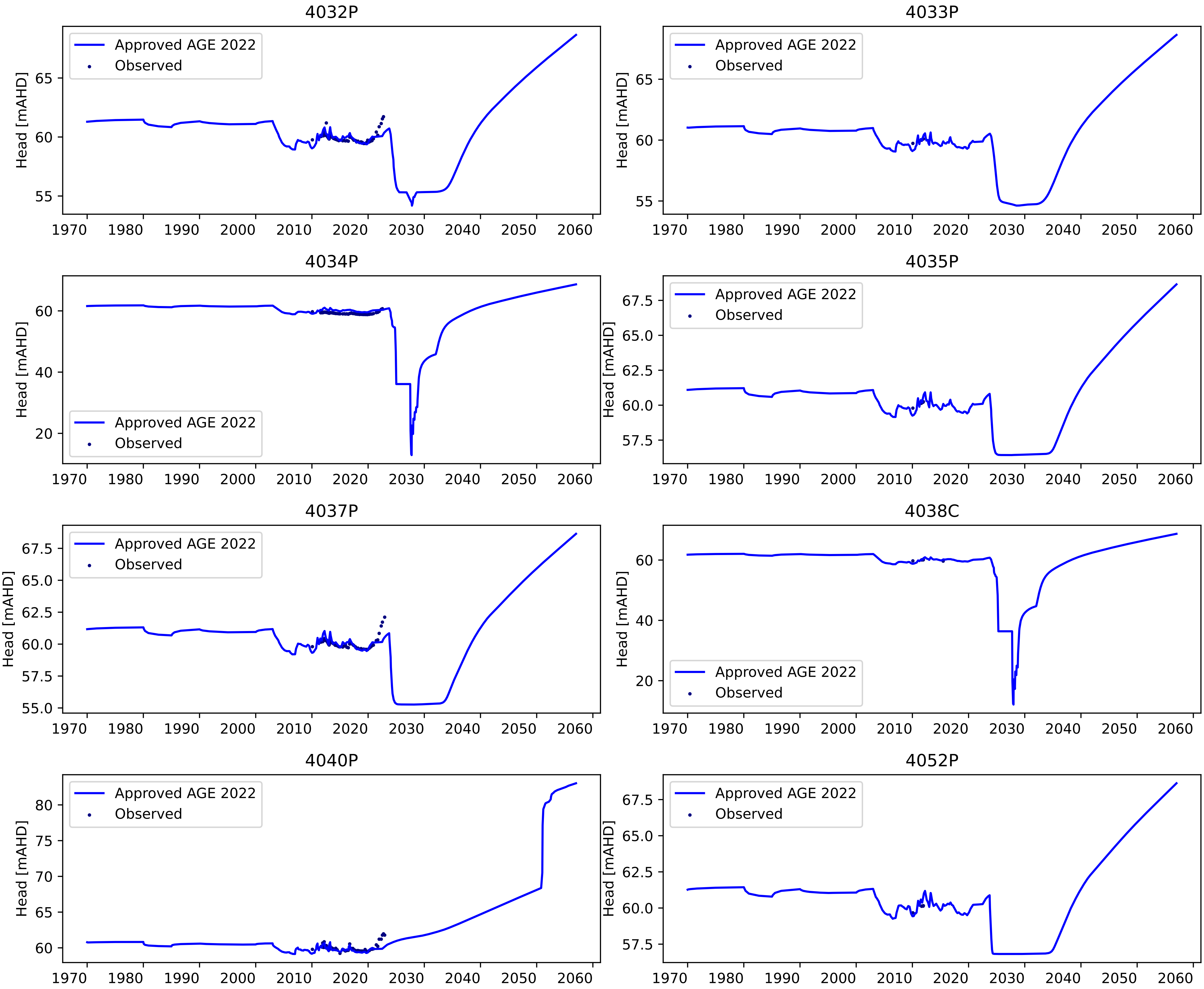
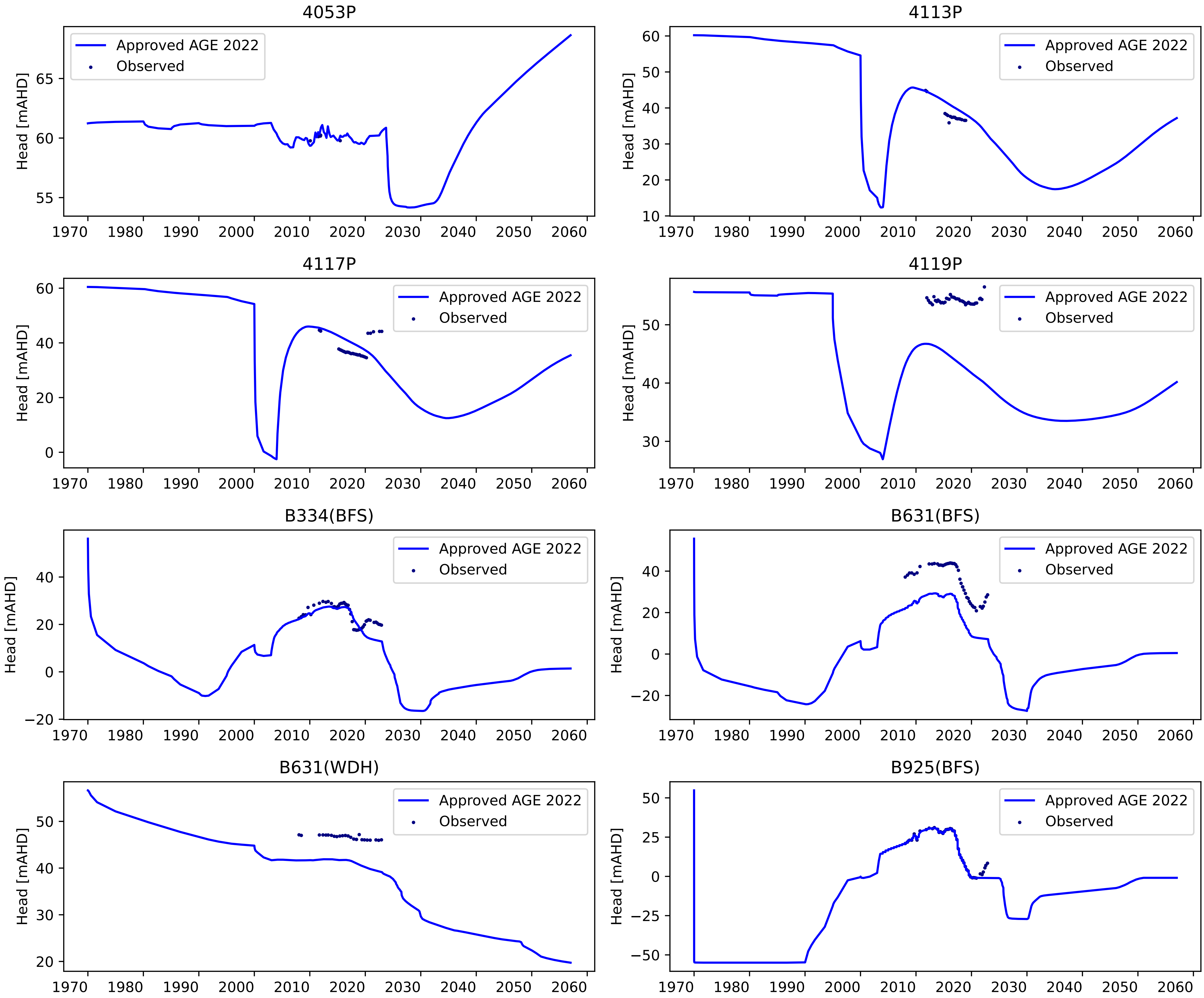
SLR Consulting Australia Pty Ltd, 2020, Mining Operation Plan 2020 30 September 2020 - 31 December 2022 report, Prepared for: Hunter Valley Operations Lemington Road Lemington NSW 2330 SLR Ref: 630.12895-R01 Version No: -v9.0 December 2020.

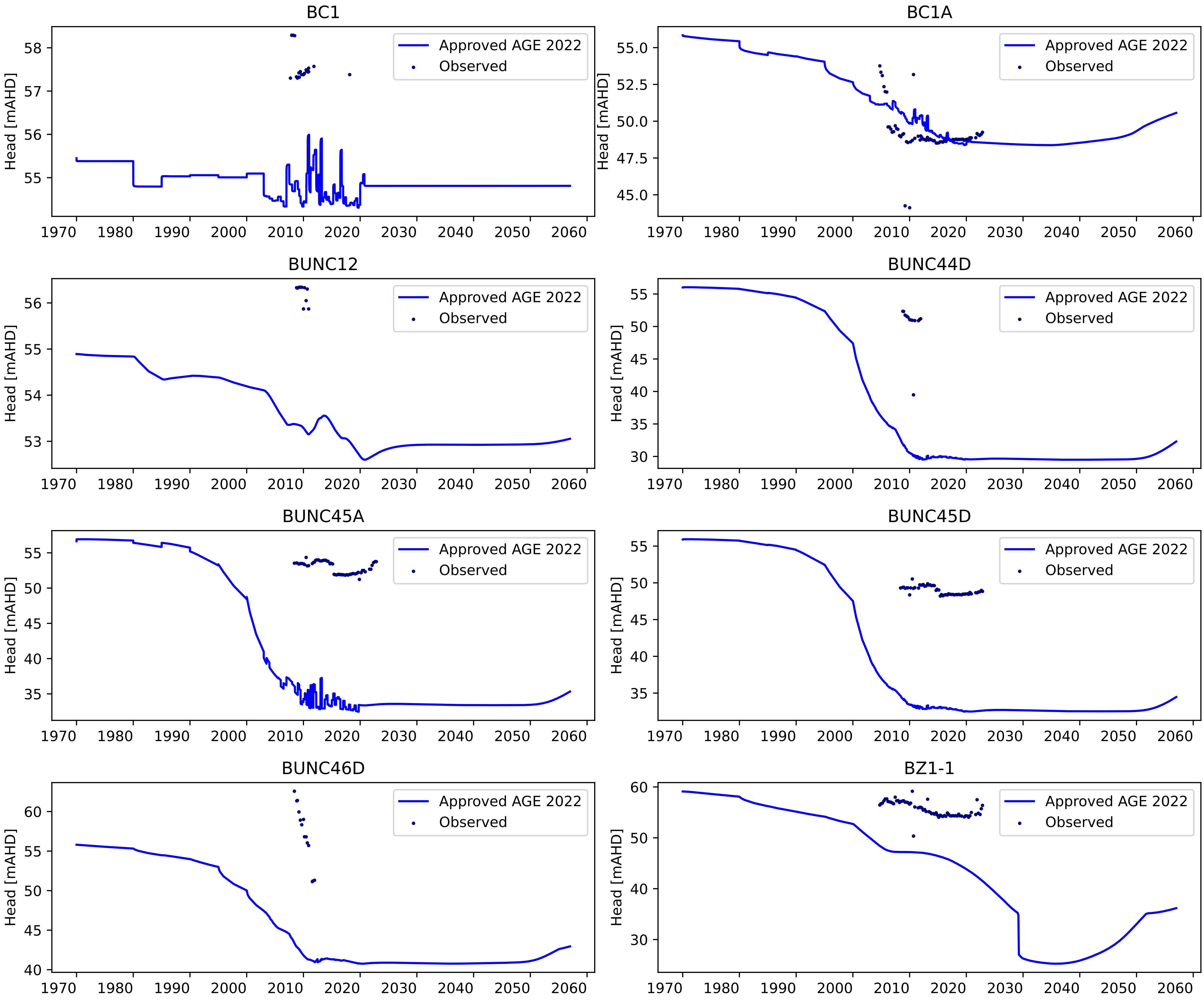
Mackie, C.D., 2008, Hydrogeological characterisation of coal measures and overview of impacts of coal mining on groundwater systems in the upper hunter valley of NSW, A thesis submitted in fulfillment of the requirements for the degree of doctor of philosophy in groundwater management Faculty of science, university of technology, Sydney NSW. Australia.

APPENDIX A

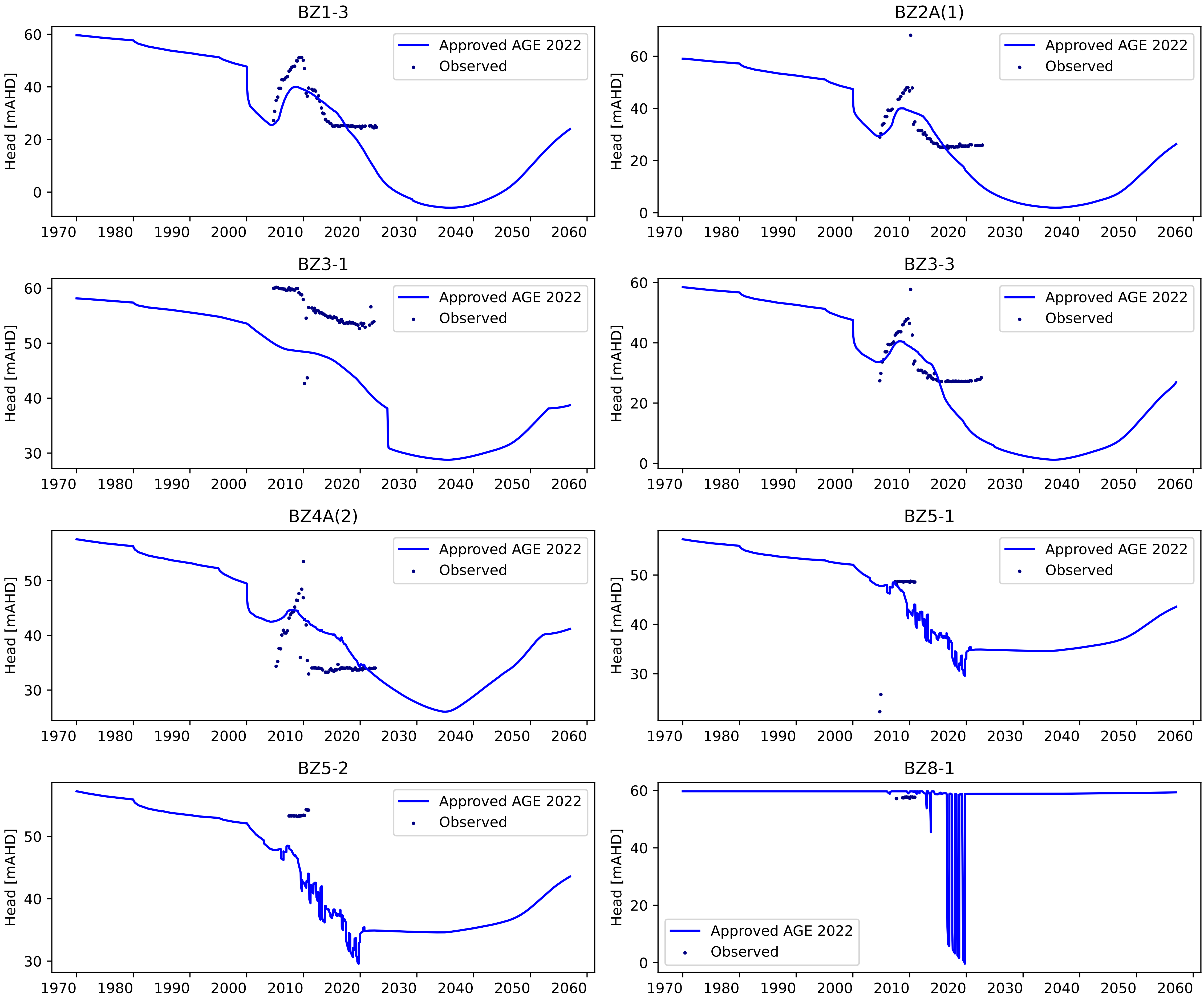
Modelled Vs Observed Groundwater Levels


4032P
4033P
4034P
4035P
4037P
4038C
4040P
4052P
Approved AGE 2022
Observed
Head [mAHD]
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060


4053P
4113P
4117P
4119P
B334(BFS)
B631(BFS)
B631(WDH)
B925(BFS)
Approved AGE 2022
Observed
Head [mAHD]
1970 1980 1990 2000 2010 2020 2030 2040 2050 2060



BC1
BC1A
BUNC12
BUNC44D
BUNC45A
BUNC45D
BUNC46D
BZ1-1
Approved AGE 2022
Observed
Head [mAHD]
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060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BZ2A(1)
BZ3-1
BZ3-3
BZ4A(2)
BZ5-1
BZ5-2
BZ8-1
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Observed
1970
1980
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2000
2010
2020
2030
2040
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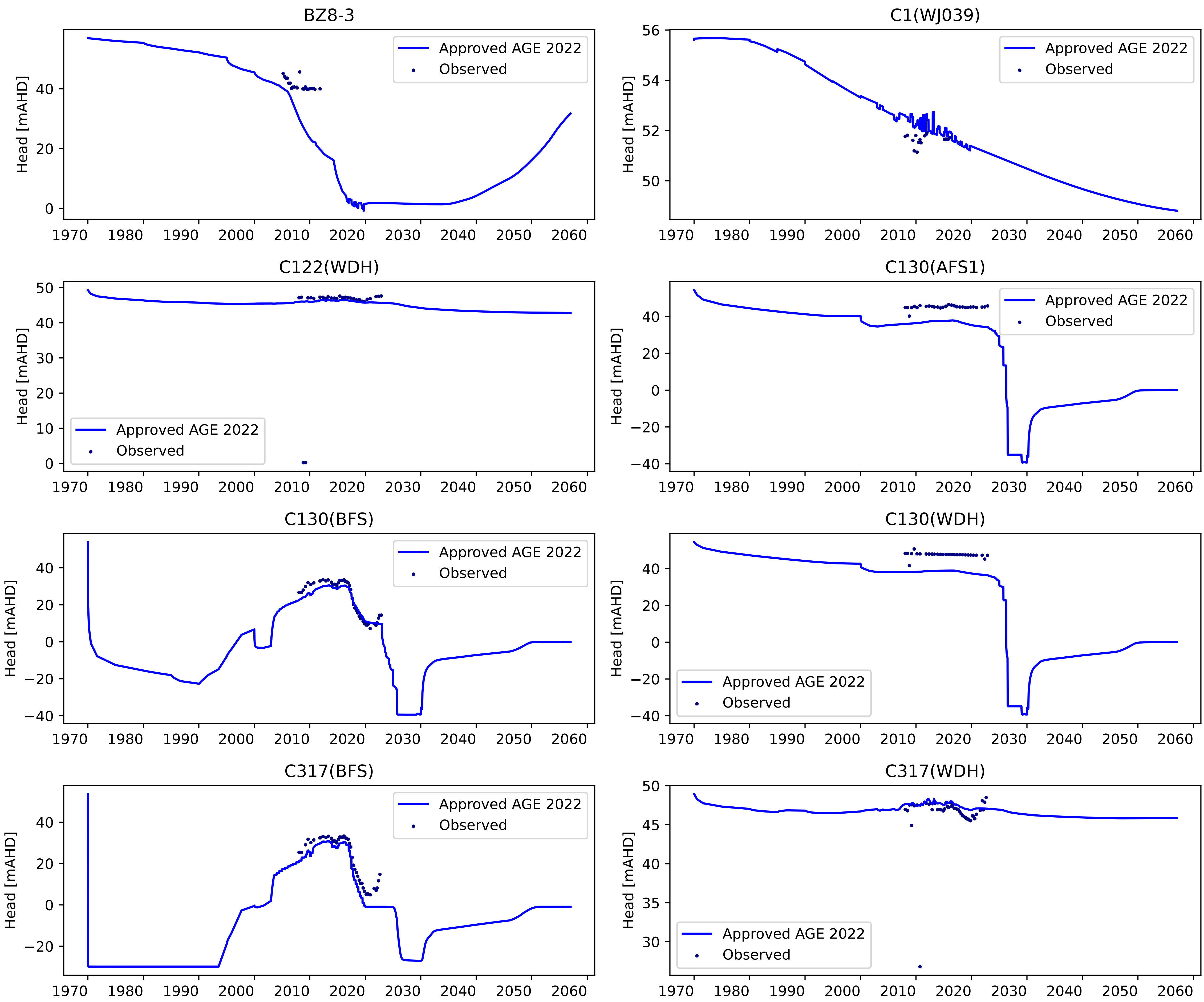
2060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2000
2010
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2040
2050
2060
Approved AGE 2022
Observed
C1(WJ039)
Head [mAHD]
50
52
54
56
C122(WDH)
Head [mAHD]
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10
20
30
40
50
C130(AFS1)
Head [mAHD]
−40
−20
0
20
40
C130(BFS)
Head [mAHD]
−40
−20
0
20
40
C130(WDH)
Head [mAHD]
−40
−20
0
20
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C317(BFS)
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C317(WDH)
Head [mAHD]
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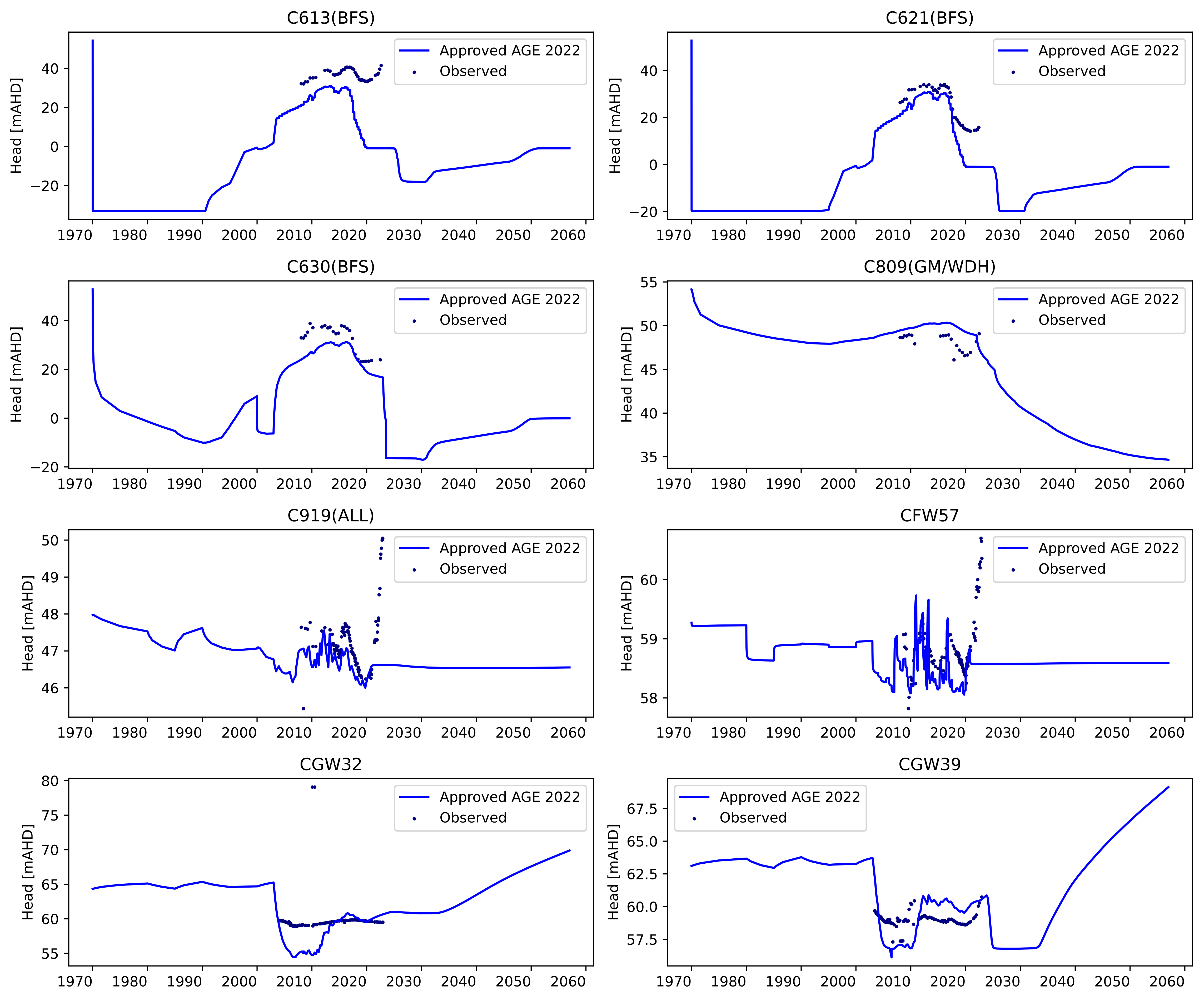
45
50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C621(BFS)
C630(BFS)
C809(GM/WDH)
C919(ALL)
CFW57
CGW32
CGW39
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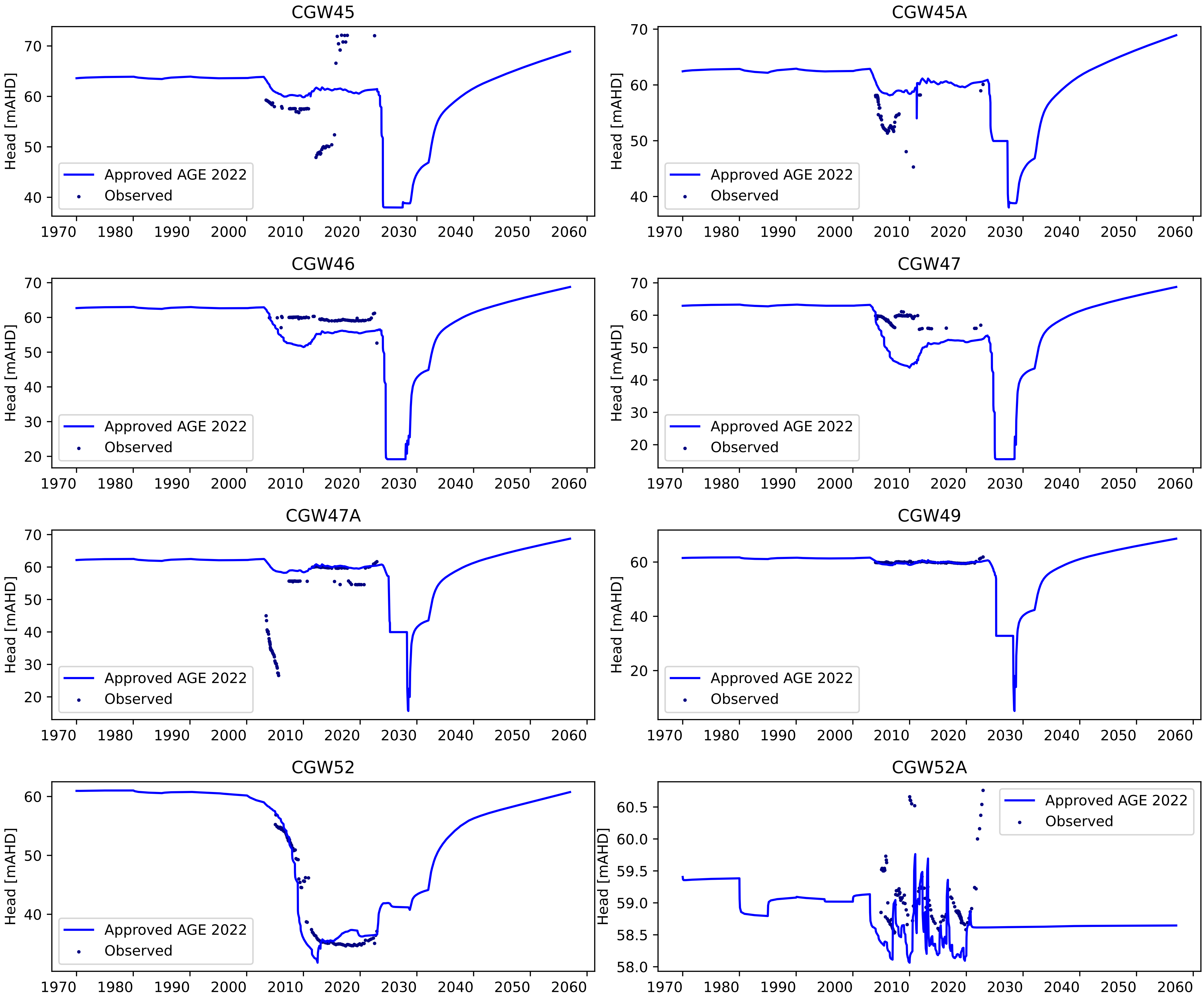
Observed
Head [mAHD]
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060



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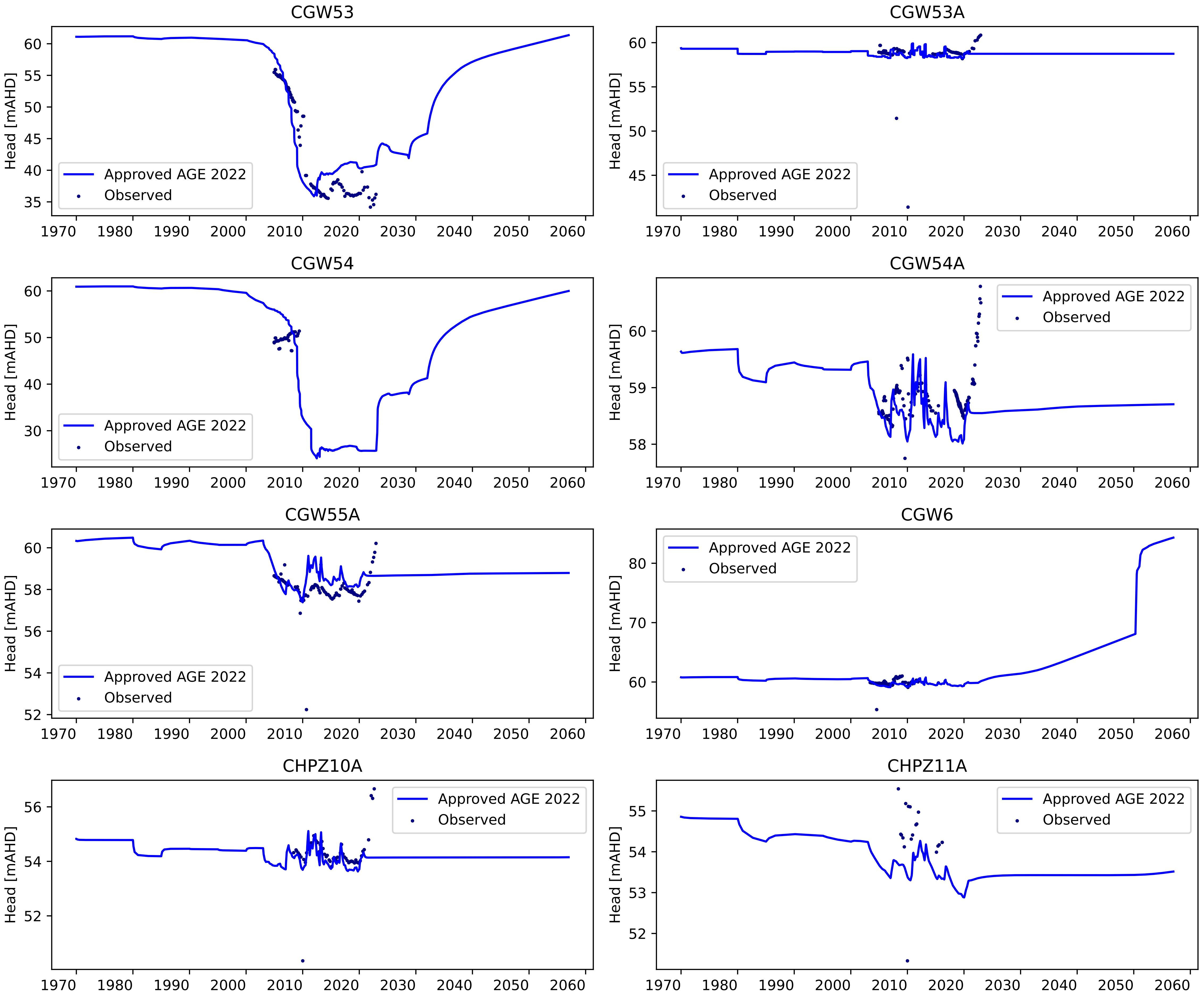
Observed
CGW45A
Head [mAHD]
Approved AGE 2022
Observed
CGW46
Head [mAHD]
Approved AGE 2022
Observed
CGW47
Head [mAHD]
Approved AGE 2022
Observed
CGW47A
Head [mAHD]
Approved AGE 2022
Observed
CGW49
Head [mAHD]
Approved AGE 2022
Observed
CGW52
Head [mAHD]
Approved AGE 2022
Observed
CGW52A
Head [mAHD]
Approved AGE 2022
Observed
1970 1980 1990 2000 2010 2020 2030 2040 2050 2060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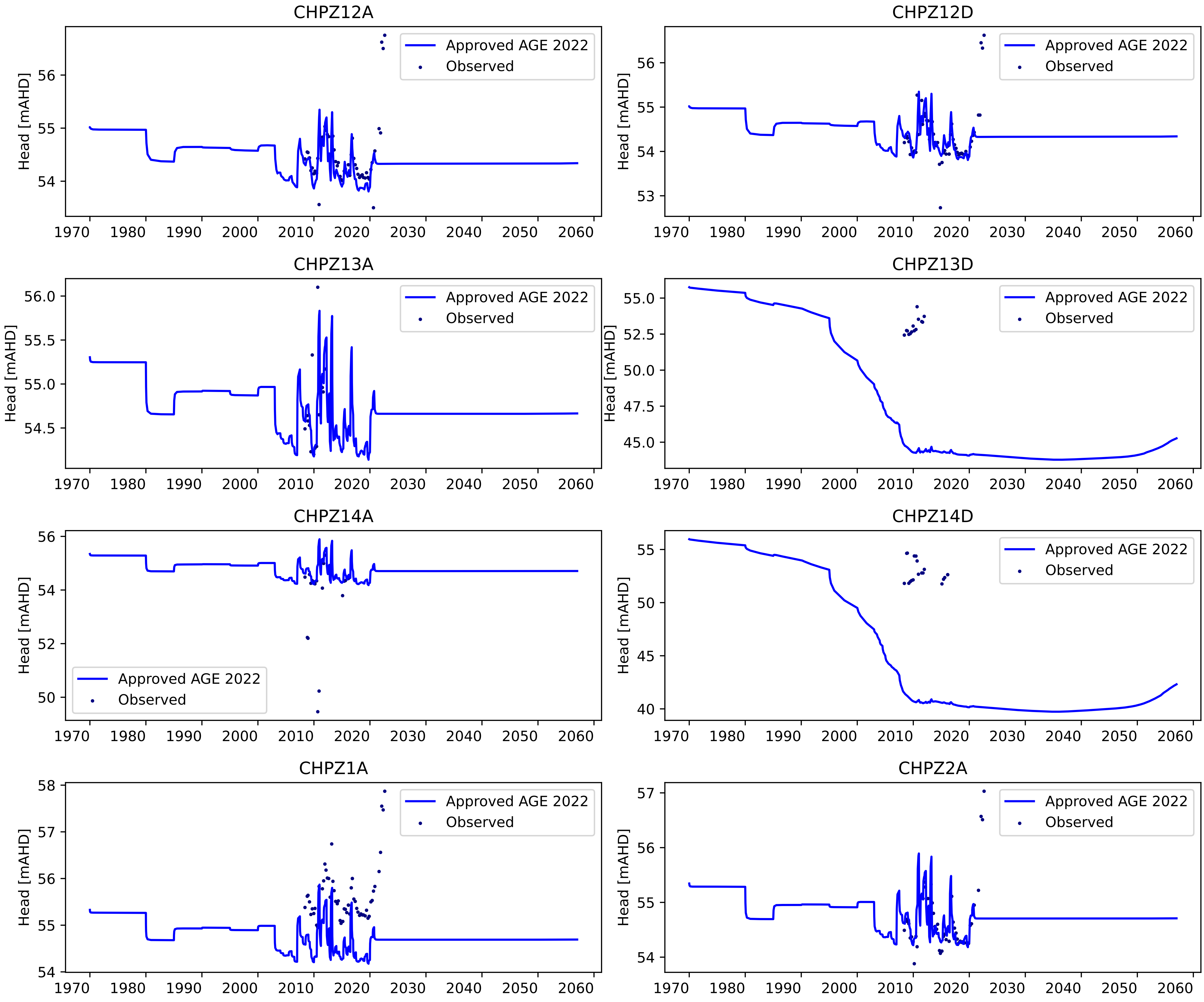
CGW53A
CGW54
CGW54A
CGW55A
CGW6
CHPZ10A
CHPZ11A
Head [mAHD]
Approved AGE 2022
Observed
1970 1980 1990 2000 2010 2020 2030 2040 2050 2060



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Approved AGE 2022
Observed
CHPZ12D
Head [mAHD]
Approved AGE 2022
Observed
CHPZ13A
Head [mAHD]
Approved AGE 2022
Observed
CHPZ13D
Head [mAHD]
Approved AGE 2022
Observed
CHPZ14A
Head [mAHD]
Approved AGE 2022
Observed
CHPZ14D
Head [mAHD]
Approved AGE 2022
Observed
CHPZ1A
Head [mAHD]
Approved AGE 2022
Observed
CHPZ2A
Head [mAHD]
Approved AGE 2022
Observed
1970
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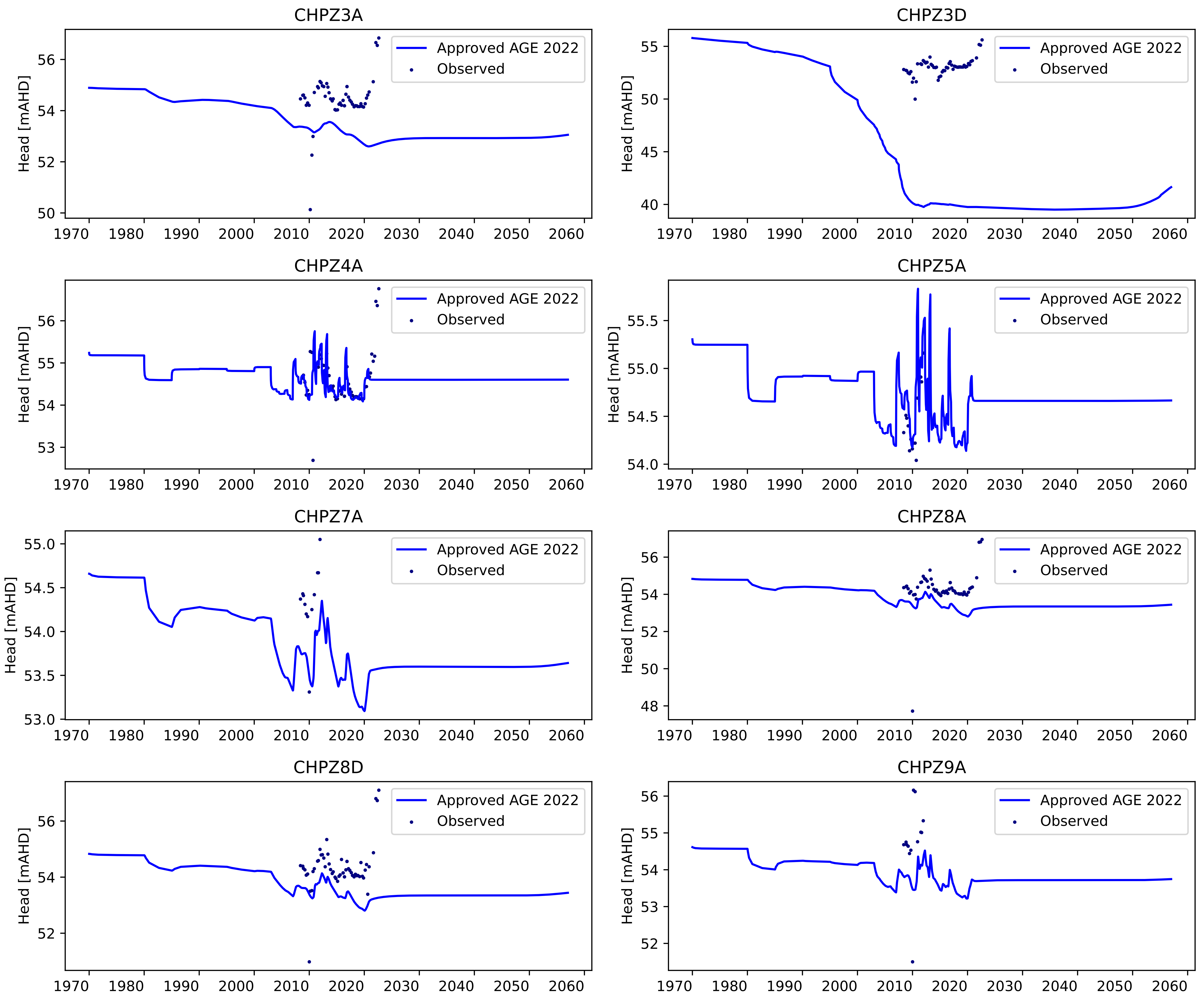
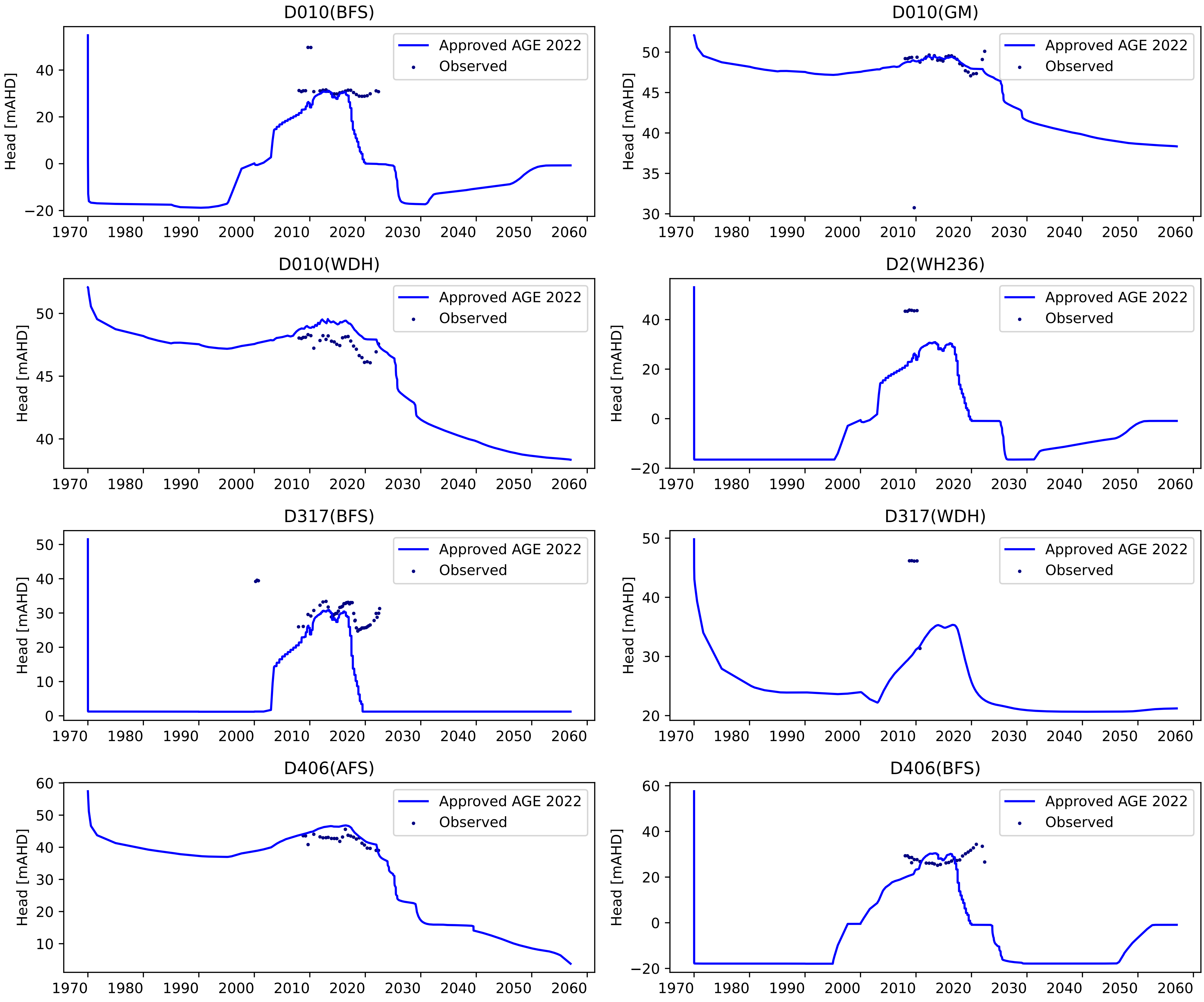


CHPZ3A
CHPZ3D
CHPZ4A
CHPZ5A
CHPZ7A
CHPZ8A
CHPZ8D
CHPZ9A
Head [mAHD]
Approved AGE 2022
Observed
1970 1980 1990 2000 2010 2020 2030 2040 2050 2060


D010(BFS)
D010(GM)
D010(WDH)
D2(WH236)
D317(BFS)
D317(WDH)
D406(AFS)
D406(BFS)
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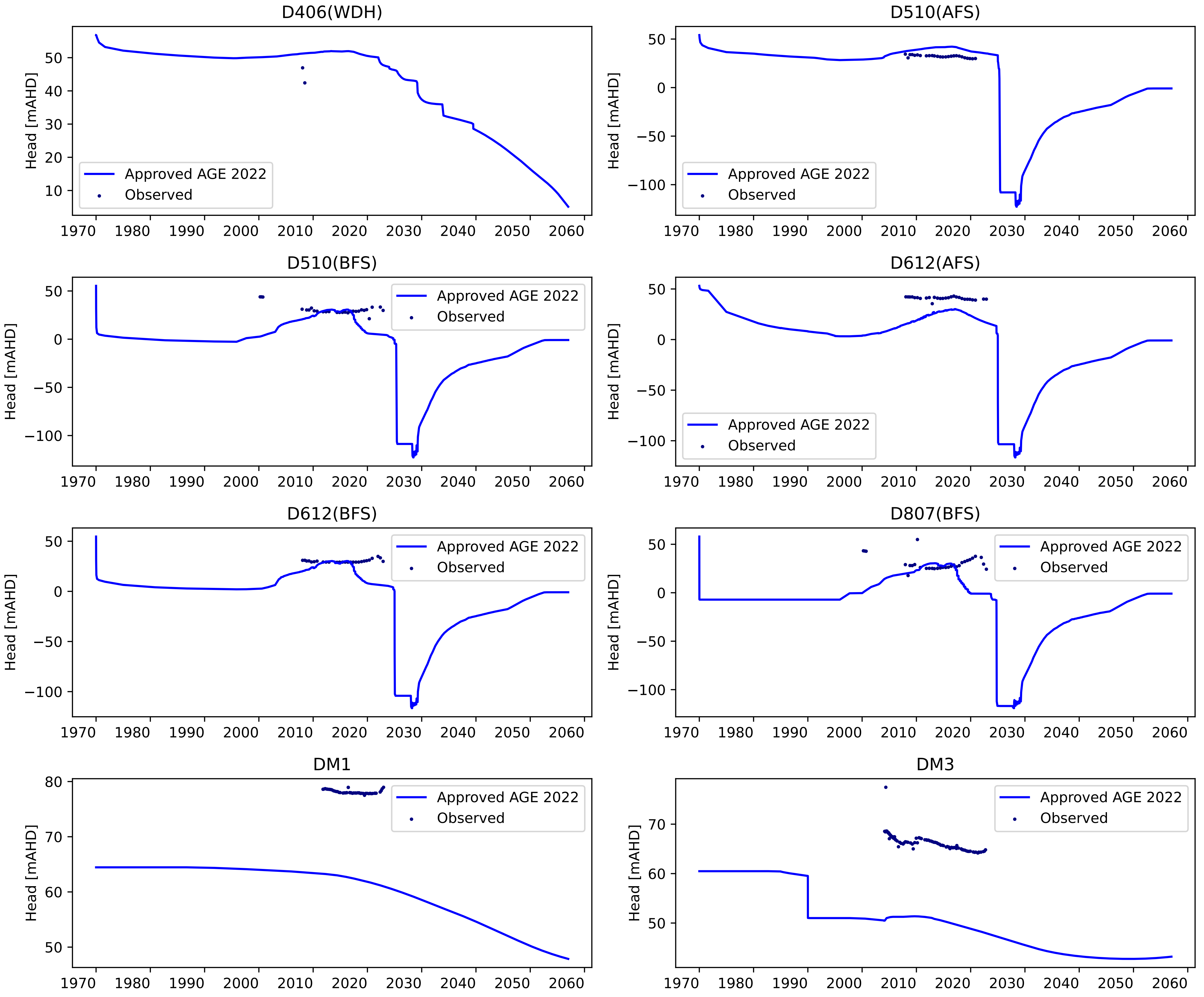
Observed
Head [mAHD]
1970 1980 1990 2000 2010 2020 2030 2040 2050 2060


D406(WDH)
Head [mAHD]
Approved AGE 2022
Observed
D510(AFS)
Head [mAHD]
Approved AGE 2022
Observed
D510(BFS)
Head [mAHD]
Approved AGE 2022
Observed
D612(AFS)
Head [mAHD]
Approved AGE 2022
Observed
D612(BFS)
Head [mAHD]
Approved AGE 2022
Observed
D807(BFS)
Head [mAHD]
Approved AGE 2022
Observed
DM1
Head [mAHD]
Approved AGE 2022
Observed
DM3
Head [mAHD]
Approved AGE 2022
Observed
1970
1980
1990
2000
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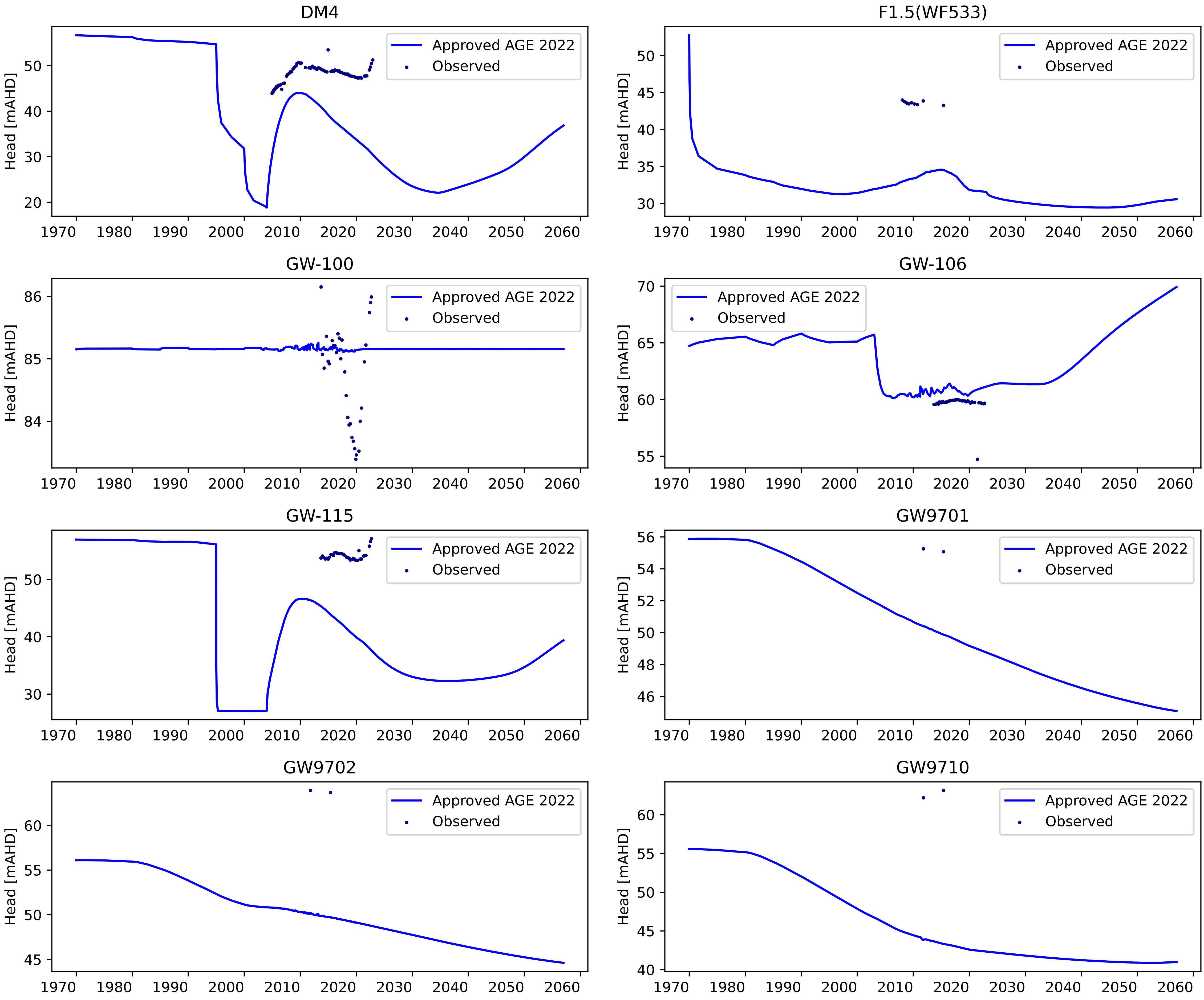
2030
2040
2050
2060


DM4
Approved AGE 2022
Observed
Head [mAHD]
20
30
40
50
F1.5(WF533)
Approved AGE 2022
Observed
Head [mAHD]
30
35
40
45
50
GW-100
Approved AGE 2022
Observed
Head [mAHD]
84
85
86
GW-106
Approved AGE 2022
Observed
Head [mAHD]
55
60
65
70
GW-115
Approved AGE 2022
Observed
Head [mAHD]
30
40
50
GW9701
Approved AGE 2022
Observed
Head [mAHD]
46
48
50
52
54
56
GW9702
Approved AGE 2022
Observed
Head [mAHD]
45
50
55
60
GW9710
Approved AGE 2022
Observed
Head [mAHD]
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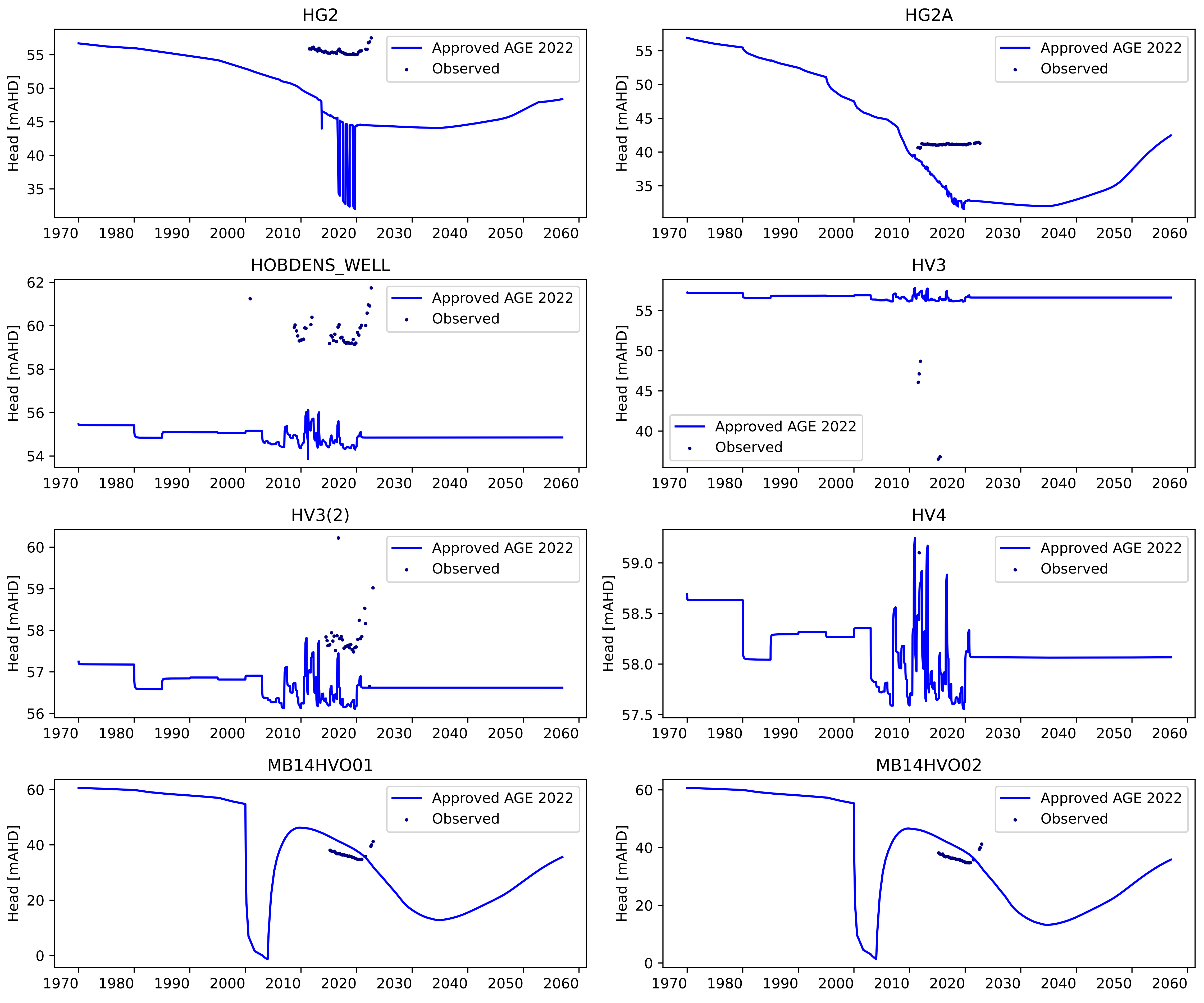
2060


HG2
HG2A
HOBDENS_WELL
HV3
HV3(2)
HV4
MB14HVO01
MB14HVO02
Head [mAHD]
Approved AGE 2022
Observed
1970
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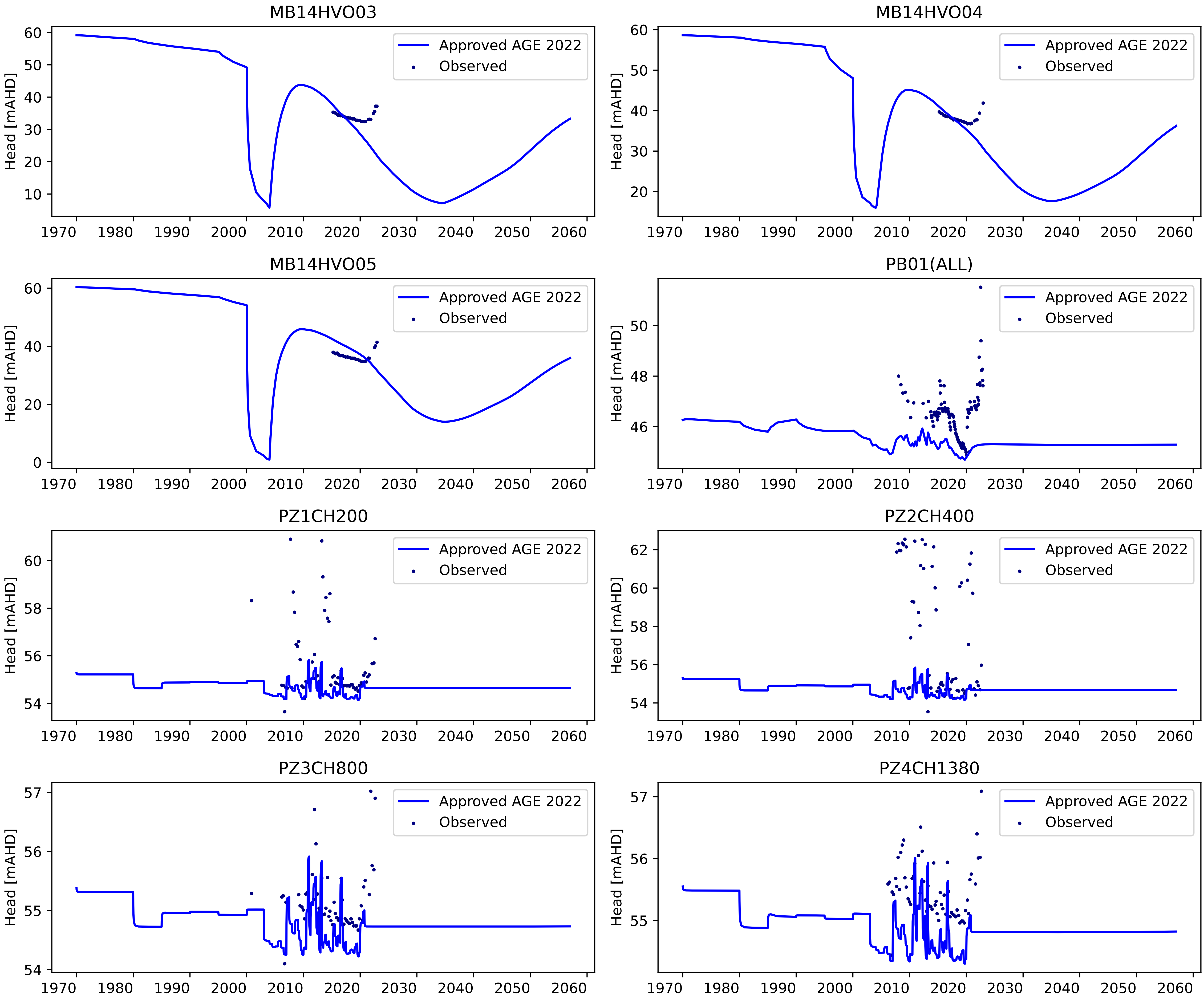
2030
2040
2050
2060


MB14HVO03
MB14HVO04
MB14HVO05
PB01(ALL)
PZ1CH200
PZ2CH400
PZ3CH800
PZ4CH1380
Approved AGE 2022
Observed
Head [mAHD]
1970
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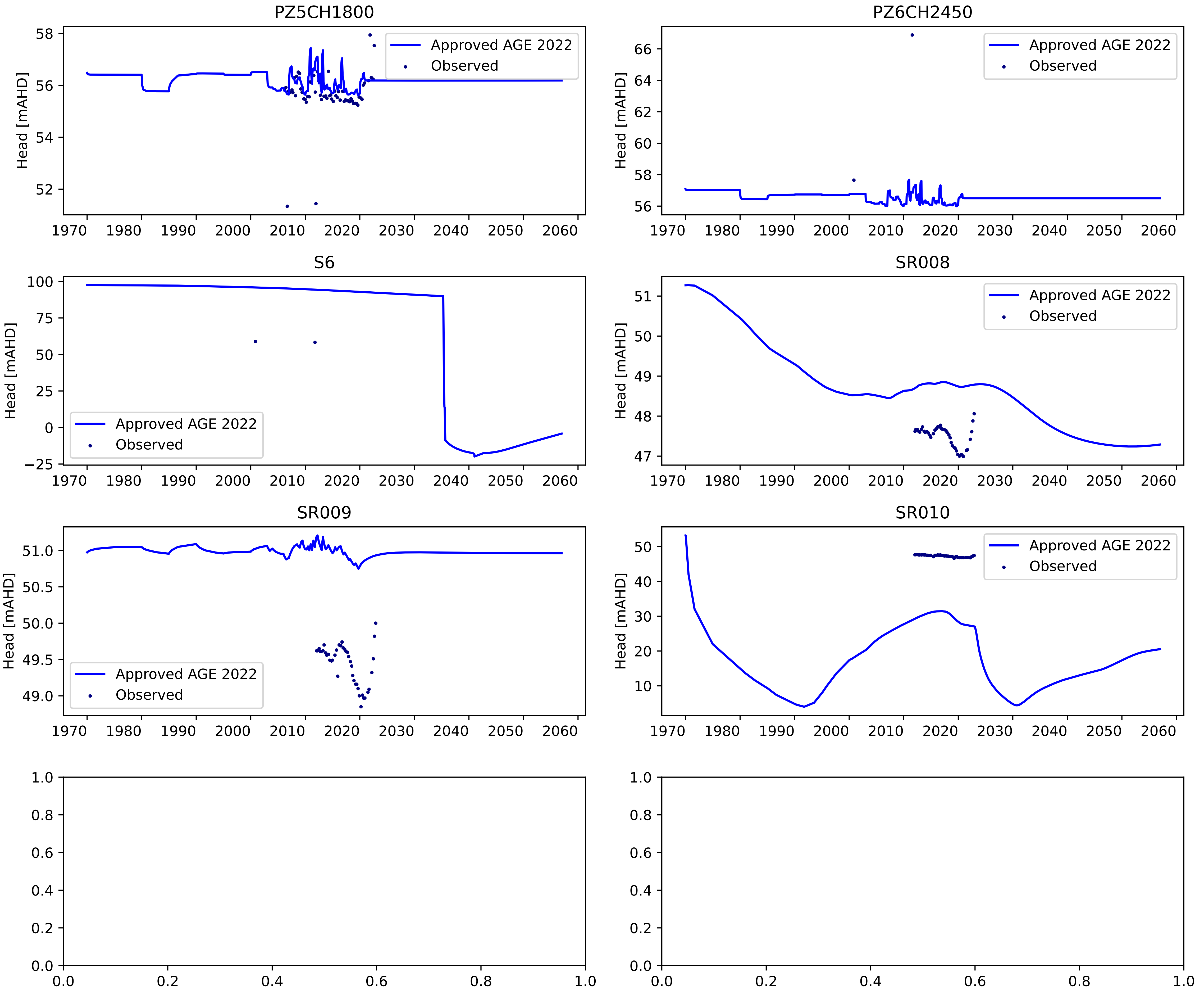
2040
2050
2060


PZ5CH1800
Head [mAHD]
Approved AGE 2022
Observed
PZ6CH2450
S6
SR008
SR009
SR010
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
0.0
0.2
0.4
0.6
0.8
1.0

umwelt

umwelt

Environmental & Social
Consultants

Umwelt (Australia) Pty Limited

T| 1300 793 267 E| info@umwelt.com.au www.umwelt.com.au

APPENDIX C: HVO S240 REHABILITATION MAINTENANCE SCHEDULE

GMD Area	Wilton GMD Part HVOWIL201401	West North 230 GMD Part HVOWES201402	Cheshunt East Embankment GMD HOCHE201301, HVOCHE201202, part HVOCHE201203	Barry's Cheshunt GMD HVOCHE201703, HVOCHETBA, HVOCHE201603, HVOCHE201602	West North 230 Eastern Batter HVOWES201402, HVOWES201503	HVO WOOP Dump
Area (ha)	6.26 ha	11.04 ha	25.88 ha	33.20 ha	15.85 ha	52.94 ha
Month Reported	24/04/2021	30/04/2021	25/06/2021	15/10/2021	30/12/2021	13/1/2023
HVO Pit	West Pit	West Pit	Cheshunt Pit	Cheshunt Pit	West Pit	West of Riverview Pit
MOP Domain	Final Landform Grassland	Final Landform Grassland	Final Landform Woodland	Final Landform Woodland	Final Landform Woodland	Final Landform Woodland
Polygon Centroid Easting	307118.907	309384.524	314913.610	313212.020	309745.442	308666.660
Polygon Centroid Northing	6407359.000	6410584.097	6401251.966	6401508.610	6410690.202	6399187.340
Slope (minimum)	0	0	Refer Tech Services	Refer Tech Services	Refer Tech Services	10.1 deg
Slope (maximum)	0	0	Refer Tech Services	Refer Tech Services	Refer Tech Services	15.6 deg
Primary Aspect	North west	n/a	East	North	North	East
Secondary Aspect	n/a	n/a	North east	North east	East	West
Landform Surface Preparation	Boomspray Surface Vegetation	Boomspray Surface Vegetation	Boomspray Surface Vegetation	Boomspray Surface Vegetation	Mulch Acacia Saligna	Slash surface vegetation

GMD Area	Wilton GMD Part HVOWIL201401	West North 230 GMD Part HVOWES201402	Cheshunt East Embankment GMD HOCHE201301, HVOCHE201202, part HVOCHE201203	Barry's Cheshunt GMD HVOCHE201703, HVOCHETBA, HVOCHE201603, HVOCHE201602	West North 230 Eastern Batter HVOWES201402, HVOWES201503	HVO WOOP Dump
	Chisel Plough	Chisel Plough	Slash/Mulch Vegetation Repair Contours Soil Aeration	Mulch Vegetation Repair Contours Desilt and re-distribute topsoil from drains Soil Aeration	Spot Spray Stems Repair Contour Soil Aeration Boomspray Surface Vegetation Mulch Vegetation	Repair Contours Soil Aeration Seed
Growth Medium Surface Preparation	Chisel Plough (tractor)	Chisel Plough (tractor)	Rock Pile, Aerate (tractor)	Rock Pile, Aerate	Rock Pile, Aerate	Aerate

APPENDIX D: 2022 HERITAGE COMPLIANCE INSPECTION AUDITS

Hunter Valley Operations South Aboriginal Heritage Management Plan April 2022 Compliance Audit Inspections

Report prepared for

Hunter Valley Operations

May 2022

Joel Deacon

ARROW HERITAGE SOLUTIONS

Introduction

The Hunter Valley Operations Joint Venture (HVOJV) manages the Hunter Valley Operations (HVO) mining complex and associated Biodiversity Areas located in the Hunter Valley. The HVOJV provides management services that include accountability for Aboriginal cultural heritage (ACH) management & community consultation.

The development of HVO mining operations has occurred through a process of expansion and acquisition, and as a result there are two separate development approvals that apply to the operation. The mining & processing activities at HVO are geographically divided by the Hunter River, with movements of coal, overburden, equipment, materials and personnel between two operational areas - HVO North (DA_450-10-2003) and HVO South (PA_06_0261).

Each consent contains a condition requiring the development of an Aboriginal Heritage Management Plan (AHMP). Such plans have been developed (in consultation with the Aboriginal community through the HVO Cultural Heritage Working Group - CHWG) and approved for each operational area. Within the HVO South plan, provision is made to conduct biannual AHMP compliance inspections with members of the Aboriginal community throughout the life of operations. The purpose of the compliance inspections is to afford the Aboriginal stakeholders and the HVOJV:

- the opportunity to visit mine operations and mine areas to inspect the operational compliance with AHMP provisions and Ground Disturbance Permit (GDP) procedures;
- to inspect and monitor the condition and management of various sites; and
- to review the effectiveness and performance of AHMP provisions in the management of ACH at the mine.

Due to the number of ACH sites within the HVO South AHMP area & the time foreseen to inspect all sites, it is not feasible to inspect every site during the same field trip. Therefore, a regular, rolling program of compliance inspections has been implemented that will visit all sites periodically over a number of years. A record will be kept of each compliance inspection against each ACH site, so that it can be ensured that each site is inspected regularly.

Proposed Activity and Project Brief

The compliance inspection involved the following elements:

- An AHMP compliance inspection report pro-forma was completed for the nominated inspection areas and ACH sites visited;

- Photographs of the inspected ACH sites were taken; and
- Notes were compiled on the outcomes of the inspections including evidence of compliance and non-compliance with AHMP provisions, recommendations on modifications and improvements to management provisions, recommendations on corrective actions, and other comments associated with AHMP provisions;

Timing & Personnel

The April 2022 HVO South AHMP compliance inspection program was conducted on 11 April 2022. The personnel involved in these inspections were:

Name	Organisation
Joel Deacon	Arrow Heritage Solutions
Peter Bowman	HVO Environment and Community Officer
Mary Franks	Plains Clans of the Wonnarua People
Rhonda Ward	Ungooroo Cultural and Community Services

Arrow Heritage Solutions were engaged as independent heritage consultants to conduct the AHMP compliance inspection, and Joel Deacon acted as technical advisor and author of this report. HVO's Environment & Community Officer Peter Bowman arranged the compliance inspection program and escorted the field team.

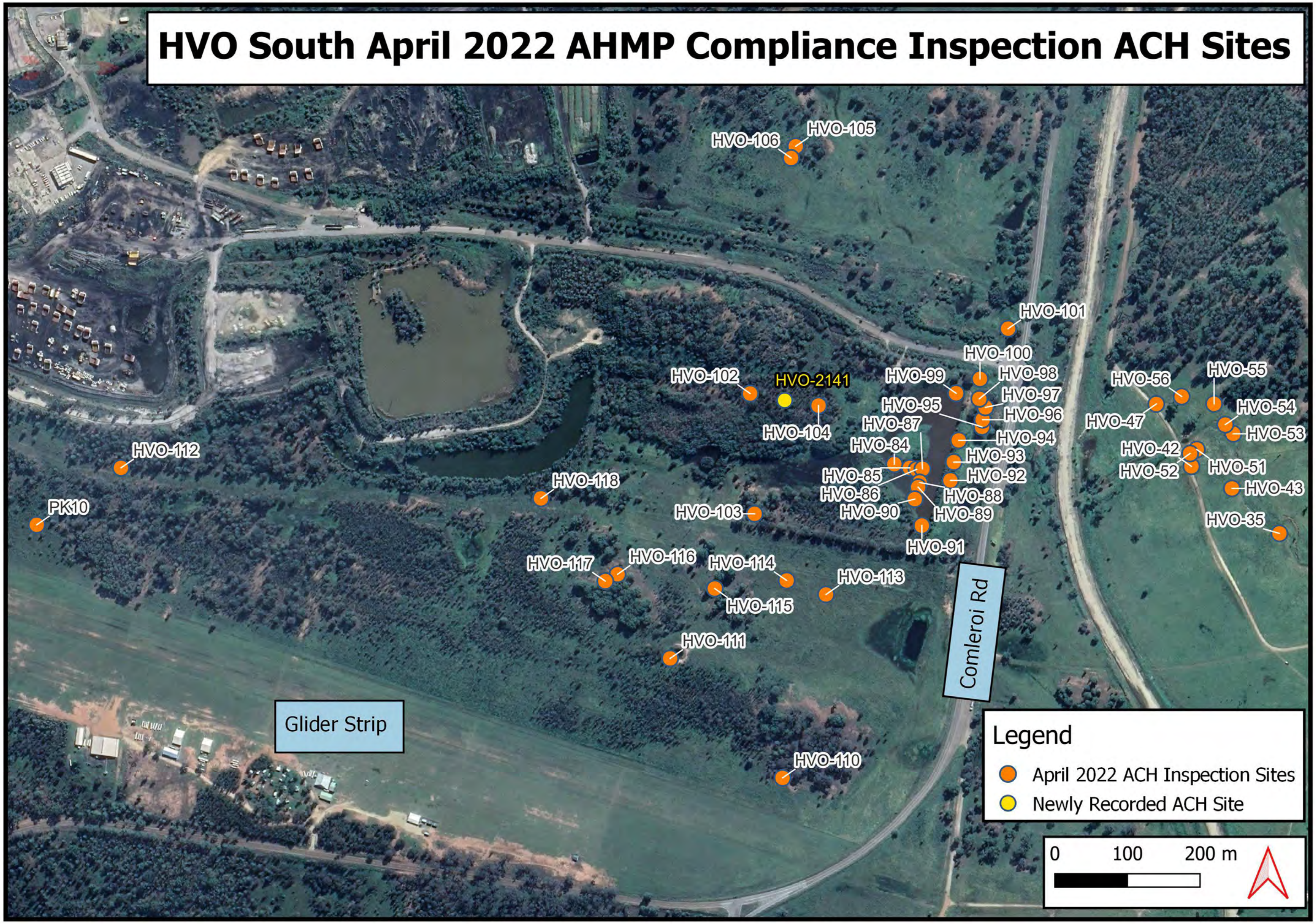
Results

During the April 2022 HVO South AHMP compliance audit a total of 43 ACH sites were inspected. These sites were located between the Hunter Valley Glider Strip (off Comleroi Rd) and the Cheshunt Pit in areas currently used for cattle grazing (see map below). Although not within an active mining area, these sites were selected for inspection as they are located in areas that are actively farmed and subject to a range of land use activities. A previous compliance inspection audit in this area had identified ACH sites at risk of damage due to livestock activity. These sites were recommended to be hard fenced by the inspection team at the time. This recommendation was endorsed by the CHWG and the sites subsequently fenced. A selection of these sites were visited during this inspection to assess the success of this measure.

The table below summarises the results of the April 2022 HVO South compliance inspection and summarises the information recorded on the individual pro-forma inspection sheets.

Using a mobile mapper pre-loaded with the GIS co-ordinates for each ACH site, the field team travelled to each location and attempted to re-identify each site. Sometimes this was not possible due to poor ground surface visibility (GSV), a result which in itself was not overly significant as long as it was determined that the vicinity had not been inadvertently disturbed. The presence and condition of barricading or fencing was noted, as well as the presence and nature of various potential site disturbing factors (e.g erosion, animal, human). General observations of each site were made if necessary, and, based on information provided for all of the above factors, management recommendations were discussed and agreed by the field team for each site.

One previously unrecorded ACH site was also identified during the audit and added into the HVO ACH sites database.


HVO South April 2022 AHMP Compliance Inspection ACH Sites
HVO-106
HVO-105
HVO-101
HVO-100
HVO-102
HVO-2141
HVO-99
HVO-98
HVO-97
HVO-96
HVO-95
HVO-104
HVO-87
HVO-94
HVO-84
HVO-93
HVO-85
HVO-92
HVO-86
HVO-88
HVO-90
HVO-89
HVO-91
HVO-56
HVO-55
HVO-54
HVO-53
HVO-47
HVO-42
HVO-51
HVO-52
HVO-43
HVO-35
HVO-112
HVO-118
PK10
HVO-103
HVO-117
HVO-116
HVO-114
HVO-113
HVO-115
HVO-111
HVO-110
Comleroi Rd
Glider Strip
Legend
April 2022 ACH Inspection Sites
Newly Recorded ACH Site
0
100
200 m

Site Name	AHIMS ID	Site re-identified	Site intact?	Site fenced/ barricaded?	Barricade/ fence intact?	Natural erosion	Livestock damage	Human disturbance	Animal disturbance	Pests & weeds	General observations	Management recommendations
HVO-35	37-6-3234	Yes	Yes	Yes	Yes	Slight	No	No	No	No	Previously hard fenced and revegetating well to control erosion	Determined that sediment fencing not required to assist with erosion control once vegetation re-establishes
HVO-42	37-6-3241	Yes	Yes	Yes	Yes	No	No	On track edge	No	No	Previously hard fenced and revegetating well to control erosion	Determined that sediment fencing not required to assist with erosion control once vegetation re-establishes
HVO-43	37-6-3242	Yes	Yes	Yes	Yes	Slight	No	No	No	No	Previously hard fenced and revegetating well to control erosion	Determined that sediment fencing not required to assist with erosion control once vegetation re-establishes
HVO-47	37-6-3246	Yes	Yes	Yes	Yes	No	No	On track edge	No	No	Previously hard fenced and revegetating well to control erosion	Determined that sediment fencing not required to assist with erosion control once vegetation re-establishes
HVO-51	37-6-3250	Yes	Yes	Yes	Yes	Slight	No	No	No	No	Previously hard fenced and revegetating well to control erosion	Determined that sediment fencing not required to assist with erosion control once vegetation re-establishes
HVO-52	37-6-3251	Yes	Yes	Yes	Yes	No	No	No	No	No	Previously hard fenced and revegetating well to control erosion	Determined that sediment fencing not required to assist with erosion control once vegetation re-establishes
HVO-53	37-6-3252	Yes	Yes	Yes	Yes	Slight	No	No	No	No	Previously hard fenced and revegetating well to control erosion	Determined that sediment fencing not required to assist with erosion control once vegetation re-establishes
HVO-54	37-6-3253	Yes	Yes	Yes	Yes	Slight	No	No	No	No	Previously hard fenced and revegetating well to control erosion	Determined that sediment fencing not required to assist with erosion control once vegetation re-establishes
HVO-55	37-6-3254	Yes	Yes	Yes	Yes	No	No	No	No	No	Previously hard fenced and revegetating well to control erosion	Determined that sediment fencing not required to assist with erosion control once vegetation re-establishes
HVO-56	37-6-3255	Yes	Yes	Yes	Yes	No	No	On old track	No	No	Previously hard fenced and revegetating well to control erosion	Determined that sediment fencing not required to assist with erosion control once vegetation re-establishes
HVO-84	37-6-3281	No	Unsure	No	-	Submerged	No	No	No	No	Site currently inundated by very high dam levels	If able, inspect during next audit to assess post-flooding condition
HVO-85	37-6-3282	No	Unsure	No	-	Submerged	No	No	No	No	Site currently inundated by very high dam levels	If able, inspect during next audit to assess post-flooding condition
HVO-86	37-6-3283	No	Unsure	No	-	Submerged	No	No	No	No	Site currently inundated by very high dam levels	If able, inspect during next audit to assess post-flooding condition
HVO-87	37-6-3279	No	Unsure	No	-	Submerged	No	No	No	No	Site currently inundated by very high dam levels	If able, inspect during next audit to assess post-flooding condition
HVO-88	37-6-3284	No	Unsure	No	-	Submerged	No	No	No	No	Site currently inundated by very high dam levels	If able, inspect during next audit to assess post-flooding condition
HVO-89	37-6-3285	No	Unsure	No	-	Submerged	No	No	No	No	Site currently inundated by very high dam levels	If able, inspect during next audit to assess post-flooding condition

Site Name	AHIMS ID	Site re-identified	Site intact?	Site fenced/ barricaded?	Barricade/ fence intact?	Natural erosion	Livestock damage	Human disturbance	Animal disturbance	Pests & weeds	General observations	Management recommendations
HVO-90	37-6-3286	No	Unsure	No	-	Submerged	No	No	No	No	Site currently inundated by very high dam levels	If able, inspect during next audit to assess post-flooding condition
HVO-91	37-6-3287	No	Unsure	No	-	Submerged	No	No	No	No	Site currently inundated by very high dam levels	If able, inspect during next audit to assess post-flooding condition
HVO-92	37-6-3288	Yes	Yes	Yes	Yes	No	No	On dam wall	No	No		Nil
HVO-93	37-6-3289	Yes	Yes	Yes	Yes	No	No	On dam wall	No	No		Nil
HVO-94	37-6-3290	Yes	Yes	Yes	Yes	No	No	On dam wall	No	No		Nil
HVO-95	37-6-3291	No	Yes	Yes	Yes	No	No	On dam wall	No	No		Nil
HVO-96	37-6-3292	No	Yes	Yes	Yes	No	No	On dam wall	No	No		Nil
HVO-97	37-6-3293	Yes	Yes	Yes	Yes	No	No	No	No	No		Nil
HVO-98	37-6-3294	Yes	Yes	Yes	Yes	No	No	On dam wall	No	No		Nil
HVO-99	37-6-3295	No	Unsure	No	-	Submerged	No	No	No	No	Site currently inundated by very high dam levels	If able, inspect during next audit to assess post-flooding condition
HVO-100	37-6-3296	Yes	Yes	Yes	Yes	No	No	No	No	No		Nil
HVO-101	37-6-3297	No	Yes	Yes	No	No	No	No	No	No		Repair barricading
HVO-102	37-6-3298	Yes	Yes	Yes	No	No	No	No	No	No		Repair barricading
HVO-103	37-6-3299	No	Yes	Yes	No	No	No	No	No	No		Repair barricading
HVO-104	37-6-3300	No	Yes	Yes	No	No	No	No	No	Prickly pear		Repair barricading
HVO-105	37-6-3301	No	Yes	Yes	No	No	No	No	No	No		Repair barricading
HVO-106	37-6-3302	Yes	Yes	Yes	No	No	No	No	No	No		Repair barricading
HVO-110	37-6-1741	No	Unsure	No	-	No	No	On track	No	No	May be being impacted by track use	Install barricading after thorough inspection – close or re-route track if required.
HVO-111	37-6-1742	No	Yes	Yes	No	No	No	No	No	No		Repair barricading
HVO-112	37-6-1743	No	Yes	Yes	Yes	Some recent wash	No	No	No	No		Nil
HVO-113	37-6-1744	No	Yes	Yes	No	No	No	No	No	No		Repair barricading
HVO-114	37-6-1745	No	Yes	Yes	No	No	No	No	No	No		Repair barricading
HVO-115	37-6-1746	No	Yes	No	-	No	No	No	No	No		Install barricading
HVO-116	37-6-1747	Yes	Yes	Yes	No	No	No	No	No	No		Repair barricading

Site Name	AHIMS ID	Site re-identified	Site intact?	Site fenced/ barricaded?	Barricade/ fence intact?	Natural erosion	Livestock damage	Human disturbance	Animal disturbance	Pests & weeds	General observations	Management recommendations
HVO-117	37-6-1748	No	Yes	Yes	No	No	No	No	No	No		Repair barricading
HVO-118	37-6-1749	Yes	Yes	Yes	No	No	No	On track edge	No	No		Nil
PK10	37-6-0878	No	Yes	Yes	Yes	No	No	No	No	No	Old site, unfamiliar barricading	Reassess next audit with report to relocate and better define site.

Aboriginal Site Management Recommendations

Management recommendations were provided for most of the ACH sites visited, the nature of which are described below.

Hard fencing inspection and evaluation

Sites: HVO-35; 42; 43; 47; 51; 52; 53; 54; 55; 56

Several ACH sites that had been previously hard fenced to protect against livestock impacts were inspected in order to review the effectiveness of this fencing. Several of these sites are located on the edge of an ephemeral gully where erosion and wash had previously been active and where it was considered that artefacts may have been at risk of being lost to these processes. Previous discussions with CHWG representatives had recommended that consideration be given to installing sediment fencing on the downslope boundary of these sites to prevent possible artefact loss. However, during this inspection it was noted that the areas inside these fences had revegetated to such a degree that this ground cover was now providing a stabilising effect in preventing the levels of erosion previously noted at these sites.

The new hard-fencing specification being trialled across HVO has been received positively by CHWG members and is considered the favoured option if potential stock impacts are present. As shown in the photographs below, due to the effectiveness of the revegetating ground cover in reducing or halting erosion impacts, the use of sediment fencing as a further control is now considered redundant. However, this issue should be revisited if vegetation conditions change – i.e. during drought situations.

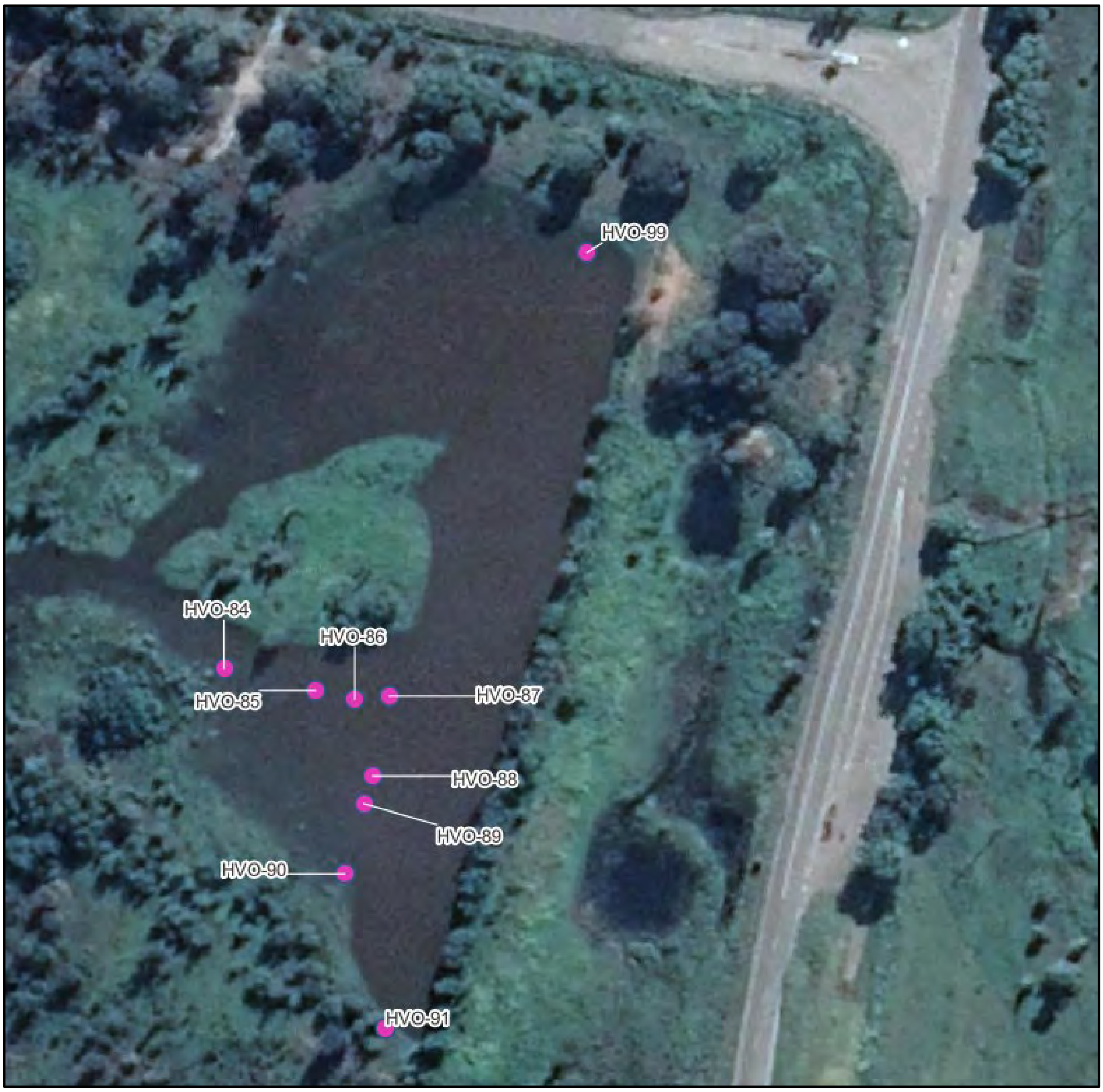
View east across ACH site HVO-35 in August 2020 a few months after fencing installed

Same view across site in April 2022 showing almost total revegetation

Assess post-flooding condition

Sites: HVO-84; 85; 86; 87; 88; 89; 90; 91; 99

These ACH sites are located along the edge of a dam just to the west of Comleroi Rd. They were likely recorded during a time of sparse rainfall, however, due to heavy recent rain filling the dam, these sites have now been inundated. Although this inundation may not necessarily have an adverse impact on the overall integrity of these sites, it is recommended that once water levels fall sufficiently that they be reinspected in order to thoroughly assess any effects of submergence (i.e. silting over or artefact movement) and make informed management recommendations.



Aerial photograph showing the inundated sites in question west of Comleroi Rd

Repair barricading and signage

Sites: HVO-101; 102; 103; 104; 105; 106; 111; 113; 114; 116; 117

These sites have been barricaded in the past, however this barricading is now in a state of disrepair. As these sites are located in areas subject to regular pastoral activity, it is recommended that the barricading, fencing and signage at these sites be repaired or re-instated to prevent inadvertent disturbance.

Consideration should be given to installing the new hard fencing specification successfully trialled at several ACH sites across HVO, which has received positively by RAPs. Such fencing is a particularly favourable option in instances like these where livestock impacts are a potential issue.

Examples of dilapidated barricading at HVO-115 (l) and HVO-117 (r)

Install barricading or fencing

Sites: HVO-110; HVO-115; PK10

These ACH sites would benefit having barricading installed for their protection, with consideration given to hard fencing if livestock impacts are a possibility.

Site HVO-110 is recorded on the edge of a farm track and was unable to be relocated during the present audit. Due to the potential for damage to occur through vehicles traversing along this track, a thorough reassessment of the area should be undertaken when ground cover is reduced in order to identify and barricade the artefact (a mudstone flake). If the artefact cannot be relocated then the site's co-ordinates should be used as a centroid for a barricaded area of 5-10m in radius. If necessary then the farm track should be re-routed to avoid impacting the barricaded area.

Site HVO-115 was not barricaded at the time of the present audit, whereas all surrounding sites were. This site should also be barricaded, with a similar buffer used as for HVO-110 if the artefact (a mudstone flake) is unable to be relocated.

Previous reconnoitres and audits have failed to relocate any artefacts at the recorded co-ordinates for site PK10, with site card description and mapping issues noted. Bunting is currently installed in the vicinity of the site co-ordinates but no artefacts were noted during this audit. A thorough re-assessment of the area should be made, with reference to the site card and original report, in an attempt to relocate and barricade this site. If any updates are found to be required relating to the nature or location of this site then these should be applied through the AHIMS (Heritage NSW's Aboriginal Heritage Information Management System) process.

Bunting located around the PK10 co-ordinates

★ ★ ★

For all other ACH sites visited during the audit inspection no further recommendations were forthcoming from the CHWG attendees. These sites were found to be in generally good repair, with the only issue encountered being poor GSV at some sites which prevented the relocation of any artefacts. These sites should be re-inspected during a later audit when ground conditions are more favourable.

Newly Recorded Aboriginal Site

During the course of the current audit, an additional previously unrecorded ACH site was located by the field team (shown on Map, p5). This site has been added to the HVO ACH Sites database and also registered on AHIMS.

HVO-2141 (AHIMS ID 37-6-4196)

315136E 6397492N (GDA94z56)

This site consists of six flakes of silcrete located within a casuarina woodland. The site is c.75m north of the main watercourse that feeds the dam adjacent to Comleroi Rd. GSV in this area was fairly good and two existing isolated artefact sites are located c.50m either side of this site. The site extent measures c.5m x 5m.

Silcrete artefacts recorded at HVO-2141

Recommendations from April 2022 HVO South AHMP Compliance Audit Inspection

The following ACH management recommendations were agreed during the April 2021 HVO South AHMP compliance audit and should be presented to the CHWG for consideration.

1. **Future requirements for hard fencing will not necessitate the addition of sediment fencing to prevent potential artefact wash as evidence from current instances show that the improved ground cover afforded by hard fencing and livestock avoidance is sufficient in this regard;**
2. **Once dam water levels subside ACH sites HVO-84; 85; 86; 87; 88; 89; 90; 91; and 99 should be reassessed to examine the affects of inundation and appropriate management recommendations put forward;**
3. **Repair barricading and signage at ACH sites HVO-101; 102; 103; 104; 105; 106; 111; 113; 114; 116; and 117, with consideration given to installing hard fencing to protect against potential livestock damage; and**
4. **Install barricading or hard fencing at sites PK10, HVO-110 and HVO-115, with further assessment required at the former two sites to identify the location and nature of the cultural material present.**

Hunter Valley Operations Aboriginal Heritage Management Plans November 2022 Compliance Audit Inspections

Report prepared for

Hunter Valley Operations

November 2022

Joel Deacon

ARROW HERITAGE SOLUTIONS

Introduction

The Hunter Valley Operations Joint Venture (HVOJV) manages the Hunter Valley Operations (HVO) mining complex and associated Biodiversity Areas located in the Hunter Valley. The HVOJV provides management services that include accountability for Aboriginal cultural heritage (ACH) and community consultation.

The development of HVO's mining operations has occurred through a process of expansion and acquisition, and as a result there are two separate development approvals that apply to the operation - HVO North (DA_450-10-2003) and HVO South (PA_06_0261). The mining & processing activities at HVO are geographically divided by the Hunter River, with movement of coal, overburden, equipment, materials and personnel between two operational areas.

Each consent contains a condition requiring the development of an Aboriginal Heritage Management Plan (AHMP). Such plans have been developed in consultation with the Aboriginal community through the HVO Cultural Heritage Working Group (CHWG) and approved for each operational area. Within each of these plans provision is made to conduct annual AHMP compliance inspections (biannual for HVO South) with members of the Aboriginal community throughout the life of operations. The purpose of the compliance inspections is to afford the Aboriginal stakeholders and the HVOJV:

- the opportunity to visit mine operations and mine areas to inspect the operational compliance with AHMP provisions and Ground Disturbance Permit procedures;
- to inspect and monitor the condition and management of various ACH sites; and
- to review the effectiveness and performance of AHMP provisions in the management of cultural heritage at the mine.

Due to the number of ACH sites within the AHMP areas & the time required to inspect all sites, it is not feasible to inspect every ACH site during the same field trip. Therefore, a regular, rolling program of compliance inspections has been implemented that will visit all sites periodically over a number of years. A record will be kept of each compliance inspection against each ACH site, so that it can be ensured that each site is inspected regularly.

Proposed Activity and Project Brief

The compliance inspections involved the following elements:

- An AHMP compliance inspection report pro-forma was completed for each ACH site or area visited;

- Photographs of the inspected ACH sites were also taken;
- The pro-forma noted the outcomes of the inspection including evidence of compliance or non-compliance with AHMP provisions, recommendations on improvements to management provisions and/or recommendations on corrective actions;
- Specific site condition monitoring inspection of CM-CD1, as per Schedule 15 of the HVO North HMP.

Timing & Personnel

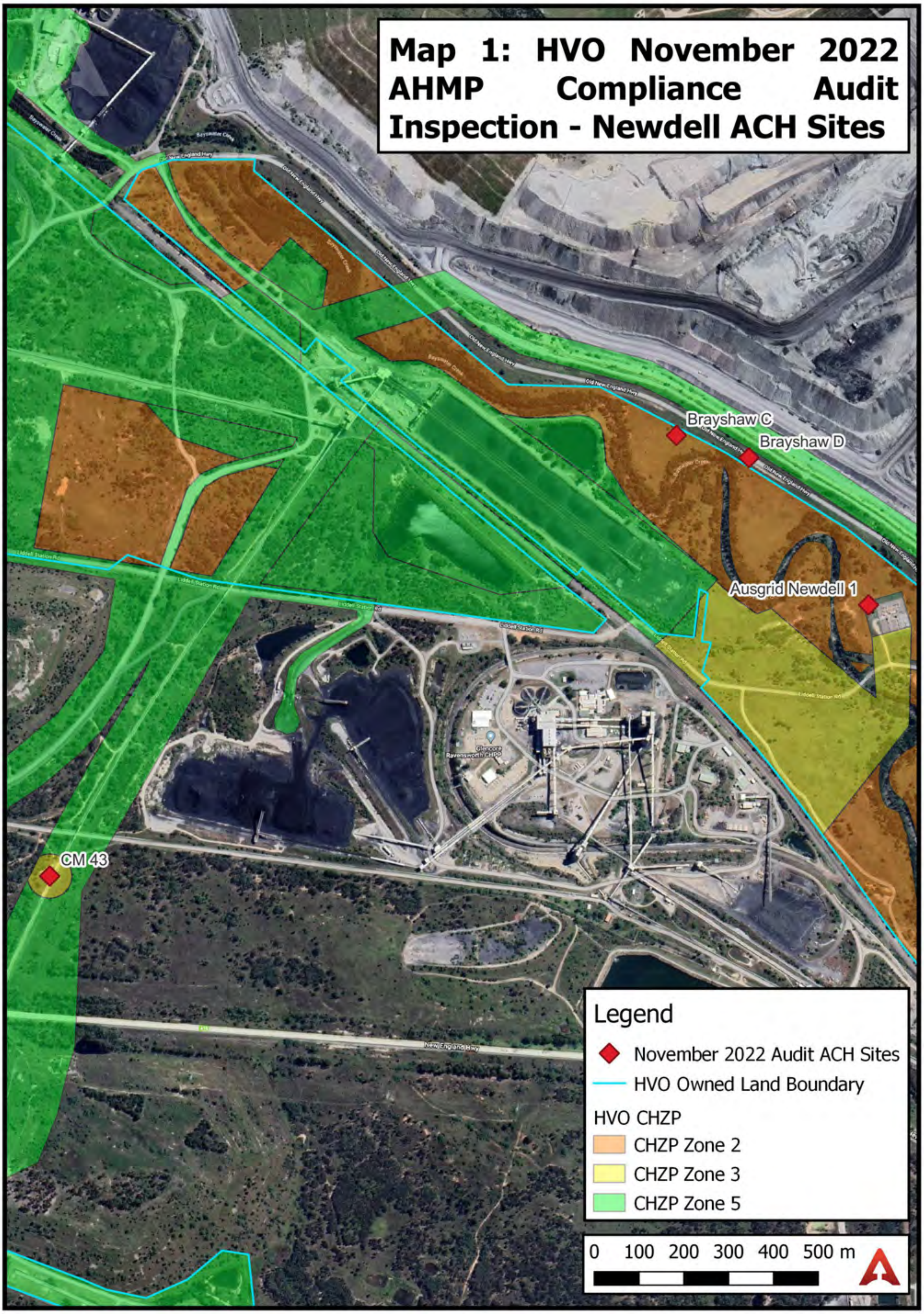
The HVO 2022 H2 AHMP compliance inspection program was conducted between 8-10 November 2022. The personnel involved in these inspections were:

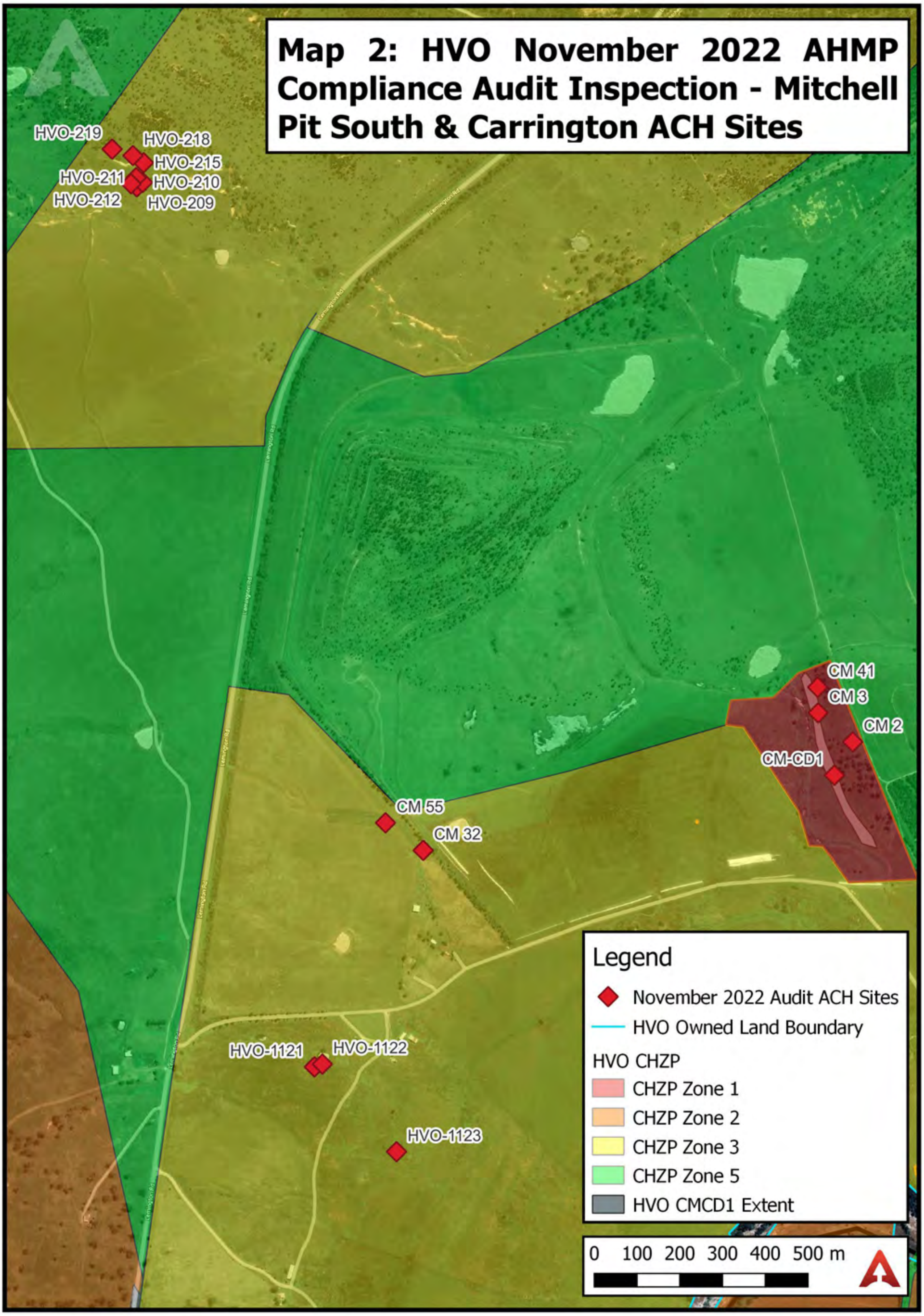
- Joel Deacon (Arrow Heritage Solutions Principal Archaeologist)
- Peter Bowman (HVO Environment and Community Officer)
- Mary Franks (CHWG Representative – Tocumwall)
- Rhonda Ward (CHWG Representative – Ungooroo Cultural & Community Services)
- Maree Waugh (CHWG Representative - Wallangan)

Arrow Heritage Solutions were engaged as independent heritage consultants to conduct the AHMP compliance inspections, and Joel Deacon acted as technical advisor and author of this report. HVO's Environment & Community Officer Peter Bowman arranged the compliance inspection programs and escorted the field team.

HVO North AHMP Compliance Inspection

A total of 20 ACH sites were inspected across various areas at HVO North, including the Newdell Loading Facility Area, Mitchell Pit South and the Carrington area (see Maps 1-2). Although not active mining zones, these areas were selected for inspection for a variety of reasons. Some of the sites are located adjacent to active infrastructure areas, some were visited to obtain further information regarding their extent, contents and condition, and others were inspected to assess the success of measures implemented as a result of previous audit recommendations.


Map 1: HVO November 2022 AHMP Compliance Audit Inspection - Newdell ACH Sites
Brayshaw C
Brayshaw D
Ausgrid Newdell 1
CM 43
Legend
November 2022 Audit ACH Sites
HVO Owned Land Boundary
HVO CHZP
CHZP Zone 2
CHZP Zone 3
CHZP Zone 5
0 100 200 300 400 500 m



Map 2: HVO November 2022 AHMP Compliance Audit Inspection - Mitchell Pit South & Carrington ACH Sites
HVO-219
HVO-218
HVO-215
HVO-211
HVO-210
HVO-212
HVO-209
CM 41
CM 3
CM 2
CM-CD1
CM 55
CM 32
HVO-1121
HVO-1122
HVO-1123
Legend
November 2022 Audit ACH Sites
HVO Owned Land Boundary
HVO CHZP
CHZP Zone 1
CHZP Zone 2
CHZP Zone 3
CHZP Zone 5
HVO CMCD1 Extent
0 100 200 300 400 500 m

Results

Table 1 details the results of the HVO North compliance inspection and summarises the information recorded on the individual pro-forma inspection sheets. Using a mobile mapper pre-loaded with the GIS co-ordinates for each ACH site, the field team travelled to each locale and attempted to re-identify each site. Sometimes this was not possible due to poor ground surface visibility (GSV) arising from high vegetation cover, in which case the site was assessed to determine that the vicinity had not been inadvertently disturbed. Another factor affecting site re-identification was the age of the original recording and the level of data recorded. The presence and condition of barricading or fencing was noted, as well as the presence and nature of various potential site disturbing factors (e.g erosion, animal, human). General observations of each site were made if necessary, and, based on information provided for all of the above factors, management recommendations were discussed and agreed by the field team for each site.

AHIMS ID	Site Name	Inspection Date	Site re-identified?	Site intact?	Site fenced/barricaded?	Fencing/barricading intact?	Natural erosion	Livestock damage	Human disturbance	Animal disturbance	Pests & weeds	General observations	Management recommendations
37-2-0794	HVO-209	8/11/2022	Yes	Yes	No	-	No	No	No	No	No		Install signage at nearby fence to prevent vehicle access
37-2-0794	HVO-210	8/11/2022	Yes	Yes	No	-	No	No	No	No	No		Install signage at nearby fence to prevent vehicle access
37-2-0794	HVO-211	8/11/2022	Yes	Yes	No	-	No	No	No	No	No		Install signage at nearby fence to prevent vehicle access
37-2-0794	HVO-212	8/11/2022	Yes	Yes	No	-	No	No	No	No	No		Install signage at nearby fence to prevent vehicle access
37-2-0794	HVO-215	8/11/2022	Yes	Yes	Yes	Yes	some	No	No	No	No	has been hard fenced to promote revegetation	
37-2-0794	HVO-218	8/11/2022	Yes	Yes	Yes	Yes	some	No	No	No	No	has been hard fenced to promote revegetation	
37-2-0794	HVO-219	8/11/2022	Yes	Yes	Yes	Yes	some	No	No	No	No	has been hard fenced to promote revegetation	
37-2-2754	HVO-1121	8/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect when better GSV
37-2-2755	HVO-1122	8/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect when better GSV
37-2-2756	HVO-1123	8/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect when better GSV
37-3-1210	Ausgrid Newdell 1	8/11/2022	No	Yes	No	-	No	No	regularly slashed	No	No		Investigate records to see if actually salvaged
37-2-1505	CM 2	8/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect when better GSV
37-2-1506	CM 3	8/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect when better GSV
37-2-1875	CM 55	8/11/2022	Yes	Yes	Yes	Yes	No	No	No	No	No		
37-2-1877	CM-CD1	8/11/2022	Yes	Yes	Yes	Yes	No	No	No	No	No	Overgrown, v. poor GSV	
37-3-0391	CM 43	8/11/2022	No	Yes	No	-	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect when better GSV
37-3-0458	Brayshaw D	8/11/2022	No	?	No	-	No	No	?	No	No	co-ords place site on road	Investigate records to see if actually salvaged
37-3-0459	Brayshaw C	8/11/2022	No	Yes	No	-	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect when better GSV
37-2-1544	CM 41	8/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect when better GSV
37-5-0261	HVS 37	9/11/2022	No	Yes	No	-	No	No	No	No	No	Site probably recorded at HVO-1670-4	
37-5-0914	TGOS1	9/11/2022	No	Yes	No	-	No	No	No	No	No	some flagging on grass	Obtain site details to better identify and barricade

Table 1: Results of the October 2021 HVO North Aboriginal Sites Compliance Inspection

Aboriginal Site Management Recommendations

Management recommendations were provided for several of the ACH sites visited. The nature of these recommendations are described below.

Install precautionary signage

Site: 37-2-0794 (HVO-209, 210, 211, 212)

These sites are located in an area where vehicles intermittently access to conduct inspections. There is the potential that these sites could be impacted by such access and so it is recommended that signage be installed at the nearby track edge informing personnel that ACH sites are located in the vicinity and that no vehicular access off the track is permitted.

Investigate site records

Site: 37-3-0458; 37-3-1210

These two sites are ACH sites recorded outside of HVO's standard process and, therefore, information on their nature, extent and validity is lacking. The co-ordinates on hand for these sites place them in areas that have been heavily disturbed and it is likely that they have been destroyed or salvaged. Investigation of site cards and reports is required to ascertain the exact circumstances surrounding their recording and potential salvage.

Reinspect when GSV permits

Sites: 37-2-2754; 37-2-2755; 37-2-2756; 37-2-1505; 37-2-1506; 37-2-1544; 37-3-0391; 37-3-0459

These sites are located in areas where surface vegetation is extremely thick and prevents visibility of the ground surface. It is recommended that the sites are revisited during a future audit inspection when vegetation levels are much lower so that better attempts can be made to relocate their contents. It should be noted, however, that one benefit to such thick vegetation is that this will aid in preventing movement of any artefacts through erosion or other means.

Example of poor GSV at site 37-3-0459

CM-CD1

The HVO North HMP (Schedule 15) contains a specific Plan of Management for Aboriginal site CM-CD1 (AHIMS ID 37-2-1877) that includes a description of measures that would be implemented to protect, monitor and manage potential impacts on the site by HVO North's mining operations and associated activities. As shown in Map 2 above, CM-CD1 includes an area c.450m long and up to 25m in width and is located immediately to the west of HVO Carrington Pit and c.900m north of the Hunter River.

As part of the brief for this compliance inspection audit, the consultant was also required to audit the current condition of CM-CD1 with reference to the management measures outlined in Schedule 15 of the HVO AHMP. It should be positively noted that the elements of the management regime identified in previous compliance audits continue to be robustly applied. The maintenance of these management processes will be the ongoing focus of compliance audits at CM-CD1:

1. A disturbance exclusion buffer area will be maintained around Aboriginal cultural heritage site 37-2-1877 (CM-CD1) of not less than 20m from the

boundary of the recorded extent of the CM-CD1 site and incorporating the Older Stratum.

During the November 2022 inspection of CM-CD1 no unauthorised ground disturbance was noted within the disturbance exclusion buffer area (as depicted in Map 2 and the co-ordinates in Point 2 below). The archaeological excavation pits that were open during the 2021 inspection have now been filled.

2. The CM-CD1 disturbance exclusion buffer area will be aligned within the following coordinates (GDA 94):
   i. North-East corner at E308805 and N6403833
   ii. North-West corner at E308696 and N6403791
   iii. South-West corner at E308861 and N6403341
   iv. South-East corner at E308996 and N6403355

   See Point 1.

3. The CM-CD1 disturbance exclusion buffer area is to be zoned as a Zone 1 Restricted Access Area within the HVO North Cultural Heritage Zoning Scheme (CHZS). All development disturbance activities are to be excluded from within the buffer area.

   The CM-CD1 exclusion area is zoned as Zone 1 in the HVO North CHZS.

4. The CM-CD1 disturbance exclusion buffer area will be delineated with stock-proof fencing and appropriate signage denoting that the area is a Restricted Access Area and no ground disturbance is authorised within the buffer area except where such ground disturbance is authorised under the provisions of this Plan of Management. Ground disturbance, such as for archaeological investigations, may require a consent under relevant legislation.

   The entirety of CM-CD1, including a substantial buffer, has been delineated with stock-proof fencing and adequate Cultural Heritage Site signage is visible on the fence.

5. Access within the CM-CD1 disturbance exclusion buffer area will be limited to authorised personnel and visitors only either on foot (e.g. for monitoring inspections) or in light vehicles (e.g. for pest, weed and fire management) for the purposes of implementing the management provisions approved under this Plan of Management.

   No evidence was noted to suggest the contrary has occurred.

6. An annual site condition monitoring inspection will be conducted by HVO personnel with representatives of the CHWG and the results of the inspection reported as an element of the HVO North DA 450-10-2003 Annual Environmental Management Report. The results of the inspection will also be reported to Aboriginal community stakeholders through the CHWG and/or other relevant Aboriginal community consultation forum.
   This report documents the 2022 annual site condition inspection.

7. A series of condition and disturbance monitoring photo points will be established within the CM-CD1 disturbance exclusion buffer area and condition monitoring images taken during the course of the annual monitoring inspection.
   Five photographic monitoring points have been established from where disturbance monitoring photographs of CM-CD1 are taken. These points are located in the north-west, north-east, south-west and south-east of the site, as well as the centre. These photographs and their locational information are contained in Appendix A of this report.

8. HVO will determine the nature and risks of potential impacts of blasting activities upon site CM-CD1 as an element of the HVO North blast management plan. Consistent with the results of the risk assessment process used to inform the development of the HVO North blast management plan, HVO will implement appropriate management measures to protect site CM-CD1 from any adverse impact that may be caused by blasting in a manner consistent with the provisions of this Plan of Management. In accordance with Schedule 4 of Condition 40 of the Approval, regular visual monitoring will be undertaken to confirm that impacts have not been caused by blasting vibration or from flyrock impacts.
   No evidence of any blasting-related disturbance or flyrock impacts were noted during the site inspection. Indeed, blasting activity in the Carrington Pit ceased on the 17th October 2018 and mining and blasting activity was been focused on the eastern side of the Carrington Pit in the years leading up to the cessation of blasting.

9. As mining, and related blasting activities, approach the CM-CD1 disturbance exclusion buffer area, regular visual monitoring to confirm that impacts have not been caused by blasting vibration will be conducted by HVO personnel.

Damage to CM-CD1 caused by flyrock is considered a very low risk, however, if it is evident, through regular monitoring, that this risk profile may increase in the future, protective management measures will be considered.
See above Point 8.

10. A variety of land management activities will be required to maintain the cultural and environmental values of the CM-CD1 disturbance exclusion buffer area. Land management activities approved under this HMP are as follows.
    i. Hand or light vehicle spraying of weeds.
    ii. Brush cutting by hand to control weeds and vegetation.
    iii. Prescribed burning and fire protection management.
    iv. Maintenance of fencing including replacement of posts as required.

    No evidence was noted of any adverse impacts to CM-CD1 by any of the land management practices listed above. However, it was noted that weed and vegetation growth throughout the CM-CD1 disturbance exclusion buffer area was very high. Potential management measures were discussed with the field team and are presented as recommendations below.

Recommendations

CM-CD1 is being managed well, with no evident impacts to the site's cultural heritage values. All recommended actions from previous compliance inspections have been implemented. The following recommendations relate to land management activities that could be implemented to maintain the environmental values of the site:

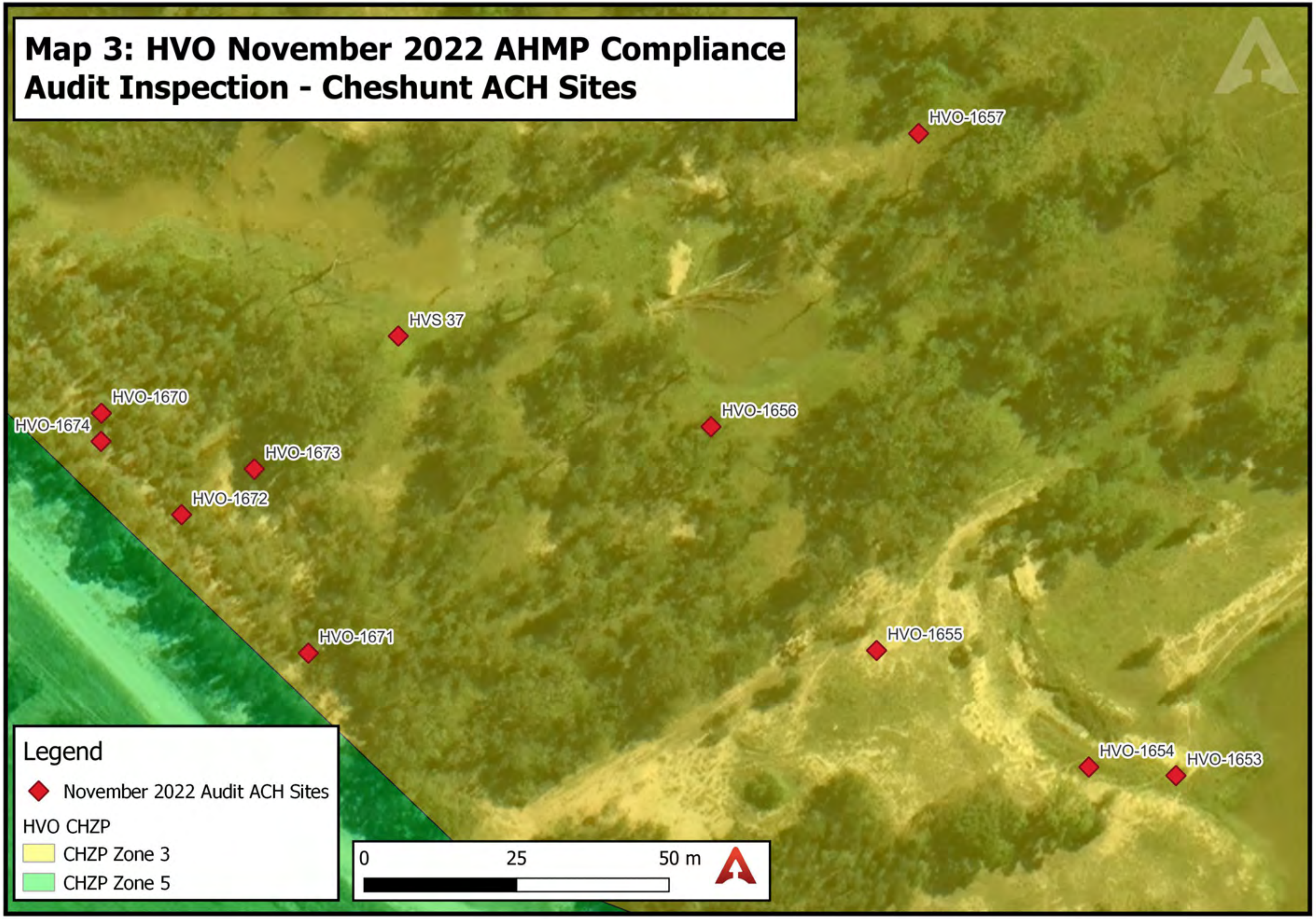
- **Using a hand-held brush-cutter and proceeding on foot, the 20m CM-CD1 buffer area should be subject to weed and vegetation growth slashing;**
- **A fence should be installed around this 20m CM-CD1 buffer area;**
- **Access between this fence and the outer perimeter fence is restricted to light vehicles and the management of vegetation and pasture-based fuel loads to be achieved through low impact intermittent grazing by livestock;**
- **The CM-CD1 area should continue to be targeted during HVO's vermin control program in order to reduce feral pig disturbance as much as possible.**

HVO South AHMP Compliance Inspection

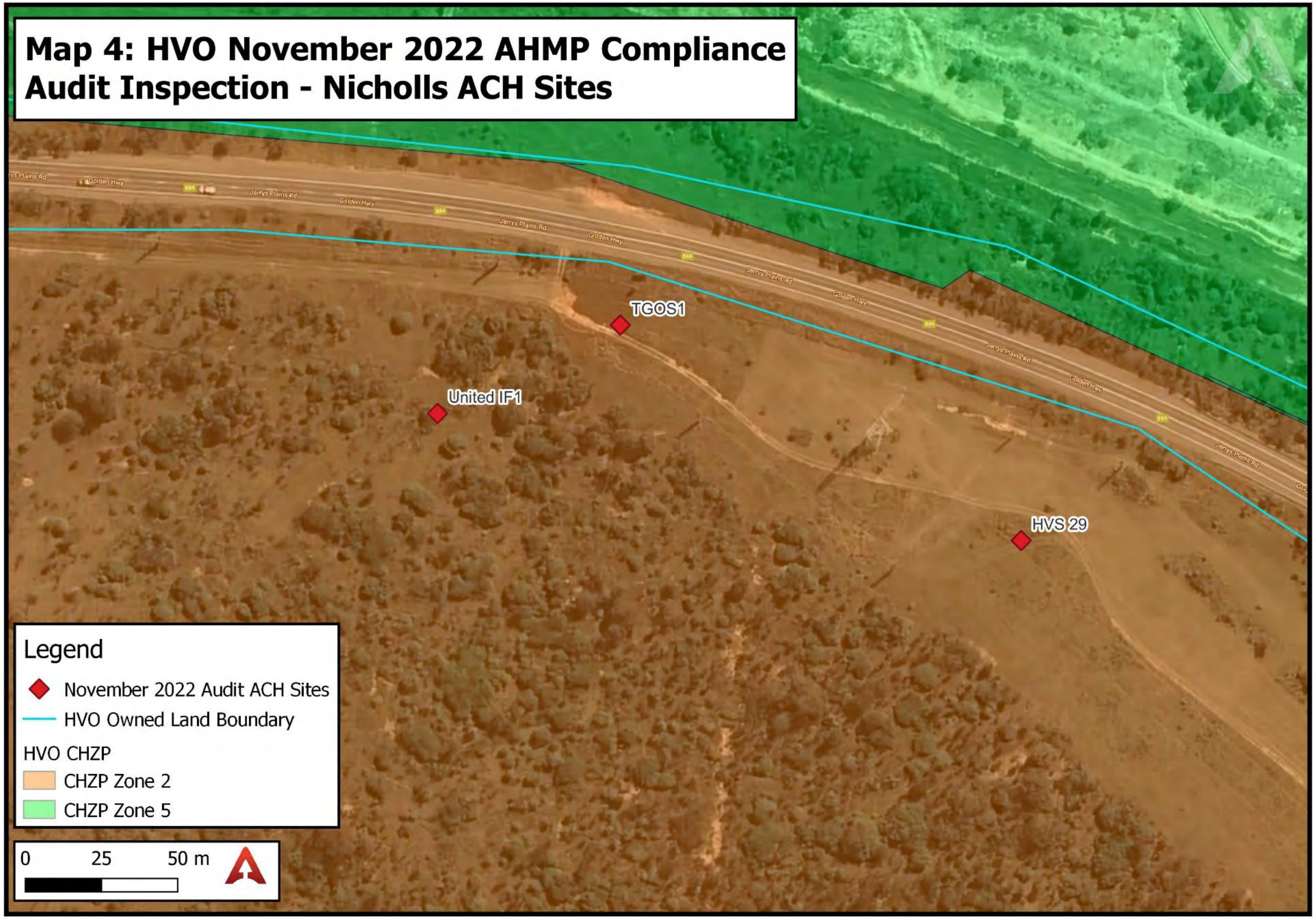
A total of 67 Aboriginal heritage sites were inspected in the HVO South area, at Cheshunt, Nicholls, Glider Strip North and the HVO Southern areas (see Maps 3-6). Although not active mining zones, these areas were selected for inspection as they are accessed by third party users, including for grazing activities.

Results

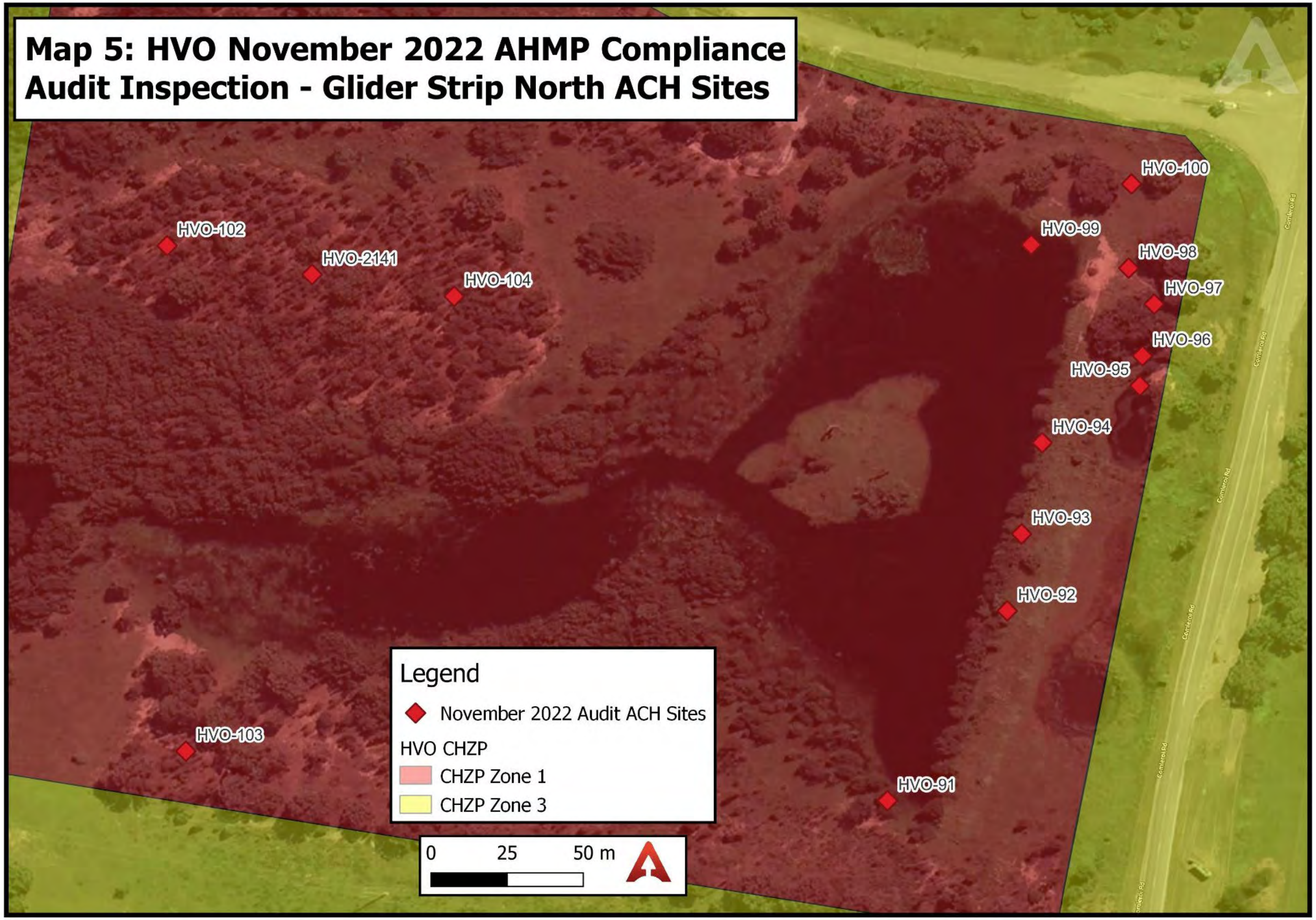
Table 2 summarises the results of the HVO South compliance inspection and summarises the information recorded on the individual pro-forma inspection sheets. Using a mobile mapper pre-loaded with the GIS co-ordinates for each Aboriginal heritage site, the field team travelled to each locale and attempted to re-identify each site. Sometimes this was not possible due to poor GSV arising from high vegetation cover, in which case the site was assessed to determine that the vicinity had not been inadvertently disturbed. Another factor affecting site re-identification was the age of the original recording and the level of data recorded. The presence and condition of barricading or fencing was noted, as well as the presence and nature of various potential site disturbing factors (e.g erosion, animal, human). General observations of each site were made if necessary, and, based on information provided for all of the above factors, management recommendations were discussed and agreed by the field team for each site.



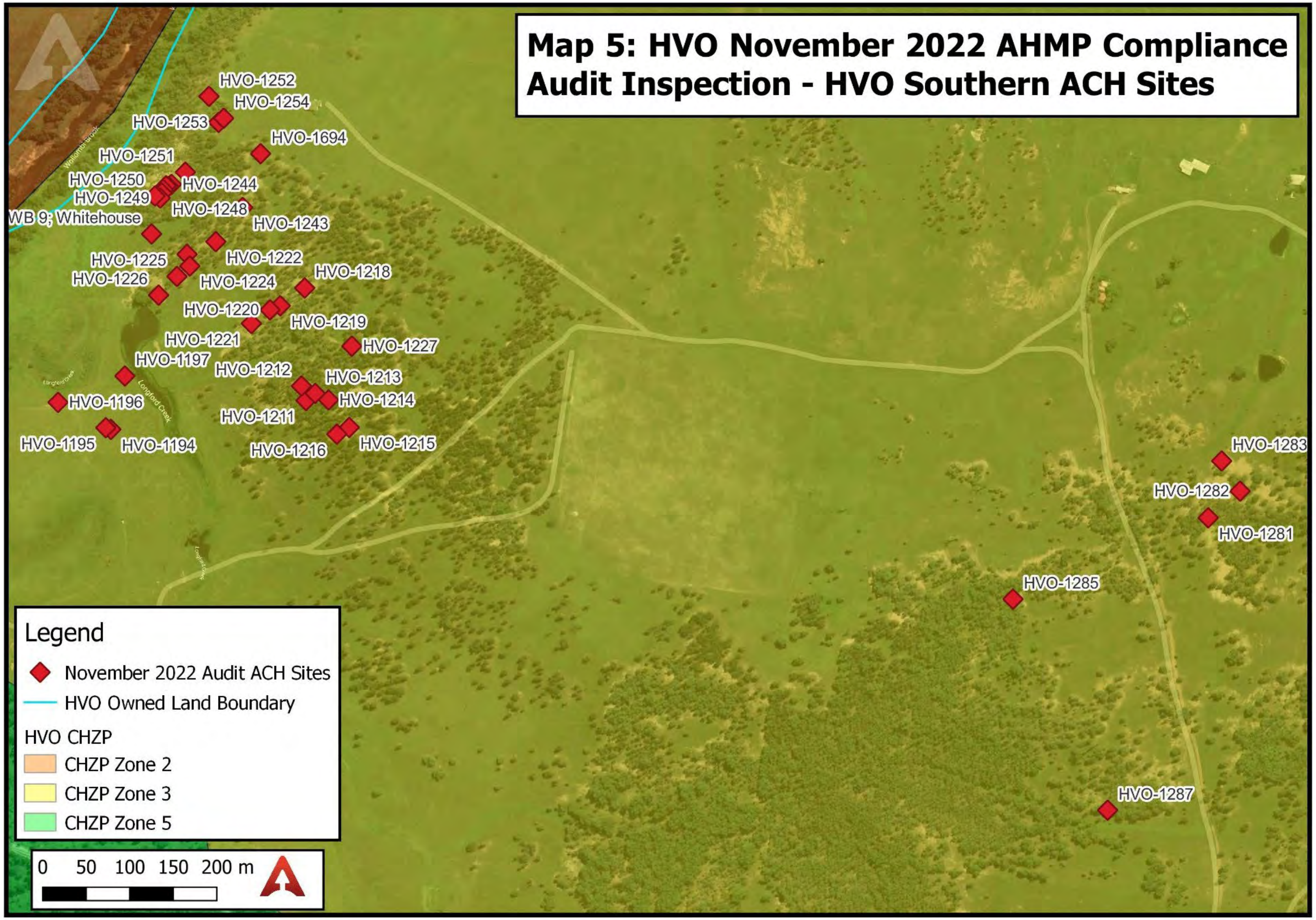
Map 3: HVO November 2022 AHMP Compliance Audit Inspection - Cheshunt ACH Sites
HVO-1657
HVS 37
HVO-1670
HVO-1674
HVO-1673
HVO-1656
HVO-1672
HVO-1671
HVO-1655
HVO-1654
HVO-1653
Legend
November 2022 Audit ACH Sites
HVO CHZP
CHZP Zone 3
CHZP Zone 5
0
25
50 m



Map 4: HVO November 2022 AHMP Compliance Audit Inspection - Nicholls ACH Sites



Map 5: HVO November 2022 AHMP Compliance Audit Inspection - Glider Strip North ACH Sites
HVO-100
HVO-99
HVO-98
HVO-97
HVO-96
HVO-95
HVO-94
HVO-93
HVO-92
HVO-91
HVO-102
HVO-2141
HVO-104
HVO-103
Legend
November 2022 Audit ACH Sites
HVO CHZP
CHZP Zone 1
CHZP Zone 3
0
25
50 m


Map 5: HVO November 2022 AHMP Compliance Audit Inspection - HVO Southern ACH Sites
HVO-1252
HVO-1254
HVO-1253
HVO-1694
HVO-1251
HVO-1250
HVO-1244
HVO-1249
HVO-1248
WB 9; Whitehouse
HVO-1243
HVO-1225
HVO-1222
HVO-1226
HVO-1224
HVO-1218
HVO-1220
HVO-1219
HVO-1221
HVO-1227
HVO-1197
HVO-1212
HVO-1213
HVO-1196
HVO-1214
HVO-1211
HVO-1195
HVO-1194
HVO-1216
HVO-1215
HVO-1283
HVO-1282
HVO-1281
HVO-1285
HVO-1287
Legend
November 2022 Audit ACH Sites
HVO Owned Land Boundary
HVO CHZP
CHZP Zone 2
CHZP Zone 3
CHZP Zone 5
0 50 100 150 200 m

AHIMS ID	Site Name	Inspection Date	Site re-identified?	Site intact?	Site fenced/barricaded?	Fencing/barricading intact?	Natural erosion	Livestock damage	Human disturbance	Animal disturbance	Pests & weeds	General observations	Management recommendations
37-6-3287	HVO-91	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-6-3288	HVO-92	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-6-3289	HVO-93	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-6-3290	HVO-94	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-6-3291	HVO-95	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-6-3292	HVO-96	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-6-3293	HVO-97	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-6-3294	HVO-98	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-6-3295	HVO-99	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-6-3296	HVO-100	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-6-3298	HVO-102	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-6-3299	HVO-103	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-6-3300	HVO-104	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No		To be hard fenced
37-6-3312	HVO-1194	10/11/2022	No	Yes	No	-	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect with better GSV
37-6-3313	HVO-1195	10/11/2022	No	Yes	No	-	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect with better GSV
37-6-3314	HVO-1196	10/11/2022	No	Yes	No	-	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect with better GSV
37-6-3315	HVO-1197	10/11/2022	No	Yes	No	-	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect with better GSV
37-6-3328	HVO-1211	10/11/2022	No	Yes	No	-	No	No	No	No	No		
37-6-3329	HVO-1212	10/11/2022	No	Yes	No	-	No	No	No	No	No		
37-6-3330	HVO-1213	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3331	HVO-1214	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3332	HVO-1215	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3333	HVO-1216	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3335	HVO-1218	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3336	HVO-1219	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3337	HVO-1220	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3338	HVO-1221	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3339	HVO-1222	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3340	HVO-1223	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3341	HVO-1224	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3342	HVO-1225	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3410	HVO-1226	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3343	HVO-1227	10/11/2022	No	Yes	No	-	No	No	No	No	No		
37-6-3361	HVO-1243	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3362	HVO-1244	10/11/2022	Yes	Yes	No	-	massive gully erosion	No	No	No	No		
37-6-3363	HVO-1245	10/11/2022	Yes	Yes	No	-	massive gully erosion	No	No	No	No		
37-6-3364	HVO-1246	10/11/2022	Yes	Yes	No	-	massive gully erosion	No	No	No	No		
37-6-3365	HVO-1247	10/11/2022	Yes	Yes	No	-	massive gully erosion	No	No	No	No		
37-6-3366	HVO-1248	10/11/2022	Yes	Yes	No	-	massive gully erosion	No	No	No	No		
37-6-3367	HVO-1249	10/11/2022	Yes	Yes	No	-	massive gully erosion	No	No	No	No		
37-6-3368	HVO-1250	10/11/2022	Yes	Yes	No	-	massive gully erosion	No	No	No	No		
37-6-3369	HVO-1251	10/11/2022	Yes	Yes	No	-	massive gully erosion	No	No	No	No		
37-6-3370	HVO-1252	10/11/2022	No	Yes	No	-	No	No	No	No	No		

37-6-3371	HVO-1253	10/11/2022	No	Yes	No	-	No	No	No	No	No		
37-6-3372	HVO-1254	10/11/2022	No	Yes	No	-	No	No	No	No	No		
37-6-3424	HVO-1281	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3425	HVO-1282	10/11/2022	No	Yes	No	-	No	No	No	No	Some prickly pear		
37-6-3426	HVO-1283	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3428	HVO-1285	10/11/2022	No	Yes	No	-	No	No	No	No	No		
37-6-3430	HVO-1287	10/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3026	HVO-1653	9/11/2022	Yes	Yes	No	-	quite severe	No	No	No	No		
37-6-2991	HVO-1654	9/11/2022	Yes	Yes	No	-	quite severe	No	No	No	No		
37-6-3025	HVO-1655	9/11/2022	Yes	Yes	No	-	sheet wash	No	No	No	No		
37-6-3024	HVO-1656	9/11/2022	Yes	Yes	No	-	No	No	No	No	No		
37-6-3023	HVO-1657	9/11/2022	No	Yes	No	-	No	No	No	No	No		
37-6-3010	HVO-1670	9/11/2022	Yes	Yes	No	-	No	No	on old track	No	No	Probably HVS 37	
37-6-3009	HVO-1671	9/11/2022	Yes	Yes	No	-	sheet wash	No	on old track	No	No	Probably HVS 37	
37-6-3008	HVO-1672	9/11/2022	Yes	Yes	No	-	No	No	on old track	No	No	Probably HVS 37	
37-6-3007	HVO-1673	9/11/2022	Yes	Yes	No	-	sheet wash	No	No	No	No	Probably HVS 37	
37-6-3006	HVO-1674	9/11/2022	Yes	Yes	No	-	No	No	on old track	No	No	Probably HVS 37	
37-6-3548	HVO-1694	10/11/2022	No	Yes	No	-	No	No	No	No	No		
37-5-0253	HVS 29	9/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Overgrown, v. poor GSV	Reinspect with better GSV
37-6-0626	WB 9; Whitehouse	10/11/2022	Yes	Yes	Yes	Yes	massive gully erosion	No	No	No	No	old white wire fence	
37-5-0584	United IF1	9/11/2022	No	Yes	Yes	No	No	No	No	No	No	out of harm's way	Reinspect with better GSV
37-2-1535	CM 32	8/11/2022	No	Yes	Yes	Yes	No	No	No	No	No	Overgrown, v. poor GSV	
37-6-4196	HVO-2141	9/11/2022	Yes	Yes	Yes	Yes	No	No	No	No	No	Newly hard fenced	
37-5-0914	TGOS1	9/11/2022	No	Yes	No	-	No	No	No	No	No	some flagging on grass	Obtain site details to better identify and barricade

Table 2: Results of the November 2022 HVO South Aboriginal Sites Compliance Inspection

Aboriginal Site Management Recommendations

Management recommendations were provided for some of the ACH sites visited, however, as the majority of sites were located on intact landforms with very low risk of future disturbance, the field team were satisfied with the current passive management regime. The nature of those recommendations that were forthcoming are described below.

Install hard fencing

Site: 37-6-3300

This site is located within the HVO CHZP Zone 1 area west of Comleroi Rd & north of the glider strip. It has been earmarked to be hard fenced for its protection.

Several examples of HVO's new hard fencing style were inspected by the CHWG members in attendance, with all present remarking that it was a very effective and prudent measure in ACH site protection.

Example of hard fencing at 37-2-0794

Investigate site records

Site: 37-5-0914

This ACH site was recorded outside of HVO's standard process and, therefore, information on its nature, extent and validity is lacking. Investigation of site cards and reports is required to better understand this site and determine whether or not protective barricading or fencing is required.

Reinspect when GSV permits

Sites: 37-5-0253; 37-5-0584; 37-6-3312; 37-6-3313; 37-6-3314; 37-6-3315

These sites are located in areas where surface vegetation is extremely thick and prevents visibility of the ground surface. It is recommended that the sites are revisited during a future audit inspection when vegetation levels are much lower so that better attempts can be made to relocate their contents. It should again be noted, however, that one benefit to such thick vegetation is that this will aid in preventing movement of any artefacts through erosion or other means.

Recommendations from the October 2021 AHMP Audit

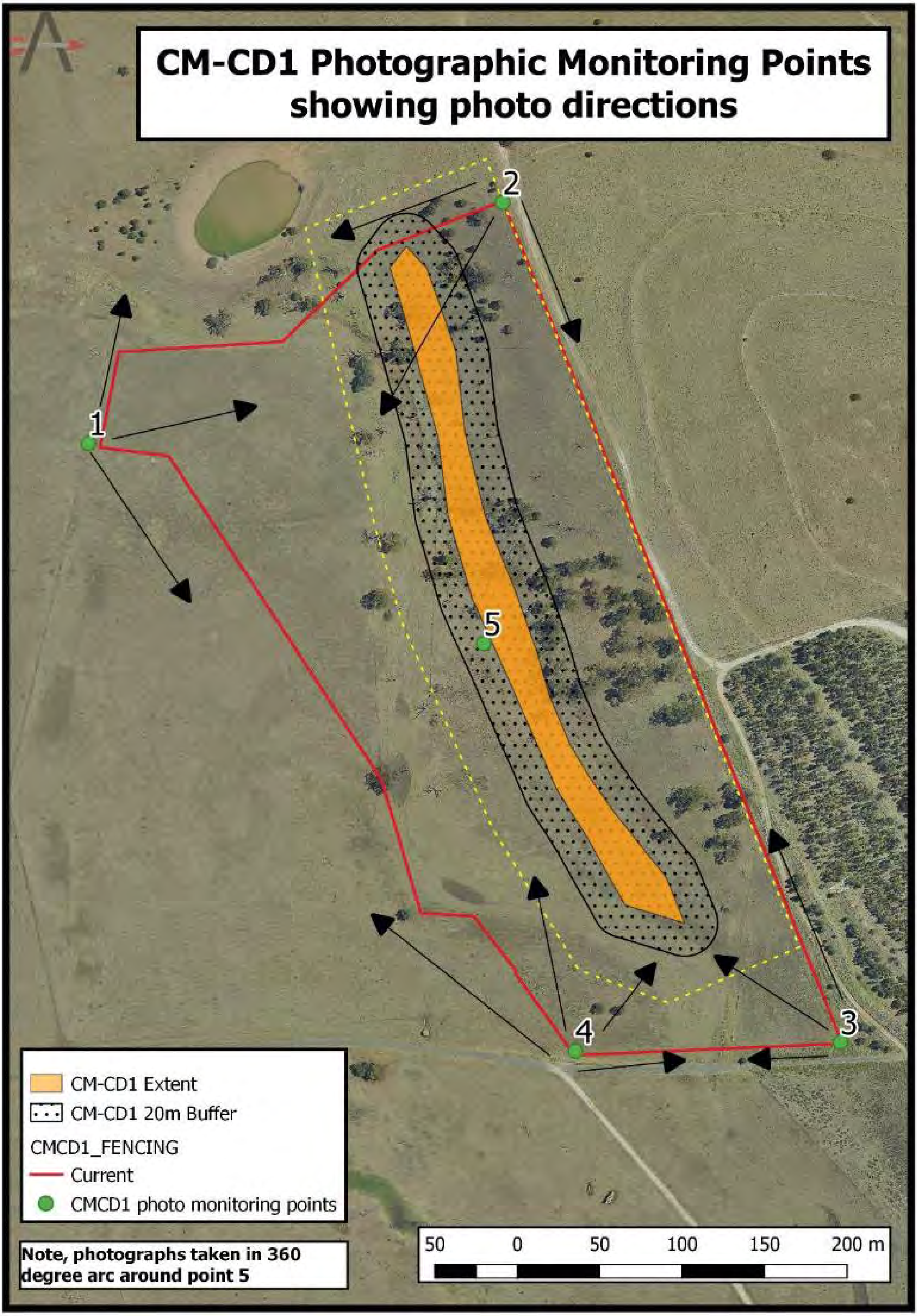
The following ACH management recommendations are provided as a result of the November 2022 AHMPs Compliance Audit.

1. **Install precautionary signage in the vicinity of site 37-2-0794 (HVO-209, 210, 211, 212) to prevent vehicular access;**
2. **Install hard fencing around site 37-6-3300;**
3. **Using site cards & original reports, ascertain accurate locations & extents of sites 37-3-0458; 37-3-1210 and 37-5-0914, and, if necessary, install barricading;**
4. **Reinspect sites 37-2-2754; 37-2-2755; 37-2-2756; 37-2-1505; 37-2-1506; 37-2-1544; 37-3-0391; 37-3-0459; 37-5-0253; 37-5-0584; 37-6-3312; 37-6-3313; 37-6-3314 and 37-6-3315 when vegetation levels are much lower to ascertain actual location & extent of sites;**
5. **Using a hand-held brush-cutter and proceeding on foot, the 20m CM-CD1 buffer area should be subject to weed and vegetation growth slashing;**
6. **A fence should be installed around this 20m CM-CD1 buffer area;**
7. **Access between this fence and the outer perimeter fence is restricted to light vehicles and the management of vegetation and pasture-based fuel loads to be achieved through low impact intermittent grazing by livestock; and**
8. **The CM-CD1 area should continue to be targeted during HVO's vermin control program in order to reduce feral pig disturbance as much as possible.**

APPENDIX A – CM-CD1 PHOTO MONITORING RESULTS

Photo Point #	Location at CM-CD1	Easting	Northing
1	North-west	308614	6403653
2	North-east	308814	6403807
3	South-east	309022	6403297
4	South-west	308860	6403290
5	Centre	308809	6403513

Co-ordinates (GDA94, z56) for CM-CD1 photo monitoring points



Location of CM-CD1 photo monitoring points

CM-CD1 Monitoring Point 1 Panorama – December 2018

CM-CD1 Monitoring Point 1 Panorama – October 2019

CM-CD1 Monitoring Point 1 Panorama – November 2020

CM-CD1 Monitoring Point 1 Panorama – October 2021

CM-CD1 Monitoring Point 1 Panorama – November 2022

CM-CD1 Monitoring Point 2 Panorama – December 2018

CM-CD1 Monitoring Point 2 Panorama – October 2019

CM-CD1 Monitoring Point 2 Panorama – November 2020

CM-CD1 Monitoring Point 2 Panorama – October 2021

CM-CD1 Monitoring Point 2 Panorama – November 2022

CM-CD1 Monitoring Point 3 Panorama – December 2018

CM-CD1 Monitoring Point 3 Panorama – October 2019

CM-CD1 Monitoring Point 3 Panorama – November 2020

CM-CD1 Monitoring Point 3 Panorama – October 2021

CM-CD1 Monitoring Point 3 Panorama – November 2022

CM-CD1 Monitoring Point 4 Panorama – December 2018

CM-CD1 Monitoring Point 4 Panorama – October 2019

CM-CD1 Monitoring Point 4 Panorama – November 2020

CM-CD1 Monitoring Point 4 Panorama – October 2021

CM-CD1 Monitoring Point 4 Panorama – November 2022

CM-CD1 Monitoring Point 5 Panorama – December 2018: (L-R: north through east through south)

CM-CD1 Monitoring Point 5 Panorama – December 2018 (L-R: south through west through north)

CM-CD1 Monitoring Point 5 Panorama – October 2019

CM-CD1 Monitoring Point 5 Panorama – November 2020

CM-CD1 Monitoring Point 5 Panorama – October 2021: (L-R: north through east through south)

CM-CD1 Monitoring Point 5 Panorama – October 2021 (L-R: south through west through north)

CM-CD1 Monitoring Point 5 Panorama – November 2022: (L-R: north through east through south)

CM-CD1 Monitoring Point 5 Panorama – November 2022 (L-R: south through west through north)