Wallerawang Ash Dam Area

Annual Environmental Management Report

April 2019– March 2020

Wallerawang Ash Dam Areas
Annual Environmental Management Report

Name of Operation	**Wallerawang Ash Dam Areas**
Name of Operator	**EnergyAustralia NSW**
Development Consent / Project Approval #	**07_0005**
Environment Protection Licence (EPL) #	**766**
Water Access Licence (WAL) #	**27428**
Water Supply and Water Use Approval #	**10CA117220**
AEMR start date	**1st April 2019**
AEMR end date	**31st March 2020**

I, Ben Eastwood, certify that this report is a true and accurate record of the compliance status of Wallerawang Ash Dam Areas for the period 1st April 2019 to 31st March 2020 and that I am authorised to make this statement on behalf of EnergyAustralia NSW.

Note:

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.

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	**Ben Eastwood**
Title of authorised reporting officer	**NSW Environment Leader**
Signature of authorised reporting officer	
Date	**26 June 2020**

This report may be cited as:

EnergyAustralia NSW (2020) Wallerawang Ash Dam Area Annual Environmental Management Report – June 2020. EnergyAustralia NSW, NSW Australia.

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1. Summary of compliance

The Wallerawang Ash Dam Areas consist of the Kerosene Vale Ash Repository Stage 2 and Sawyers Swamp Creek Ash Dam (SSCAD). The Wallerawang Ash Dam Area (WADA) Annual Environment Management Report (AEMR) has been prepared pursuant to Schedule 2, Condition 7.3 of the Project Approval 07_0005. The AEMR has been prepared in accordance with the NSW Government's *Post-approval requirements for State significant mining developments Annual Review Guideline* dated October 2015.

A summary of the Wallerawang Ash Dam Area compliance achieved during the reporting period is provided in Table 1. Any non-compliance during the reporting period is briefly detailed in Table 2, with an extended review of compliance with the Conditions of Approval (CoA) presented in Appendix A.

Table 1: Statement of Compliance During 2019-20 Reporting Period

Were all conditions of the relevant approval(s) complied with?	
Project Approval #07_0005	NO
Environment Protection Licence #766	YES
Water Access Licence #27428	YES
Water Supply Work and Water Use Approval #10CA117220	YES

Table 2: Details of Non-Compliance during 2019-20 Reporting Period

Relevant Approval	Condition No.	Summary of Condition	Compliance Status	Comment	Section where addressed within AEMR
PA 07_0005	2.1	Ash re-use	Low	The goal of 40% ash reuse was not achieved by 31 December 2013, as required.	Section 11
EPL 766	NA	NA	NA	NA	NA
27428	NA	NA	NA	NA	NA
10CA117220	NA	NA	NA	NA	NA

In assessing compliance with CoAs the key for compliance assessment provided in Table 3 was used, in accordance with the NSW Government's Independent Audit Guideline.

Table 3: Compliance Status Key

Risk Level	Colour Code	Description
High	🟥	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence.
Medium	🟧	Non-compliance with: • Potential for serious environmental consequences, but is unlikely to occur; or • Potential for moderate environmental consequences, but is likely to occur.
Low	🟨	Non-compliance with: • Potential for moderate environmental consequences, but is unlikely to occur; or • Potential for low environmental consequences, but is likely to occur.
Administrative non-compliance	🟦	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).
Compliant	🟩	The intent and all elements of the requirement of the regulatory approval have been complied with.

An acceptable standard of environmental performance has been achieved during the reporting period as evidenced by the following:

- One non-compliance recorded during the reporting period relating to ash reuse.
- Noise from the Kerosene Vale Ash Repository site was inaudible at sensitive receivers during the reporting period.
- Air quality monitoring results relating to activities at the Wallerawang Ash Dam Area were below the Operational Environment Management Plan (OEMP) assessment criteria for depositional dust gauges located in Wallerawang and Lidsdale townships.
- There was one reportable incident during the reporting period, which was the result of a bushfire at Lidsdale causing damage to WADA infrastructure, including pumps, above ground HDPE and asbestos pipeline. Water from the Sawyers Swamp Creek Ash Dam, utilised by helicopters to suppress the fire, contributed to a white precipitate forming in Sawyers Swamp Creek and friable asbestos being spread from the damaged asbestos pipeline. The Department of Planning, Infrastructure & Environment were notified of the incident on Monday 9th September 2019.
- An uncontrolled release of a small volume of seepage water reported to Sawyers Swamp Creek during the reporting period as part of the incident.
- There were no community complaints received relating to the management of the Wallerawang Ash Dam Area.

2. Introduction

2.1 Background

The Wallerawang Ash Dam Area (WADA) includes the Kerosene Vale Ash Repository Stage 2 (KVAR) and Sawyers Swamp Creek Ash Dam (SSCAD). The WADA is owned and operated by EnergyAustralia NSW and is located approximately 2.5 kilometres north-east of Wallerawang Power Station and approximately 10 kilometres north-west of the city of Lithgow, which is 150 kilometres west of Sydney (Figure 1). KVAR is situated in the centre of the Sawyers Swamp Creek (SSC) catchment and receives rainfall runoff from the surrounding areas.

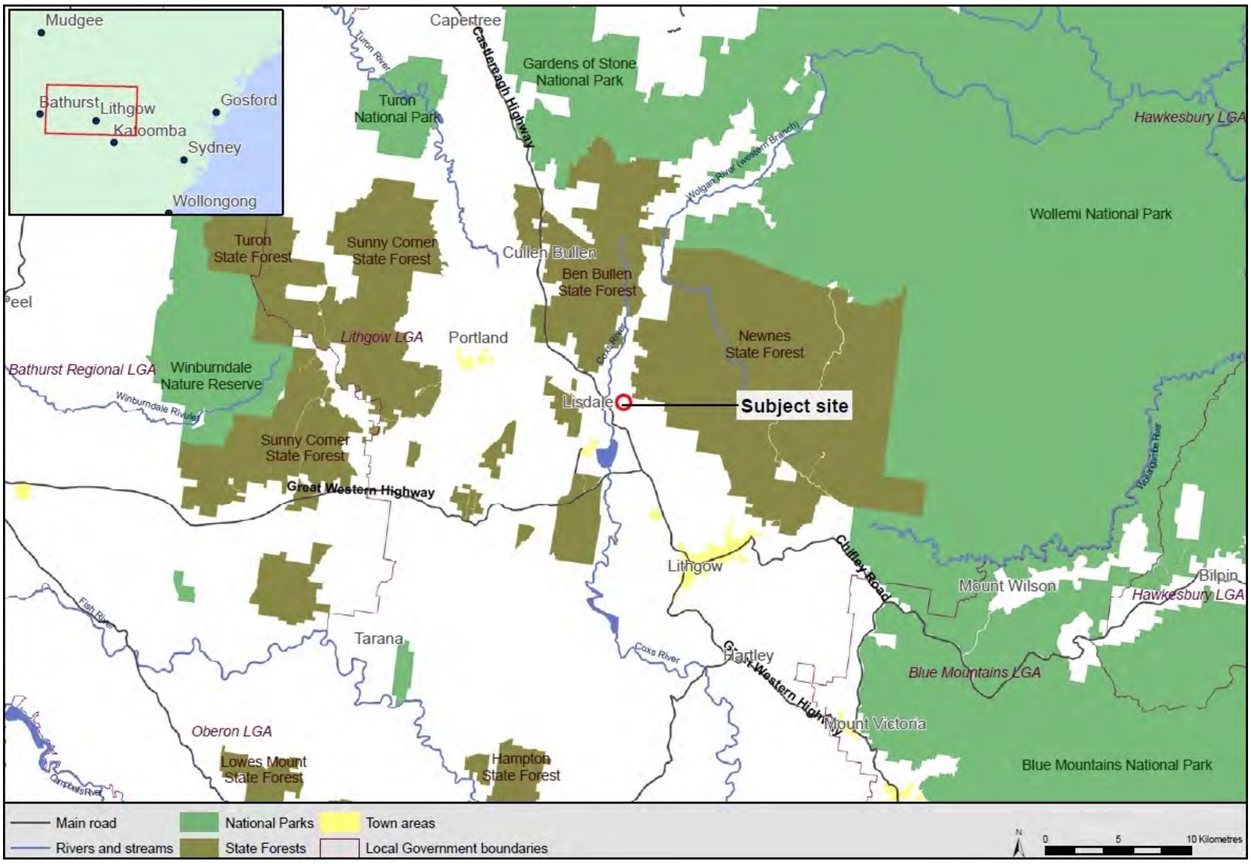

Figure 1: Regional context map

The original ash placement operations were at the Kerosene Vale Ash Dam (KVAD). The void was filled with ash transported from the Wallerawang Power Station as slurry (i.e. wet ash placement). When the KVAD was full, it was capped with a clay capping and then ash placement operations began at the Sawyers Swamp Creek Ash Dam (SSCAD), which saw wet ash placement take place from 1980 to 2003.

The need to further develop the KVAR area in order to maintain power-generation operations at Wallerawang Power Station was identified in 2001. The existing wet ash storage area (i.e. SSCAD) was approaching its design capacity. The placement of dry ash at the KVAR was identified as a viable alternative. The extent of both stages is outlined in Figure 2.

Conversion from wet to dry ash placement aimed to minimise environmental and social impacts potentially resulting from heavy metal accumulation. Key benefits of a dry ash handling facility included:

- The potential for ash to be beneficially reused in its dry form;
- An approximate 80% decrease in the water required to transport ash;
- Discharges to the Coxs River are decreased in the long term;
- The SSCAD can be progressively rehabilitated; and
- There would be a decreased flood risk for Kerosene Vale, Lidsdale and surrounding areas (Hyder Consulting, 2001)

In 2002, Project Approval was granted by the Minister of Planning to change from wet to dry ash-producing activities and to use the Kerosene Vale Ash Repository (KVAR) area for dry ash storage. On 26 November 2008, Project Approval was granted by the Minister of Planning for the extension of the existing KVAR area to permit the continued disposal of ash generated by the Wallerawang Power Station under Section 75J of the *Environmental Planning and Assessment Act 1979*. The KVAR Stage 1 placement works were completed and capped in February 2009. The KVAR Stage 2 placement works commenced soon after in April 2009 (Aurecon, 2011).

The original ash placement strategy, as outlined within the Operation Environmental Management Plan (OEMP) (EANSW, 2018), was as follows:

- Stage 2A as an extension of Stage 1;
- Stage 2B to allow time for the re-alignment of Sawyer's Swamp Creek and for material to be obtained from the pine plantation area to reinforce the stabilisation berm to the north of KVAR Stage 1; and
- Stage 2C as a final ash placement area once reinforcements of a proposed stabilisation berm with creek realignment had been carried out.

Since the first AEMR was submitted in 2011, the ash placement strategy for Kerosene Vale Stage 2 Ash Repository has been updated to reflect changes from the three-stage process outlined above, to a two-staged approach. This change in strategy was in response to Centennial Coal relinquishing their right to extract coal from the areas of mining interest within the KVAR Stage 2 proposal (Figure 2).

In January 2014, Wallerawang Power Station's Unit 7 was removed from service and deregistered from the market; whilst in March 2014, Unit 8 was placed in long term storage. However, in November 2014, EnergyAustralia NSW announced that Unit 8 was to be removed from service and deregistered from the market. Wallerawang Power Station ceased energy production in April 2014 and is currently being decommissioned and dismantled.

The bulk transport and disposal of ash to the WADA subsequently ceased following the closure of the Wallerawang Power Station. The WADA is currently being managed in a care and maintenance arrangement. Small volumes of ash will be disposed when required during the demolition of the Wallerawang Power Station. Preliminary plans are being developed for the deconstruction and rehabilitation (DDR) of the entire operational facility at Wallerawang, including the ash placement areas.

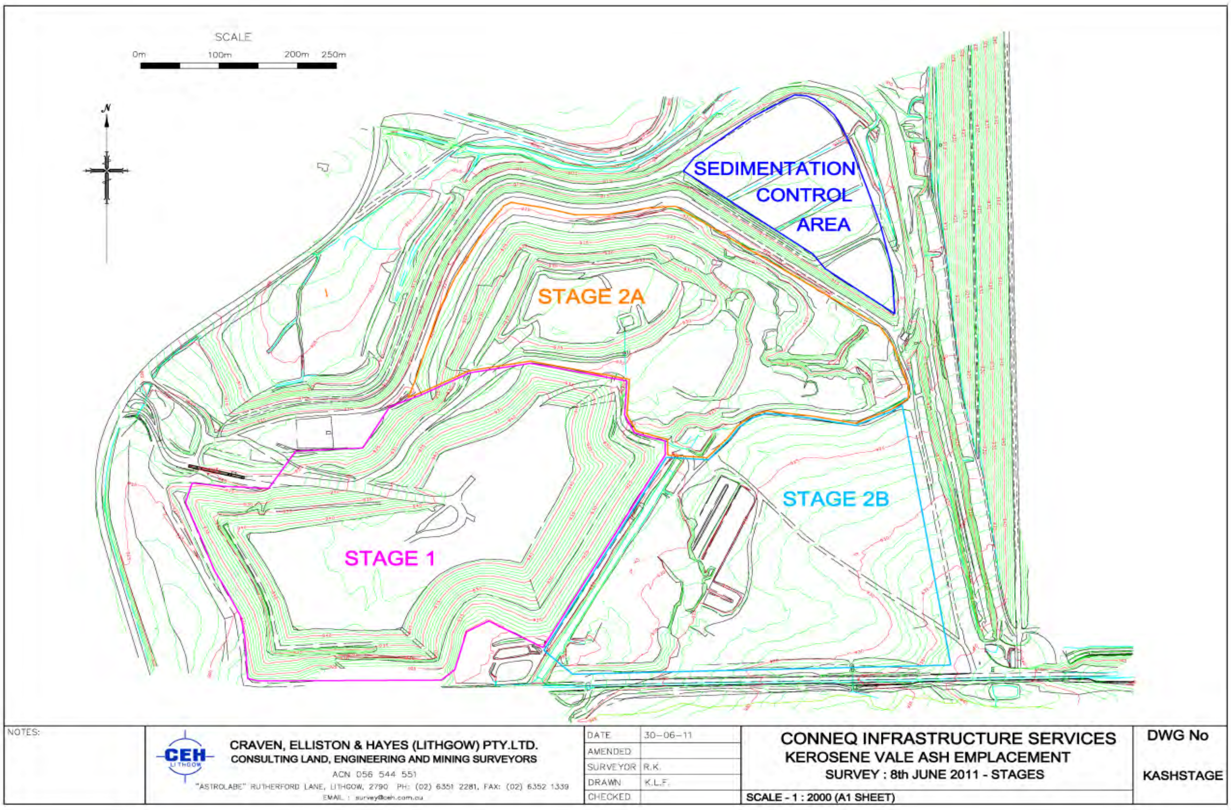

Figure 2: Revised ash placement strategy for KVAR- Stages 1, 2A and 2B

2.2 Purpose of the AEMR

This Annual Environmental Management Report (AEMR) has been prepared in order to satisfy Condition 7.3 of the Project Approval 07_0005 (DPIE, 2018). This report covers the operations and environment and community performance of the Wallerawang Ash Dam Area from April 2019 and March 2020 (reporting period).

The AEMR has been prepared in accordance with the NSW Government's *Post-approval requirements for State significant mining developments Annual Review Guideline* dated October 2015.

2.3 Project contacts

The contact details for the Wallerawang Ash Dam Areas (WADA) are listed in Table 4.

Table 4: Kerosene Vale Ash Repository Contact

Contact Person	Position	Telephone
Mr Ben Eastwood	NSW Environment Leader & WADA Environment Representative	(02) 6354 8111

3. Consents, Leases and Licences

This AEMR has been prepared to address the conditions of the project approval and the Statement of Commitments for the reporting period. The operation of the WADA project operates in accordance with the following statutory authorities (Table 5):

Table 5: Key Consents, Leases, Licences and Permits

Approval/Lease/Licence	Issue Date	Expiry Date	Details/Comments
Project Approval 07_0005	29 Jul 2005 (Renewed 26 Nov 2008) 9 Aug 2018 (Mod 1)	26 Nov 2013	Granted by Minister for DoP, Section 75J of the EP&A Act.
Environment Protection Licence (EPL) No. 766	20 Dec 2017	20 Dec (Annual Anniversary Date)	Granted by NSW Environment Protection Authority
Water Access Licence No. 27428	01 July 2001	-	Granted by DPI Water, under the *Water Management Act 2000*
Water Supply Work and Water Use Approval **10CA117220**	01 July 2001	30 Jun 2031	Granted by DPI Water, under the *Water Management Act 2000*

3.1 Operations Environmental Management Plan

The Operations Environmental Management Plant (OEMP) provides the framework to manage the environmental aspects associated with the operation of the WADA. The OEMP outlines the requirements associated with the project as stipulated in the relevant provisions of the Project Approval 07_0005 administered by the NSW Department of Planning and Environment, the Environment Protection Licence 766 (EPL) administered by the NSW Environment Protection Authority (EPA), and the Statement of Commitments (SoC) presented in the Submissions Report (EANSW, 2018).

The scope of the OEMP covers operations involving the movement and placement of ash from Wallerawang Power Station (WWPS) to the WADA.

3.2 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) for KVAR Stage 2B was developed in consultation with EnergyAustralia NSW's Western Environment Section and approved by the DP&I in August 2011. The CEMP meets the requirements of CoA's 6.2 and 6.3, providing the framework to manage the environmental aspects associated with construction works during KVAR Stage 2B operations. The CEMP has been written to address the requirements associated with the project as stipulated in the relevant provisions of the Project Approval 07_0005 issued by the DPIE.

4. Operations during reporting period

Due to the closure of Wallerawang Power Station, WADA has been placed in care and maintenance.

To ensure ongoing compliance when in care and maintenance, EnergyAustralia NSW has engaged a contractor to undertake regular, ongoing maintenance activities. The contractor primarily maintains surface water management structures, water sprays for dust suppression and any other works required. There was no ash delivered or reused during the reporting period. The total ash footprint has remained the same from the previous reporting period and no additional capping or rehabilitation activities were completed. A summary of activities during the reporting period is provided in. (Table 6).

Table 6: Operations Summary

Activity	Previous reporting period	This reporting period	Next reporting period
Ash delivered to site (T)	0	0	0
Ash reused (T)	0	0	0
Total Ash Footprint (ha)	37.07	37.07	37.07
Area of repository capped (ha)	33.4	33.4	33.4

4.1 Normal operating hours

The normal hours of operation for the Project are between 7 am and 10 pm Monday to Sunday, in accordance with Condition 2.8. Operations outside these hours are defined as abnormal or emergency operating conditions and are subject to specific requirements (Section 4.2).

No works occurred at KVAR outside the normal operating hours during the reporting period.

4.2 Abnormal or emergency operating conditions

Conditions under which operations outside the normal hours of operation can occur have been specified in the Project Approval (CoA 2.10) and can be described as follows:

- Where it is required to avoid the loss of lives, property and/or to prevent environmental harm
- Where a breakdown of plant and/or equipment at the repository or the Wallerawang Power Station can affect or limit the capacity of ash storage at the power station itself outside the normal operating hours
- Where a breakdown of an ash haulage truck(s) prevents haulage during the operating hours stipulated under '*Normal Conditions*' combined with insufficient storage capacity at the Wallerawang Power Station to store ash outside of the normal operating hours
- In the event that the National Electricity Market Management Company (NEMMCO), or a person authorised by NEMMCO, directs EnergyAustralia NSW (as a licensee) under the National Electricity Rules to maintain, increase or be available to increase power generation for system security and there is insufficient ash storage capacity at the Wallerawang Power Station to allow for the ash to be stored.

Under these circumstances, EnergyAustralia NSW is required to notify the OEH, formerly DECC, and nearby sensitive receivers prior to any emergency ash haulage or placement operations, as well as the Secretary of the DPiE, formerly DP&I, within 1 week after the emergency operations have occurred.

No operating conditions have occurred outside the normal operating hours during the reporting period.

4.3 Construction activities

No construction activities were carried out during the reporting period.

4.4 Wallerawang DDR Works

There is a three-phase plan for the closure of the Wallerawang Power Station that involves the decommissioning, deconstruction and repurposing (DDR) of the site including the ash repository and SSCAD.

EnergyAustralia NSW staff met with representatives from the Department on 18 October 2017 to provide an update on the Decommissioning, Demolition and Rehabilitation (DDR) of the Wallerawang Power Station, including the closure and rehabilitation of the KVAR. It is not proposed to develop a Closure and Rehabilitation Plan for KVAR or SSCAD in isolation at this time without considering the adjacent sites. EnergyAustralia NSW will keep the Department informed of its progress regarding the development of the Closure and Rehabilitation Plan for KVAR, Sawyers Swamp Creek Ash Dam and adjacent ancillary infrastructure areas.

The NSW Environment Protection Licence (EPL 766) will continue to cover the activities associated with the Closure of Wallerawang power station and the ash placement areas. The EPL and Project Approval were modified within the previous reporting period to enable the import of Virgin Excavated natural material (VENM) and Excavated natural material (ENM) onto the premises for land rehabilitation purposes. The VENM and ENM importation project will allow for the completion of capping and rehabilitation of the uncapped sections of KVAR and SSCAD.

Care and maintenance activities will continue to be undertaken in accordance with the Project Approval and Environmental Protection Licence. Monitoring will be undertaken to ensure compliance with relevant air and noise emission levels. The management of environmental aspects, including groundwater, surface water and landscape aspects of KVAR, will continue to be controlled and monitored to ensure regulatory compliance is achieved.

5. Actions required from previous AEMR review

In a letter dated 22 August 2019, the DPIE stated it was generally satisfied that the 2018-19 Annual Review adequately addressed the relevant requirements of the Project Approval. There was one action requested by DPIE, which is summarised below in Table 7.

Table 7: Actions required from last AEMR

Item	Action required from previous Annual Review	Requested by	Action taken	Where discussed in AEMR
1	***Webpage*** *In accordance with Condition 5.1 of Schedule 2 of the Consent, the Proponent is required to make a copy of the Annual Review publicly available on the company website within one month of the date of this letter.*	DPIE	The Annual Review is publicly available and is uploaded onto the company website annually.	Section 5 Table 7

6. Environmental management and performance

Environmental monitoring for the KVAR and specifically for the KVAR Stage 2 operations is designed to comply with the regulatory requirements specified in Section 3 of this AEMR, and also to provide an ongoing analysis of the condition of the environment surrounding the site. Environmental monitoring is performed as part of the monitoring program at the sites indicated shown in Figure 3. The results are used as indicators of the effectiveness of the environmental controls, and as guidelines for the management and maintenance of key environmental procedures.

Detailed procedures outlining the environmental monitoring responsibilities of key stakeholders and the impacts to be mitigated can be found within the individual sub-plans of the OEMP, and include:

- Ash Delivery and Placement Sub-plan
- Operational Noise and Vibration Management Sub-Plan
- Surface Water Quality Sub-Plan
- Groundwater Management Sub-plan
- Air Quality Management Sub-plan
- Landscape and Revegetation Sub-Plan
- Waste Management Sub-plan

A summary of the environmental management measures and associated performance is provided in Table 8. Detailed discussions of the key environmental performance indicators are presented in the sections below (6.1 – 6.6, 7.1 - 7.2).

Performance against environmental monitoring and compliance requirements are provided by Lend Lease as a monthly Client Service Report and through external consultant and internal data and reports. Summaries of these reports are provided in the sections below (6.1 – 6.6, 7.1 - 7.2) and in Appendices B & C.

Table 8: Environmental Performance

Aspect	Approval Criteria	EA Prediction	Performance during reporting period	Trends / Management Implications	Management Actions
Noise	Site 1 – Site 3 Criteria 40 dB(A) LAeq	Site 1 33 Site 2 33 Site 3 31 dB(A) LAeq	Site 1 Nil detected Site 2 Nil detected Site 3 Nil detected	NA – no operational noise generated.	Nil additional management actions required
Ecological	Minimal impacts on ecology of Sawyers Swamp Creek following its realignment.	Potential impacts associated with realignment of Sawyers Swamp Creek	Sawyers Swamp Creek was not realigned therefore no ecological monitoring is required.	NA – Sawyers Swamp Creek was not aligned.	Nil additional management actions required
Air Quality	Maximum total deposited dust 4 g/m^2/month annual	Annual average of 3.5 g/m^2/month deposited dust	Annual average range 1.11 to 2.85 g/m^2/month deposited dust	Annual average dust levels show a slight increasing trend.	Nil additional management actions required.
Waste	Waste disposal to reflect EPL 766.	Wastes disposed of accordingly.	Nil waste disposed of at the Repository during the reporting period.	Decrease in waste disposed of at the repository.	Nil additional management actions required.
Heritage	Minimal impact on heritage values of the area.	Heritage impacts considered to be minimal and are manageable with appropriate and well-established procedures.	No additional heritage sites were identified.	No additional heritage sites have been identified throughout KVAR operation.	Nil additional management actions required.

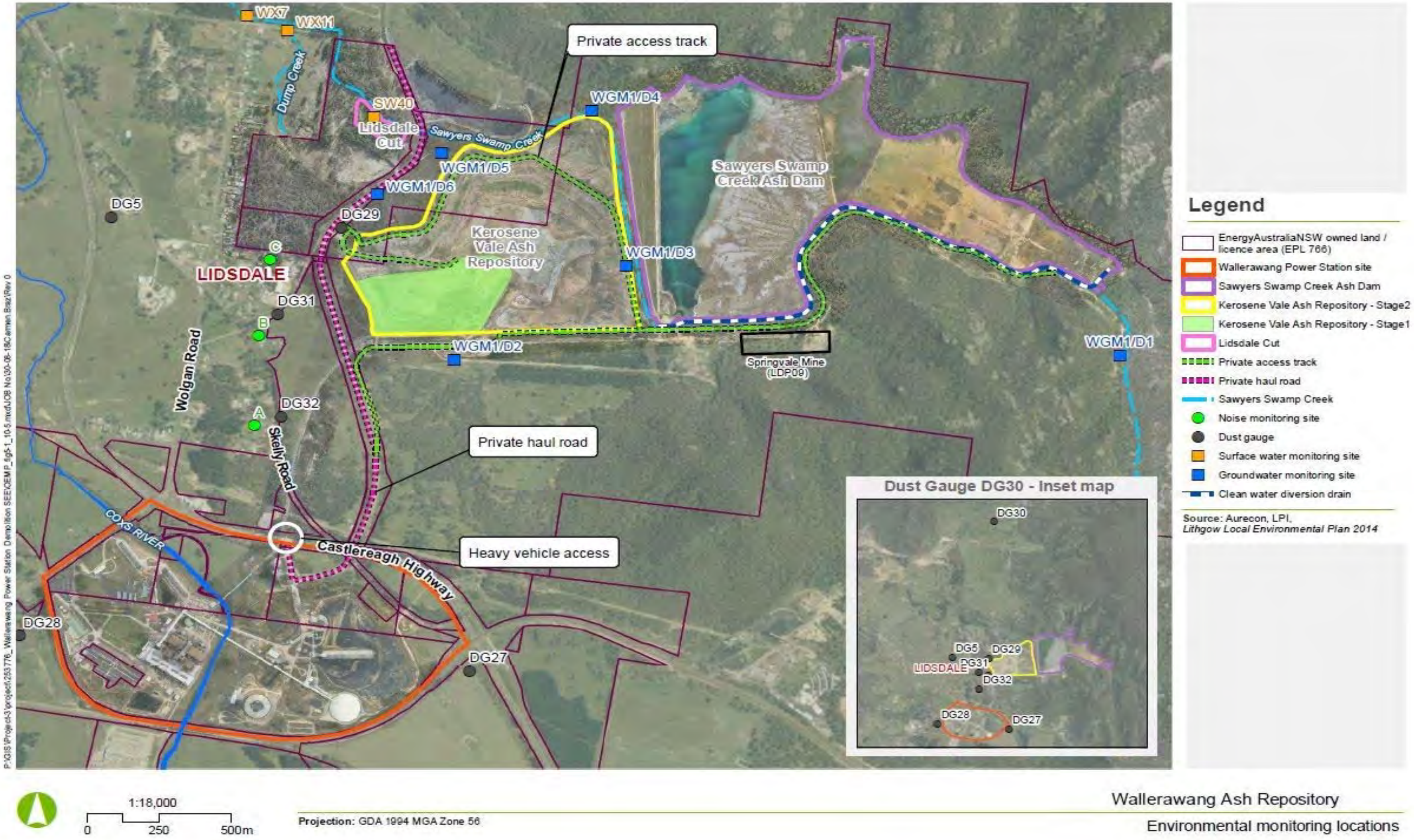

Figure 3: Environmental monitoring locations

6.1 Ash delivery and placement

Due to the closure of Wallerawang Power Station, no ash has been placed at KVAR Stage 2 within the reporting period.

In a survey performed in February 2018 (Figure 4), the ash footprint areas were as detailed in Table 9. No changes have occurred to the ash footprint areas, since the 2018 survey.

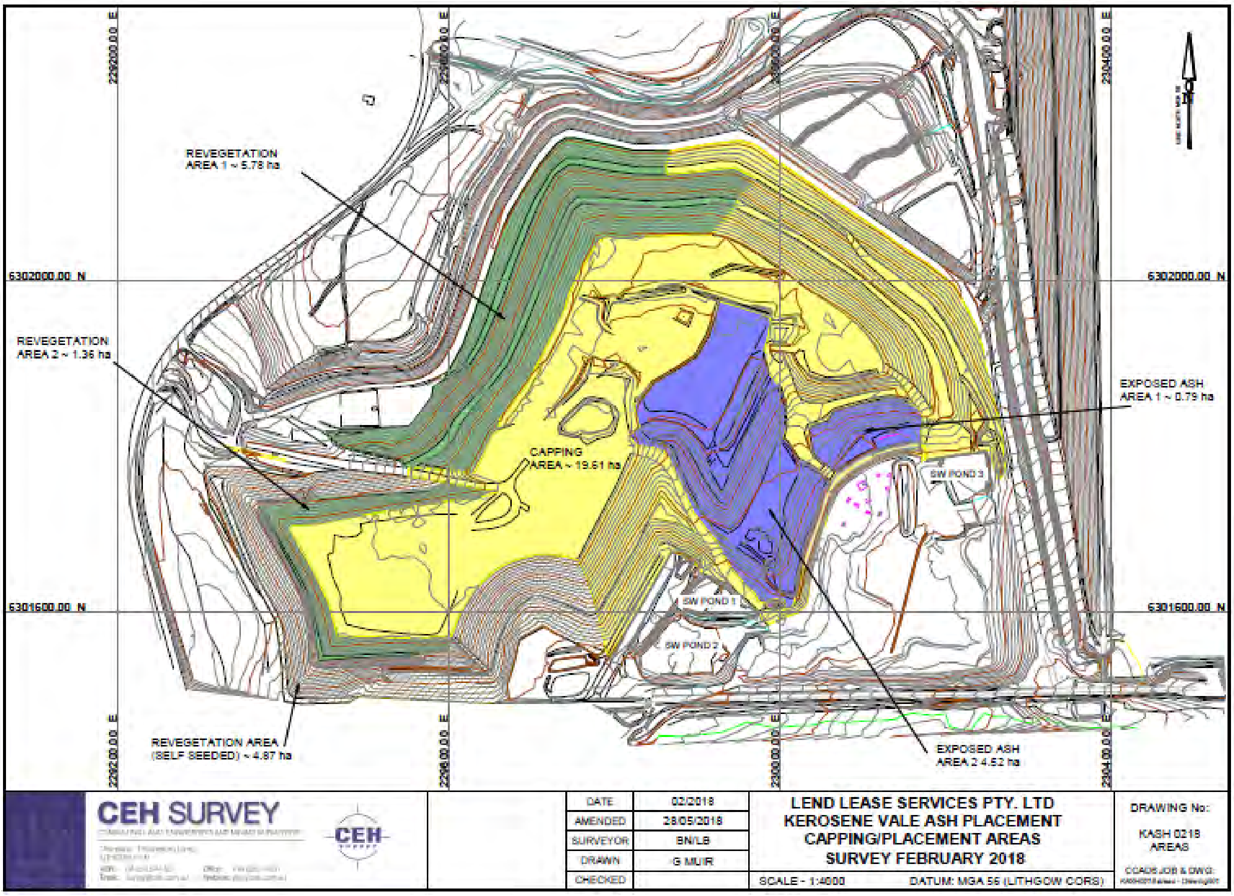

Figure 4: Area of exposed ash remaining at Kerosene Vale Ash Repository Stage 2

Table 9: Ash Footprint areas

Ash Footprint area	Area (ha)
Exposed ash	5.3
Footprint	13.1
Batters	10.0
Laybacks	2.5
Top Level	6.2
Total Ash Footprint	37.07

Operations of the KVAR Stage 2 are considered to have met the following targets of the Ash Delivery and Placement Sub Plan of the OEMP. The management and mitigation measures specified in the OEMP were assessed to be compliant.

6.2 Operational Noise Monitoring

6.2.1 Environmental Management

The KVAR Stage 2 Operational Noise and Vibration Management Plan (ONVMP) has been developed in accordance with Condition 6.5 of Project Approval 07_005 for the KVAR Stage 2 area.

The Operational Noise and Vibration Management Plan identifies measures to minimise and mitigate noise impacts on surrounding land uses from the proposed works. The level of noise generated during the proposed works program will depend on the location of the receiver, the type and duration of works and intervening topography, and existing building structures between the noise emission source and receiver.

The residential community of Lidsdale is located to the west of the private haul road and ash repository site. The following residential properties, located within 300m from the haul road, have been identified as the nearest potentially affected sensitive receivers to noise from the repository site:

Table 10: Representative noise measurement locations

Sensitive Receiver	Distance to Haulage Road (m)
60 Skelly Road	300
10 Skelly Road	270
21 Neubeck Street	145

During the reporting period compliance monitoring was conducted during the early morning and evening periods as per the requirements outlined in the ONVMP. The applicable operational noise criteria are outlined in the Project Approval (No. 07_0005), the Environment Protection Licence (EPL) No. 766, the OEMP and the ONVMP. The criteria are summarised as follows:

> *The cumulative operational noise from the ash placement area and ash haulage activity shall not exceed a $L_{Aeq\ (15\ minute)}$ of 40 dBA at the nearest most affected sensitive receiver during normal operating hours as defined in condition 2.8.*
>
> *This criterion applies under the following meteorological conditions:*
>
> *a) Wind speeds up to 3 m/s at 10 meters above ground; and/or*
>
> *b) Temperature inversion conditions of up to 3°C/100 m and source to receiver gradient winds of up to 2 m/s at 10 m above ground level*

6.2.2 Environmental Performance

Due to the closure of Wallerawang Power Station, no fly ash trucks have been hauling to the ash placement area. Minor earthworks and maintenance activities at the ash placement area were the only activities undertaken that have the potential to cause noise impacts to sensitive receivers.

Aurecon conducted operational noise monitoring for the Stage 2 KVAR located in Wallerawang NSW. The noise measurements were carried out at the three affected sensitive receivers' locations on Friday 28 June 2019 and Saturday 29 June 2019, in the early morning and evening in accordance with the KVAR Stage 2 ONVMP. The primary contributor to the background and ambient noise levels at all measurement locations was the traffic noise on the nearby public roads. Aurecon has determined Stage 2 KVAR operations is compliant with the Conditions of Approval.

Based on site observations and information reviewed, potential noise impacts from the operation and maintenance of the KVAR Stage 2 are considered to have been effectively mitigated and managed. There were no noise complaints received for the KVAR during the reporting period.

6.2.3 Reportable Incidents

No reportable incidents have been recorded against operational noise for the reporting period.

6.2.4 Further Improvements

There were no exceedances of the operational noise criteria during the reporting period, as such there are no further improvements required.

EA will review the scope of the noise monitoring assessment commensurate with the level of activity while the site is in care and maintenance. Any review will be undertaken to ensure compliance with the Project Approval.

6.3 Ecological Monitoring

EnergyAustralia NSW has determined that there is no longer any need to realign SSC. Therefore, ecological monitoring as required under CoA 3.7 is not required.

6.4 Air Quality Monitoring

6.4.1 Environmental Management

The Site Management Plan (Lend Lease, 2012) for KVAR Stage 2 operations contains an Implementation Strategy in accordance with the Air Quality Monitoring Program, which is outlined in the OEMP. The strategy includes specific site management pertaining to the transport and emplacement of ash, managing dust within the ash repository using an extensive sprinkler system and water cart applications, and continuous monitoring for dust/airborne particulates.

Dust management at KVAR is included in the responsibilities of all activities, including:

- Wash-down of security roadways, haul road/s and vehicle access roads;
- Use of perimeter sprays at the ash placement area;
- Mobile sprinkler system;
- Ash placement operations;
- Final and temporary capping of ash; and
- General maintenance of the ash placement area (Lend Lease, 2012).

6.4.1.1 Dust suppression – KVAR sprinkler system

Water application (measured in sprinkler hours) is based on wind velocity, humidity and temperature. The water used for dust suppression in KVAR is sourced from the Sawyer's Swamp Creek Ash Dam return water system. This maximises the recycling of water for dust suppression, no additional clean water is used in this application.

The updated Repository Management Plan (Lend Lease, 2012) provides a guide for sprinkler hours at an optimum of 4 hours per day during low evaporation at less than 3 mm per day to ensure that a target of 5 mm by irrigation application is not exceeded (Table 11).

Table 11: Guide for sprinkler hours

Water use guidelines	Water use guidelines
>25^o >20km/hr (10hrs/day)	15^o <20km/hr (<4 hours/day)
15-24^o <20km/hr (8 hrs/day)	
15^o <20km/hr (4 hours/day)	
Evaporation 3-7 mm per day	**Evaporation < 3 mm per day**
Oct, Nov, Dec, Jan, Feb, Mar,	April, May, June, July, Aug, Sept
* Operation of sprinklers in extreme hot and dry conditions requires extended irrigation hours.	

6.4.1.2 Dust deposition monitoring

Air quality is monitored at the seven depositional dust gauges listed within the OEMP and results are reviewed to ensure compliance with the Project Approval conditions relating to air quality. These gauges are situated close to residential areas outside of the WADA (Figure 3). Data collection commenced in March 2009, with results recorded on a monthly basis with colour and textural observations. Data from these gauges provide an indicative assessment of potential air quality impacts from WADA. It should be noted that the levels at these locations includes dust from all land use practices in the local area and not only from WADA.

6.4.2 Environmental Performance

6.4.2.1 Dust suppression – KVAR sprinkler system

Figure 5 reflects the relationship between sprinkler application and evaporation to identify that the target or maximum application rates for irrigation at 5 mm / day was achieved for the majority of the reporting period. Net irrigation was calculated by subtracting the daily evaporation from the daily sprinkler irrigation.

Sprinkler application rates did reach above the maximum target in November 2019. These irrigation rates track with high evaporation rates resulted in a net irrigation rate below the maximum application rate for irrigation.

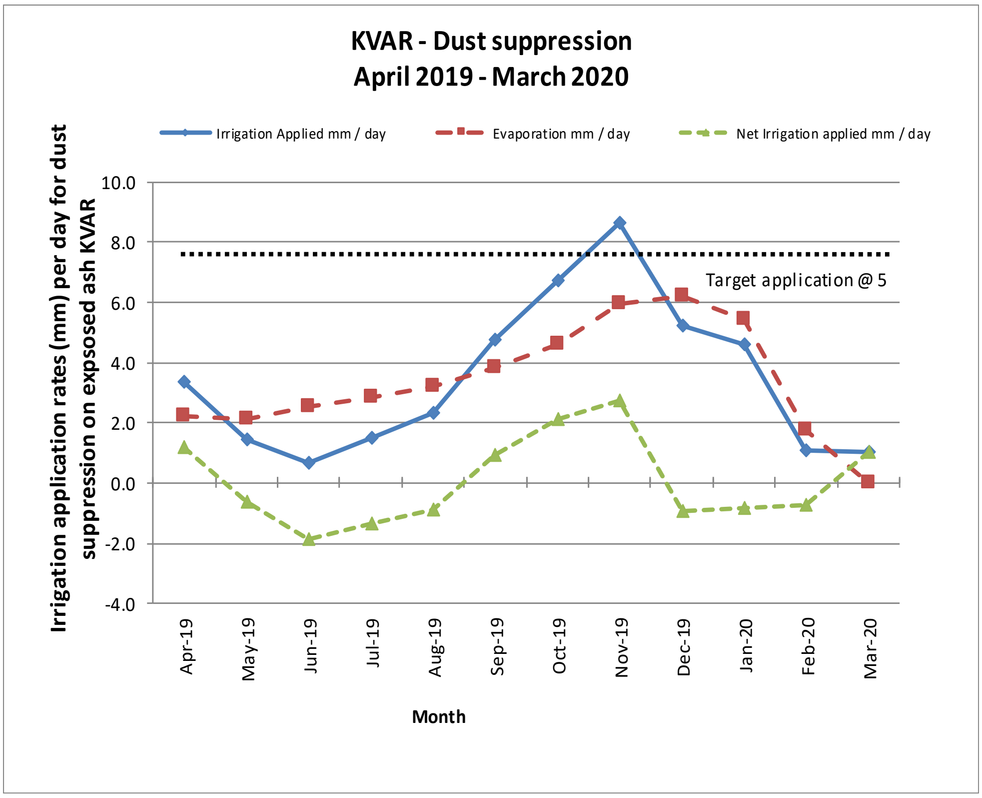

Figure 5: Efficacy of irrigation operations April 2019– March 2020

6.4.2.2 Dust deposition monitoring

Dust gauge data from the 2019-20 reporting period of KVAR Stage 2 operations confirm that air quality emissions have complied with compliance criteria. No additional air quality control measures have been implemented beyond the existing effective practices.

Annual average depositional dust data for each of the seven OEMP dust deposition gauges are presented over the previous three-year period is presented in Figure 6 to Figure 12. In examination of the historical data indicates a slight increase in the depositional dust concentrations in dust gauges situated around the Wallerawang Ash Dam Areas (WADA) during the April 2018 to March 2019 reporting period, with increase continuing into the current reporting period. This correlates with the extended drought conditions between 2017 to 2019 which was associated with frequent state-wide dust storms and the severe fire season over the 2019 and 2020 summer. Operations at Wallerawang Power Station and in turn WADA, ceased in April 2014, with a reduction in depositional dust concentrations previously reflected during the Care and Maintenance phase (2014 onwards). Depositional dust results are shown to be considerably lower than the concentrations predicted in the Environmental Assessment (predicted annual average of 3.5 g/m^2/month deposited dust).

Historical high depositional dust gauge readings have generally been isolated events and are often associated with elevated combustible material which indicates possible insect activity or other similar type interference. Elevated results typically occur over the warmer months. It is possible that hazard reduction burns, and state-wide dust events may influence these results as well. The WADA is in care and maintenance with minimal activity and vehicle movements. There is no ongoing trend that indicates the WADA is impacting air quality in the local area.

At the request of the landowner, EnergyAustralia ceased monitoring of Dust Gauge 5 (DG5) and removed the gauge from its intended location in November 2019 (Figure 6). EnergyAustralia has communicated that it will reinstate DG5 if requested by the landowner. Monitoring prior to the removal of DG5 indicated no ongoing trend that reflected degradation of air quality that could be attributed to WADA. Historical elevated results (in October 2018), refer to Figure 6, were deemed to be an isolated occurrence, not typical for or considered representative for the site, and were partially attributed to a known state-wide dust storm in October 2018.

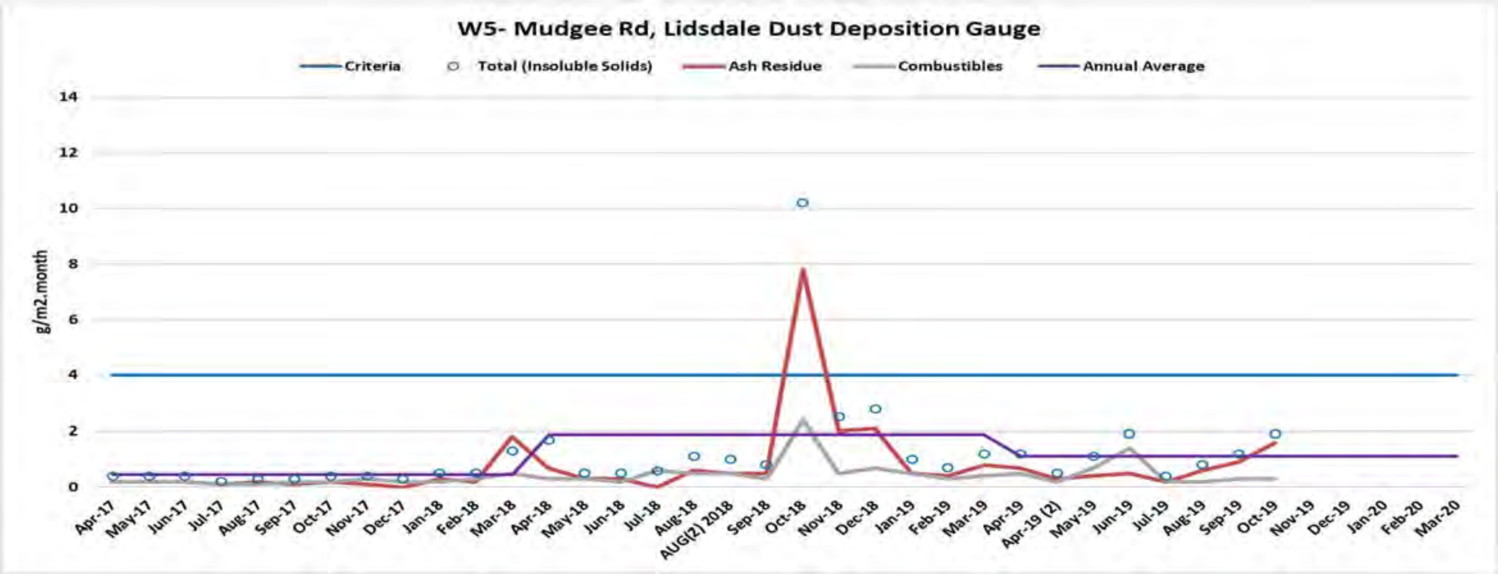

Figure 6: Depositional Dust Summary - Dust Gauge 5

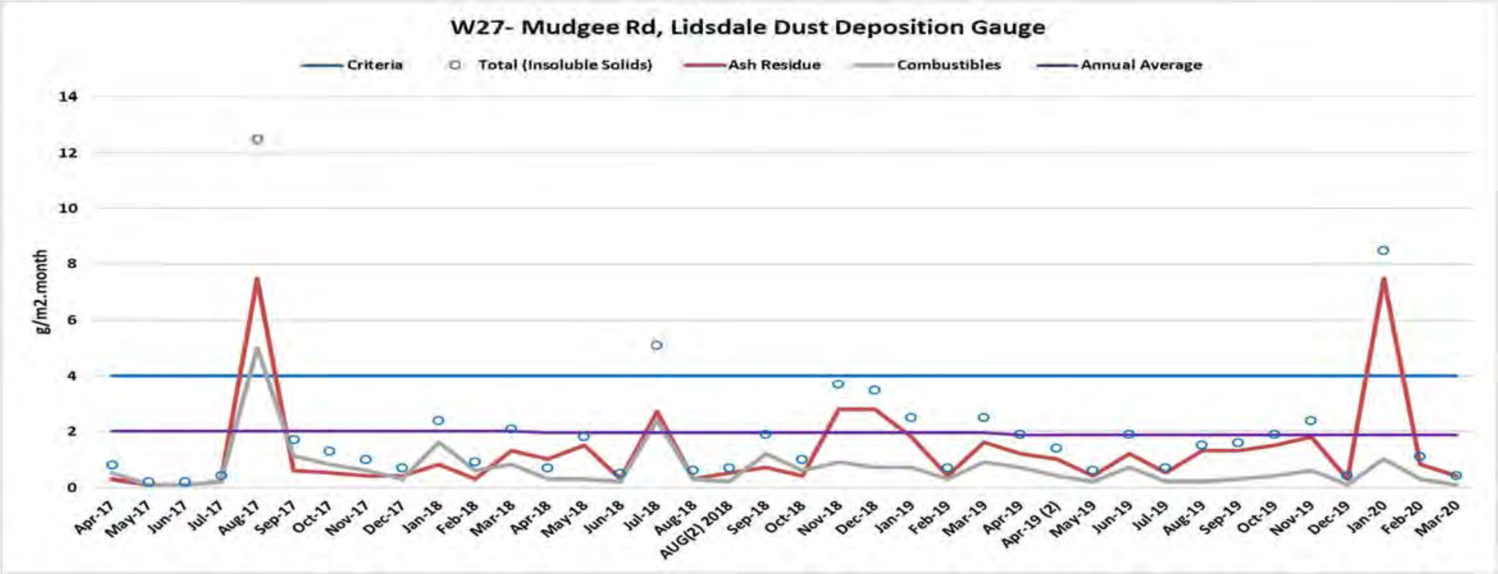

Figure 7: Depositional Dust Summary - Dust Gauge27

The elevated level of combustible material recorded at DG28 in July 2019 (Figure 8) is not attributable to activities at WADA as air quality emissions from WADA are non-combustible material. This is reflective of either increased insect activity or additional plant related material that has found its way into the gauge. This is typical of the external influences which can influence dust gauge results.

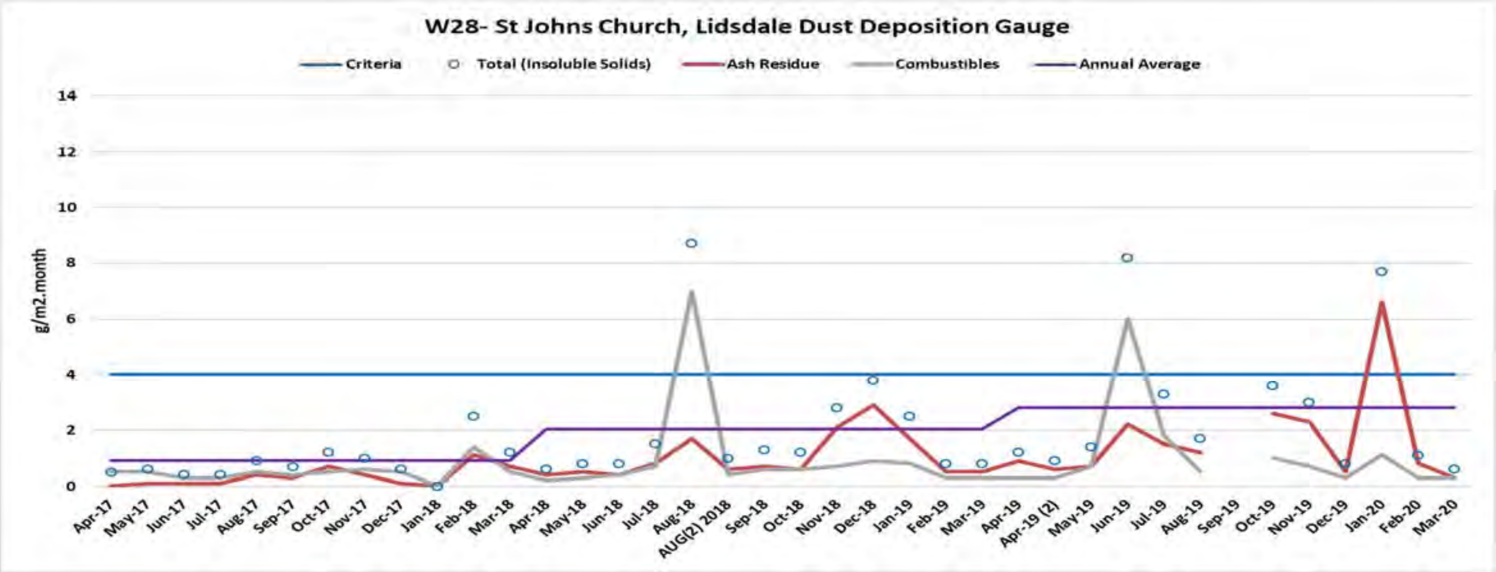

Figure 8: Depositional Dust Summary - Dust Gauge 28

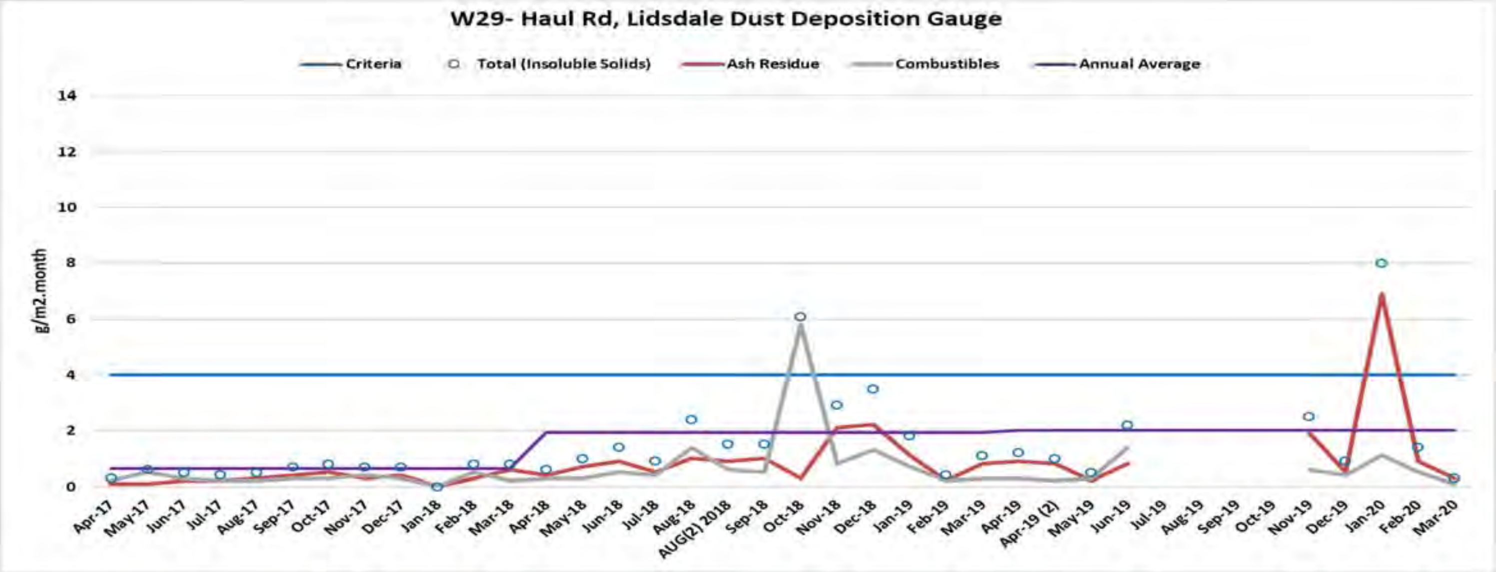

Figure 9: Depositional Dust Summary - Dust Gauge 29

No sample was recorded for Dust Gauge 30 for the month of January 2020 (Figure 10) as the bottle was discovered to be broken at the time of sampling.

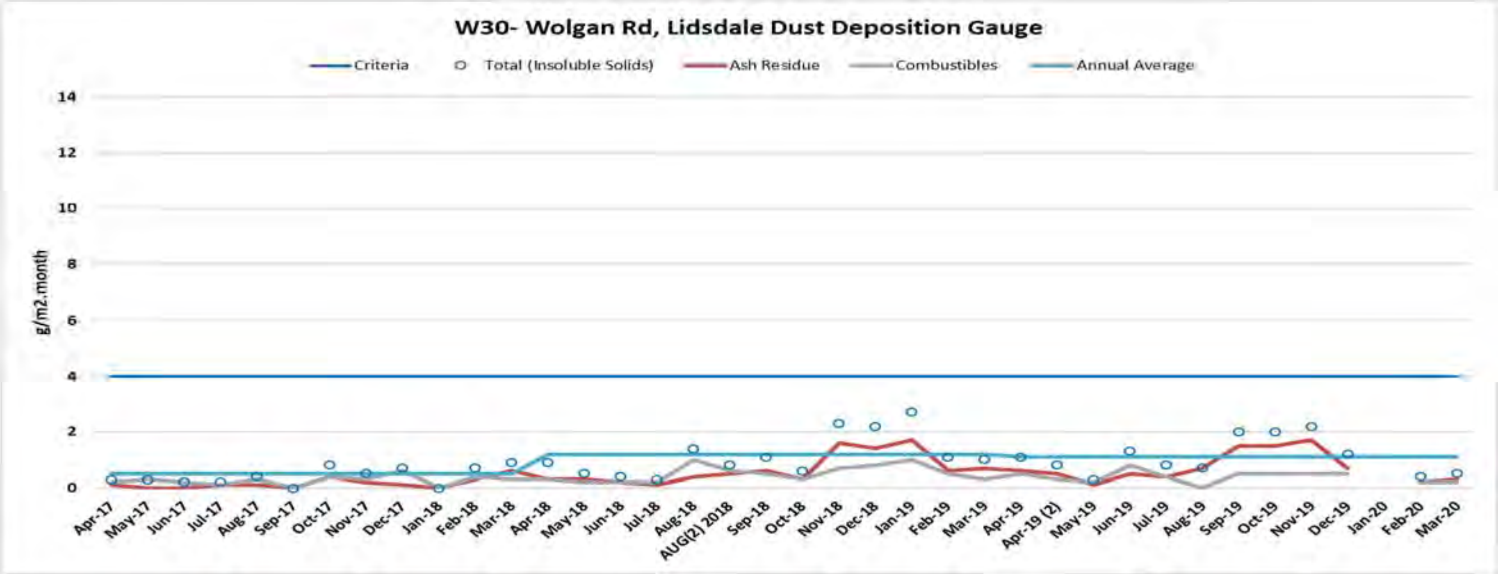

Figure 10: Depositional Dust Summary - Dust Gauge 30

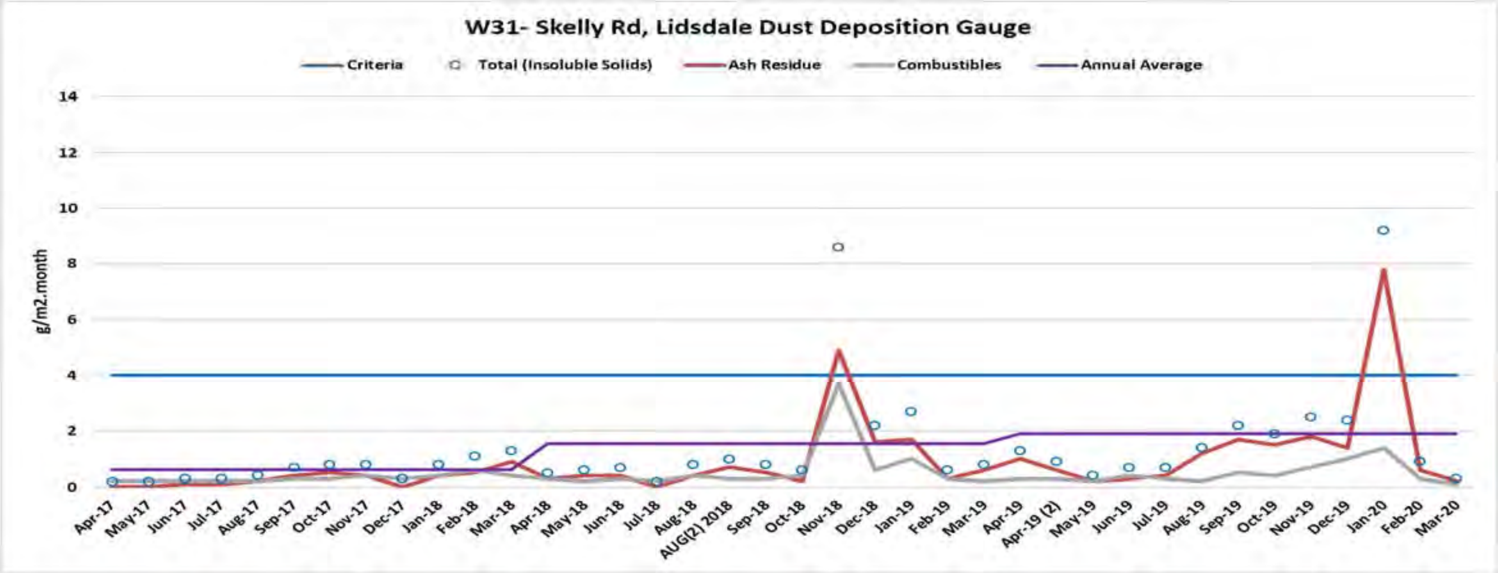

Figure 11: Depositional Dust Summary - Dust Gauge 31

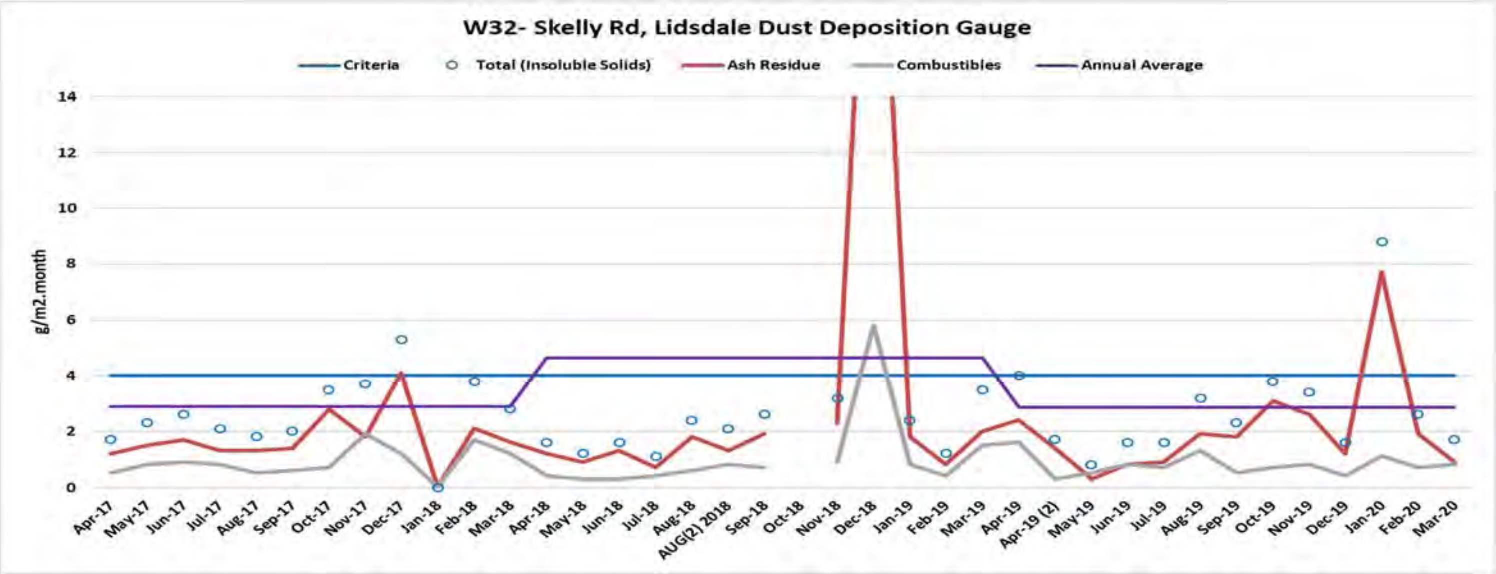

Figure 12: Depositional Dust Summary - Dust Gauge 32

The elevated results recorded in the majority of dust gauges in January 2020 (Figures 7 – 12) do not appear to relate to activities at the WADA for the following reasons:

- There were no activities occurring at WADA in regard to construction activity or ash transport as the site is currently in care and maintenance;
- The dust suppression systems were operating and functional;
- There were no community complaints of visible dust leaving the site during the month;
- There was a general increase in depositional dust across all gauges in January 2020, with the exception of DG5, which had ceased monitoring and been removed at the request of the landholder, and DG30 due to its bottle being broken so no sample was taken;
- Climatic conditions throughout the reporting period were dry, with 2019 being Australia’s driest year on record (BOM, 2020a). Nationally-averaged rainfall was 40% below average and most of the country was affected by drought, which was particularly severe in NSW (BOM, 2020a), refer to Plate 1. Summer 2019/2020 began with the second-driest December recorded within NSW and January 2020 continued a run of ten consecutive months of below average rainfall for New South Wales as a whole (BOM, 2020b).
- State-wide dust storms were experienced throughout November 2019 to January 2020 (OEH, 2020), refer to Plates 2 & 3. A large state-wide dust storm swept through NSW on the 11th January 2020 (OEH, 2020) and raised dust fell as dirty brown rain over the Sydney basin on 24th January 2020 as reported by the Bureau of Meteorology (BOM, 2020c);
- Two bushfires occurred in the area during the reporting period – the Lidsdale bushfire in September 2019 (Plate 4) and the Gospers Mountain fire (Plate 5) which started in October 2019 and continued to January 2020 when it was extinguished;
- The samples collected during this period reported having fine brown dust, insects, organic matter and coarse brown dust;
- The peaks are isolated, one-off events for individual gauges;

- There is no obvious trend from the monitoring network that indicates regional air quality is diminishing because of WADA.
- Based on the conditions experienced during the reporting period, it is not unexpected that high depositional dust episodes were recorded.

Plate 1: Dried farm dam located at Meadow Flat, 23 Jan 2020

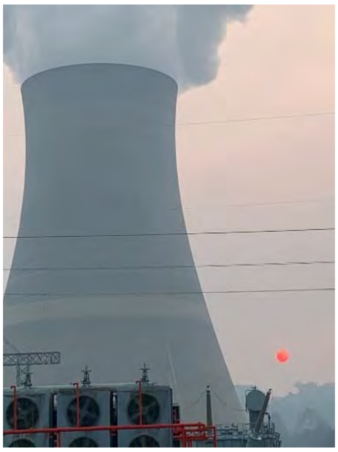

Plate 2: Sunrise at Mt Piper Power Station, 11 Dec 2019

Plate 3: Dusty sky at Meadow Flat, 23 Jan 2020

Plate 4: Lidsdale Fire, 6 Sept 2019

Plate 5: View of Gospers Mountain Fire from Mt Piper Power Station, 16 Dec 2019

Having reviewed available information and data and from site inspections, the requirements for air quality emissions and management as described under the OEMP were compliant through the 2019-20 reporting period. These results confirm that the control measures in place at the WADA are effective in controlling air emissions.

6.4.3 Reportable Incidents

No reportable incidents have been received in relation to air quality management for the reporting period.

6.4.4 Further Improvements

Investigate if methods are available to minimise bugs infestation and vandalism (e.g. stealing or breaking) to dust gauge bottles, particularly gauges located near residential areas.

6.5 Waste Management

6.5.1 Environmental Management

Waste disposal practices at the Kerosene Vale Ash Repository are managed in accordance with Environmental Protection Licence 766 and the Waste Management Sub-Plan (OEMP Section 6.9). Waste materials are assessed, classified, managed and disposed of in accordance with Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes (EPA, 1999).

EnergyAustralia NSW and associated contractors are not to cause, permit or allow any waste generated outside the ash repository to be received at the ash repository for storage, treatment, processing, reprocessing or disposal, including no wastes other than those as stated on the licence approval to be kept on the site. Waste generated by site personnel shall (including maintenance wastes such as oils and greases) are collected on a regular basis to be recycled or disposed of to an appropriate facility.

Staff and contractors involved in the KVAR Stage 2 operations are made aware of the waste management procedures as outlined in the OEMP sub-plan. Waste-related documents and records reflect adherence to these protocols, thereby providing the foundations for a transparent approach to waste management. The OEMP provides further guidance and detail on specific waste streams and applicable management measures (OEMP Section 6.9).

6.5.2 Environmental Performance

Nil wastes were placed at the Kerosene Vale Ash Repository during the reporting period. The activities at the WADA were deemed to have met the OEMP targets for waste management for the 2019-20 year. In addition, no non-conformances were identified and the OEMP requirements with respect to waste management were found to be complied with.

6.5.3 Reportable Incidents

No reportable incidents have been recorded against waste management for the reporting period.

6.5.4 Further Improvements

No further improvements have been identified for the next reporting period.

6.6 Heritage Management

6.6.1 Environmental Management

The OEMP provides guidance surrounding the management methods required to comply with CoA's 2.37-2.38 regarding the protection of Aboriginal and non-indigenous heritage sites. Specifically, this is addressed in the Ash delivery and placement sub-plan.

The Environmental Assessment performed by Parsons Brinckerhoff (2008a) for KVAR Stage 2 included a preliminary archaeology and heritage assessment. The assessment concluded that the KVAR Stage 2 works pose no threat to the Aboriginal archaeological or heritage values and would not result in any further impact on Aboriginal archaeological potential. Based on these findings, the following statements of commitment, in regards to heritage sites, were made:

- Disturbance to the western portion of the ash repository shall be limited to reduce the potential for inadvertent disturbance of the Aboriginal heritage values of the area.
- In the event that any heritage sites or items be discovered during operation, all works likely to affect the area are to cease immediately. The EnergyAustralia NSW Environmental representative is to be notified immediately and relevant stakeholders including the OEH Regional Archaeologist, the Bathurst Local Aboriginal Land Council, or the NSW Heritage Office, so that an appropriate course of action can be determined.

All construction and earthworks personnel are informed on their obligations in respect of the protection of Aboriginal and non-indigenous heritage sites and items as part of the site induction.

6.6.2 Environmental Performance

No known Aboriginal and non-indigenous heritage sites were impacted during the reporting period and no additional sites were discovered or identified.

6.6.3 Reportable Incidents

No reportable incidents have been recorded against heritage management for the reporting period.

6.6.4 Further Improvements

No further improvements have been identified for the next reporting period.

7. Water management

Water for operations at Kerosene Vale Ash Repository, is extracted from onsite storages or taken from the Fish River in accordance with Water Access Licence 27428 (WAL) and Water Supply Works and Water Use Approval 10CA117220. Table 12 includes details of the water taken under the WAL for operations during the previous water year (i.e. 1 July 2019 – 30 June 2020).

Table 12: Water Take

Water Licence #	Water Sharing Plan, source and management zone	Entitlement (ML)	Passive take / inflows (ML)	Active pumping (ML)	TOTAL
27428	Water Sharing Plan for Greater Metropolitan Region – Unregulated River Water Sources Upper Nepean and Upstream Warragamba Rivers Water Source Wywandy Management Zone	25,000	0	0	0

7.1 Groundwater Monitoring

7.1.1 Environmental Management

The groundwaters of the Kerosene Vale Ash Repository area are monitored regularly to determine the extent of impacts, if any, of KVAR Stage 2 operations on regional waters, and to examine the movement of water beneath the site and through the catchment.

The OEMP (EANSW, 2018) includes a Groundwater Management Plan for KVAR and adjacent KVAD (Kerosene Vale Ash Dam). The focus of the Management Plan was to understand water quality impacts on the immediate area and the influence of regional groundwater on the stability of the KVAR Stage 2 operations, due to the placement of the site over the reclaimed ash dam.

On site, dry ash placement management has mainly involved limiting rainfall infiltration and reducing seepage from KVAD into the local groundwater. The effectiveness of these activities was demonstrated by improved water quality in the local groundwater during Stage I placement, from 2003 to 2006, before the toe drains of the Ash Dam became blocked (Aurecon, 2011).

Subsurface investigations and subsurface drainage work (for seepage collection) and installation of additional water monitoring points (Figure 13) have provided for management and assessment of water levels beneath the Stage 1 repository (Golder Associates, 2013).

The groundwater monitoring network includes six regional bores – WGM1/D1 (32), WGM1/D2 (33), WGM1/D3 (34), WGM1/D4 (35), WGM1/D5 (36) and WGM1/D6 (37) (Figure 13). Additional sites sampling the local Kerosene Vale Ash Dam and Repository (KVAD/R) seepage and SSCAD, offer further information in regard to the local groundwater quality under SSCAD, KVAD and the KVAR.

Figure 13: Surface and groundwater monitoring sites for SSCAD and KVAR

7.1.2 Environmental Performance

EnergyAustralia NSW engaged independent specialist consultants Aurecon to undertake a Water Quality Assessment for the April 2019 to March 2020 reporting period for the Wallerawang Ash Dam Area (Aurecon 2020). In summary, the Water Quality Assessment found that, based on the available data, there is no evidence that KVAR has had significant effects on the local groundwater aquifers during the reporting period. The Water Quality Assessment is provided in full in Appendix C.

The Aurecon report indicates the 95th percentile concentrations of water quality parameters within groundwater bore D5 (site 36) currently exceeds the selected Water Quality Goal Values (WQGVs) for pH, Aluminium (Al), Boron (B), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Manganese (Mn), Nickel (Ni), Lead (Pb), Selenium (Se) and Zinc (Zn) (Appendix C Table 5-2). A couple of these exceedances could potentially be attributed to background levels including pH, Al, Cd, Cr, Cu, and Pb, as historically they exceeded the WQGV above the ash repository area at site WGM1/D1 (site 32). The results are reflective of water quality contributions from current and historic land use practices.

The groundwater data obtained has been graphed to identify water quality at seepage detection bore D5 (Figure 14). Time series graph for indicator parameters show that concentrations of Mn, and B decrease initially following completion of Stage 1 dry ash emplacement in the KVAR (February 2009), and again in Feb 2010 following the unblocking of the toe drains. The trend of decreasing concentrations is interrupted in July 2013, following commencement of discharge from Springvale Mine to Sawyers Swamp Creek at LDP009. It is observed that concentrations of key parameters fluctuate significantly following July 2013, with stable to rising trends for key parameters.

The cessation of water discharge from Springvale Mine licenced discharge point 9 into Sawyers Swamp Creek in June 2019 has changed the hydraulic characteristics of the Wallerawang Ash Dam Area. Groundwater bore D5 has been dry since July 2019, however, the two samples taken from the bore during the reporting period indicate slight improvements in the groundwater conditions in the area.

Due to the complexity of current and historic land use activities, including local coal chitter deposits, pumping and discharge regimes for the KVAD and Swayers Swamp Creek Ash Dam, it is not conclusive (based on the data set available) to directly attribute water quality impacts observed in groundwater in Bore D5 solely to a single source such as the KVAR.

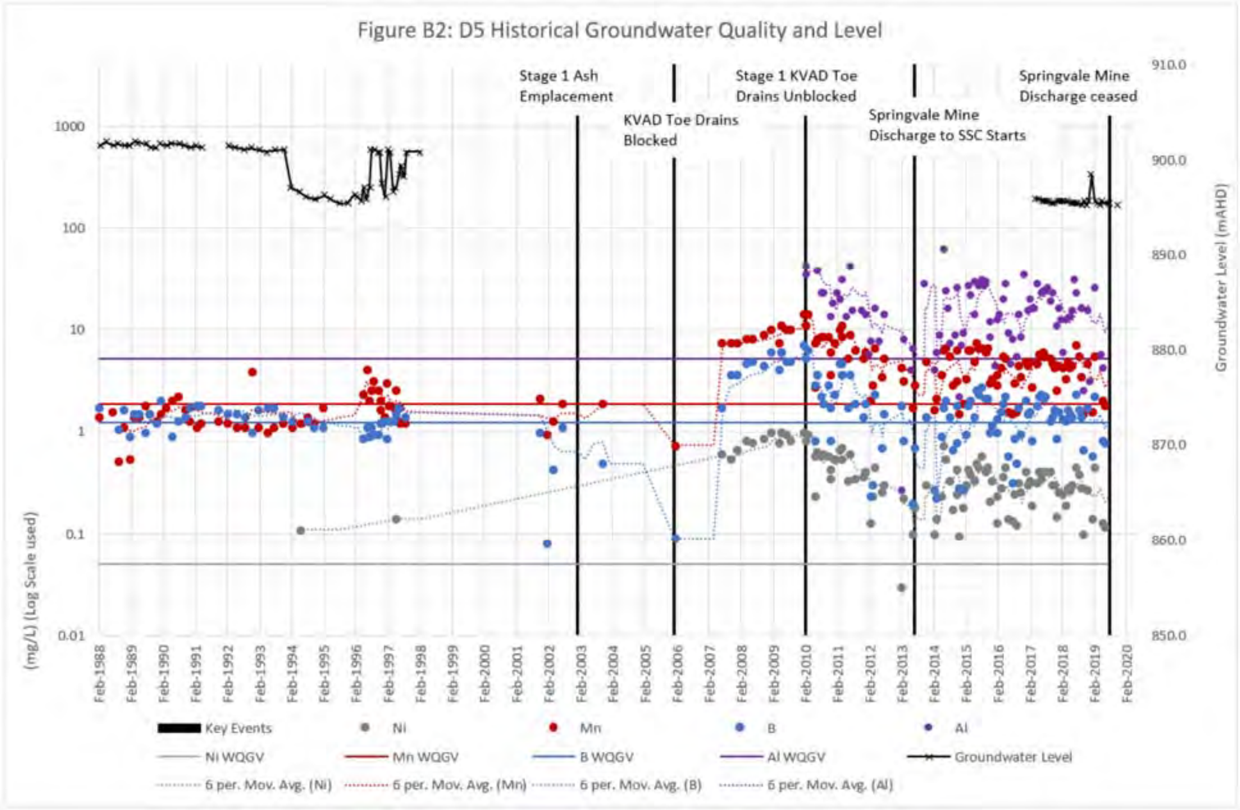

Figure 14: Historical trend of water quality within groundwater bore D5

7.1.2.1 Lidsdale Cut

The Lidsdale Cut mine void pond acts as a collection basin for KVAD groundwater seepage. Groundwater seepage is directed to Lidsdale Cut through a series of drainage lines and sediment ponds. This includes rainfall infiltration through the KVAR dry ash placement and surface water runoff which is collected in pits.

EnergyAustralia NSW has been managing the water level within the Lidsdale Cut pond by pumping the level down to between 0.4 to 0.6 m above the bottom of the pond, generally in response to rainfall (Figure 15)

Previous Water Quality Assessments (Aurecon, 2015) have indicated that there have been increases in trace metal concentrations within the pond when the water level is pumped down. It is understood that water with elevated metals reports to Lidsdale cut from other sources when the water level is low. Aurecon (2015) recommended Lidsdale Cut be maintained at a higher water level to minimise trace metal release from pyrites in the adjacent coal waste/chitter.

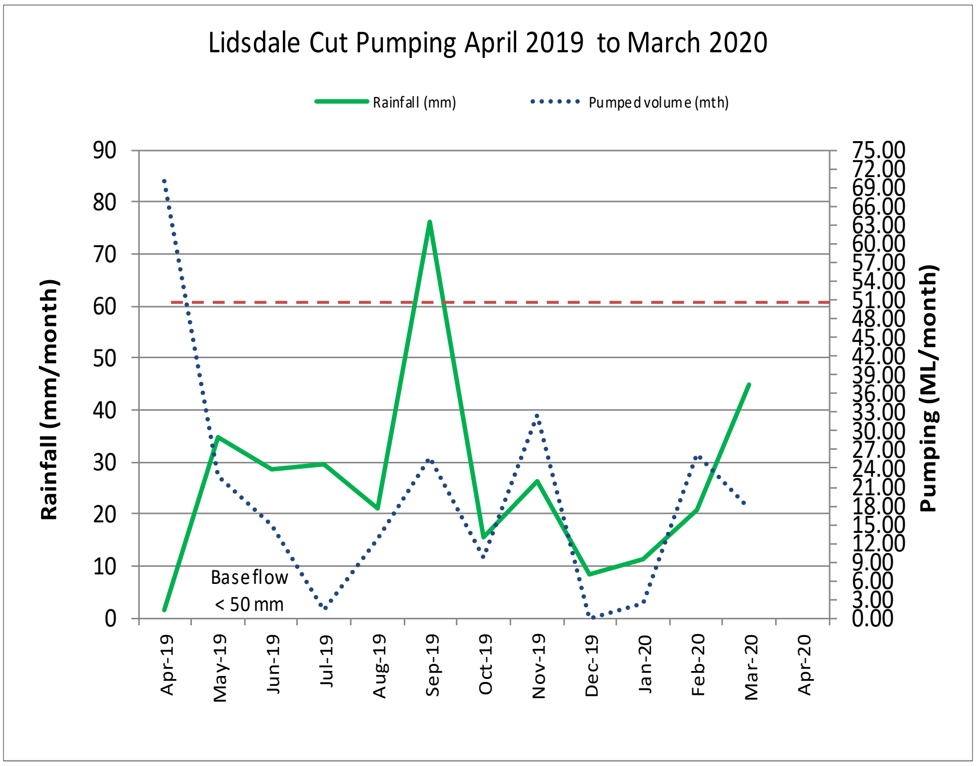

Figure 15: Rainfall compared to the amount pumped from Lidsdale Cut

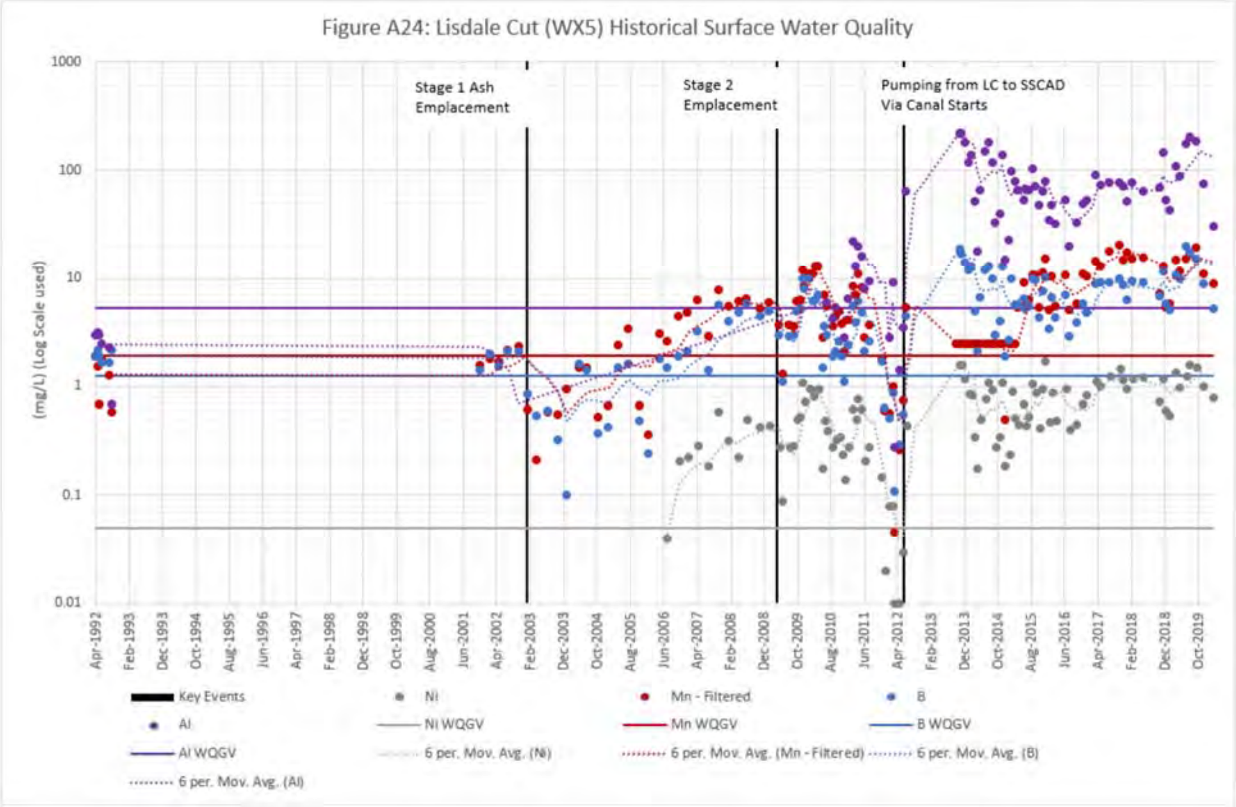

Figure 16: Historical trend for water quality within Lidsdale Cut Pond

There have been increases in trace metal concentrations within the Lidsdale Cut monitoring site (Figure 16). Lidsdale cut forms part of the water management system at WADA. Water in Lidsdale Cut is not discharged to the environment and is recycled onsite.

Water quality concentrations within Lidsdale Cut Pond are comparable to those recorded within KVAR/D, which is indicative of the current drainage system of the KVAD/R toe drains draining to Lidsdale Cut (Appendix C Table 5-1). This is supported by the highly acidic pH recorded within Lidsdale Cut samples, which are indicative of potential leachate from an acidic fly ash.

7.1.3 Reportable Incidents

No reportable incidents have been recorded against groundwater management for the reporting period.

7.1.4 Further Improvements

Further hydrogeological investigations would be required as part of the Closure & Rehabilitation of the WADA.

7.2 Surface Water Quality Monitoring

7.2.1 Environmental Management

The surface waters of Kerosene Vale are mostly comprised of runoff generated within the ash repository site. All runoff from KVAR is restricted from entering SSC and is contained for reuse for the conditioning of ash and dust suppression. The CoAs stipulate that a monitoring program must be implemented to record and observe water quality and potential impacts from repository operations on regional surface waters. This monitoring included a program following the realignment of SSC - however, as the creek has not been realigned, this aspect of monitoring is no longer necessary.

The design concept for managing surface water for the repository is outlined in the Repository Management Plan (Lend Lease, 2012), and based on reducing water pooling or ponding on exposed ash benches and eliminating flow from these areas over batters managed by controlled outflow structures.

The Operational Environment Management Plan for WADA requires sampling within SSC at four locations, this includes: two (2) on SSC, one (1) on Dump Creek to the northwest of the repository, and one (1) in SSC Ash Dam. The purpose of the surface water monitoring program is to ensure operations are not impacting on catchment surface waters, and to comply with Section 120 of the *Protection of the Environment Operations Act 1997*.

Sampling has been undertaken at Site ID numbers 38, 39, 40 and 41 since January 2003.

7.2.2 Environmental Performance

As stated in Section 7.1.2, Aurecon were engaged to undertake a detailed Water Quality Assessment for surface water in the KVAR Stage 2 area for the April 2019 to March 2020 reporting period (Aurecon, 2020). In summary, the assessment found that there have been no significant effects of the KVAR dry ash placement area on the local surface water receiving site during the reporting period. The Water Quality Assessment is provided in full in Appendix C.

To assess the impacts, if any, of the KVAR dry ash placement during the reporting period on the surface water receiving site at WX7, the other potential sources of water quality and trace metal inputs to the creek need to be considered. Figures 17 & 18 show trends in indicator parameters for WX7 since 1991 to 2020. A comparison of parameters for other relevant surface water sites located in the area surrounding KVAR for the reporting period and since 1991 are provided in Appendix D Table 5-1.

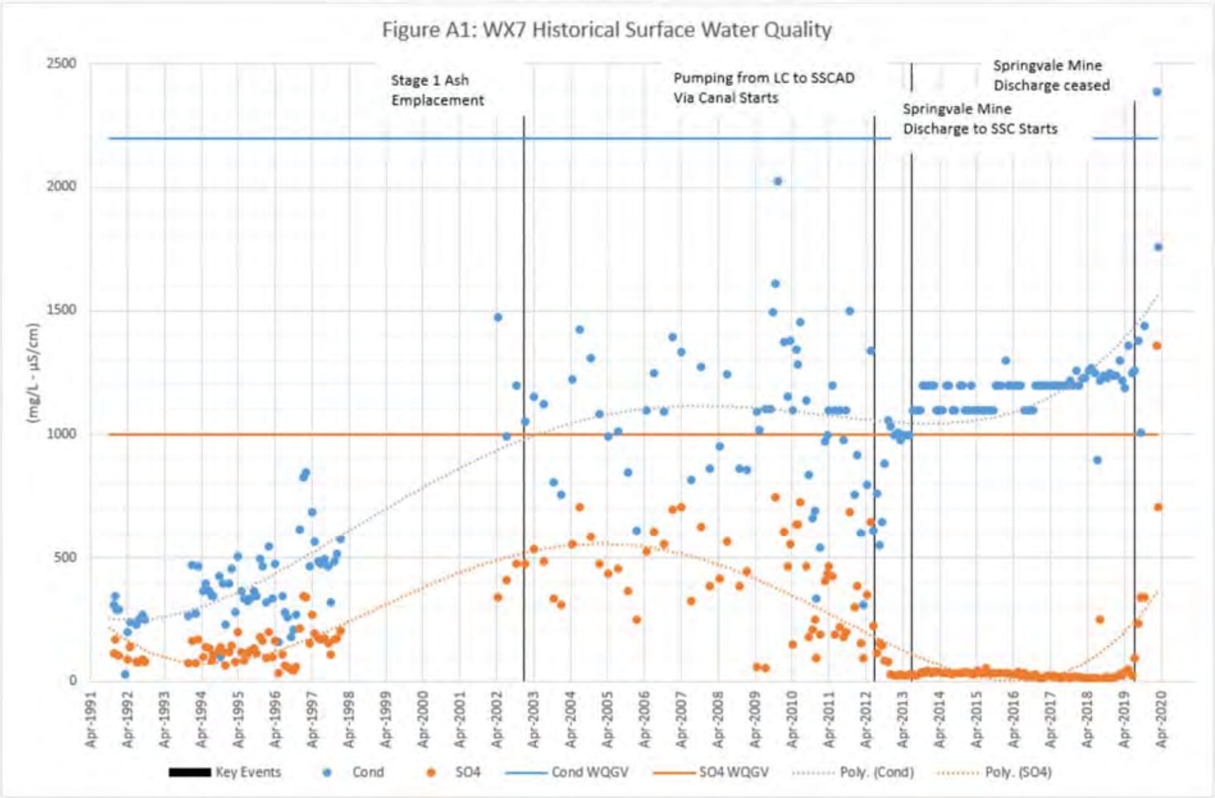

Figure 17: Historical Trend for Conductivity & Sulphate at Sawyers Swamp Creek at WX7

The assessment of surface water quality found that:

Concentrations of overall conductivity and sulphate have gradually increased in parallel to one another until early 2010, when sulphate concentrations and other key water quality parameters began to decline (Figures 17 & 18). However, this declining trend ceased around July 2013, at which point Springvale Mine commenced discharging from their Licence Discharge Point (LDP09) dominating the water quality of WX7.

The water quality at WX7 continues to meet the local/ANZECC (2000) guideline goals for the majority of analytes, with the exception of arsenic and molybdenum (Appendix C Table 5-1). Arsenic and molybdenum were slightly above the ANSECC guideline and is consistent with the results measured at the upstream monitoring sites on SSC, with the exception of the upstream SSC site (WX1) due to it being dry since 2017 (Appendix C Table 5-1). As these concentrations differ to those of Kerosene Vale Ash Dam or Repository (KVAD/R) Seepage (Appendix C Table 5-1), it is likely that these are associated with other land use practices in the area and are not directly related to KVAD/R.

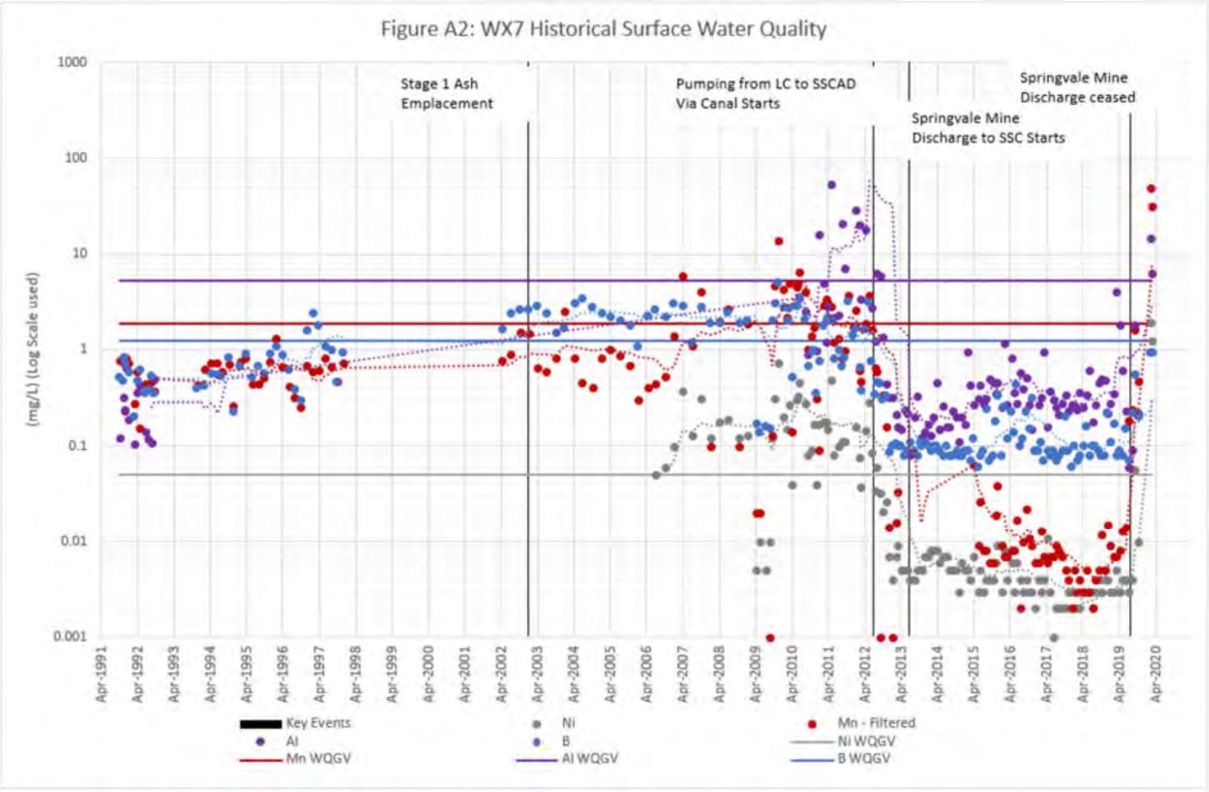

Figure 18: Historical Trend for key analytes at Sawyers Swamp Creek at WX7.

When compared to Dump Creek and Springvale Mine Water discharge, the water quality and trace metal concentrations in Sawyers Swamp Creek at WX7 is similar to that recorded for the Springvale Coal Mine water discharge point. Springvale Coal Mine commenced discharging water into SSC in February 2009 and ceased discharging in July 2019. Approximately 20 ML of water per day was discharged by the mining operations into Sawyers Swamp Creek during this period. The water quality in SSC being dominated by discharges from Springvale Coal Mine must be considered when assessing potential surface water impacts from KVAR against relevant ANZECC guidelines.

Based on site observations and information reviewed, potential surface water impacts from the operation of the WADA have been effectively mitigated and managed as anticipated within the Environmental Assessment (Parsons Brinckerhoff, 2008a).

Operations of the KVAR Stage 2 are considered to have met the target of zero environmental incidents relating to pollution of waters at SSC. Hydrological monitoring has been determined by EnergyAustralia NSW that it is no longer required as there is no longer any need to realign SSC. As such, hydrological monitoring as required under CoA 3.6 is not required.

7.2.3 Reportable Incidents

No reportable incidents have been recorded against surface water management for the reporting period.

7.2.4 Further Improvements

Continue monthly water quality monitoring at the EnergyAustralia NSW routine surface water monitoring sites in accordance with the approved OEMP.

7.3 Erosion and Sediment Control

7.3.1 Environmental Management

The management, collection and monitoring of surface water to ensure site runoff is undertaken as part of the operational and development activities of the WADA and is addressed within the surface water quality sub-plan of the OEMP. Site specific management practices are used to prevent site runoff from exposed ash surfaces from entering Sawyers Swamp Creek. Site surface water management measures include:

- Sediment and erosion controls:
    - Works in disturbed areas restricted during heavy rainfall events;
    - Operations-related earthworks not undertaken within 50m of Sawyers Swamp Creek where reasonable and feasible;
    - Cleared vegetation is mulched, chipped or re-used onsite for sediment filter fences or other uses, where appropriate.
- Development of a retention basin (or use of the existing basin) to capture site surface water runoff;
- Placement of ash with designated slopes to direct water to retention areas;
- Diversion of clean water away from disturbed areas to existing surface water drains and Sawyers Swamp Creek to provide environmental flows (Figure 19); and
- Capping and revegetating completed areas to enable the diversion of clean water to site drainage systems.

An additional clean water detention pond (SW Pond 3) was excavated in the already disturbed area of exposed soil at the north-eastern corner of KVAR Stage 2B in the 2015-16 reporting period (Figure 19).

Figure 19: Existing site water drainage system

7.3.2 Environmental Performance

The KVAR site (50.7 ha) is dominated by two water catchments: one reporting to the north and one reporting to the south. Both catchments have been designed to hold sediment laden water during operations and will capture clean water as per the water management plan for the final landform design. The northern catchment has a plan area of 28.5 ha and the southern catchment has a plan area of 19.7 ha, including the 7.2 ha of not-completed final excavation area for KVAR Stage 2B.

During the reporting period, rainfall runoff flows were re-directed from the North Holding Pond to report into the North Stormwater Area. Outflow from the North Holding Pond was managed via a pump-back system to the Sawyers Swamp Creek Ash Dam, with water from this pond also used for dust suppression irrigation and as a water cart fill point. Other flows from the North Holding Pond were directed into the collection system which reports to Lidsdale Cut and subsequently gets pumped back to the Southern water management area (now referred to as the transfer pond), for pumping back to Sawyers Swamp Creek Ash Dam.

At commencement of the ash placement operation, any water pumped to the Southern water management area (at the return water canal) was re-directed to the Wallerawang Power Station Caustic Injection Ponds. However, the need to pump back to the power station was eliminated with the clean out of the collection ponds within the Southern water management area. The current internal storage capacity in this southern area is SW Pond 1 capacity 4,766 cubic metres (4.7 ML) and SW Pond 2 capacity 6,515 cubic metre (6.5 ML).

The sediments in the Return Water Canal and collection ponds were removed during the previous reporting period, with disposal of the removed sediments at Sawyers Swamp Creek Ash Dam. The pump-back of the water from the Southern Water Management Area to the Sawyers Swamp Creek Ash Dam is now reinstated.

7.3.3 Reportable Incidents

No reportable incidents have been recorded against erosion and sediment control for the reporting period

7.3.4 Further Improvements

Implement effective sediment and erosion control measures and undertake any rehabilitation works in accordance with approved management plans.

8. Landscape and Revegetation

8.1.1 Environmental Management

The scope of landscape and revegetation environmental management is provided in the Site Repository Plan (Lend Lease, 2012) and in the Landscape and Revegetation sub-plan of the OEMP. The Landscape and Revegetation plan is based on an overall requirement to integrate the ash repository into the existing landscape.

As the repository takes shape, landscape and revegetation works occur along the batters only, with an opportunity to plant the top surface arising as part of the final site requirements. As such, revegetation occurs intermittently, constrained by seasonality and the development of the repository.

8.1.2 Environmental Performance

The status of rehabilitation is shown graphically in Figure 20. This provides a more accurate representation of rehabilitated areas. This primarily accounts for the changes in the land area types detailed in Table 13 when compared to areas reported in previous years.

Table 13: Rehabilitation Area Summary

Area Type	Previous Reporting Period Apr 2018 – Mar 2019		This Reporting period Apr 2019 – Mar 2020		Next Reporting period Apr 2020 – Mar 2021	
	SSCAD	**KVAR**	**SSCAD**	**KVAR**	**SSCAD**	**KVAR**
Total footprint	79.7	50.7	79.7	50.7	79.7	50.7
Total active disturbance	79.7	43.7	79.7	43.7	79.7	43.7
Land being prepared for rehabilitation	22.1	40.3	22.1	40.3	22.1	40.3
Land under active rehabilitation	0.0	7	0.0	7	0.0	7
Completed rehabilitation	0.0	0.0	0.0	0.0	0.0	0.0

Approximately 7.0 ha have had topsoil applied and have been seeded and is actively growing. and is considered to be land under active rehabilitation Table 13 and Figure 20. Approximately 5 ha of previously rehabilitated land has been disturbed to accommodate changes to the final landform dur to the cessation of power generation at the Wallerawang Power Station.

Additionally, 3.4 ha require remedial soil cover of between 1-2 m placement to reach final form and grade and a further 10.1 ha requires a dress soil cover of approximately 0.5 – 1 m before topsoil can be applied for revegetation.

Landscaping and revegetation at the KVAR for the 2019-20 reporting period has been limited to maintaining the previous planting and weed management for blackberry, thistle and pampas grass colonisation. Successful spraying campaign was completed on February 2019, with the next campaign scheduled for November-December 2020.

Source: Aurecon, LPI, *Lithgow Local Environmental Plan 2014*

Projection: GDA 1994 MGA Zone 56

Wallerawang Power Station (21 June 2018)

PLAN 2: Rehabilitation Status

Figure 20: Current status of rehabilitation at Kerosene Vale Ash Repository

Plate 6: Kerosene Vale Ash Repository Stage 1 rehabilitation works [view east] (planted August 2014, photo taken 18 June 2019)

Plate 7: Kerosene Vale Ash Repository Stage 1 rehabilitation works [view West] (planted August 2014, photo taken 18 June 2019)

The Department of Planning and Environment granted Modification 1 to Project Approval 07_0005 in August 2018 for the import of capping material from areas outside of the Lithgow local government area to the Wallerawang Ash Dam Area. Capping material to be used for this will be sourced from various locations across NSW and will comprise virgin excavated natural material (VENM) and excavated natural material (ENM). No capping has been performed during the 2019-2020 reporting period.

Plate 8: Excavated area of KVAR Stage 2B requires a reinstated soil profile.

The site requires soil placement within a 'capping and rehabilitation program' to cover a plan area of 20.7 ha (excluding the exposed ash area that is not capped and water management areas). The amount of capping material required is estimated to be in the order of 207,000 m3.

Final rehabilitation progress is subject to decisions about the water management design (including management of acidic groundwater pumped-back from Lidsdale Cut); the potential for accessing the ash for manufacturing; the availability and access to engineering fill, topsoil and the organic amendments needed to complete the planting works.

As indicated in Table 14, the majority of the OEMP requirements with respect to landscaping/revegetation were found to be satisfactory or not applicable as ash has yet to reach the design RL (940 m AHD). However, the interim landscaping/revegetation activities undertaken are considered to be in line with the relevant OEMP target, given the project's progress to date.

Table 14: Rehabilitation Status Summary

Performance Indicator	Completion Criteria*	Current Status (Reporting Period)
Visual impact	Measures to reduce the visual impact implemented as soon as practical.	**Satisfactory** – Batters located closest to residents have been revegetated.
	Ash Placement will be concentrated on the Eastern face of the KVAR Stage 2 ash repository in order to shield the residents from future ash placement activities.	**Not Applicable** – Ash placement no longer performed due to decommissioning of Wallerawang Power Station.
Capping	Ash to be capped to a depth of 0.75 m and contour ripped to preclude soil movement during rainfall or other erosion events.	**Satisfactory** – No soil loss or erosion identified in capped areas.
	Capping shall be conditioned to facilitate revegetation, which may include the use of cover crop grasses.	**Satisfactory** – Virgin Excavated Natural Material (VENM) or Excavated Natural Material (ENM) used for capping and conditioned using a mix of oats and rye-corn.
Revegetation	Develop a broad acre planting strategy on slopes at a 1 to 4 ratio.	**Satisfactory** – As detailed in the Repository Management Plan (Lend Lease, 2012).
	A developed revegetation procedure in place and implemented.	**Satisfactory** Procedure detailed in the Repository Management Plan (Lend Lease, 2012).
	Grass cover revegetation to include perennial grasses.	**Satisfactory** – Perennial grasses planted include Couch, Phalaris and Poa.
	Planting of shrubs and trees undertaken using tube stock of local provenance tree species to be performed after establishment of perennial grasses.	**Satisfactory** – Red Stringy Bark, Narrow-leaved Peppermint, Western Scribbly Gum, Silver Wattle and Red Stem Wattle tube stock planted in August 2014.
	Plant establishment (trees and shrubs) to minimise soil loss and erosion.	**Satisfactory** – No soil loss or erosion identified in revegetated areas.
Irrigation	Irrigation undertaken at establishment and as required thereafter.	**Satisfactory** – Irrigation performed through the use of water cart sprays and sprinklers already installed on and around Kerosene Vale Ash Repository.
Animal Control	Threats to vegetation such as grazing by animals managed accordingly.	**Satisfactory** – No evidence of animal grazing on revegetated areas.
Rehabilitation	All new batters rehabilitated as soon as practicable.	**Not Applicable** – No new batters have been developed.
	All areas of ash placement that have reached RL 940 m to be rehabilitated or in the process of rehabilitation as per revegetation plan.	**Ongoing** - 13.5 ha for require remedial soil cover or a dress soil cover, prior to planting. Stage 2 is 6.1 ha require remedial soil cover

* Completion Criteria taken from the OEMP Landscape and Re-vegetation Plan

8.1.3 Reportable Incidents

No reportable incidents have been recorded against landscape and revegetation management for the reporting period.

8.1.4 Further Improvements

Progress development of the closure and rehabilitation management plan for KVAR.

Control the spread of invasive weed species including blackberry and pampas grass.

9. Community

9.1 Community Engagement

During the reporting period Community Reference Group meetings were held on 20 May 2019, 19 August 2019, 2 December 2019 and 2 March 2020. The Community Consultative Committee comprises representatives from the local community and EnergyAustralia NSW. The Committee meets on a quarterly basis to discuss matters relating to operations at Mt Piper and Wallerawang Power Stations, including activities at the ash repositories. The Community Consultative Committee minutes are made publicly available via the Mt Piper and Wallerawang Community page on the Company's website www.energyaustralia.com.au.

9.2 Community Contributions

Wallerawang Power Station and the associated Kerosene Vale Ash Repository has contributed to the economy of the district and State through the purchase of materials and services from local and regional suppliers, and by direct and indirect employment. EnergyAustralia NSW continues to support a number of community groups and organisations through in-kind support and financial sponsorship programs. During the reporting period, EnergyAustralia NSW had the opportunity to support up to 60 different community organisations and events during the reporting period. A comprehensive list of these organisations and events are included in Appendix F.

9.3 Community complaints

No Complaints were received in the reporting period.

EnergyAustralia NSW maintains a 24-hour hotline for the public to report incidents, complaints or enquiries with contact details available on the EnergyAustralia website. EnergyAustralia NSW records the details of all complaints received in a Complaints Register.

The Contract Administrator, Site Manager and the Environment Representative ensure that the community relations protocols are communicated to all project personnel involved in the complaints process and that appropriate training covering the protocols is established in site inductions.

The key elements of the on-site complaints' management protocol include:

- All persons wishing to register a complaint to operations personnel will be politely directed to the Support Services Leader, in line with EnergyAustralia NSW's existing complaints procedure.
- The Support Services Leader will deal with the complaint and take down particulars of the complaint as per the criteria listed on the complaints register. Action will then be taken to resolve the issue whilst ensuring that all correspondence relating to the issue is documented. All attempts will be made to resolve the issue on the same day, however if this is not possible, the complainant will be updated regularly on the progress of the matter where practical.

9.4 Website Information

A project specific webpage has been developed to keep the broader community up to date with recent activities at the Kerosene Vale Ash Repository in accordance with Schedule 5, Condition 5.1 of the Project’s Conditions of Approval. Copies of the following documents are made publicly available on the EnergyAustralia website:

https://www.energyaustralia.com.au/about-us/energy-generation/wallerawang-power-station-closure/kerosene-vale-ash-repository

- Environment Assessment
- Project Approval 07_0005
- Construction Environment Management Plan
- Operation Environmental Management Plan
- Annual Environmental Management Reports

https://www.energyaustralia.com.au/about-us/energy-generation/wallerawang-power-station-closure/wallerawang-epa-reports

- Environment Protection Licence 766
- Pollution Incident Response Management Plan

https://www.energyaustralia.com.au/about-us/energy-generation/mt-piper-power-station/mt-piper-and-wallerawang-community

- Community Consultative Committee Minutes

https://www.energyaustralia.com.au/about-us/energy-generation/mt-piper-power-station/mt-piper-and-wallerawang-water-data

- Water Access Licence
- Water Supply Work and Water Use Approval

10. Independent Audit

There was no independent environmental audit undertaken during the reporting period. There is no requirement under Project Approval 07_0005 to perform an independent audit on the KVAR Stage 2 activities. Despite this, KVAR Stage 2 is subject to EnergyAustralia NSW's internal environmental audit and inspection schedule.

10.1 Internal Environmental Audits & Inspections

Environmental audits and inspections are undertaken by the Environment representative and Site Manager, in accordance with the program outlined in Table 15. The inspections assist to identify areas where improvements to the environmental performance of the KVAR Stage 2 activities can be achieved. Further detail is provided in section 3.7 of the OEMP. Reports from inspections undertaken are submitted to and reviewed by EnergyAustralia NSW monthly, with all areas discussed in detail during regular client/contractor meetings.

Table 15: Environmental inspection program

Potential impact	Locations	Technique	Frequency	Reporting	Responsibility
General Environmental Impacts	All KVAR Stage 2 operational areas	Site environmental inspections	Daily	Daily site environmental checklists	Contractor
			Monthly	Monthly site environmental checklists	Environmental representative

11. Incidents and non-compliances during the reporting period

As the WADA is in care and maintenance there is limited vehicle and people movements at the site. As such the potential for environmental incidents and non-compliances is substantially reduced.

During the 2019-20 reporting period, there was one instance of non-compliance in relation the project approval 07_005 Condition 2.1. The goal of 40% ash reuse was not achieved by 31st December 2013, with a total of only 0.32% ash reuse occurring from Wallerawang Power Station by the end of 2013. In March 2014, when it was announced that Wallerawang Power Station was being put out of service, the ash reuse from Wallerawang had remained at 0.32%.

Ash utilisation has been an ongoing program for the power station. Since then, more research and development of products and potential markets have been performed by external third parties. Generally, the major limitation to further market development is a lack of rail, building and industrial infrastructure, particularly for the storage of ash at Wallerawang. Despite this EnergyAustralia NSW is supporting a number of initiatives that are looking to utilise the stored ash.

There was one reportable incident during the reporting period. A bushfire at Lidsdale occurred over the weekend of 7th and 8th September 2019, which caused damage to WADA infrastructure, including pumps, above ground HDPE and asbestos pipeline, . An uncontrolled release of a small volume of seepage water reported to Sawyers Swamp Creek. Additional water from the Sawyers Swamp Creek Ash Dam, utilised by helicopters to suppress the fire, has contributed to a white precipitate forming in Sawyers Swamp Creek and friable asbestos being spread from the damaged asbestos pipeline. The Department of Planning, Infrastructure & Environment were notified of the incident on Monday 9th September 2019.

Plate 9: Fire damage to asbestos pipeline, 8 Sept 2020

There were no official cautions, warning letters, penalty notices or prosecution proceedings by any regulatory body during the reporting period.

12. Activities to be completed in the next reporting period

WADA will continue under care and maintenance arrangements. Activities to be completed in the next reporting period will include:

- Environmental compliance monitoring for air quality, noise emissions and water quality;
- Water management works including the maintenance of sediment and erosion control structures;
- Dust suppression activities to minimise potential air quality impacts from WADA;
- Minor earthworks including road maintenance and drain works as required;
- Ash management works as required to stabilise slopes and minimise potential impacts;
- Environmental assessments and other specialist studies to inform the development of the final closure and rehabilitation plan. These may include additional groundwater, surface water and ecological assessment as required.

EnergyAustralia NSW will be assessing the repurposing of the Wallerawang Power Station which may include the WADA. This assessment is ongoing and will form part of the final closure and rehabilitation plan. It should be noted that a development application may be required to be submitted to either the Lithgow Shire Council or the DPE. EnergyAustralia NSW will consult with the relevant regulatory authority at the appropriate time as required.

12.1 Environmental Management Targets and Strategies for the Next Year

Environmental measures to be implemented in the 2019-20 reporting period are detailed in Table 16.

Table 16: Measures to be implemented in the Next Reporting Period

Environment Management Area	Target / Strategy	Timeframe
Noise	Maintain compliance	Annual
Air Quality	Maintain compliance	Monthly
Water Quality	Continue water quality monitoring at the licenced ground and surface water sites	Monthly, until advised otherwise.
	Continue water quality monitoring in Lidsdale Cut Pond to see if concentrations reach equilibrium	Monthly, until advised otherwise.
Erosion & Sedimentation	Implement effective sediment and erosion control measures and undertake any rehabilitation works in accordance with approved management plans.	Annual
Landscape & Revegetation	Control the spread of invasive weed species in particular pampas grass.	Annual

13. References

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14. Glossary of Terms

AEMR	Annual Environmental Management Report
ANZECC	Australian and New Zealand Environmental Conservation Council
BOM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
CoA	Condition of Approval (also known as MCoA – Minister's CoA)
DDR	Decommissioning, Deconstruction & Rehabilitation
DECC	Department of Environment & Climate Change
DoP	Department of Planning
DP&I	Department of Planning and Infrastructure
DPIE	Department of Planning, Industry & Environment (formerly DP&I/DoP)
DPI Water	Department of Primary Industry – Water (now referred to as NRAR)
EANSW	EnergyAustralia NSW
ENM	Excavated Natural Material
EPA	Environment Protection Authority
EPL	Environment Protection Licence
HDPE	High-density Polyethylene
KVAD	Kerosene Vale Ash Dam
KVAD/R	Kerosene Vale Ash Dam and Repository
KVAR	Kerosene Vale Ash Repository
NEMMCO	National Electricity Market Management Company
NRAR	Natural Resources Access Regulator (formerly DPI Water)
OEH	Office of Environment & Heritage (formerly DECC)
OEMP	Operation Environmental Management Plan
ONVMP	Operational Noise and Vibration Management Plan
RL	Relative Level
SoC	Statement of Commitments
SSC	Sawyers Swamp Creek
SSCAD	Sawyers Swamp Creek Ash Dam
VENM	Virgin Excavated Natural Material
WADA	Wallerawang Ash Dam Areas
WAL	Water Access Licence
WWPS	Wallerawang Power Station

Appendix A
Detailed review checklist and Recommendations for Conditions of Approval

Administrative Conditions

Terms of approval

Minister's Condition of Approval 1.1
The proponent shall carry out the project generally in accordance with the: ***a) Major Project Application 07_0005;*** ***b)* Kerosene Vale – Stage 2 Ash Repository Area *(two volumes)* – Environmental Assessment, *prepared by Parsons Brinckerhoff and dated 1 April 2008;*** ***c)* Kerosene Vale – Stage 2 Ash Repository Area – Submissions Report, *prepared by Parsons Brinckerhoff and dated 30 May 2008; and*** ***d)* The conditions of this approval.**
Compliance Assessment Observations and Comments Based on the review undertaken, the KVAR Stage 2 operations have been carried out in accordance with the above requirements.
Compliance Assessment Finding – Compliant
Minister's Condition of Approval 1.2
In the event of an inconsistency between: ***a) The conditions of this approval and any document listed from condition 1.1a) – 1.1c) inclusive the conditions of this approval shall prevail to the extent of the inconsistency; and*** ***b) Any of the documents listed from the condition 1.1a) – 1.1c) inclusive, the most recent document shall prevail to the extent of the inconsistency.***
Compliance Assessment Observations and Comments No inconsistencies were observed between the documents listed above during implementation of the project or during the course of the review of operations in preparing this AEMR.
Compliance Assessment Finding – Compliant

Minister's Condition of Approval 1.3

The proponent shall comply with the reasonable requirements of the Director-General arising from the Department's assessment of:

- ***a) Any reports, plans or correspondence that are submitted in accordance with this approval; and***
- ***b) The implementation of any actions or measures contained in these reports, plans or correspondence.***

Compliance Assessment Observations and Comments

In a letter dated 22 August 2019, the DPE made a comment in regards to the 2018-19 Annual Review. The response to this action is provided within Table 7.

Table 7, Section 5 of this report. No further requests from the Secretary of the DPE were received in the 2019-20 reporting period.

Compliance Assessment Finding – Compliant

Limits of approval

Minister's Condition of Approval 1.4

This approval shall lapse five years after the date on which it is granted, unless the works that are the subject of this approval are physically commenced on or before that time.

Compliance Assessment Observations and Comments

The Project Approval for KVAR Stage 2 is dated 26 November 2008, indicating a 26 November 2013 lapse date. Works on the KVAR Stage 2B project commenced June 2013, well before the 'deadline' date.

Compliance Assessment Finding – Compliant

Statutory requirements

Minister's Condition of Approval 1.5

The Proponent shall ensure that all licences, permits and approvals are obtained as required by law and maintained as required with respect to the project. No condition of this approval removes the obligation for the Proponent to obtain, renew or comply with such licences, permits or approvals.

Compliance Assessment Observations and Comments

The project complies with the requirements of EnergyAustralia NSW's EPL 766. (See Table 1).

Compliance Assessment Finding – Compliant

Specific Environmental Conditions

Ash management

Minister’s Condition of Approval 2.1
The Proponent shall prepare a long-term ash-management strategy including a program for investigation and assessment of alternative ash management measures with a goal of 40% reuse of ash by 31 December 2013. The report shall be submitted to the Director-General within six months of the commencement of operations. The Proponent shall report on the status and outcomes of its investigations to the Director-General every two years from the commencement of the operation of the project, unless otherwise agreed by the Director-General.
Compliance Assessment Observations and Comments EnergyAustralia NSW commissioned the report *Fly Ash: Strategy Development for Aggregates and Other Bulk Use Applications* (DMC, 2010). The reports were submitted to DP&I in September 2011. Ash reuse progress is communicated via the Lend Lease Monthly Compliance Report and tracked in EnergyAustralia NSW’s Annual Sustainability Report. The goal of 40% ash reuse was not achieved by 31st December 2013, with a total of only 0.32% ash reuse occurring from Wallerawang Power Station by the end of 2013. In March 2014, when it was announced that Wallerawang Power Station was being put out of service, the total ash reuse from Wallerawang had remained at 0.32%. However, ash utilisation has been an ongoing program for the power station. Since then, more research and development to develop markets have been performed, rather than to solely focus on servicing established market opportunities. Generally, the major limitation to further market development is a lack of rail, building and industrial infrastructure, particularly for the storage of ash at Wallerawang.
Compliance Assessment Finding – Non-Compliant
Minister’s Condition of Approval 2.2
To facilitate assessment of the viability of coal resources in the project area and provide a finite opportunity for their extraction, the Proponent shall undertake revised staging of ash placement activities as described in the document referred to in condition 1.1c) of this approval
Compliance Assessment Observations and Comments Centennial Coal declined to extract the coal resources in the project area. Ash will not be placed over the coal resource in the project area as a result of the non-operational status of Wallerawang Power Station, which is finite opportunity. As outlined in this report, the pine plantation area now constitutes KVAR Stage 2B.
Compliance Assessment Finding - Compliant

Noise impacts

Minister's Condition of Approval 2.3
Construction activities associated with the project shall only be undertaken during the following hours: ***a) 7:00 am to 6:00 pm, Mondays to Fridays, inclusive;*** ***b) 8:00 am to 1:00 pm on Saturdays; and*** ***c) At no time on Sundays or public holidays.***
Compliance Assessment Observations and Comments A CEMP was prepared for the works associated with the development of KVAR Stage 2B in preparation for ash placement and included a Construction Noise Management Plan and Noise Monitoring Program. This was submitted to DP&I in August 2011 and approved on the 16th December 2011. No construction activities have occurred during the reporting period.
Compliance Assessment Finding – Not Applicable
Minister's Condition of Approval 2.4
Activities resulting in impulsive or tonal noise emission (such as rock breaking or rock hammering) shall be limited to 8:00 am to 12:00 pm, Monday to Saturday and 2:00 pm to 5:00 pm Monday to Friday. The Proponent shall not undertake such activities for more than three continuous hours and must provide a minimum one-hour respite period.
Compliance Assessment Observations and Comments No activities resulting in tonal or impulsive noise emission have occurred during the monitoring period.
Compliance Assessment Finding - Not Applicable

Minister's Condition of Approval 2.5

Construction outside the hours stipulated in condition 2.3 of this approval is permitted in the following circumstances:

a) ***Where construction works do not cause audible noise at any sensitive receiver; or***

b) ***For the delivery of materials required outside these hours by the Police or other authorities for safety reasons; or***

c) ***Where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.***

Compliance Assessment Observations and Comments

No construction activities have taken place during the reporting period.

Compliance Assessment Finding - Not Applicable

Minister's Condition of Approval 2.6

The hours of construction activities specified under condition 2.3 of this approval may be varied with the prior written approval of the Director-General. Any request to alter the hours of construction specified under condition 2.3 shall be:

a) ***Considered on a case-by-case basis;***

b) ***Accompanied by details of the nature and need for activities to be conducted during the varied construction hours; and***

c) ***Accompanied by any information necessary for the Director-General to reasonably determine that activities undertaken during the varied construction hours will not adversely impact on the acoustic amenity of sensitive receivers in the vicinity of the site.***

Compliance Assessment Observations and Comments

There has been no requirement to vary hours of construction during the reporting period, as no construction activities have taken place.

Compliance Assessment Finding - Not Applicable

Minister's Condition of Approval 2.7

The construction noise objective for the proponent is to manage noise from construction activities (as measured by $L_{A10\ (15minute)}$ descriptor) so as not to exceed the background L_{A90} noise level by more than 10dB(A) at any sensitive receiver.

Any activities that have the potential for noise emissions that exceed the objective must be identified and managed in accordance with the Construction Noise Management Plan (as referred under condition 6.3B) of this approval). The Proponent shall implement all reasonable and feasible noise mitigation measures with the aim of achieving the construction noise objective.

Compliance Assessment Observations and Comments

No construction activities with the potential to exceed background noise levels were undertaken during the reporting period.

Compliance Assessment Finding – Not Applicable

Minister's Condition of Approval 2.8
Operational activities associated with the project shall only be undertaken from 7:00am to 10:00pm Monday to Sunday.
Compliance Assessment Observations and Comments Lend Lease have advised that no operational activities have taken place during or outside the hours designated above. Aurecon reported that: "No ash truck movements were noticed during the entire noise survey."
Compliance Assessment Finding - Compliant
Minister's Condition of Approval 2.9
Within six months of commencement of operation of the project the Proponent shall prepare and submit to the Director-General a review of the logistical arrangements for ash haulage and placement to determine the feasibility of reducing the hours of operation. If, as a result of the review, it is determined that ash haulage and placement times can commence later and/or finish earlier, the Proponent shall aim to observe the reduced hours whenever possible.
Compliance Assessment Observations and Comments The review was conducted within six months of commencement of operations and submitted to the DP&I on the 26th April 2012. The review determined that ash haulage and placement times could not commence later or finish earlier. This review was not submitted to the Director-General.
Compliance Assessment Finding - Compliant

Minister's Condition of Approval 2.10

Operations outside the hours stipulated in condition 2.8 of this approval are only permitted in the following emergency situations:

- ***a) Where it is required to avoid the loss of live, property and/or to prevent environmental harm; or***
- ***b) Breakdown of plant and/or equipment at the repository or the Wallerawang Power Station with the effect of limiting or preventing ash storage at the power station outside the operating hours defined in condition 2.8; or***
- ***c) A breakdown of an ash haulage truck(s) preventing haulage during the operating hours stipulated in condition 2.8 combined with insufficient storage capacity at the Wallerawang Power Station to store ash outside of the project operating hours; or***
- ***d) In the event that the National Electricity Market Management Company (NEMMCO), or a person authorised by NEMMCO, directs the Proponent (as a licensee) under the National Electricity Rules to maintain, increase or be available to increase power generation for system security and there is insufficient ash storage capacity at the Wallerawang Power Station to allow for the ash to be stored.***

In the event of conditions 2.10b) or 2.10c) arising, the Proponent is to take all reasonable and feasible measures to repair the breakdown in the shortest time possible.

Compliance Assessment Observations and Comments

Lend Lease have advised that no operational activities have taken place outside the hours.

Compliance Assessment Finding - Not Applicable

Minister's Conditions of Approval 2.11, 2.12, 2.13 and 2.14
2.11- In the event that an emergency situation as referred to under condition 2.10b) or 2.10c) occurs more than once in any two-month period, the Proponent shall prepare and submit to the Director-General for approval a report including, but not limited to: ***a) The dates and a description of the emergency situations;*** ***b) An assessment of all reasonable and feasible mitigation measure to avoid recurrence of the emergency situations;*** ***c) Identification of a preferred mitigation measure(s); and*** ***d) Timing and responsibility for implementation of the mitigation measure (s).*** ***The report is to be submitted to the Director-General within 60 days of the second exceedence occurring. The Proponent shall implement all reasonable and feasible mitigation measures in accordance with the requirements of the Director-General.*** ***2.12- The Proponent shall notify the DECC prior to undertaking any emergency ash haulage or placement operations outside of the hours of operation stipulated in condition 2.8 of this approval and keep a log of such operations.*** ***2.13- The Proponent shall notify the Director-General in writing within seven days of undertaking any emergency ash haulage or placement operations outside of the hours of operation stipulated in condition 2.8 of this approval.*** ***2.14- The Proponent shall notify nearby sensitive receivers (as defined in the Operational Noise Management Plan required under condition 6.5a) of this approval) prior to 8.00pm where it is known that emergency ash haulage or placement operations will be required outside of the hours of operation stipulated in condition 2.8 of this approval.***
Compliance Assessment Observations and Comments No emergency situations have occurred during the reporting period.
Compliance Assessment Finding - Not Applicable

Minister's Condition of Approval 2.15
The cumulative operational noise from the ash placement area and ash haulage activity shall not exceed an $L_{Aeq\ (15\ minute)}$ of 40 dB(A) at the nearest most affected sensitive receiver during normal operating hours as defined in condition 2.8 of this approval. ***This noise criterion applies under the following meteorological conditions:*** ***a) Wind speeds up to 3m/s at 10 metres above ground; and/or*** ***b) Temperature inversion conditions of up to 3^0C/100m and source to receiver gradient winds of up to 2m/s at 10m above ground level.*** ***This criterion does not apply where the Proponent and the affected landowner have reached a negotiated agreement in regard to noise, and a copy of the agreement has been forwarded to the Director-General and the DECC.***
Compliance Assessment Observations and Comments Measured noise levels during June 2019 indicate KVAR Stage 2 operations are compliant with operational noise criteria (Aurecon, 2019) EnergyAustralia NSW has not entered into any agreements regarding noise from KVAR with any potentially affected landholders, nor had any noise related complaints regarding the KVAR Stage 2 project. (See Section 6.2).
Compliance Assessment Finding - Compliant
Minister's Condition of Approval 2.16
The Proponent shall implement measures to ensure noise attenuation of trucks. These measures may include, but are not limited to, installation of residential class mufflers, engine shrouds, body dampening, speed limiting, fitting of rubber stoppers to tail gates, limiting the use of compression breaking, and ensuring trucks operate in a one-way system at the ash repository where feasible.
Compliance Assessment Observations and Comments Lend Lease has engaged a fleet of Mercedes-Benz Actros trucks which are compliant with the noise emission standards outlined above. No compression braking is used on the repository, trucks are well maintained with engines enclosed, mufflers in place, and proceed in a unidirectional format according to enforced speed limits. Minimal ash truck movements have occurred during the reporting period as a result of minimal ash being placed within Kerosene Vale Ash Repository due to the operational status of Wallerawang Power Station.
Compliance Assessment Finding - Compliant

Minister’s Condition of Approval 2.17
The Proponent shall liaise with the owner/operator of Angus Place Coal Mine with the aim of preparing a protocol which provides for a co-operative approach for the management and mitigation of noise impacts associated with coal and ash truck movements along the private haul road.
Compliance Assessment Observations and Comments EnergyAustralia NSW regularly liaises with Centennial Coal through monthly fuel supply meetings. The protocol developed between EnergyAustralia NSW and Centennial includes the restriction of movement of trucks along the haul road between 6pm and 7am daily- trucks are diverted from the haul road passage during these hours as necessary. Centennial Coal reports to EnergyAustralia NSW with any instances that may impact on background noise caused by truck movement through the monthly meetings, and are bound by their Environment Protection Licence 467. Information provided to EnergyAustralia NSW by Centennial regarding potential Angus Place noise impacts associated with coal and ash truck movements underneath this licence included hours of operation, noise level limits and pollutants. In 2015, Angus Place Coal Mine was placed into Care and Maintenance functionality. As a result, no coal truck movements have occurred on the private haul road. In addition, minimal ash truck movements have occurred along the private haul road during the reporting period as a result of minimal ash being placed within Kerosene Vale Ash Repository due to the operational status of Wallerawang Power Station.
Compliance Assessment Finding - Compliant

Minister's Condition of Approval 2.18

Where noise monitoring (as required by conditions 3.2 or 3.3 of this approval) identifies any non-compliance with the operational noise criterion specified under condition 2.15 of this approval the Proponent shall prepare and submit to the Director-General for approval a report including, but not limited to:

- **a) An assessment of all reasonable and feasible physical and other mitigation measures for reducing noise at the source including, but not limited to –**
    - **i. Construction of a noise barrier along the haulage road**
    - **ii. Alternative ash haulage routes, and**
    - **iii. Alternative methods of ash conveyance to the repository; and**
- **b) Identification of the preferred measure(s) for reducing noise at the source;**
- **c) Feedback from directly affected property owners and the DECC on the proposed noise mitigation measures; and**
- **d) Location, type, timing and responsibility for implementation of the noise mitigation measure(s).**

The report is to be submitted to the Director-General within 60 days of undertaking the noise monitoring which has identified exceedences of the operational noise criterion specified under condition 2.15, unless otherwise agreed to by the Director-General. The Proponent shall implement all reasonable and feasible mitigation measures in accordance with the requirements of the Director-General.

Compliance Assessment Observations and Comments

No non-compliances were identified during the reporting period. Refer to Appendices B for further details.

Compliance Assessment Finding - Compliant

Minister's Condition of Approval 2.19

If, after the implementation of all reasonable and feasible source controls, as identified in the report required by condition 2.18, the noise generated by the project exceeds the criterion stipulated in condition 2.15 at:

- ***a) Any sensitive receiver in existence at the date of this approval; or***
- ***b) Any residential dwelling for which an approval has been sought or obtained under the* Environmental Planning and Assessment Act 1979 *no later than six months after the confirmation of operational noise levels;***

Upon receiving a written request from an affected landowner (unless that landowner has acquisition rights under condition 2.20 of this approval and has requested acquisition) the Proponent shall implement additional noise mitigation measures such as double glazing, insulation, air conditioning and or other building acoustic treatments at any residence on the land, in consultation with the landowner.

For the purpose of this condition and condition 2.20, confirmation of operational noise levels means:

- ***a) Completion of the operational noise review required under condition 3.2 this approval; and***
- ***b) Implementation of any source controls, as required under condition 2.18 of this approval, should the operational noise review indicate noise levels in excess of the operational noise criterion specified in condition 2.15; and***
- ***c) Monitoring of operational noise levels, as required under condition 3.3b) of this approval, following the implementation of any source controls.***

The additional mitigation measures must be reasonable and feasible. If within three months of receiving this request from the landowner the Proponent and landowner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Director-General for resolution, whose decision shall be final.

Compliance Assessment Observations and Comments

No non-compliances were identified during the reporting period. Refer to Appendices B for further details.

EnergyAustralia NSW has received no written requests from affected landowners regarding noise mitigation measures.

Compliance Assessment Finding - Compliant

Minister’s Condition of Approval 2.20

If, after the implementation of all reasonable and feasible source controls, as identified in the report required by condition 2.18, the noise generated by the project exceeds the criterion stipulated in condition 2.15 by more than 5dB(A):

- ***a) At a sensitive receiver in existence at the date of this approval; or***
- ***b) At any residential dwelling for which an approval has been sought or obtained under the*** **Environmental Planning and Assessment Act 1979** ***prior to the landholder receiving written notification that they are entitled to land acquisition rights, as per condition 2.25 of this approval; or***
- ***c) Over 25% or more of the area of a vacant allotment in existence at the date of this approval, and where a dwelling is permissible under the*** **Environmental Planning and Assessment Act 1979** ***at that date, with the exception of land that is currently used for industrial or mining purposes;***

The Proponent shall, upon receiving a written request for acquisition from the landowner, acquire the land in accordance with the procedures in conditions 2.22 to 2.24 of this approval.

Any landowner that has agreed to, or property that has been the subject of, the application of additional noise mitigation measures under condition 2.19 of this approval waives the right to land acquisition.

Compliance Assessment Observations and Comments

EnergyAustralia NSW has received no written or verbal requests from landowners to acquire their land.

Compliance Assessment Finding - Compliant

Minister’s Condition of Approval 2.21

The land acquisition rights under condition 2.20 of this approval do not apply to landowners who have sought approval to subdivide their land after the date of this approval, unless the subdivision is created pursuant to condition 2.24 of this approval.

Compliance Assessment Observations and Comments

No landholders have applied for approval to subdivide their land according to the land acquisition rights.

Compliance Assessment Finding - Not Applicable

Minister's Condition of Approval 2.22

Within three months of receiving a written request from a landowner with acquisition rights under condition 2.20 of this approval, the Proponent shall make a binding written offer to the landowner based on:

- ***a) The current market value of the landowner's interest in the property at the date of this written request, as if the property were unaffected by the project which is the subject of the project application, having regard to the:***
  - ***i. Existing and permissible use of the land, in accordance with the applicable planning instruments at the date of the written request; and***
  - ***ii. Presence of improvements on the property and/or any approved building or structure which has been physically commenced at the date of the landowner's written request, and is due to be completed subsequent to that date, but excluding any improvements that have resulted from the implementation of condition 2.19 of this approval;***
- ***b) The reasonable costs associated with:***
  - ***i. Relocating within the Lithgow local government area, or to any other local government area determined by the Director-General;***
  - ***ii. Obtaining legal advice and expert advice for determining the acquisition price of the land, and the terms upon which it is required; and***
- ***c) Reasonable compensation for any disturbance caused by the land acquisition process.***

However, if at the end of this period, the Proponent and landowner cannot agree on the acquisition price of the land, and/or the terms upon which the land is to be acquired, then either party may refer the matter to the Director-General for resolution.

Upon receiving such a request, the Director-General shall request the President of the NSW Division of the Australian Property Institute to appoint a qualified independent valuer or Fellow of the Institute, to consider submissions from both parties, and determine a fair and reasonable acquisition price for the land, and/or terms upon which the land is to be acquired.

Within 14 days of receiving an independent valuer's determinations, the Proponent shall make a written offer to purchase the land at a price not less than the independent valuer's determination.

If the landowner refuses to accept this offer within six months of the date of the Proponent's offer, the Proponent's obligations to acquire the land shall cease, unless otherwise agreed by the Director-General.

Compliance Assessment Observations and Comments

No landholders have applied for approval to subdivide their land according to the land acquisition rights.

Compliance Assessment Finding - Not Applicable

Minister's Conditions of Approval 2.23, 2.24 and 2.25

2.23- The Proponent shall bear the costs of any valuation or survey assessment requested by the independent valuer or the Director-General and the costs of determination referred to above.

2.24- If the Proponent and landowner agree that only part of the land shall be acquired, then the Proponent shall pay all reasonable costs associated with obtaining Council approval for any plan of subdivision (where permissible), and registration of the plan at the Office of the Registrar-General.

2.25- The Proponent shall provide written notice to all landowners that are entitled to rights under conditions 2.19 and 2.20 within 21 days of determining the landholdings were additional noise mitigation measures or land acquisition apply. For the purpose of condition 2.20b), this condition only applies where operational noise levels have been confirmed in accordance with the definition in condition 2.19.

Compliance Assessment Observations and Comments

No landholders have applied for approval to subdivide their land according to the land acquisition rights.

Compliance Assessment Finding - Not Applicable

Sawyers Swamp Creek realignment

EnergyAustralia NSW decided upon commencement of the Project that the realignment of SSC was not necessary. Therefore, the CoAs relating to SSC realignment are not applicable. This refers to CoAs 2.26 (a – m), 2.27, 2.28 and 2.29.

Surface water quality

Minister's Condition of Approval 2.30

The Proponent shall take all reasonable and feasible measures to prevent discharge of sediments and pollutants from the construction and operation of the project entering waterways.

Note: Section 120 of the* Protection of the Environment Operations Act 1997 *prohibits the pollution of water except where expressly provided by an Environmental Protection Licence.

Compliance Assessment Observations and Comments

No surface waters from KVAR Stage 2 are allowed to enter the SSC catchment. Measures to prevent surface water discharge include a series of collection ponds on site, with water reticulated around KVAR for the treatment of ash and dust suppression.

Surface waters from SSCAD were used for fire-fighting operations during the September 2019 Lidsdale fire, even though the Rural Fire Service were advised against the use of these waters.

Compliance Assessment Finding - Compliant

Minister's Condition of Approval 2.31
Earthworks not associated with the realignment of Sawyer Swamp Creek shall not be undertaken within 50m of the creek where reasonable and feasible.
Compliance Assessment Observations and Comments A minimum buffer zone of 50m has been maintained along the riparian area of SSC for all operations.
Compliance Assessment Finding - Compliant
Minister's Condition of Approval 2.32
All equipment, machinery and vehicles associated with the construction and operation of the project shall be operated and maintained in a manner that minimises the potential for oil and grease spills/leaks.
Compliance Assessment Observations and Comments Lend Lease supply EnergyAustralia NSW with Monthly Client Service Reports detailing site safety, ash placement, operations, environmental and maintenance aspects of site management. These maintenance records include general operations (truck maintenance and hours, ash analyses, sensor repairs, vent lines, line trips etc.), projects (unit outages, silo repairs and maintenance, valve repairs and maintenance etc.), incidents /near misses, training and safety. Monthly Client Service Reports may be viewed upon request.
Compliance Assessment Finding - Compliant

Air quality impacts

Minister’s Condition of Approval 2.33
The Proponent shall construct and operate the project in a manner that minimises dust impacts generated by construction works and operational activities, including wind-blown and traffic generated dust, on the receiving environment. All activities on the site shall be undertaken with the objective of preventing visible emissions of dust from the site. Should such visible dust emissions occur at any time, the Proponent shall identify and implement all practicable dust mitigation measures, including cessation of relevant works, as appropriate, such that emissions of visible dust cease.
Compliance Assessment Observations and Comments Dust management within the site is included in the responsibilities of all operations, including: • Use of perimeter sprays at the ash placement area; • Water cart (20,000 L) on site during all ash placement operations 8 am to 5 pm Mondays to Sundays; • Ash placement operations; • Final capping of ash; and • General maintenance and rehabilitation of the ash placement area.
Compliance Assessment Finding - Compliant
Minister’s Condition of Approval 2.34
The Proponent shall ensure that the load carrying compartment(s) of all ash haulage trucks are covered at all times except when loading or unloading ash material.
Compliance Assessment Observations and Comments No issues with load coverings were recorded for the 2019-20 reporting period.
Compliance Assessment Finding - Compliant

Lighting emissions

Minister's Condition of Approval 2.35

***The Proponent shall take all practicable measures to mitigate off-site lighting impacts from the project and ensure all external lighting associated with the project complies with* Australian Standard AS4282 1997 – Control of the Obtrusive Effects of Outdoor Lighting.**

Compliance Assessment Observations and Comments

Lend Lease Work Procedures Manual contains procedures that apply to all personnel and equipment operating at Kerosene Vale, including mobile lighting towers for ash placement operations, and details the responsibilities, application and procedures for using outdoor lighting for the project, within the project area.

Lights used to illuminate the tipping area must face south or east, operators must ensure the horizontal distance of the illuminated area is not less than 40m and as access to the repository for ash transport is between 7am and 10pm lights must be extinguished by 10pm.

The lights used at KVAR are the HILITE 4000 hired from Coates Hire Operations Pty Ltd. The specification sheets for these lights form part of the Work Procedures Manual for lighting.

Compliance Assessment Finding - Compliant

Construction traffic and transport impacts

Minister's Condition of Approval 2.36

The Proponent shall ensure that construction vehicles associated with the project:

- ***a) Minimise the use of local roads (though residential streets and town centres) to gain access to the site;***
- ***b) Adhere to any nominated haulage routes identified in the Construction Traffic Management Plan as referred to in condition 6.3a) of this approval; and***
- ***c) Adhere to a Construction Vehicle Code of Conduct prepared to manage driver behaviour along the local road network to address traffic impacts (and associated noise) along nominated haulage routes.***

Compliance Assessment Observations and Comments

A Construction Traffic Management Plan was submitted to and approved by the DP&I as part of the Construction Environment Management Plan.

Compliance Assessment Finding - Compliant

Heritage impacts

Minister’s Condition of Approval 2.37

The Proponent shall ensure that all construction personnel are educated on their obligations in respect of the protection of Aboriginal and non-indigenous heritage sites and items.

Compliance Assessment Observations and Comments

The Lend Lease Work Procedures Manual includes Environmental Management Controls for Cultural Heritage and applies to all personnel.

No aboriginal or other cultural heritage sites have been identified at Kerosene Vale. All of EnergyAustralia NSW’s cultural sites are listed in the Section 170 Heritage and Conservation Register.

Compliance Assessment Finding - Compliant

Minister’s Condition of Approval 2.38

If any previously unidentified heritage sites or items (Aboriginal and/or non-indigenous) are discovered during construction works or operational activities, all work likely to affect the heritage sites or item(s) is to cease immediately and the discovery of the objects shall be reported to DECC or the Department as relevant.

Compliance Assessment Observations and Comments

No previously unidentified heritage sites or items were discovered during the reporting period.

Compliance Assessment Finding - Not applicable

Waste management

Minister’s Condition of Approval 2.39

All waste materials shall be assessed, classified, managed and disposed of in accordance with **Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes** ***(EPA, 1999).***

Compliance Assessment Observations and Comments

Lend Lease provides Monthly Ash Placement Work Instructions to address all issues of routine site maintenance as part of a monthly work program. Waste management is conducted in accordance with EPA guidelines.

Compliance Assessment Finding - Compliant

Minister's Condition of Approval 2.40

All waste materials removed from the site shall only be directed to a waste management facility lawfully permitted to accept the materials.

Compliance Assessment Observations and Comments

Lend Lease utilises EnergyAustralia NSW's waste management facilities for wastes generated in the operation of the repository, including waste oils, general waste and materials for recycling. These are stored in intermediate storage facilities at Wallerawang Power Station and routinely removed by EnergyAustralia NSW's waste contractors. No additional waste materials were removed from the site during the reporting period.

Compliance Assessment Finding - Compliant

Minister's Condition of Approval 2.41

The Proponent shall not cause, permit or allow any waste generated outside the site to be received at the site for storage, treatment, processing, reprocessing, or disposal on the site, except as expressly permitted by a licence under the **Protection of the Environment Operations Act 1997*****, if such a licence is required in relation to that waste.***

Compliance Assessment Observations and Comments

No wastes generated outside the Kerosene Vale site are allowed to enter the area.

To prevent the unlawful access to the repository area, regular security patrols are conducted across the site. Both Lend Lease and EnergyAustralia NSW security personnel are required to report if they encounter any rubbish or wastes outside those that are allowed during routine operations.

Compliance Assessment Finding - Compliant

Environmental Monitoring

Construction noise monitoring

Minister's Condition of Approval 3.1
The Proponent shall prepare and implement a Construction Noise Monitoring Program to confirm the predictions of the noise assessment detailed in the document referred to under condition 1.1b) of this approval and assess compliance against the construction noise criterion stipulated in condition 2.7 of this approval. The noise monitoring program shall be prepared in consultation with, and to the satisfaction of, the DECC. The monitoring program shall form part of the Construction Noise Management Plan referred to in condition 6.3b) of this approval and must include monitoring of the construction noise generated during: ***a) The realignment of Sawyers Swamp Creek;*** ***b) Construction of the stabilisation berm;*** ***c) Excavation of the former pine plantation area;*** ***d) Relocation and construction of surface water management structures; and*** ***e) Concurrent construction activities.*** ***The Proponent shall forward to the DECC and the Director-General a report containing the results of each noise assessment and describing any non-compliance within 14 days of conducting a noise assessment.***
Compliance Assessment Observations and Comments A CEMP was prepared for the construction works associated with the development of KVAR Stage 2B in preparation for ash placement, including a Construction Noise Management Plan and Noise Monitoring Program. This was submitted to DP&I in August 2011 and approved on the 16th December 2011. No construction activities took place during the reporting period.
Compliance Assessment Finding - Compliant

Operational noise review

Minister's Condition of Approval 3.2
Within 60 days of the commencement of operation of the project, unless otherwise agreed to by the Director-General, the Proponent shall submit for the approval of the Director-General an Operational Noise Review to confirm the operational noise impacts of the project. The Operational Noise Review must be prepared in consultation with, and to the satisfaction of, the DECC. The Review shall: ***a) Identify the appropriate operational noise objectives and level for sensitive receivers;*** ***b) Describe the methodologies for noise monitoring including the frequency of measurements and location of monitoring sites;*** ***c) Document the operational noise levels at sensitive receivers as ascertained by the noise monitoring program;*** ***d) Assess the noise performance of the project against the noise criterion specified in condition 2.15 of this approval and the predicted noise levels as detailed in the report referred to under condition 1.1b) of this approval; and*** ***e) Provide details of any entries in the Complaints Register (as required under condition 5.4 of this approval) relating to noise impacts.*** ***Where monitoring indicates noise levels in excess of the operational noise criterion specified in condition 2.15 of this approval, the Proponent shall prepare a report as required by condition 2.18 of this approval.***
Compliance Assessment Observations and Comments The Operational Noise Review (Parsons Brinckerhoff, 2009) was submitted to the DP&I on 16 September 2009, and the Department acknowledged its satisfaction that CoA 3.2 had been met on 18 September 2009.
Compliance Assessment Finding - Compliant

Ongoing operational noise monitoring

Minister's Condition of Approval 3.3
The Proponent shall prepare and implement an Operational Noise Monitoring Program to assess compliance against the operational noise criterion stipulated in condition 2.15 of this approval, throughout the life of the project. The noise monitoring program shall be prepared in consultation with, and to the satisfaction of, the DECC. ***The noise monitoring program shall be prepared in accordance with the requirements of the*** **New South Wales Industrial Noise Policy** ***(EPA, 2000) and must include, but not be limited to:*** ***a) Monitoring during ash placement in the far western area of the site adjacent to the haul road; and*** ***b) Monitoring of the effectiveness of any noise mitigation measures implemented under condition 2.18 of this approval, against the noise criterion specified in condition 2.15 of this approval.*** ***Noise from the project is to be measured at the most affected point on or within the residential boundary, or at the most affected point within 30 metres of a dwelling where the dwelling is more than 30 metres from the boundary, to determine compliance with the noise criterion stipulated in condition 2.15 of this approval. Where it can be demonstrated that direct measurement of noise from the project is impractical, the DECC may accept alternative means of determining compliance (see Chapter 11 of the*** **NSW Industrial Noise Policy*****). The modification factors in Section 4 of the*** **NSW Industrial Noise Policy** ***shall also be applied to the measured noise levels where applicable.*** ***The Proponent shall forward to the DECC and the Director-General a report containing the results of any non-compliance within 14 days of conducting a noise assessment.*** ***Where monitoring indicates noise levels in excess of the operational noise criterion specified in condition 2.15 of this approval, the Proponent shall prepare a report as required by condition 2.18 of this approval.*** ***The monitoring program shall form part of the Operational Noise Management Plan referred to in condition 6.5a) of this approval.***
Compliance Assessment Observations and Comments An Operational Noise Monitoring Program in the form of the Operational Noise sub-plan was developed as part of the OEMP (EANSW, 2018) and provided to EnergyAustralia to determine the minimum monitoring requirements for noise following receipt of approval from the DP&I. EnergyAustralia NSW continue to implement the required noise monitoring assessments. No non-compliances were identified during the reporting period.
Compliance Assessment Finding - Compliant

Groundwater monitoring

Minister's Condition of Approval 3.4
The Proponent shall prepare and implement a Groundwater Monitoring Program to monitor the impacts of ash placement activities on local groundwater quality and hydrology. The program shall be developed in consultation with, and to the satisfaction of, the SCA, and shall describe the location, frequency, rationale and procedures and protocols for collecting groundwater samples, as well as the parameters analysed and methods of analysis. The monitoring program shall be ongoing for the life of the project and include, but not be limited to: ***a) Monitoring at established bore sites (or replacement bore sites in the event that existing sites are damaged or lost) as described in the document referred to under condition 1.1b) of this approval; and*** ***b) A schedule for periodic monitoring of groundwater quality, depth and flow at all monitoring sites, at an initial frequency of no less than once every month for the first 12 months of operation.*** ***The monitoring program shall form part of the Groundwater Management Plan referred to in condition 6.5b) of this approval.***
Compliance Assessment Observations and Comments A Groundwater Monitoring Program in the form of the Groundwater Quality sub-plan was developed as part of the OEMP (EANSW, 2018) and provided to EnergyAustralia NSW, then Delta, to determine the minimum monitoring requirements for groundwater following receipt of approval from the DP&I.
Compliance Assessment Finding - Compliant

Surface water quality monitoring

Minister's Condition of Approval 3.5
The Proponent is to implement a surface water quality monitoring program to monitor the impacts of the ash placement activities on, and the realignment of, Sawyers Swamp Creek. The Program shall be developed in consultation with and to the satisfaction of the DPI (Fisheries) and SCA, and shall describe the location, frequency, rationale and the procedures and protocols for collecting water samples as well as the parameters analysed and methods of analysis. The program shall include, but not necessarily be limited to: ***a) Monitoring at the four-existing water quality monitoring sites as described in the document referred to under 1.1b) of this approval;*** ***b) Monitoring downstream of the realigned section of Sawyers Swamp Creek;*** ***c) Monitoring at groundwater discharge points into Sawyers Swamp Creek;*** ***d) Wet weather monitoring with a minimum of two events recorded within the first 12 months of both the operation of the project and post realignment of Sawyers Swamp Creek; and*** ***e) A schedule for periodic monitoring of surface quality at all sites throughout the life of the project, at an initial frequency of no less than once every month for the first 12 months and must include, but not be limited to, dissolved oxygen, turbidity, total phosphorus and total nitrogen.*** ***The monitoring program shall form part of the Surface Water Management Plan referred to in condition 6.5c) of this approval.***
Compliance Assessment Observations and Comments A surface water Monitoring Program in the form of the surface water Quality sub-plan was developed as part of the OEMP (EANSW, 2018) and provided to Delta to determine the minimum monitoring requirements for surface water following receipt of approval from the DP&I.
Compliance Assessment Finding - Compliant

Sawyers Swamp Creek realignment monitoring

EnergyAustralia NSW decided upon commencement of the Project that the realignment of SSC was not necessary. Therefore, CoAs 3.6 and 3.7 relating to SSC realignment are not applicable.

Air quality monitoring

Minister's Condition of Approval 3.8

The Proponent shall prepare an Air Quality Monitoring Program, in consultation with, and to the satisfaction of, the DECC. The Program shall include but not necessarily be limited to, monitoring for dust at the monitoring sites identified in the document referred to under condition 1.1b) of this approval. The air quality monitoring program shall be ongoing for the life of the project, including final rehabilitation and stabilisation of the site.

The monitoring program shall form part of the Air Quality Management Plan referred to in condition 6.5d) of this approval.

Compliance Assessment Observations and Comments

An air quality monitoring program in the form of the air quality sub-plan was developed as part of the OEMP (EANSW, 2018) and provided to Delta to determine the minimum monitoring requirements for air quality following receipt of approval from the DP&I.

Dust monitoring results are recorded monthly with colour and textural observations. These results indicate that KVAR is managed effectively for ash dust and as such is in compliance with CoAs 2.33 and 3.8.

Compliance Assessment Finding - Compliant

Compliance Monitoring and Tracking

Minister's Condition of Approval 4.1

Prior to each of the events listed below, the Proponent shall certify in writing to the satisfaction of the Director-General that it has complied with all conditions of this approval applicable prior to that event:

- ***a) Commencement of any construction works on the land subject of this approval; and***
- ***b) Commencement of operation of the project.***

Compliance Assessment Observations and Comments

The DP&I indicated its satisfaction that EnergyAustralia NSW had met the relevant pre-operational requirements of this project before commencement in 2009. This included submission of a Pre-Operation Compliance Report, Compliance Tracking Program, and the Operation Environmental Management Plan.

Compliance Assessment Finding - Compliant

Minister's Condition of Approval 4.2

The Proponent shall develop and implement a Compliance Tracking Program for the project, prior to commencing operations, to track compliance with the requirements of this approval and shall include, but not necessarily be limited to:

- ***a) Provisions for periodic review of the compliance status of the project against the requirements of this approval and the Statement of Commitments detailed in the document referred to in condition 1.1c) of this approval;***
- ***b) Provisions for periodic reporting of the compliance status to the Director-General;***
- ***c) A program for independent environmental auditing in accordance with*** **AS/NZ ISO 19011:2003 – Guidelines for Quality and/or Environmental Management Systems Auditing*****;***
- ***d) Procedures for rectifying any non-compliance identified during environmental auditing or review of compliance;***
- ***e) Mechanisms for recording environmental incidents and actions taken in response to those incidents;***
- ***f) Provisions for reporting environmental incidents to the Director-General during construction and operation; and***
- ***g) Provisions for ensuring all employees, contractors and sub-contractors are aware of, and comply with, the conditions of this approval relevant to their respective activities.***

The Compliance Tracking Program shall be implemented prior to operation of the project with a copy submitted to the Director-General for approval within four weeks of commencement of the project, unless otherwise agreed by the Director-General.

Compliance Assessment Observations and Comments

Environmental incidents that may occur in respect to KVAR Stage 2 operations are reported in accordance with the Operation Environmental Management Plan (EANSW, 2018) and are captured within the Environmental Management System. Annual reporting requirements are covered by the preparation of the AEMR.

Sections of the Minister approved OEMP that relate to this Condition include:

- Section 3.8 Environmental Audits (CoA 4.2c);
- Section 3.8 Environmental Audits and Section 3.8.1 Non-Compliances (CoA 4.2d);
- Section 3.9 Environmental Incidents Management (CoA 4.2e);
- Section 3.9 Environmental Incidents Management (CoA4.2f); and
- Section 3.5 Environmental Awareness Training and Site Inductions (4.2g).

Lend Lease have included the directive in the Repository Site Management Plan (Conneq, 2010) that formal site management processes be documented monthly and weekly in line with the OEMP and the Repository Management Plan. The Monthly Client Service Reports are used as a method for recording any incidences.

Compliance Assessment Finding - Compliant

Minister’s Condition of Approval 4.3 and 4.4
CoA 4.3 – Nothing in this approval restricts the Proponent from utilising any existing compliance tracking programs administered by the Proponent to satisfy the requirements of condition 4.2. In doing so, the Proponent must demonstrate to the Director-General how these systems address the requirements and/or have been amended to comply with the requirements of the condition. ***CoA 4.4 – The Proponent shall meet the requirements of the Director-General in respect of the implementation of any measure necessary to ensure compliance with the conditions of this approval, and general consistency with the documents listed under condition 1.1 of this approval.***
Compliance Assessment Observations and Comments This project has a Minister approved OEMP (EANSW, 2018). The project also operates under EnergyAustralia NSW’s ISO14001 accreditation and Environmental Management System. The Secretary has not issued any requests to implement any additional measure to ensure compliance with the relevant CoAs for the KVAR Stage 2 project.
Compliance Assessment Finding - Not applicable

Community Information and Complaints Management

Provision of Information

Minister's Conditions of Approval 5.1 and 5.2
Prior to the commencement of the project, the Proponent shall establish and maintain a website for the provision of electronic information associated with the project. The Proponent shall, subject to confidentiality, publish and maintain up-to-date information on this website or dedicated pages including, but not necessarily limited to: ***a) The documents referred to under condition 1.1 of this approval;*** ***b) This project approval, Environment Protection Licence and any other relevant environmental approval, licence or permit required and obtained in relation to the project;*** ***c) All strategies, plans and program required under this project approval, or details of where this information can be viewed;*** ***d) Information on construction and operational progress;*** ***e) The outcomes of compliance tracking in accordance with the requirements of this project approval.*** ***5.2 – The Proponent shall make all documents required to be provided under condition 5.1 of this approval publicly available.***
Compliance Assessment Observations and Comments EA have developed a specific project website for Kerosene Vale Ash Repository that enables the provision of electronic information listed within CoA 5.1. A link to this web page is below. https://www.energyaustralia.com.au/about-us/energy-generation/wallerawang-power-station-closure/kerosene-vale-ash-repository The website includes: • Major Project Application 07_0005 • Kerosene Vale – Stage 2 Ash Repository Area (two volumes) – Environmental Assessment prepared by Parsons Brinckerhoff and dated 1 April 2008. (Parsons Brinckerhoff, 2008a) • Kerosene Vale – Stage 2 Ash Repository Area – Submissions Report prepared by Parsons Brinckerhoff and dated 30 May 2008. (Parsons Brinckerhoff, 2008b) • Project Approval (Conditions of Approval) File S07/00001, dated 26 November 2008. • Construction Environment Management Plan (Conneq, 2011) • Operation Environment Management Plan (EANSW, 2018) • Copies of previous Annual Environment Management Reports The Environment Protection Licence and Pollution Incident Response Management Plan are available at the web page below: https://www.energyaustralia.com.au/about-us/energy-generation/wallerawang-power-station-closure/wallerawang-epa-reports.

Community information on construction and operational progress is provided on the web page below: https://www.energyaustralia.com.au/about-us/energy-generation/mt-piper-power-station/mt-piper-and-wallerawang-community. The Water Access Licence and Water Supply Work and Water Use Approval are available at the web page below: https://www.energyaustralia.com.au/about-us/energy-generation/mt-piper-power-station/mt-piper-and-wallerawang-water-data
Compliance Assessment Finding - Compliant

Complaints and enquiries procedure

Minister's Condition of Approval 5.3
Prior to the commencement of the project, the Proponent shall ensure that the following are available for community complaints and enquiries during construction and operation: ***a) A 24-hour contact number(s) on which complaints and enquiries about construction and operational activities may be registered;*** ***b) A postal address to which written complaints and enquiries may be sent; and*** ***c) An email address to which electronic complaints and enquiries may be sent; and*** ***d) An email address to which electronic complaints and enquiries may be transmitted.*** ***The telephone number, postal address and email address shall be published in a newspaper circulating in the local area prior to the commencement of the project. The above details shall also be provided on the website required by condition 5.1 of this approval.***
Compliance Assessment Observations and Comments The website: https://www.energyaustralia.com.au/about-us/energy-generation/mt-piper-power-station lists the following contact details for the project: 24-hour contact number - via the Switchboard on 02 6354 8111 Postal address: Environment Specialist EnergyAustralia NSW Locked Bag 1000, Portland NSW 2847 Email: contactus@energyaustraliansw.com.au
Compliance Assessment Finding - Compliant

Minister's Condition of Approval 5.4

The Proponent shall record the details of all complaints received through the means listed under condition 5.3 of this approval in an up-to-date Complaints Register. The Register shall record, but not necessarily be limited to:

- ***a) The date and time of the complaint;***
- ***b) The means by which the complaint was made (e.g. telephone, email, mail, in person);***
- ***c) Any personal details of the complainant that were provided, or if no details were provided a note to that effect;***
- ***d) The nature of the complaint;***
- ***e) The time taken to respond to the complaint;***
- ***f) Any investigations and actions taken by the Proponent in relation to the complainant; and***
- ***g) If no action was taken by the Proponent in relation to the complaint, the reason(s) why no action was taken.***

The Complaints Register shall be made available for inspection by the Director-General upon request.

Compliance Assessment Observations and Comments

Any complaints called in to EnergyAustralia NSW go via the switchboard (02 6354 8111) and are then redirected to the appropriate area of EnergyAustralia NSW operations.

All complaints are recorded in the Ellipse system in the Incidents and Complaints Register with all details captured including actions to be taken if necessary.

If actions were necessary, a review of those actions is undertaken before the work order is closed.

No complaints were received regarding KVAR for the reporting period.

Compliance Assessment Finding - Compliant

Environmental Management

Environmental representative

Minister's Condition of Approval 6.1
Prior to the commencement of any construction or operational activities, or as otherwise agreed by the Director-General, the Proponent shall nominate for the approval of the Director-General a suitably qualified and experienced Environmental Representative(s) independent of the design, construction and operation personnel. The Proponent shall engage the Environmental Representative(s) during any construction activities, and throughout the life of the project, or as otherwise agreed by the Director-General. The Environmental Representative(s) shall: ***a) Oversee the implementation of all environmental management plans and monitoring programs required under this approval, and advise the Proponent upon the achievements of these plans/programs;*** ***b) Have responsibility for considering and advising the Proponent on matters specified in the conditions of this approval and the Statement of Commitments as referred to under condition 1.1c) of this approval;*** ***c) Oversee the implementation of the environmental auditing of the project in accordance with the requirements of condition 4.2 of this approval and all relevant project Environmental Management System(s); and*** ***d) Be given the authority and independence to recommend to the Proponent reasonable steps to be taken to avoid or minimise unintended or adverse environmental impacts, and, failing the effectiveness of such steps, to recommend to the Proponent that relevant activities are to be ceased as soon as reasonably practicable if there is a significant risk that an adverse impact on the environment will be likely to occur.***
Compliance Assessment Observations and Comments In March 2009 EnergyAustralia NSW nominated the Environment Manager- Western Nino di Falco as the Environmental Representative. The Environment Manager oversees the implementation of all operations at KVAR through attendance at Monthly Client Meetings with Lend Lease and regular liaison with the External Plant Manager. The Environment Manager guides the project through site visits, sampling and other regulatory activities to ensure compliance with the environmental requirements of the CoAs and all relevant licences. In February 2015, EnergyAustralia NSW notified the DPE of Mr di Falco's retirement and nominated the new Environment Manager, Peter Griffiths, as the Environmental Representative. Furthermore, in a letter dated 19 January 2017, EnergyAustralia NSW notified the DPE of Peter Griffiths appointment to Safety Leader within the Organisation and nominated the new NSW Environment Leader, Ben Eastwood, as the Environmental Representative, which was agreed to by the Secretary in a letter dated 28 February 2017.
Compliance Assessment Finding - Compliant

Construction environmental management

Minister's Conditions of Approval 6.2 and 6.3

6.2 – Prior to the commencement of construction work, the Proponent shall prepare and implement a Construction Environmental Management Plan (CEMP). The CEMP shall outline the environmental management practices and procedures to be followed during construction. The CEMP shall be prepared in accordance with **Guideline for the Preparation of Environmental Management Plans** ***(DIPNR, 2004).***

The Construction Environmental Management Plan for the project (or any stage of the project) shall be submitted to the Director General for approval at least four weeks prior to the commencement of any construction work associated with the project (or stage as relevant), unless otherwise agreed by the Director-General. Construction shall not commence until written approval has been received from the Director-General.

6.3 – As part of the Construction Environmental Management Plan for the project, the Proponent shall prepare and implement the following plans:

- ***a) A Construction Traffic Management Plan, prepared in consultation with the RTA, the relevant Council and emergency services to manage the construction traffic impacts of the project, including but not limited to:***
  - ***i. Identifying construction vehicle volumes (construction staff vehicles, heavy vehicles and oversized loads) and haulage routes;***
  - ***ii. Identifying any road closures and/or traffic detours during the haulage of oversized loads as agreed to by the relevant roads authority;***
  - ***iii. Detailing a Construction Vehicle Code of Conduct to set driver behaviour controls to minimise impacts on the land uses along haulage routes (including noise minimisation measures); and***
  - ***iv. Complying with the document*** **Procedures for Use in the Preparation of a Traffic Management Plan** ***(RTA, 2011).***
- ***b) A Construction Noise Management Plan to detail how construction noise impacts would be minimised and managed. The Strategy shall be developed in consultation with, and to the satisfaction of, the DECC and shall include, but not necessarily be limited to:***
  - ***i. Details of construction activities and an indicative schedule for construction works;***
  - ***ii. Identification of construction activities that have the potential to generate noise impacts on sensitive receivers;***
  - ***iii. Procedures for assessing noise levels at sensitive receivers and compliance;***
  - ***iv. Details of the reasonable and feasible actions and measures to be implemented to minimise noise impacts and, if any noise exceedence is detected, how any non-compliance would be rectified; and***
  - ***v. Procedures for notifying sensitive receivers of construction activities that are likely to affect their noise amenity.***
- ***c) An Erosion and Sediment Control Plan to detail measures to minimise erosion and the discharge of sediment and other pollutants to land and/or water during construction works. The Plan must include, but not necessarily be limited to:***
  - ***i. Identification of the construction activities that could cause soil erosion or discharge sediment or water pollutants from the site;***

ii. A description of the management methods to minimise soil erosion or discharge of sediment or water pollutants from the site, including a strategy to minimise the area of bare surfaces, stabilise disturbed areas, and minimise bank erosion; and   ***Demonstration that the proposed erosion and sediment control measures will conform with, or exceed, the relevant requirements of*** **Managing Urban Stormwater: Soils and Construction** ***(Landcom, 2004).***
Compliance Assessment Observations and Comments   A Construction Environmental Management Plan for KVAR Stage 2B was developed in consultation with EnergyAustralia NSW's Western Environment Section and approved by the DP&I in August 2011.
Compliance Assessment Finding - Compliant

Operational environmental management

Minister's Conditions of Approval 6.4 and 6.5
6.4 – The Proponent shall prepare and implement and Operation Environmental Management Plan to detail an environmental management framework, practices and procedures to be followed during operation of the project. The Plan shall be consistent with **Guideline for the Preparation of Environmental Management Plans** ***(DIPNR, 2004) and shall include, but not be limited to:***   ***a) Identification of all statutory and other obligations that the Proponent is required to fulfil in relation to operation of the project, including all approvals, licences and consultations;***   ***b) A description of the roles and responsibilities for all relevant employees (including contractors) involved in the operation of the project;***   ***c) Overall environmental policies and principles to be applied to the operation of the project***   ***d) Standards and performance measures to be applied to the project, and a means by which environmental performance can be periodically reviewed and improved, where appropriate;***   ***e) Management policies to ensure that environmental performance goals are met and to comply with the conditions of this approval;***   ***f) The additional plans listed under condition 6.5 of this approval; and***   ***g) The environmental monitoring requirements outlined under conditions 3.3 to 3.5 inclusive and 3.8 of this approval.***   ***The Plan shall be submitted for the approval of the Director-General no later than four weeks prior to the commencement of operation of the project, unless otherwise agreed by the Director-General. Operation shall not commence until written approval has been received from the Director-General.***   ***Nothing in this approval precludes the Proponent from incorporating the requirements of the Operational Environmental Management Plan into existing environmental management systems and plan administered by the Proponent.***   ***6.5 – As part of the Operation Environmental Management Plan for the project, required under condition 6.4 of this approval, the Proponent shall prepare and implement the following Management Plans:***

a) An Operational Noise Management Plan to detail measures to mitigate and manage noise during operation of the project. The Plan shall be prepared in consultation with, and to the satisfaction of, the DECC and include, but not necessarily be limited to:

- ***i. Procedures to ensure that all reasonable and feasible noise mitigation measures are applied during operation of the project;***
- ***ii. Identification of all relevant sensitive receivers and the applicable criteria at those receivers commensurate with the noise limit specified under condition 2.15 of this approval;***
- ***iii. Identification of activities that will be carried out in relation to the project and the associated noise sources;***
- ***iv. Noise monitoring procedures (as referred to in condition 3.3 of this approval) for periodic assessment of noise impacts at the relevant receivers against the noise limits specified under this approval and the predicted noise levels as detailed in the report referred to under condition 1.1b) of this approval;***
- ***v. Details of all management methods and procedures that will be implemented to control individual and overall noise emissions from the site during operation;***
- ***vi. Procedures and corrective actions to be undertaken if non-compliance against the operational noise criteria is detected; and***
- ***vii. Provisions for periodic reporting of results to DECC.***

b) A Groundwater Management Plan to detail measures to mitigate and manage groundwater impacts. The Plan shall be prepared in consultation with, and to the satisfaction of, the SCA and include, but not necessarily be limited to:

- ***i. Baseline data on groundwater quality, depth and flow in the project area;***
- ***ii. Groundwater objectives and impact assessment criteria;***
- ***iii. A program to monitor groundwater flows and groundwater quality in the project area as required by condition 3.4 of this approval;***
- ***iv. A protocol for the investigation of identified exceedences of the groundwater impact assessment criteria;***
- ***v. A response plan to address potential exceedences and groundwater impacts; and***
- ***vi. Provisions for periodic reporting of results to the SCA.***

c) A Surface Water Management Plan to outline measures that will be employed to manage water on the site, to minimise soil erosion and the discharge of sediments and other pollutants to land and/or waters throughout the life of the project. The Plan shall be based on best environmental practice and shall be prepared in consultation with, and to the satisfaction of, the SCA and DPI (Fisheries). The Plan shall include, but not necessarily be limited to:

- ***i. Baseline data on the water quality and flow in Sawyers Swamp Creek up to the date of this approval;***
- ***ii. Water quality objectives and impact assessment criteria for Sawyers Swamp Creek;***
- ***iii. A program to monitor surface water quality in Sawyers Swamp Creek as referred to in condition 3.5 of this approval;***
- ***iv. A protocol for the investigation of identified exceedences in the impact assessment criteria;***
- ***v. A response plan to address potential adverse surface water quality exceedences;***

vi. A site water management strategy identifying clean and dirty water areas for Stage A, B and C of the project and the associated water management measures including erosion and sediment controls and provisions for recycling/reuse of water and the procedures for decommissioning water management structures on the site; and

vii. Provisions for periodic reporting of results to the DPI (Fisheries) and the SCA.

d) An Air Quality Management Plan to outline measures to minimise impacts from the project on local air quality. The Plan shall be prepared in consultation with, and to the satisfaction of, the DECC and include, but not necessarily be limited to:

- ***i. Baseline data on dust deposition levels;***
- ***ii. Air quality objectives and impact assessment criteria;***
- ***iii. An air quality monitoring program as referred to in condition 3.8 of this approval;***
- ***iv. An assessment of alternative methods of ash placement to minimise the exposure of active placement areas to prevailing winds;***
- ***v. Mitigation measures to be incorporated during emplacement activities and haulage of ash;***
- ***vi. An operating protocol for the repository irrigation system including activation rates, application rates and area of coverage;***
- ***vii. A protocol for the investigation of visible emissions from the repository area;***
- ***viii. A response plan to address visible emissions from the repository area; and***
- ***ix. Provisions for periodic reporting of results to the DECC.***

e) A Landscape/Revegetation Plan to outline measures to minimise the visual impacts of the repository and ensure the long-term stabilisation of the site and compatibility with the surrounding land fabric and land use. The Plan shall include, but not necessarily be limited to:

- ***i. Identification of design objectives and standards based on local environmental values, vistas, and land uses;***
- ***ii. A description of short- and long-term revegetation measures;***
- ***iii. A schedule of species to be used in revegetation;***
- ***iv. Timing and progressive implementation of revegetation works as placement areas are completed, including landscape plans; and***
- ***v. Procedures and methods to monitor and maintain revegetated areas during the establishment phase and long-term.***

Revegetation works must incorporate the use of local native species.

Compliance Assessment Observations and Comments

The Operation Environmental Management Plan was prepared by Parsons Brinckerhoff. Approval was granted in April 2009 and operations at KVAR Stage 2 commenced in September 2009. The OEMP was reviewed by EnergyAustralia NSW during the 2017-18 reporting period to ensure that it reflects the current Care and Maintenance activities. The reviewed OEMP was prepared in consultation with the EPA, WaterNSW, DPI-Water, DPI-Fisheries and was approved by the Director on the 21 November 2018.

Compliance Assessment Finding - Compliant

Environmental Reporting

Environmental incident reporting

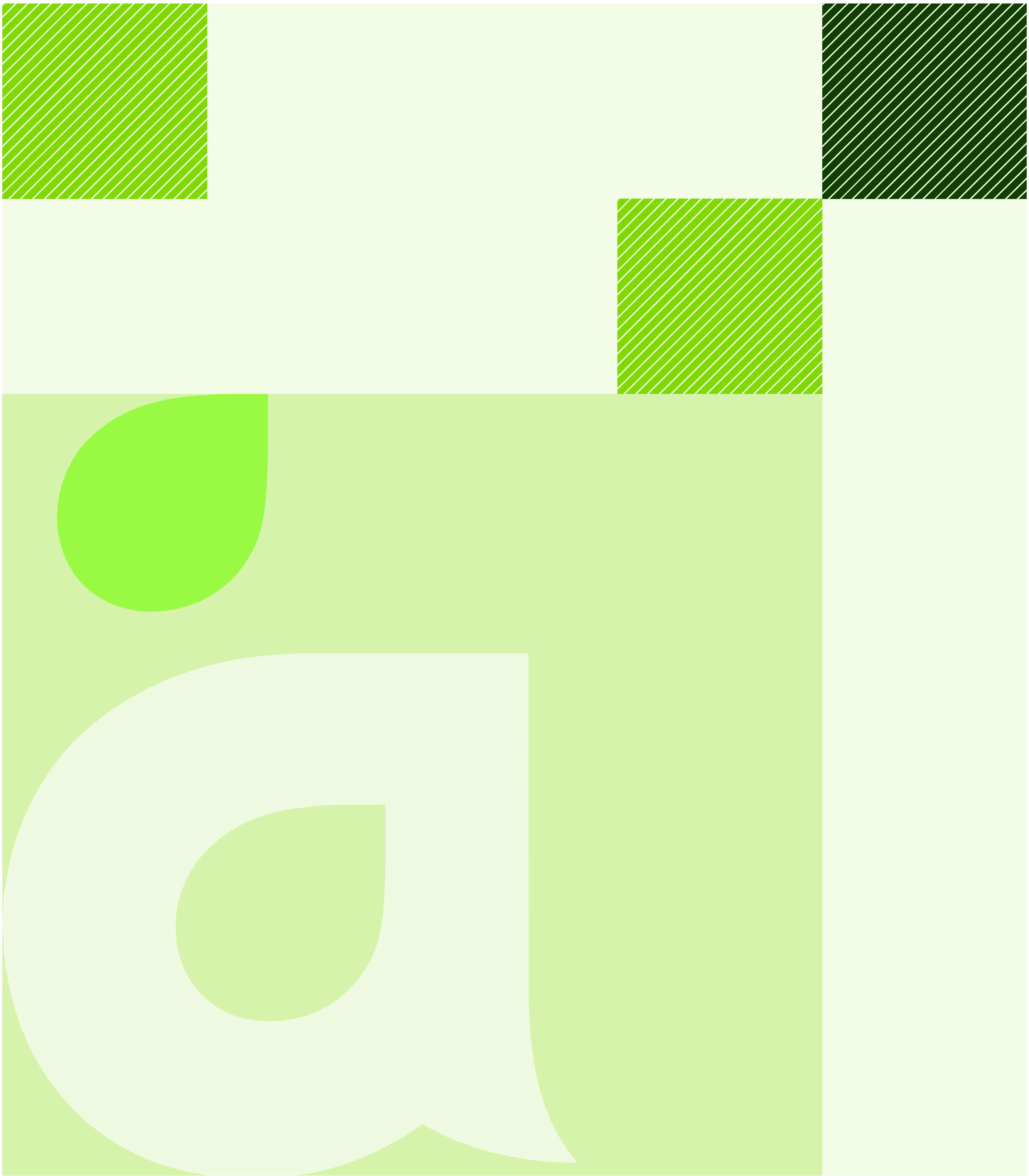
Minister's Conditions of Approval 7.1 and 7.2
7.1 – The Proponent shall notify the Director-General of any environmental incident within 12 hours of becoming aware of the incident. The Proponent shall provide full written details of the incident to the Director-General within seven days of the date on which the incident occurred. ***7.2 – The Proponent shall meet the requirements of the Director-General to address the cause or impact of any environmental incident, as it related to this approval, reported in accordance with condition 7.1 of this approval, within such period as the Director-General may require.***
Compliance Assessment Observations and Comments There was one reportable incident during the 2019-2020 reporting period. A bushfire at Lidsdale occurred over the weekend of 7th and 8th September 2019, which caused damage to WADA infrastructure, including pumps, above ground HDPE and asbestos pipeline. An uncontrolled release of a small volume of seepage water reported to Sawyers Swamp Creek. Additional water from the Sawyers Swamp Creek Ash Dam, utilised by helicopters to suppress the fire, has contributed to a white precipitate forming in Sawyers Swamp Creek and friable asbestos being spread from the damaged asbestos pipeline. The Department of Planning, Infrastructure & Environment were notified of the incident on Monday 9th September 2019.
Compliance Assessment Finding - Compliant

Annual performance reporting

Minister's Condition of Approval 7.3
The Proponent shall, throughout the life of the project, prepare and submit for the approval of the Director-General, an Annual Environmental Management Report (AEMR). The AEMR shall review the performance of the project against the Operation Environmental Management Plan (refer to condition 6.4 of this approval) and the conditions of this approval. The AEMR shall include, but not necessarily by limited to: ***a) Details of compliance with the conditions of this approval;*** ***b) A copy of the Complaints Register (refer to 5.4 of this approval) for the preceding twelve-month period (exclusive of personal details), and details of how these complaints were addressed and resolved;*** ***c) Identification of any circumstances in which the environmental impacts and performance of the project during the year have not been generally consistent with the environmental impacts and performance predicted in the documents listed under condition 1.1 of this approval, with details of additional mitigation measures applied to the project to address recurrence of these circumstances;*** ***d) Results of all environmental monitoring required under conditions 3.3 to 3.8 of this approval, including interpretations and discussion by a suitably qualified person; and***

e) A list of all occasions in the preceding twelve-month period when environmental goals/objectives/impact assessment criteria for the project have not been achieved, indicating the reason for failure to meet the criteria and the action taken to prevent recurrence of that type of failure. ***The Proponent shall submit a copy of the AEMR to the Director-General every year, with the first AEMR to be submitted no later than twelve months after the commencement of operation of the project. The Director-General may require the Proponent to address certain matters in relation to the environmental performance of the project in response to review of the Annual Environmental Report. Any action required to be undertaken shall be completed within such period as the Director-General may require. The Proponent shall make copies of each AEMR available for public inspection on request.***
Compliance Assessment Observations and Comments This AEMR satisfies the requirements of CoA 7.3.
Compliance Assessment Finding - Compliant

Appendix B
KVAR Stage 2 Noise Report – June 2019



aurecon

Project: Kerosene Vale Ash Repository Stage 2

Ongoing operational noise measurements (June 2019)

Prepared for:
EnergyAustralia NSW

Project: 247023

22 July 2019

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Document prepared by:

Aurecon Australasia Pty Ltd
ABN 54 005 139 873
Level 5, 116 Military Road
Neutral Bay NSW 2089
PO Box 538
Neutral Bay NSW 2089
Australia

T +61 2 9465 5599
F +61 2 9465 5598
E sydney@aurecongroup.com
W aurecongroup.com

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Approval

Author Signature		Approver Signature	
Name	Yogi Kalkunte	Name	Les Thorpe
Title	Acoustic Consultant	Title	Project Director

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1 Introduction

Aurecon was engaged by EnergyAustralia NSW to carry out ongoing operational noise measurements for the Kerosene Vale Stage 2 Ash Repository (KVAR) located in Wallerawang NSW, in accordance with Project Approval Application No. 07_0005. Noise measurements were conducted from Friday 28 June to Saturday 29 June 2019, during the morning and evening periods, as per the requirements outlined in the KVAR Stage 2 Operational Noise and Vibration Management Plan (ONVMP).

1.1 Site Details

The project site consists of an Ash Repository which services the nearby Wallerawang Power Station (WPS). During normal operation of the KVAR Stage 2, the following major noise emissions would be expected.

- Unloading of ash from trucks at the repository.
- Placement and handling of ash at the repository site.
- Operation of trucks on the private haulage road; this includes trucks leaving WPS loaded with ash (travelling north) and returning from the repository empty (travelling south).
- Water pumps operating at the repository.
- Water cart driving around.

WPS is currently being decommissioned, and as such KVAR is no longer fully operational.

Figure 1 shows the site layout and location of sensitive receivers relative to the major noise sources which include the decommissioned WPS, as well as major roads in the area. Table 1 outlines the most affected sensitive receivers and their distance to the haulage road.

Table 1: Representative sensitive receivers

Representative sensitive receiver	Distance to haulage road (meters)*
60 Skelly Road	300
10 Skelly Road	270
21 Neubeck Street	145

***** *distance relates to the property boundary or a point 30m from the dwelling location*

It should be noted that coal supply trucks also utilise the private haulage road. Their noise impacts are not considered to be part of the Stage 2 KVAR works and hence outside the scope of this report. While undertaking noise measurements it is extremely difficult to visually distinguish between coal supply trucks and ash trucks, therefore EnergyAustralia NSW has provided us with the number of ash truck movements during the monitoring period, to assist in the prediction of noise impacts resulting from these movements.

Figure 1 | Site details and Measurement Locations

2 Noise criteria

The applicable operational noise criteria are outlined in the Project Approval, Application No. 07_0005. The criteria are summarised in Condition 2.15 as follows:

> *2.15 The cumulative operational noise from the ash placement area and ash haulage activity shall not exceed a* **$L_{Aeq\ (15\ minute)}$ *of 40 dB(A)*** *at the nearest most affected sensitive receiver during normal operating hours as defined in condition 2.8.*
>
> *This criterion applies under the following meteorological conditions:*
>
> *a) Wind speeds up to 3 m/s at 10 meters above ground*[1]*; and/or*
> *b) Temperature inversion conditions of up to 3°C/100 m and source to receiver gradient winds of up to 2 m/s at 10 m above ground level*

Normal operating hours in accordance with condition 2.8 are 7:00 am to 10:00 pm Monday to Sunday.

---

[1] As per AS 1055.1 – 1997, noise measurements should be avoided when maximum windspeed exceed 5 m/s at the microphone position.

3 Noise measurements

3.1 Measurement Methodology

Two types of measurements were carried out during the current monitoring period:

- Ambient noise measurements
- Sound exposure level measurements

Ambient noise measurements

Measurements were carried out on Friday 28 June and Saturday 29 June 2019, during the morning and evening periods, in accordance with the normal operating hours (7:00 am to 10:00 pm Monday to Sunday) approved under conditions 2.8 of the project approval.

Ambient noise measurements were conducted using a Brüel & Kjær Type 2270 Class 1 sound analyser, fitted with a type 4189 ½" microphone, set to record using 'A' frequency weighting in fast response mode. The sound analyser was also fitted with an approved windshield. Measurements were typically taken at a height of 1.2 metres and at least 3.5 metres from any reflecting structure other than the ground.

Measurements were undertaken for a period of 15-minutes at each of the selected measurement locations (see Figure 1). A Brüel & Kjær Type 4230 calibrator was utilised to calibrate the sound level meter before and after each series of measurements. No significant calibration drift was noted.

Weather conditions

The weather during the noise survey period can be summarised as sunny conditions, with no rainfall and wind speeds were less than 5m/s at ground level. Measurements were generally taken in accordance with the Australian Standard *AS 1055.1 1997: Acoustics – Description and measurement of environmental noise*.

Sound exposure level (SEL) measurements

Measurements were previously conducted by this office on the 7th November 2011, 21st April 2013 and 31st March 2014.

The Sound Exposure Level (SEL) measurements were also carried out using the Larson Davis 831 Type 1 sound level meter. SEL is the equivalent one second A-weighted sound level which produces the same sound energy as an actual identified event. The SEL measurement was commenced when a truck/ light vehicle was observed to pass a nominated reference location and stopped when the end of the truck passed a second nominated reference location. The nominated reference locations were identified where the truck could be visually observed.

3.2 Conditions During Measurements

3.2.1 Operating conditions

EnergyAustralia NSW has confirmed that no ash haulage or ash placement operations were being undertaken during the monitoring periods.

3.2.2 Meteorological conditions

The weather conditions applicable to the noise survey period are based on meteorological data provided by EnergyAustralia for the Mt Piper weather station (located within the Mt Piper Power Plant site), attached in Appendix C.

3.3 Results

3.3.1 Ambient noise measurements

The results from the 15-minute ambient noise measurements at each of the measurement locations are shown in

Table 2.

Table 2: Results of Noise Survey

Location	Date of measurement	Time	Measured sound pressure level dB(A)					Predicted noise contribution by KVAR (dBA)	Number of truck pass-by and direction of travel[1]		
			L_{Aeq}#	L_{Amax}*	L_{Amin}**	L_{A10}^^	L_{A90}^		North	South	Total
60 Skelly Road (A)	Friday 28/06/2019	8:50	**49**	75	44	47	45	0	0	0	0
		20:23	**47**	68	33	51	35	0	0	0	0
	Saturday 29/06/2019	9:21	**46**	61	43	47	44	0	0	0	0
		19:50	**41**	60	30	44	34	0	0	0	0
10 Skelly Road (B)	Friday 28/06/2019	9:08	**49**	78	38	44	41	0	0	0	0
		20:56	**44**	65	30	46	34	0	0	0	0
	Saturday 29/06/2019	9:38	**48**	62	36	50	40	0	0	0	0
		19:15	38	61	32	40	34	0	0	0	0
21 Neubeck Street (C)	Friday 28/06/2019	8:26	**47**	69	27	50	32	0	0	0	0
		20:09	**41**	61	30	44	32	0	0	0	0
	Saturday 29/06/2019	8:59	**49**	76	30	41	34	0	0	0	0
		18:56	**46**	72	35	48	37	0	0	0	0

Note: Exceedances of the $L_{Aeq\ (15\ min)}$ of 40 dB(A) are shown in bold.

[1] *Truck counts include ash trucks and light commercial vehicles.*

\# *L_{Aeq} refers to A-weighted equivalent continuous sound pressure level over measurement period. It is used to quantify the average noise level over a time period.*

* *L_{Amax} refers to the maximum A-weighted noise level detected during the measuring period. It refers to the maximum background noise detected.*

** *L_{Amin} refers to the minimum A-weighted noise level detected during the measuring period. It refers to the minimum background noise detected.*

^^ *L_{A10} refers to the A-weighted noise level which is exceeded for only 10% of the measuring period. It is usually used as the descriptor for intrusive noise level and represents ambient road traffic noise in general.*

^ *L_{A90} refers to the A-weighted noise level which is exceeded for 90% of the measuring period. It is usually used as the descriptor for background noise level during the measurement period.*

3.3.2 SEL measurements

Individual truck pass-by noise event (SEL) measurements were previously conducted by this office at Location D, which is approx. 80 meters from the haulage road (see Figure 1). These results are summarised in Table 3. The number of actual truck pass-bys counted during the daytime survey are also summarised in Table 3. This data was then used to predict noise impacts from truck movements at the surrounding identified sensitive receivers.

During the site visits it was noted that the gradient (slope) of the haulage road rises from south to north. Trucks moving in the northerly direction on the haulage road appear to rev the engine more compared to the trucks moving in the opposite direction and thereby producing a marginally higher SEL as evident in the results detailed below.

Table 3: SEL Noise Measurement Results at Location D

Date	Truck travelling direction	Average event duration (sec)	Average SEL dB(A)	No. of valid truck event measurements
7/11/2011	South	28.9	68	8
	North	18.1	70	9
21/04/2013	South	24.0	67	5
	North	19.5	70	7
31/04/2014	South	27.7	69	2
	North	28.3	70	2

4 Discussion

- With the exception of the evening period measurement at location B, the measured $L_{Aeq(15\ min)}$ noise levels at all three receiver locations, exceeds the assessment criteria of 40 dB(A) $L_{eq(15\ min)}$.
  - We have been advised that no truck movements associated with the operation of the KVAR occurred during the monitoring period. Additionally, no operational noise was audible at the measurement locations from the KVAR. Hence, it can be concluded that KVAR operations did not contribute to the ambient noise levels at any of the measurement locations and the measured noise levels are associated with local noise events such as traffic from surrounding roads (Wolgan Road and Castlereagh Highway), birds/insects and dogs barking.

    Noise contributions from the Stage 2 KVAR is therefore considered negligible or insignificant, and compliant with Condition 2.15 of the Project Approval.
  - To assess the noise impacts associated with ash truck movements (in the event operations resume), the influence of individual truck pass-by noise events (see section 3.3.2) and total number of truck movements (worst case scenario) during a 15-minute period will need to be considered. Noise emissions are predicted based on the SEL measurement results (shown in Table 3) and the number of truck movements provided by EnergyAustralia NSW.
    - The predicted noise levels take into account the total number of truck pass-bys (including ash trucks and small commercial vehicles) and distance to the receiver.
    - The assessment includes a barrier effect (- 2dB(A)) at Location C. This is due to an earth mound located along the northern boundary of the site, providing a line of sight barrier between 21 Neubeck Street and the haulage road, thereby attenuating the noise from the haulage road. Generally, trucks operate at a constant rate, with approximately 15-20-minute circuits for each truck. Table 4 provides a summary of truck pass-bys based on information collected during a previous site visit.

Table 4: Truck Movement Data

Periods	**Information collected during site visit on 30-31 March 2014**	
	Total number of trucks pass bys per 45 minutes	**Average number of trucks pass bys per 15 minutes**
Morning 30/03/2014	7	**2.3**
Evening 30/03/2014	2	0.7
Morning 31/03/2014	7	**2.3**
Evening 31/03/2014	3	1.0

Note: the figure in bold represents the worst-case (most frequent) and is used to predict the noise contribution from the truck movements (shown in Table 5)

- As shown in Table 4, the maximum number of truck pass-bys was noted on two occasions, both during the morning period on the 30/03/2014 and 31/03/2014. The lowest number of truck pass-bys was noted during the evening period on the 30/03/2014. Noise emission predictions based on this worst-case scenario (i.e. 2.3 truck pass-bys during any 15-minute period) is detailed in the table below.

Table 5: Noise Predictions from Truck Movements based on SEL Measurements

Sensitive receiver	**Distance to haulage road (m)**	**No. of average truck movements per 15min**	**Predicted contribution $L_{Aeq\ (15\ min)}$ (dBA)**	**Criteria $L_{Aeq\ (15\ min)}$ (dBA**
60 Skelly Road (A)	300	2.3	32	40
10 Skelly Road (B)	270	2.3	33	40
21 Neubeck Street (C) *	145	2.3	37*	40

- Based on the worst-case scenario, noise impacts from truck movements complies with noise criteria of $L_{Aeq\ (15\ min)}$ of 40 dB(A) at all the sensitive receiver locations.

- The following conditions were noted at the three measurement locations;
  - *Location A (60 Skelly Road)*
    - Contributions to ambient noise at this location was predominantly from traffic noise from Castlereagh Highway and the conveyor system from the Springvale Coal Mine. Intermittent traffic noise from Wolgan Road was also audible. Noise from birds and insects also contributed to the ambient noise at this location.
    - The haulage road is visible from this location; however, no coal or ash truck movements occurred during the measurement period.
    - Background noise levels were fairly consistent over the two days, ranging from 44 – 45 dB(A)L_{90} during the morning period and 34 – 35 dB(A)L_{90} during the evening period.
  - *Location B (10 Skelly Road)*

  - Contributions to the ambient noise at this location was predominantly from birds/insects, dogs barking and traffic noise from Wolgan Road.
  - The haulage road was clearly visible from this measuring location; however, no coal or ash truck movements occurred during the measurement period.
  - Background noise levels were fairly consistent over the two days ranging from 40 – 41 dB(A)L_{90} during the morning period and 34 dB(A)L_{90} during the evening period.
- *Location C (21 Neubeck Street)*
  - Contributions to the ambient noise at this location was predominantly from birds/insects, dogs barking and distant traffic noise from Wolgan Road.
  - The haulage road was not visible from this location because of an earth mound and heavy vegetation blocking the line of sight. No truck engine noise was noted during the measurement period, indicating no coal or ash truck movements during this period.
  - Background noise levels varied over the two days ranging from 32 – 34 dB(A)L_{90} during the morning period and 32 – 37 dB(A)L_{90} during the evening period.

5 Conclusion

Aurecon conducted operational noise measurements for the Stage 2 KVAR site located in Wallerawang, NSW. Noise measurements were carried out at three nearest affected sensitive receiver locations on Friday 28 June and Saturday 29 June 2019, during the morning and evening periods, in accordance with the KVAR Stage 2 ONVMP.

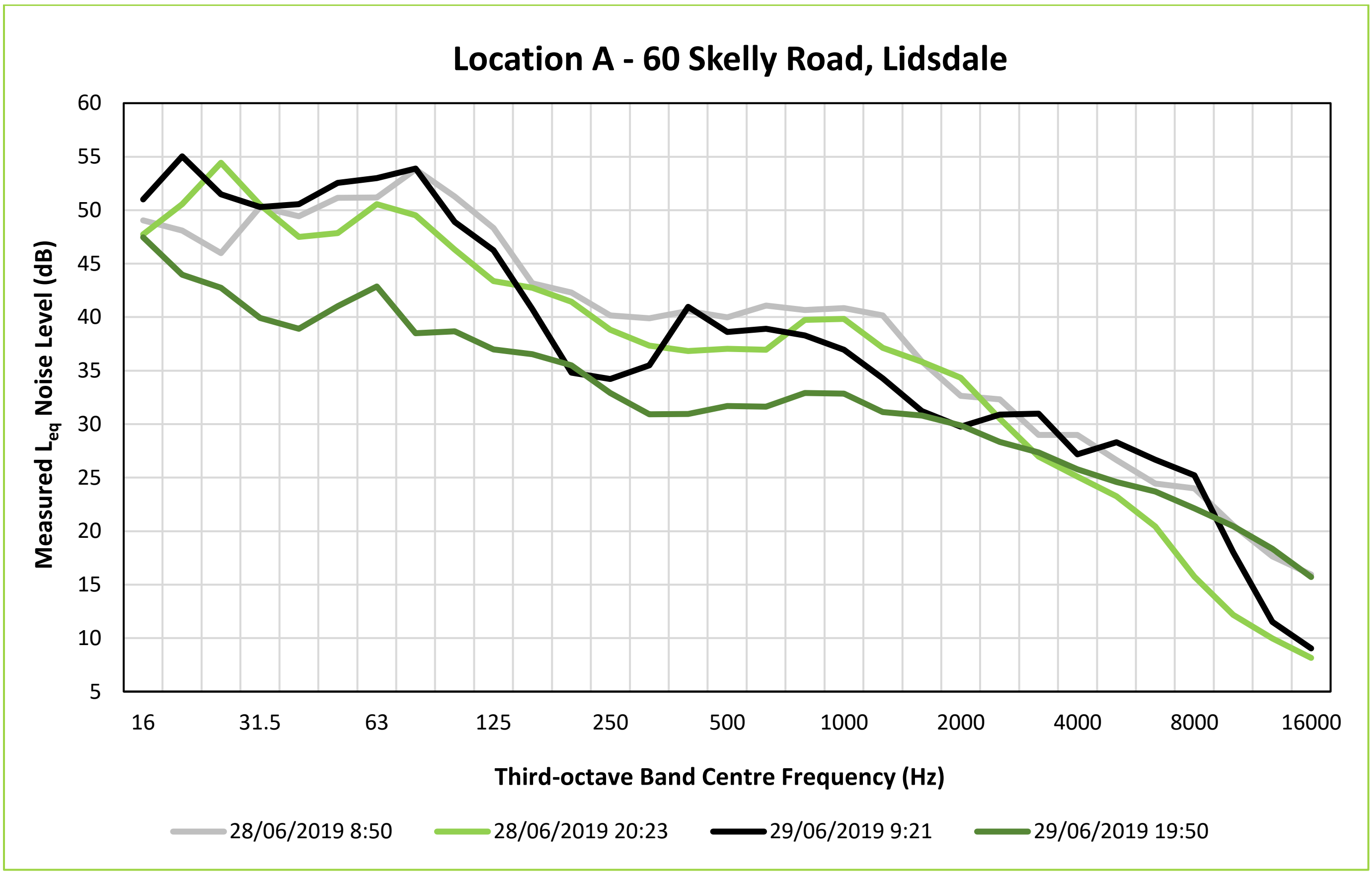
No ash haulage or ash placement operations occurred during the monitoring period. The measured noise levels at the receiver locations exceeded the 40 dB(A) criterion, however this was predominantly due to extraneous noise on the site from road traffic (Wolgan Road and Castlereagh Highway), birds and other nearby industry (operation of Springvale Coal Mine conveyor system at location A).

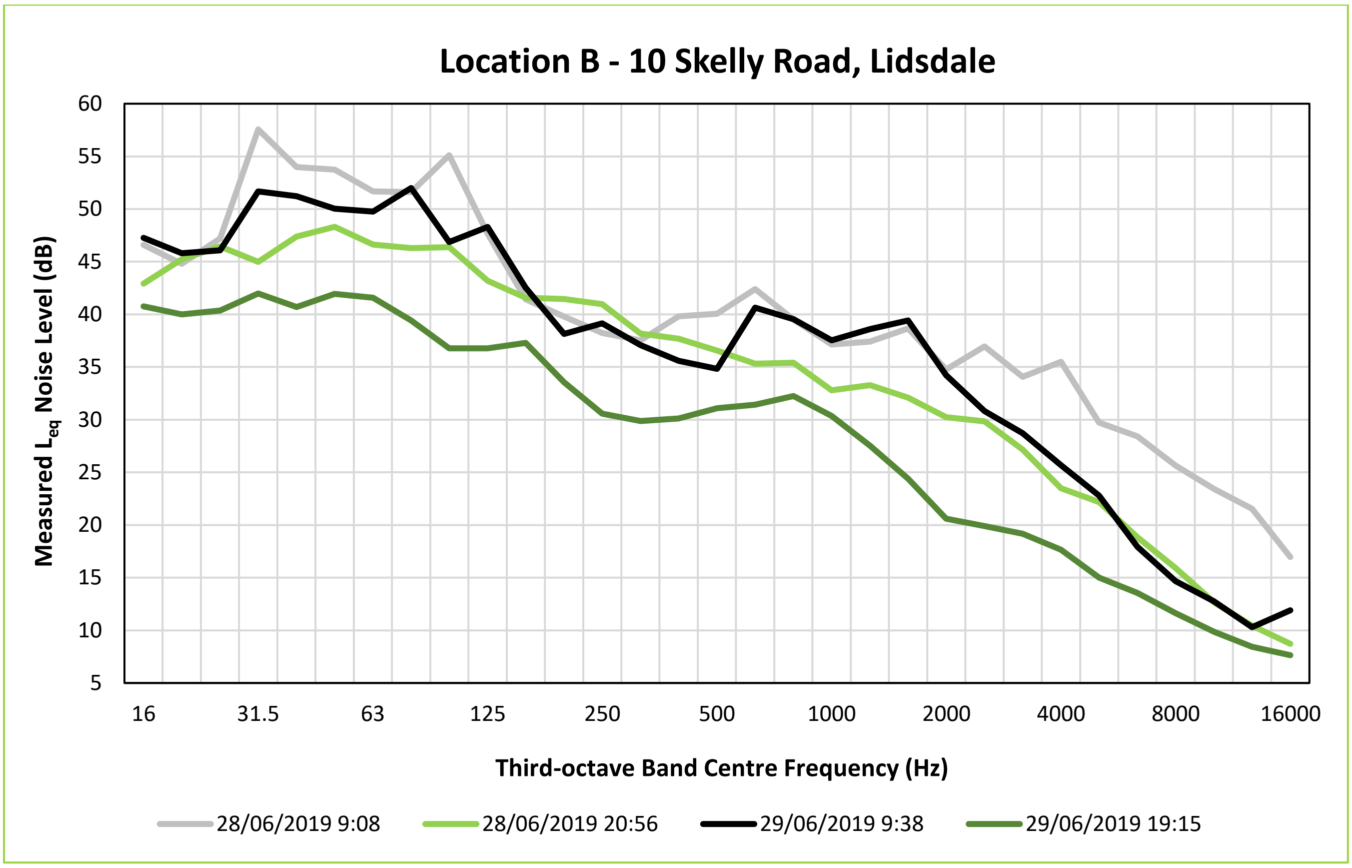
Noise from KVAR was not subjectively audible above the ambient noise levels and therefore we consider that the contribution from Stage 2 KVAR site complies with the ONVMP.

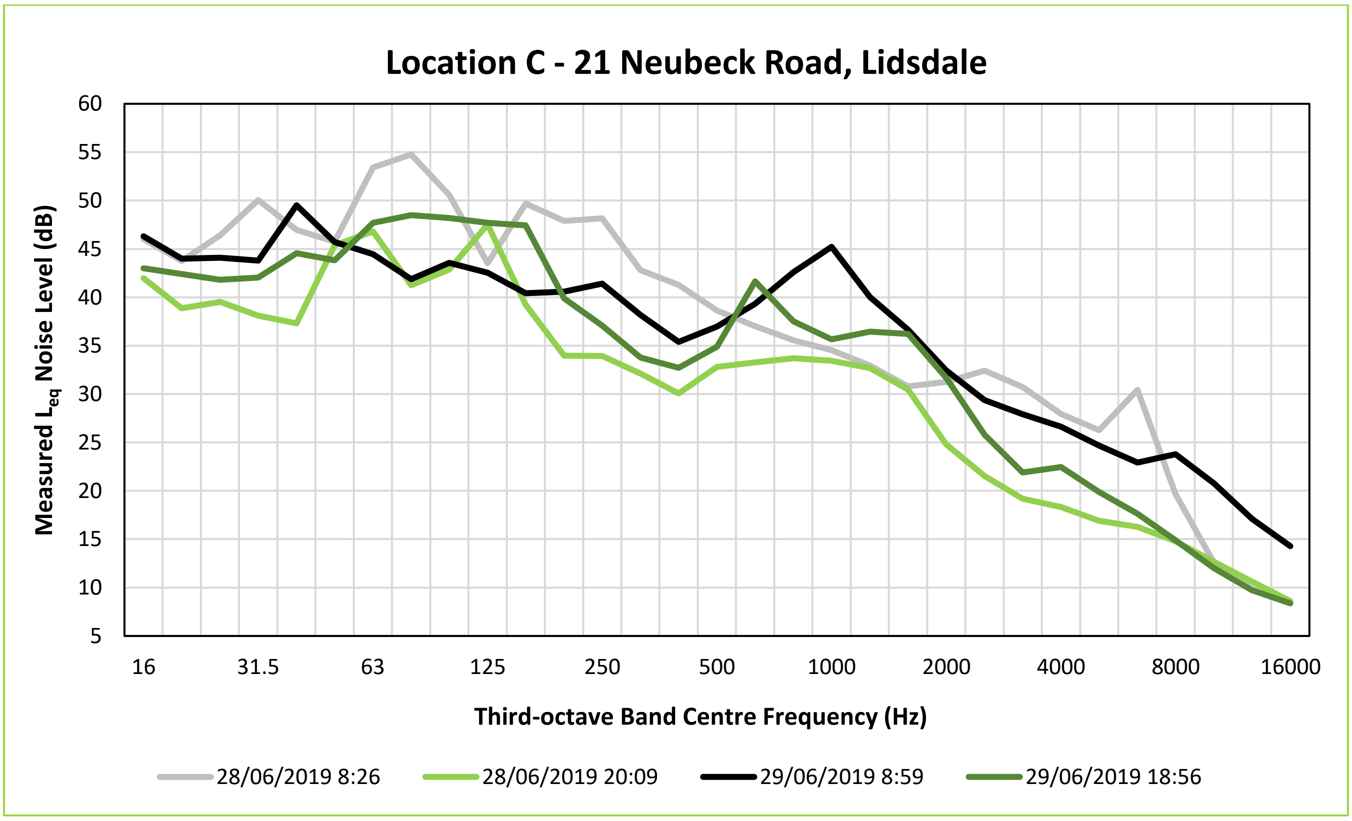
6 References

- Kerosene Vale Stage 2 Ash Repository, Operational Environmental Management Plan (OEMP), Parsons Brinckerhoff, April 2009, which includes:
  - Appendix A: KVAR Stage 2 Operations, Operational Noise and Vibration Management Plan (ONVMP), Parsons Brinckerhoff, April 2009
- Project Approval (PA), Application: No 07_0005, Delta Electricity, 26 November 2008, Department of Planning
- Stage 2 Kerosene Vale Ash Repository operational noise review, Parsons Brinckerhoff, September 2009.
- Australian Standard *AS 1055 1997: Acoustics – Description and measurement of environmental noise*.

Appendix A
Measured Noise Spectra




Location B - 10 Skelly Road, Lidsdale
Measured L_{eq} Noise Level (dB)
60
55
50
45
40
35
30
25
20
15
10
5
16
31.5
63
125
250
500
1000
2000
4000
8000
16000
Third-octave Band Centre Frequency (Hz)
28/06/2019 9:08
28/06/2019 20:56
29/06/2019 9:38
29/06/2019 19:15


Location C - 21 Neubeck Road, Lidsdale
Measured L_{eq} Noise Level (dB)
60
55
50
45
40
35
30
25
20
15
10
5
16
31.5
63
125
250
500
1000
2000
4000
8000
16000
Third-octave Band Centre Frequency (Hz)
28/06/2019 8:26
28/06/2019 20:09
29/06/2019 8:59
29/06/2019 18:56

Appendix B
Glossary of terms

Term	Definition
dB and A-weighting (dBA)	The decibel is a logarithmic unit used to measure sound level. A-weighting is a frequency weighting added to sound level measurements to replicate response of human ear, typically between 500Hz and 8kHz.
L_{Aeq}	The time averaged A-weighted sound pressure level for a time interval, as defined in AS1055.1. It is generally described as the equivalent continuous A-weighted sound pressure level that has the same mean square pressure level as a sound that varies over time. It can be considered as the average sound pressure level over the measurement period.
L_{Amax}	The RMS maximum A-weighted sound level during a measurement period or noise event. It refers to the maximum ambient noise detected.
L_{A10}	A-weighted noise level which is exceeded for only 10% of the measuring period. It is usually used as the descriptor for intrusive noise level and represents ambient road traffic noise in general.
L_{A90}	A-weighted noise level which is exceeded for 90% of the measuring period. It is usually used as the descriptor for background noise level during the measurement period.
L_{Amin}	Minimum A-weighted noise level detected during the measuring period. It refers to the minimum background noise detected.

Appendix C
Weather Data

Note: Highlighted rows indicate periods with rainfall or wind speeds > 5m/s. Corresponding noise levels measured during these periods are excluded from this assessment.

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
28/06/2019	7:00:00 AM	0	7	1	195
28/06/2019	7:05:00 AM	0	7	1	153
28/06/2019	7:10:00 AM	0	7	1	214
28/06/2019	7:15:00 AM	0	7	1	173
28/06/2019	7:20:00 AM	0	7	1	177
28/06/2019	7:25:00 AM	0	7	1	201
28/06/2019	7:30:00 AM	0	7	1	275
28/06/2019	7:35:00 AM	0	8	1	180
28/06/2019	7:40:00 AM	0	8	1	280
28/06/2019	7:45:00 AM	0	8	1	169
28/06/2019	7:50:00 AM	0	8	2	142
28/06/2019	7:55:00 AM	0	8	1	192
28/06/2019	8:00:00 AM	0	8	2	142
28/06/2019	8:05:00 AM	0	9	2	141
28/06/2019	8:10:00 AM	0	9	2	220
28/06/2019	8:15:00 AM	0	9	2	243
28/06/2019	8:20:00 AM	0	9	2	238
28/06/2019	8:25:00 AM	0	9	2	311
28/06/2019	8:30:00 AM	0	9	2	180
28/06/2019	8:35:00 AM	0	9	2	126
28/06/2019	8:40:00 AM	0	9	2	310
28/06/2019	8:45:00 AM	0	9	2	258
28/06/2019	8:50:00 AM	0	9	1	89
28/06/2019	8:55:00 AM	0	9	2	119
28/06/2019	9:00:00 AM	0	10	2	69
28/06/2019	9:05:00 AM	0	10	2	150
28/06/2019	9:10:00 AM	0	10	2	53
28/06/2019	9:15:00 AM	0	10	2	57
28/06/2019	9:20:00 AM	0	10	3	62
28/06/2019	9:25:00 AM	0	10	2	85
28/06/2019	9:30:00 AM	0	11	2	101
28/06/2019	9:35:00 AM	0	11	2	155
28/06/2019	9:40:00 AM	0	11	2	190
28/06/2019	9:45:00 AM	0	11	2	253
28/06/2019	9:50:00 AM	0	12	2	125
28/06/2019	9:55:00 AM	0	12	2	70
28/06/2019	10:00:00 AM	0	12	2	42
28/06/2019	10:05:00 AM	0	11	2	70

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
28/06/2019	10:10:00 AM	0	11	2	34
28/06/2019	10:15:00 AM	0	12	2	60
28/06/2019	10:20:00 AM	0	12	3	74
28/06/2019	10:25:00 AM	0	12	2	128
28/06/2019	10:30:00 AM	0	12	2	57
28/06/2019	10:35:00 AM	0	12	3	63
28/06/2019	10:40:00 AM	0	12	3	70
28/06/2019	10:45:00 AM	0	12	3	49
28/06/2019	10:50:00 AM	0	13	3	58
28/06/2019	10:55:00 AM	0	13	2	109
28/06/2019	11:00:00 AM	0	13	2	62
28/06/2019	11:05:00 AM	0	13	2	152
28/06/2019	11:10:00 AM	0	13	2	196
28/06/2019	11:15:00 AM	0	13	2	40
28/06/2019	11:20:00 AM	0	13	2	51
28/06/2019	11:25:00 AM	0	13	3	79
28/06/2019	11:30:00 AM	0	14	2	176
28/06/2019	11:35:00 AM	0	13	2	239
28/06/2019	11:40:00 AM	0	13	2	90
28/06/2019	11:45:00 AM	0	14	2	65
28/06/2019	11:50:00 AM	0	14	2	53
28/06/2019	11:55:00 AM	0	14	2	192
28/06/2019	12:00:00 PM	0	14	1	201
28/06/2019	12:05:00 PM	0	14	2	111
28/06/2019	12:10:00 PM	0	14	3	92
28/06/2019	12:15:00 PM	0	14	2	187
28/06/2019	12:20:00 PM	0	14	2	188
28/06/2019	12:25:00 PM	0	14	2	166
28/06/2019	12:30:00 PM	0	14	2	148
28/06/2019	12:35:00 PM	0	15	2	307
28/06/2019	12:40:00 PM	0	15	1	188
28/06/2019	12:45:00 PM	0	15	2	272
28/06/2019	12:50:00 PM	0	15	2	115
28/06/2019	12:55:00 PM	0	15	2	67
28/06/2019	1:00:00 PM	0	14	2	65
28/06/2019	1:05:00 PM	0	14	3	103
28/06/2019	1:10:00 PM	0	15	2	120
28/06/2019	1:15:00 PM	0	15	2	309
28/06/2019	1:20:00 PM	0	15	2	212
28/06/2019	1:25:00 PM	0	15	3	97
28/06/2019	1:30:00 PM	0	15	2	262
28/06/2019	1:35:00 PM	0	15	2	252
28/06/2019	1:40:00 PM	0	15	2	196
28/06/2019	1:45:00 PM	0	15	2	227
28/06/2019	1:50:00 PM	0	15	2	236
28/06/2019	1:55:00 PM	0	15	2	309
28/06/2019	2:00:00 PM	0	15	2	230
28/06/2019	2:05:00 PM	0	15	2	250
28/06/2019	2:10:00 PM	0	15	2	301
28/06/2019	2:15:00 PM	0	15	2	283
28/06/2019	2:20:00 PM	0	15	2	272
28/06/2019	2:25:00 PM	0	14	2	272
28/06/2019	2:30:00 PM	0	15	2	246

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
28/06/2019	2:35:00 PM	0	15	2	288
28/06/2019	2:40:00 PM	0	15	3	308
28/06/2019	2:45:00 PM	0	15	2	320
28/06/2019	2:50:00 PM	0	14	2	254
28/06/2019	2:55:00 PM	0	14	2	291
28/06/2019	3:00:00 PM	0	14	1	136
28/06/2019	3:05:00 PM	0	14	1	234
28/06/2019	3:10:00 PM	0	14	2	222
28/06/2019	3:15:00 PM	0	14	2	81
28/06/2019	3:20:00 PM	0	14	2	72
28/06/2019	3:25:00 PM	0	14	2	55
28/06/2019	3:30:00 PM	0	14	2	58
28/06/2019	3:35:00 PM	0	14	2	75
28/06/2019	3:40:00 PM	0	14	2	59
28/06/2019	3:45:00 PM	0	14	2	79
28/06/2019	3:50:00 PM	0	14	3	41
28/06/2019	3:55:00 PM	0	13	2	62
28/06/2019	4:00:00 PM	0	13	2	61
28/06/2019	4:05:00 PM	0	13	2	58
28/06/2019	4:10:00 PM	0	13	2	44
28/06/2019	4:15:00 PM	0	13	2	38
28/06/2019	4:20:00 PM	0	13	2	122
28/06/2019	4:25:00 PM	0	12	2	72
28/06/2019	4:30:00 PM	0	12	2	69
28/06/2019	4:35:00 PM	0	12	2	65
28/06/2019	4:40:00 PM	0	11	2	76
28/06/2019	4:45:00 PM	0	11	1	215
28/06/2019	4:50:00 PM	0	10	1	277
28/06/2019	4:55:00 PM	0	10	1	276
28/06/2019	5:00:00 PM	0	9	1	303
28/06/2019	5:05:00 PM	0	8	1	266
28/06/2019	5:10:00 PM	0	8	1	249
28/06/2019	5:15:00 PM	0	8	1	241
28/06/2019	5:20:00 PM	0	7	2	238
28/06/2019	5:25:00 PM	0	7	1	244
28/06/2019	5:30:00 PM	0	7	1	253
28/06/2019	5:35:00 PM	0	6	2	266
28/06/2019	5:40:00 PM	0	6	1	273
28/06/2019	5:45:00 PM	0	6	1	251
28/06/2019	5:50:00 PM	0	6	1	240
28/06/2019	5:55:00 PM	0	5	2	240
28/06/2019	6:00:00 PM	0	5	1	256
28/06/2019	6:05:00 PM	0	6	1	269
28/06/2019	6:10:00 PM	0	6	1	261
28/06/2019	6:15:00 PM	0	6	1	260
28/06/2019	6:20:00 PM	0	6	1	260
28/06/2019	6:25:00 PM	0	6	1	275
28/06/2019	6:30:00 PM	0	6	1	290
28/06/2019	6:35:00 PM	0	6	1	279
28/06/2019	6:40:00 PM	0	6	1	256
28/06/2019	6:45:00 PM	0	6	1	308
28/06/2019	6:50:00 PM	0	6	1	246
28/06/2019	6:55:00 PM	0	6	1	203

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
28/06/2019	7:00:00 PM	0	6	1	265
28/06/2019	7:05:00 PM	0	6	1	260
28/06/2019	7:10:00 PM	0	6	1	185
28/06/2019	7:15:00 PM	0	6	1	266
28/06/2019	7:20:00 PM	0	5	1	227
28/06/2019	7:25:00 PM	0	5	1	295
28/06/2019	7:30:00 PM	0	5	1	243
28/06/2019	7:35:00 PM	0	6	1	262
28/06/2019	7:40:00 PM	0	6	1	256
28/06/2019	7:45:00 PM	0	6	2	252
28/06/2019	7:50:00 PM	0	5	2	247
28/06/2019	7:55:00 PM	0	5	2	264
28/06/2019	8:00:00 PM	0	5	2	259
28/06/2019	8:05:00 PM	0	5	2	257
28/06/2019	8:10:00 PM	0	5	1	255
28/06/2019	8:15:00 PM	0	5	2	256
28/06/2019	8:20:00 PM	0	5	2	276
28/06/2019	8:25:00 PM	0	5	2	268
28/06/2019	8:30:00 PM	0	5	2	266
28/06/2019	8:35:00 PM	0	5	1	254
28/06/2019	8:40:00 PM	0	5	1	249
28/06/2019	8:45:00 PM	0	5	1	257
28/06/2019	8:50:00 PM	0	4	1	261
28/06/2019	8:55:00 PM	0	4	1	278
28/06/2019	9:00:00 PM	0	4	1	281
28/06/2019	9:05:00 PM	0	5	1	262
28/06/2019	9:10:00 PM	0	5	2	248
28/06/2019	9:15:00 PM	0	5	1	265
28/06/2019	9:20:00 PM	0	5	1	292
28/06/2019	9:25:00 PM	0	5	1	262
28/06/2019	9:30:00 PM	0	5	1	255
28/06/2019	9:35:00 PM	0	5	2	249
28/06/2019	9:40:00 PM	0	5	2	252
28/06/2019	9:45:00 PM	0	5	2	249
28/06/2019	9:50:00 PM	0	5	2	252
28/06/2019	9:55:00 PM	0	5	1	243
28/06/2019	10:00:00 PM	0	5	1	243
28/06/2019	10:05:00 PM	0	4	1	270
28/06/2019	10:10:00 PM	0	5	1	287
28/06/2019	10:15:00 PM	0	5	1	272
28/06/2019	10:20:00 PM	0	5	1	276
28/06/2019	10:25:00 PM	0	4	2	272
28/06/2019	10:30:00 PM	0	5	1	293
28/06/2019	10:35:00 PM	0	5	1	281
28/06/2019	10:40:00 PM	0	5	1	250
28/06/2019	10:45:00 PM	0	5	1	248
28/06/2019	10:50:00 PM	0	5	1	244
28/06/2019	10:55:00 PM	0	4	1	243
28/06/2019	11:00:00 PM	0	3	1	242
28/06/2019	11:05:00 PM	0	3	1	239
28/06/2019	11:10:00 PM	0	4	1	243
28/06/2019	11:15:00 PM	0	4	1	243
28/06/2019	11:20:00 PM	0	3	1	240

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
28/06/2019	11:25:00 PM	0	3	1	249
28/06/2019	11:30:00 PM	0	4	1	253
28/06/2019	11:35:00 PM	0	3	2	251
28/06/2019	11:40:00 PM	0	3	1	242
28/06/2019	11:45:00 PM	0	3	1	246
28/06/2019	11:50:00 PM	0	3	1	240
28/06/2019	11:55:00 PM	0	3	1	240
29/06/2019	12:00:00 AM	0	3	1	239
29/06/2019	12:05:00 AM	0	3	1	257
29/06/2019	12:10:00 AM	0	3	1	253
29/06/2019	12:15:00 AM	0	3	1	259
29/06/2019	12:20:00 AM	0	2	1	257
29/06/2019	12:25:00 AM	0	3	1	250
29/06/2019	12:30:00 AM	0	3	1	239
29/06/2019	12:35:00 AM	0	2	1	267
29/06/2019	12:40:00 AM	0	2	1	292
29/06/2019	12:45:00 AM	0	2	1	220
29/06/2019	12:50:00 AM	0	2	1	149
29/06/2019	12:55:00 AM	0	2	0	275
29/06/2019	1:00:00 AM	0	2	0	241
29/06/2019	1:05:00 AM	0	2	0	80
29/06/2019	1:10:00 AM	0	2	1	45
29/06/2019	1:15:00 AM	0	2	1	47
29/06/2019	1:20:00 AM	0	2	1	106
29/06/2019	1:25:00 AM	0	1	1	324
29/06/2019	1:30:00 AM	0	1	0	267
29/06/2019	1:35:00 AM	0	1	0	242
29/06/2019	1:40:00 AM	0	1	1	209
29/06/2019	1:45:00 AM	0	1	1	121
29/06/2019	1:50:00 AM	0	1	1	94
29/06/2019	1:55:00 AM	0	1	1	28
29/06/2019	2:00:00 AM	0	1	1	197
29/06/2019	2:05:00 AM	0	1	0	230
29/06/2019	2:10:00 AM	0	1	0	77
29/06/2019	2:15:00 AM	0	1	0	290
29/06/2019	2:20:00 AM	0	1	1	261
29/06/2019	2:25:00 AM	0	1	1	311
29/06/2019	2:30:00 AM	0	1	1	237
29/06/2019	2:35:00 AM	0	1	0	242
29/06/2019	2:40:00 AM	0	2	1	210
29/06/2019	2:45:00 AM	0	2	1	247
29/06/2019	2:50:00 AM	0	2	0	236
29/06/2019	2:55:00 AM	0	2	0	210
29/06/2019	3:00:00 AM	0	2	1	246
29/06/2019	3:05:00 AM	0	2	1	260
29/06/2019	3:10:00 AM	0	1	1	266
29/06/2019	3:15:00 AM	0	1	0	166
29/06/2019	3:20:00 AM	0	1	1	229
29/06/2019	3:25:00 AM	0	1	1	252
29/06/2019	3:30:00 AM	0	1	1	240
29/06/2019	3:35:00 AM	0	1	1	219
29/06/2019	3:40:00 AM	0	1	1	236
29/06/2019	3:45:00 AM	0	0	1	250

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
29/06/2019	3:50:00 AM	0	0	1	252
29/06/2019	3:55:00 AM	0	0	1	251
29/06/2019	4:00:00 AM	0	0	1	244
29/06/2019	4:05:00 AM	0	0	1	232
29/06/2019	4:10:00 AM	0	0	2	232
29/06/2019	4:15:00 AM	0	0	1	236
29/06/2019	4:20:00 AM	0	0	1	244
29/06/2019	4:25:00 AM	0	0	1	240
29/06/2019	4:30:00 AM	0	0	1	243
29/06/2019	4:35:00 AM	0	0	1	231
29/06/2019	4:40:00 AM	0	0	1	239
29/06/2019	4:45:00 AM	0	0	1	250
29/06/2019	4:50:00 AM	0	0	1	254
29/06/2019	4:55:00 AM	0	0	0	300
29/06/2019	5:00:00 AM	0	0	0	259
29/06/2019	5:05:00 AM	0	0	1	253
29/06/2019	5:10:00 AM	0	0	0	232
29/06/2019	5:15:00 AM	0	0	0	231
29/06/2019	5:20:00 AM	0	0	1	245
29/06/2019	5:25:00 AM	0	0	1	239
29/06/2019	5:30:00 AM	0	0	1	237
29/06/2019	5:35:00 AM	0	0	1	238
29/06/2019	5:40:00 AM	0	0	1	237
29/06/2019	5:45:00 AM	0	0	1	207
29/06/2019	5:50:00 AM	0	0	1	21
29/06/2019	5:55:00 AM	0	0	1	28
29/06/2019	6:00:00 AM	0	0	1	38
29/06/2019	6:05:00 AM	0	0	1	32
29/06/2019	6:10:00 AM	0	0	1	29
29/06/2019	6:15:00 AM	0	0	1	191
29/06/2019	6:20:00 AM	0	-1	1	254
29/06/2019	6:25:00 AM	0	-1	1	234
29/06/2019	6:30:00 AM	0	-1	1	218
29/06/2019	6:35:00 AM	0	0	1	246
29/06/2019	6:40:00 AM	0	0	1	240
29/06/2019	6:45:00 AM	0	0	1	245
29/06/2019	6:50:00 AM	0	0	1	242
29/06/2019	6:55:00 AM	0	0	1	230
29/06/2019	7:00:00 AM	0	0	1	223
29/06/2019	7:05:00 AM	0	0	1	232
29/06/2019	7:10:00 AM	0	0	1	227
29/06/2019	7:15:00 AM	0	0	1	233
29/06/2019	7:20:00 AM	0	1	0	264
29/06/2019	7:25:00 AM	0	1	0	324
29/06/2019	7:30:00 AM	0	1	0	246
29/06/2019	7:35:00 AM	0	1	0	191
29/06/2019	7:40:00 AM	0	1	1	256
29/06/2019	7:45:00 AM	0	2	1	247
29/06/2019	7:50:00 AM	0	2	1	230
29/06/2019	7:55:00 AM	0	2	1	229
29/06/2019	8:00:00 AM	0	2	1	246
29/06/2019	8:05:00 AM	0	3	1	293
29/06/2019	8:10:00 AM	0	4	1	293

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
29/06/2019	8:15:00 AM	0	5	1	301
29/06/2019	8:20:00 AM	0	6	1	300
29/06/2019	8:25:00 AM	0	6	1	309
29/06/2019	8:30:00 AM	0	7	1	308
29/06/2019	8:35:00 AM	0	7	1	277
29/06/2019	8:40:00 AM	0	8	1	299
29/06/2019	8:45:00 AM	0	8	1	304
29/06/2019	8:50:00 AM	0	8	1	202
29/06/2019	8:55:00 AM	0	8	1	287
29/06/2019	9:00:00 AM	0	9	2	298
29/06/2019	9:05:00 AM	0	9	1	263
29/06/2019	9:10:00 AM	0	10	2	294
29/06/2019	9:15:00 AM	0	10	1	160
29/06/2019	9:20:00 AM	0	10	2	78
29/06/2019	9:25:00 AM	0	11	2	154
29/06/2019	9:30:00 AM	0	11	2	76
29/06/2019	9:35:00 AM	0	10	2	90
29/06/2019	9:40:00 AM	0	11	2	154
29/06/2019	9:45:00 AM	0	11	2	76
29/06/2019	9:50:00 AM	0	11	2	99
29/06/2019	9:55:00 AM	0	11	2	176
29/06/2019	10:00:00 AM	0	11	2	265
29/06/2019	10:05:00 AM	0	11	2	146
29/06/2019	10:10:00 AM	0	12	2	151
29/06/2019	10:15:00 AM	0	12	3	156
29/06/2019	10:20:00 AM	0	12	2	130
29/06/2019	10:25:00 AM	0	12	2	120
29/06/2019	10:30:00 AM	0	12	2	258
29/06/2019	10:35:00 AM	0	12	3	145
29/06/2019	10:40:00 AM	0	12	3	157
29/06/2019	10:45:00 AM	0	13	4	124
29/06/2019	10:50:00 AM	0	13	4	174
29/06/2019	10:55:00 AM	0	13	3	308
29/06/2019	11:00:00 AM	0	13	3	298
29/06/2019	11:05:00 AM	0	13	4	289
29/06/2019	11:10:00 AM	0	13	4	105
29/06/2019	11:15:00 AM	0	13	4	224
29/06/2019	11:20:00 AM	0	14	3	169
29/06/2019	11:25:00 AM	0	14	4	114
29/06/2019	11:30:00 AM	0	14	2	236
29/06/2019	11:35:00 AM	0	14	4	106
29/06/2019	11:40:00 AM	0	14	4	229
29/06/2019	11:45:00 AM	0	15	3	174
29/06/2019	11:50:00 AM	0	15	3	81
29/06/2019	11:55:00 AM	0	14	3	241
29/06/2019	12:00:00 PM	0	14	4	200
29/06/2019	12:05:00 PM	0	15	3	212
29/06/2019	12:10:00 PM	0	15	4	159
29/06/2019	12:15:00 PM	0	14	6	110
29/06/2019	12:20:00 PM	0	14	4	144
29/06/2019	12:25:00 PM	0	15	4	169
29/06/2019	12:30:00 PM	0	15	4	123
29/06/2019	12:35:00 PM	0	15	3	187

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
29/06/2019	12:40:00 PM	0	15	6	173
29/06/2019	12:45:00 PM	0	15	4	238
29/06/2019	12:50:00 PM	0	15	3	143
29/06/2019	12:55:00 PM	0	15	4	154
29/06/2019	1:00:00 PM	0	15	4	207
29/06/2019	1:05:00 PM	0	15	5	222
29/06/2019	1:10:00 PM	0	15	5	79
29/06/2019	1:15:00 PM	0	15	6	176
29/06/2019	1:20:00 PM	0	15	6	111
29/06/2019	1:25:00 PM	0	15	5	144
29/06/2019	1:30:00 PM	0	15	4	147
29/06/2019	1:35:00 PM	0	15	4	154
29/06/2019	1:40:00 PM	0	15	5	200
29/06/2019	1:45:00 PM	0	15	5	145
29/06/2019	1:50:00 PM	0	15	4	156
29/06/2019	1:55:00 PM	0	15	6	111
29/06/2019	2:00:00 PM	0	15	5	182
29/06/2019	2:05:00 PM	0	15	5	175
29/06/2019	2:10:00 PM	0	15	5	162
29/06/2019	2:15:00 PM	0	15	4	138
29/06/2019	2:20:00 PM	0	15	4	188
29/06/2019	2:25:00 PM	0	15	4	201
29/06/2019	2:30:00 PM	0	15	4	205
29/06/2019	2:35:00 PM	0	15	4	147
29/06/2019	2:40:00 PM	0	15	5	87
29/06/2019	2:45:00 PM	0	15	4	146
29/06/2019	2:50:00 PM	0	14	5	179
29/06/2019	2:55:00 PM	0	14	5	124
29/06/2019	3:00:00 PM	0	14	6	173
29/06/2019	3:05:00 PM	0	14	5	135
29/06/2019	3:10:00 PM	0	14	5	84
29/06/2019	3:15:00 PM	0	14	4	96
29/06/2019	3:20:00 PM	0	14	4	60
29/06/2019	3:25:00 PM	0	14	5	72
29/06/2019	3:30:00 PM	0	14	4	63
29/06/2019	3:35:00 PM	0	14	5	102
29/06/2019	3:40:00 PM	0	14	5	182
29/06/2019	3:45:00 PM	0	14	4	157
29/06/2019	3:50:00 PM	0	14	3	105
29/06/2019	3:55:00 PM	0	13	5	47
29/06/2019	4:00:00 PM	0	13	5	51
29/06/2019	4:05:00 PM	0	13	6	49
29/06/2019	4:10:00 PM	0	13	5	117
29/06/2019	4:15:00 PM	0	13	5	70
29/06/2019	4:20:00 PM	0	13	5	49
29/06/2019	4:25:00 PM	0	13	4	64
29/06/2019	4:30:00 PM	0	13	4	108
29/06/2019	4:35:00 PM	0	13	4	101
29/06/2019	4:40:00 PM	0	13	3	212
29/06/2019	4:45:00 PM	0	12	4	172
29/06/2019	4:50:00 PM	0	12	4	103
29/06/2019	4:55:00 PM	0	12	4	126
29/06/2019	5:00:00 PM	0	12	4	142

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
29/06/2019	5:05:00 PM	0	12	4	73
29/06/2019	5:10:00 PM	0	12	3	123
29/06/2019	5:15:00 PM	0	12	4	123
29/06/2019	5:20:00 PM	0	11	3	98
29/06/2019	5:25:00 PM	0	11	3	161
29/06/2019	5:30:00 PM	0	11	3	94
29/06/2019	5:35:00 PM	0	11	4	128
29/06/2019	5:40:00 PM	0	11	3	70
29/06/2019	5:45:00 PM	0	11	3	135
29/06/2019	5:50:00 PM	0	11	4	69
29/06/2019	5:55:00 PM	0	11	2	163
29/06/2019	6:00:00 PM	0	11	3	204
29/06/2019	6:05:00 PM	0	11	3	219
29/06/2019	6:10:00 PM	0	11	3	131
29/06/2019	6:15:00 PM	0	11	3	111
29/06/2019	6:20:00 PM	0	11	3	116
29/06/2019	6:25:00 PM	0	11	4	164
29/06/2019	6:30:00 PM	0	11	3	122
29/06/2019	6:35:00 PM	0	11	3	88
29/06/2019	6:40:00 PM	0	11	3	105
29/06/2019	6:45:00 PM	0	11	3	135
29/06/2019	6:50:00 PM	0	11	3	240
29/06/2019	6:55:00 PM	0	11	2	225
29/06/2019	7:00:00 PM	0	11	2	162
29/06/2019	7:05:00 PM	0	10	2	136
29/06/2019	7:10:00 PM	0	10	3	145
29/06/2019	7:15:00 PM	0	10	3	146
29/06/2019	7:20:00 PM	0	10	2	127
29/06/2019	7:25:00 PM	0	10	2	69
29/06/2019	7:30:00 PM	0	10	3	55
29/06/2019	7:35:00 PM	0	10	3	91
29/06/2019	7:40:00 PM	0	10	3	121
29/06/2019	7:45:00 PM	0	10	2	91
29/06/2019	7:50:00 PM	0	10	2	161
29/06/2019	7:55:00 PM	0	9	2	119
29/06/2019	8:00:00 PM	0	9	2	103
29/06/2019	8:05:00 PM	0	9	2	49
29/06/2019	8:10:00 PM	0	9	2	78
29/06/2019	8:15:00 PM	0	9	1	69
29/06/2019	8:20:00 PM	0	9	2	58
29/06/2019	8:25:00 PM	0	9	2	94
29/06/2019	8:30:00 PM	0	9	3	83
29/06/2019	8:35:00 PM	0	10	3	71
29/06/2019	8:40:00 PM	0	10	3	104
29/06/2019	8:45:00 PM	0	10	4	74
29/06/2019	8:50:00 PM	0	10	4	71
29/06/2019	8:55:00 PM	0	10	4	87
29/06/2019	9:00:00 PM	0	10	3	68
29/06/2019	9:05:00 PM	0	10	3	115
29/06/2019	9:10:00 PM	0	10	3	160
29/06/2019	9:15:00 PM	0	10	3	154
29/06/2019	9:20:00 PM	0	10	3	215
29/06/2019	9:25:00 PM	0	10	3	111

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
29/06/2019	9:30:00 PM	0	10	2	146
29/06/2019	9:35:00 PM	0	10	3	127
29/06/2019	9:40:00 PM	0	10	3	100
29/06/2019	9:45:00 PM	0	10	3	153
29/06/2019	9:50:00 PM	0	11	3	100
29/06/2019	9:55:00 PM	0	11	4	114
29/06/2019	10:00:00 PM	0	11	4	83

Aurecon Australasia Pty Ltd
ABN 54 005 139 873

Level 5, 116 Military Road
Neutral Bay NSW 2089

PO Box 538
Neutral Bay NSW 2089
Australia

T +61 2 9465 5599
F +61 2 9465 5598
E sydney@aurecongroup.com
W aurecongroup.com

Aurecon offices are located in:
Angola, Australia, Botswana, China,
Ghana, Hong Kong, Indonesia, Kenya,
Lesotho, Macau, Mozambique,
Namibia, New Zealand, Nigeria,
Philippines, Qatar, Singapore, South Africa,
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Appendix C

Water Quality Assessment – June 2020

Wallerawang Ash Repository

Water Quality Assessment from April 2019 to March 2020 in Relation to the Decommissioned Wallerawang Power Station

Energy Australia NSW

Reference: 502838

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Document prepared by:

Aurecon Australasia Pty Ltd
ABN 54 005 139 873
Level 5, 116 Military Road
Neutral Bay NSW 2089
PO Box 538
Neutral Bay NSW 2089
Australia

T +61 2 9465 5599
F +61 2 9465 5598
E sydney@aurecongroup.com
W aurecongroup.com

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Approval

Author signature	eli tavakol	Approver signature	
Name	Eli Tavakol	Name	Amelia Basson
Title	Environmental Consultant	Title	Water Resources Engineer

Executive summary

The Wallerawang Power Station (WWPS) is a coal-fired power station owned by EnergyAustralia NSW Pty Ltd (EnergyAustralia) that is currently undergoing decommissioning. This process includes the decommissioning and rehabilitation of Wallerawang Ash Repository (WAR), which is collectively made up of the Kerosene Vale Ash Repository (KVAR), Sawyers Swamp Creek Ash Dam (SSCAD), Lidsdale Cut and associated infrastructure areas.

The annual assessments of surface water and groundwater quality are undertaken in accordance with the NSW Department of Planning, Industry and Environment (DPIE, formerly DPE) Development Consent conditions for the Wallerawang Ash Repository outlined in the WAR Operational Environmental Management Plan (OEMP) (EANSW, 2018), and because the Wallerawang Power Station Environment Protection Licence (EPL) has been retained by EnergyAustralia NSW.

Groundwater and surface water quality signals within and downgradient of the KVAR and surface water and groundwater receiving sites are highly complex spatially and temporally.

Influences on water quality are associated with several existing and past land uses including the underlying Kerosene Vale Ash Dam (KVAD), SSCAD, Lidsdale Cut, open cut mining, chitter deposits, underground mining; along with on-site management measures including subsurface drains, pump-back systems and discharge from the Springvale Mine at LDP009.

Review of historical (1991-2020) data for surface water monitoring associated with the KVAR identified that the KVAR was not having a measurable impact on surface water quality in Sawyers Swamp Creek (SSC) at the designated surface water receiving site (WX7 / site 41). There appeared to be no direct correlation between elevated levels of arsenic and molybdenum in surface waters at WX7 and activities associated with the construction or operation of KVAR or SSCAD. The water quality profile in SSC indicated that the water in the creek was dominated by the discharge water from the adjacent mining activities (LDP009), which discharged approximately 18Ml/d to SSC between 2013 and 2019.

Subsequent to the cessation of discharge from the Springvale Mine in July 2019, the key water quality parameters measured at the SSC downstream site (WX 7 / site 41) have been relatively inconsistent, but with an underlying increasing trend. The results are more closely reflecting the KVAR runoff qualities, this is supported by the fact that the upstream location on SSC (site 92) remained dry throughout the monitoring period, with little to no external water entering the system.

The 95th percentile concentrations of water quality parameters within groundwater bore D5 (site 36) currently exceeds the selected water quality guideline values (WQGV) for Al, B, Cd, Cr, Cu, Fe, Mn, Ni, Pb, Se and Zn. A number of these exceedances could potentially be attributed to background levels including pH, Al, Cr, Cu, and Pb, as historically they exceeded the WQGV above the ash repository area at site WGM1/D1 (site 32). Results are reflective of water quality contributions from current and historic land use practices. It is possible that the KVAR is contributing to some elevated parameters in groundwater for Bore D5.

Due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAR and SSCAD, it remains inconclusive (based on the data set available) to directly attribute water quality impacts observed in groundwater in Bore D5 solely to a single source such as the KVAR.

Further hydrogeological investigation and modelling would be required to assess the KVAR's and SSCAD's contribution to water quality changes in Bore D5. An integrated surface water study would also identify the potential and the extent of surface water quality impacts on the receiving environment and support future rehabilitation decision making for the site.

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1 Introduction

1.1 Background

In 2002, Delta Electricity (now EnergyAustralia NSW) obtained approval for conversion of the wet slurry ash placement process at Wallerawang Power Station to dry ash. The facility used to contain the dry ash placement is called the Kerosene Vale Ash Repository (KVAR). Stage 1 of the KVAR placement began in 2003 and was completed and capped in February 2009. Approval was obtained for further ash placement in the Stage 2 Area at the KVAR in November 2008. The Stage 2 Area placement began in April 2009 and was ongoing until Wallerawang Power Station, including the Kerosene Vale Ash Repository (KVAR), ceased operation and subsequent ash production in March 2014.

One of the primary objectives of the design and operation of the KVAR is to have no adverse impact on the local ground or surface water quality. More specifically, this means that leachates from the dry ash placement should not increase concentrations of the various water quality characteristics in the receiving waters by more than the locally derived guidelines (which is based on the 90th percentile of the background, pre-placement sites) or the ANZECC (2000) guidelines for protection of aquatic life (whichever is higher).

This report provides an assessment of surface water and groundwater quality for the April 2019 – March 2020 reporting period and considers previous years monitoring results for identification and interpretation of trends.

1.2 Site Regulation

This annual assessment report contributes to the Annual Environment Management Report (AEMR) for the 2019 / 2020 reporting period for the decommissioned and partly capped KVAR to address the requirements of the NSW Department of Planning, Industry and Environment (DPIE, formerly DPE) Consent Conditions (Condition 7.3 (c), (d) and (e) of Project Approval 07_0005) for monitoring to be undertaken to ascertain whether there have been any effects of the dry ash placement on the local surface or groundwater qualities, pursuant to Conditions 3.4 and 3.5 of Project Approval 07_0005.

1.3 Intended Outcomes

This assessment of groundwater and surface water quality for the decommissioned KVAR includes the following scope of works:

- Discuss the changes (if any) in surface water and groundwater quality as a result of the seepage collection and diversion systems for:
  - Sub-surface drains in the Kerosene Vale Ash Dam (KVAD) under the dry ash Kerosene Vale Ash Repository (KVAR)
  - The Sawyers Swamp Creek Ash Dam (SSCAD) v-notch pump-back system
  - Diversion of the KVAD groundwater to Lidsdale Cut via the unblocked KVAD toe drains
  - Diversion of the Lidsdale Cut discharge from Sawyers Swamp Creek (SSC) to the Sawyers Swamp Creek Ash Dam (SSCAD)
- The effects of the Stage 1 and Stage 2A dry ash placements on surface and groundwater receiving waters with the effects of the local coal mining and the Springvale Mine water discharge considered.

1.4 Scope of Works

To meet requirements in response to the NSW DPIE Development Consent conditions for the Kerosene Vale Ash Repository, the assessment of groundwater and surface water quality for the decommissioned KVAR includes the following scope of works, which are addressed in this report:

- Definition of Water Quality Criteria, Including:
    - ANZECC 2000 Water Quality Guideline Values* (WQGVs)
    - Local Water Quality Guideline Values (WQGVs)
- Assessment of recent (2019-2020) and historic trends in surface water quality data from upstream, downstream and background reference locations summarized in Table 4-1, Section 4.1.1
- Assessment of recent (2019-2020) and historic trends in groundwater quality and level data from upstream, downstream and background reference locations summarized in Table 4-3, Section 4.2.1
- Assessment and summary of groundwater – surface water interactions for SSC, and likely effects of groundwater seepage from the KVAR and discharge from Springvale Mine
- Comparison of groundwater and surface water quality monitoring results against ANZECC 2000 95% Species Protection Levels, ANZECC 2000 99% Species Protection Levels (mercury and selenium), and derived local WQGVs

**The ANZECC 2000 water quality guidelines have been superseded by the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018. To ensure consistency with previous reports the original project WQGV's, which were largely based on the ANZECC 2000 trigger values, have been retained.*

1.5 Previous Reports

To satisfy project objectives Aurecon has reviewed relevant information from the following existing reports:

- Aurecon (2019): Kerosene Vale Ash Dam and Dry Ash Repository – Water Quality Assessment from April 2017 to March 2018 in Relation to the Decommissioned Wallerawang Power Station. Prepared for EnergyAustralia NSW. Rev 1, 24 June 2019. Reference: 502838.
- Aurecon (2018): Kerosene Vale Ash Dam and Dry Ash Repository – Water Quality Assessment from April 2017 to March 2018 in Relation to the Decommissioned Wallerawang Power Station. Prepared for EnergyAustralia NSW. Rev 3, 22 June 2018. Reference: 502838.
- Aurecon (2017): Kerosene Vale Ash Dam and Dry Ash Repository – Water Quality Assessment from April 2016 to March 2017 in Relation to the Decommissioned Wallerawang Power Station. Prepared for EnergyAustralia NSW. Rev 1, 16 June 2017. Reference: 256109.
- Aurecon (2016): Kerosene Vale Ash Dam and Dry Ash Repository – Water Quality Assessment from April 2015 to March 2016 in Relation to the Decommissioned Wallerawang Power Station. Prepared for EnergyAustralia NSW. Rev 4, 14 November 2016. Reference: 208562.
- Aurecon (2015): Kerosene Vale Ash Dam and Dry Ash Repository – Water Quality Assessment from April 2013 to March 2015 in Relation to the Decommissioned Wallerawang Power Station. Prepared for EnergyAustralia NSW. Rev 4, 8 October 2015. Reference: 208562.
- Aurecon (2014): Kerosene Vale Ash Dam and Dry Ash Repository KVAR Stage 2 Water Quality Assessment February 2012 to March 2013. Prepared for EnergyAustralia NSW. 16th January 2014.
- Aurecon (2012): Kerosene Vale Ash Dam and Dry Ash Repository KVAR Stage 2A Water Quality Assessment April 2010 to January 2012. Prepared for Delta Electricity Western 9th October 2012.
- Aurecon (2010): KVAD Stage 2 Water Quality Assessment October 2007 to March 2010. Draft Report Prepared for Delta Electricity Western 18 June 2010.
- EnergyAustralia NSW (2014): Kerosene Vale Ash Repository Stage 2 Annual Environmental Management Report, April 2013 – March 2014. EnergyAustralia NSW, NSW Australia.
- EnergyAustralia NSW (2014): Kerosene Vale Ash Dam and Dry Ash Repository – Stage 2 Water Quality Assessment, April 2013 to March 2014. EnergyAustralia NSW, NSW Australia.
- EnergyAustralia NSW (2013): Kerosene Vale Ash Repository Stage 2 Annual Environmental Management Report, April 2012 – March 2013. EnergyAustralia NSW, NSW Australia.
- Delta Electricity (2012): Kerosene Vale Ash Repository Stage 2 Annual Environmental Management Report, May 2011 – April 2012. Delta Electricity NSW, NSW Australia.

- Delta Electricity (2011): Kerosene Vale Ash Repository Stage 2 Annual Environmental Management Report, 2010 – 2011. Delta Electricity NSW, NSW Australia.
- Parsons Brinckerhoff (2010): 1st Annual Environmental Management Report for Kerosene Vale – Stage 2 Ash Repository Area. Prepared for Delta Electricity. October 2010.

1.6 Information Provided by EnergyAustralia NSW

EnergyAustralia NSW has provided copies of the following documents to Aurecon to satisfy the project objectives:

- Surface water quality data from April 2019 to March 2020 from upstream, downstream and background reference locations summarized in Table 4-1, Section 4.1.1 (EnergyAustralia NSW, 2020a)
- Groundwater quality and level data from April 2019 to March 2020 from upstream, downstream and background reference locations summarised in Table 4-3, Section 4.2.1 (EnergyAustralia NSW, 2020b)

1.7 Data Quality

The data contained within this report has been provided to Aurecon by EnergyAustralia NSW.

The Operational Environmental Management Plan (OEMP) requires the existing monitoring program to continue, with the addition of low detection limit analysis for trace metals (to ensure that the detection limit is lower than ANZECC 2000, or locally derived WQGVs). Except for Silver (Ag), all metals were tested at levels below the WQGVs.

In accordance with ANZECC (2000) guidance (Chapter 6) protocols for data analysis and interpretation, where parameter concentrations have been recorded as less than the laboratory limits of reporting (LOR), the equivalent LOR value has been used as proxy for the parameter concentration for the purpose of statistical assessment.

In house assessment methods[1] based upon the Standard Methods (APHA, 1998) are used for the general water quality characteristics, which include:

- Alkalinity, sulfate, chloride, calcium, magnesium, sodium, potassium, total dissolved solids (TDS) and Turbidity[2] (NTU)

And for trace metals and elements, which include:

- Copper, cadmium, chromium, lead, zinc, iron, manganese, mercury, selenium, silver, arsenic, barium, boron, fluoride, molybdenum, nickel and beryllium.

The trace metals and elements monitored are the same for surface and groundwater. Molybdenum, nickel and beryllium have been monitored since July 2007, but beryllium was stopped in April 2010 and aluminium has been monitored since July 2010.

Since April 2006, the laboratory limits of reporting (LOR) for routine monitoring of most trace metals in surface water and groundwater samples were lower than the ANZECC (2000) guidelines. Particular attention has been directed at the trace metals arsenic, cadmium, chromium, copper, mercury, nickel and lead, as well as the trace element selenium, which have been analysed with a low detection limit. However, due to sample matrix interference, silver has continued to be analysed above the ANZECC guideline trigger value of 0.05 µg/L since November 2001.

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[1] Nalco has NATA accreditation Number 1099 and is accredited for ISO/IEC 17025

[2] Representative of total suspended solids (TSS, also known as non-filterable residue, NFR) – ANZECC (2000)

2 Site Characterisation

2.1 Site Location

The Kerosene Vale Ash Repository (KVAR) is owned and operated by EnergyAustralia NSW. The KVAR is located approximately 2.5 kilometres north-east of Wallerawang Power Station and approximately 10 kilometres north-west of the city of Lithgow, which is 150 kilometres north-west of Sydney (Figure 2-1). The KVAR is situated in the centre of the Sawyers Swamp Creek (SSC) catchment and receives rainfall runoff from the Newnes Plateau and surrounding hillslopes.

2.2 Landscape and Geology

The project area is located within the Kerosene Vale valley, which is defined by a drainage basin with a catchment area of approximately 9km^2. The drainage basin is characterised by an elongate, gently sloping, steep sided valley, through which the Narrabeen group sandstones have been cut, exposing the Permian Illawarra Coal Measures and depositing discrete alluvial sequences.

Geological units of the project area are presented in Table 2-1 below, and presented in Figure 2-2:

Table 2-1 Stratigraphic Units – Project Area

Period	Group	Subgroup	Formation	Seam	Approx. Thickness
Regolith / Quaternary	Quaternary	Quaternary	Quaternary Alluvium / Regolith	-	
Triassic	Narrabeen Group	Grose	Banks Wall Sandstone	-	
			Mt York Claystone	-	
			Burra Moko Head Sandstone	-	
			Caley	-	
Permian	Illawarra Coal Measures	Wallerawang	Farmers Creek	Katoomba	
				Middle River	
		Charbon	Denman	-	
			Irondale Coal	Irondale	1.4 – 1.6
		Cullen Bullen	Lidsdale	Lidsdale	1.4 – 4
			Lithgow	Lithgow	1.1 – 3.7
			Marrangaroo Conglomerate	-	
		Nile Subgroup	Gundangaroo,	-	
			Coorongooba Creek Sandstone,	-	
			Mt Marsden Claystone	-	
	Shoalhaven	Berry Siltstone	-	-	

Geological units within the immediate project area dip in accordance with the regional profile (moderately towards the east, and to the north). Borehole logs indicate the presence of 3 distinct coal seams, including an upper (shallow) coal seam at approximately 920mAHD below the KVAR, a middle (intermediate) seam at approximately 910mAHD below the KVAR, and a lower coal seam (the Lidsdale Coal Measure) at approximately 900mAHD below the KVAR.

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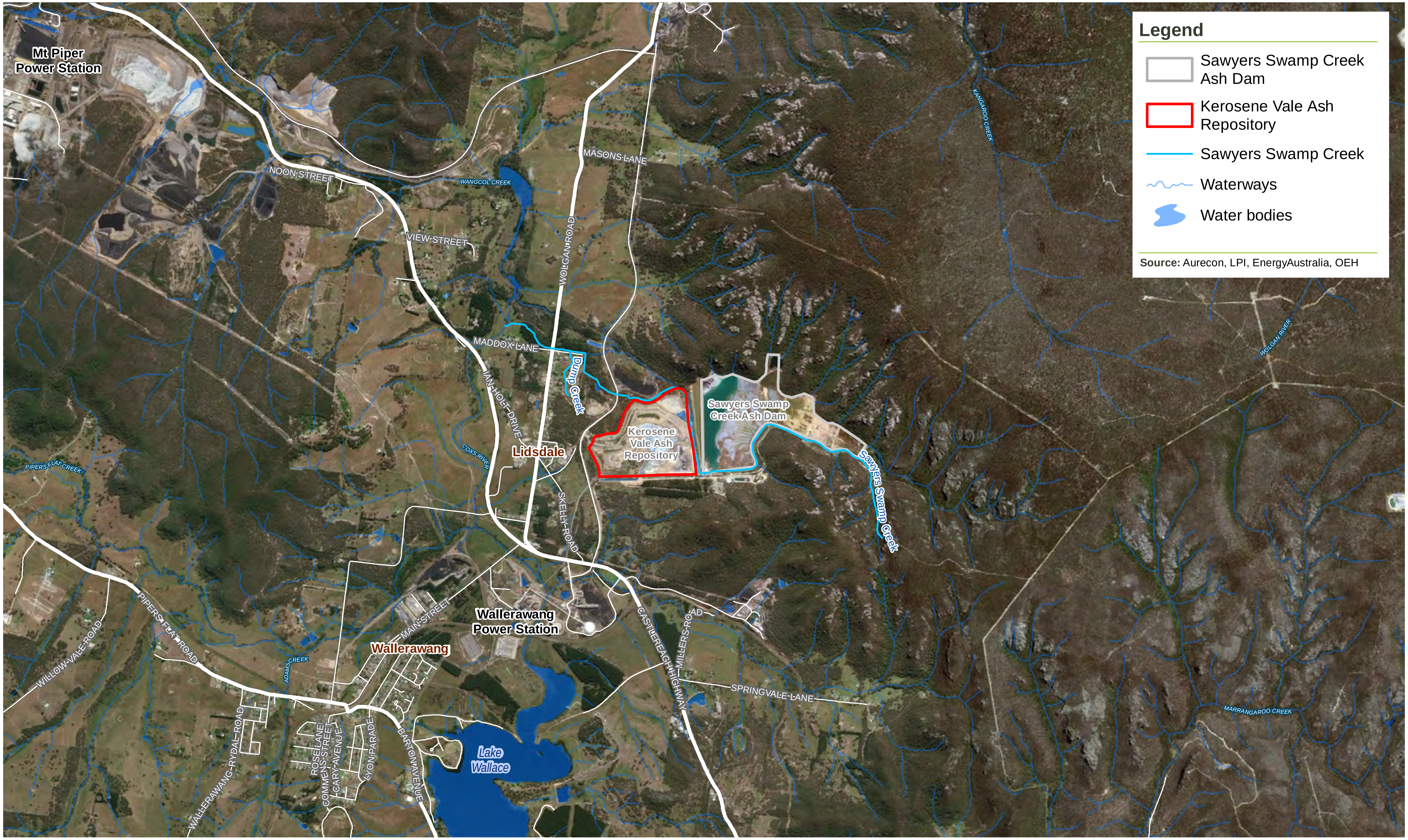

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Projection: GDA 1994 MGA Zone 56

EnergyAustralia **Wallerawang Power Station**

Figure 2-1: Site Location

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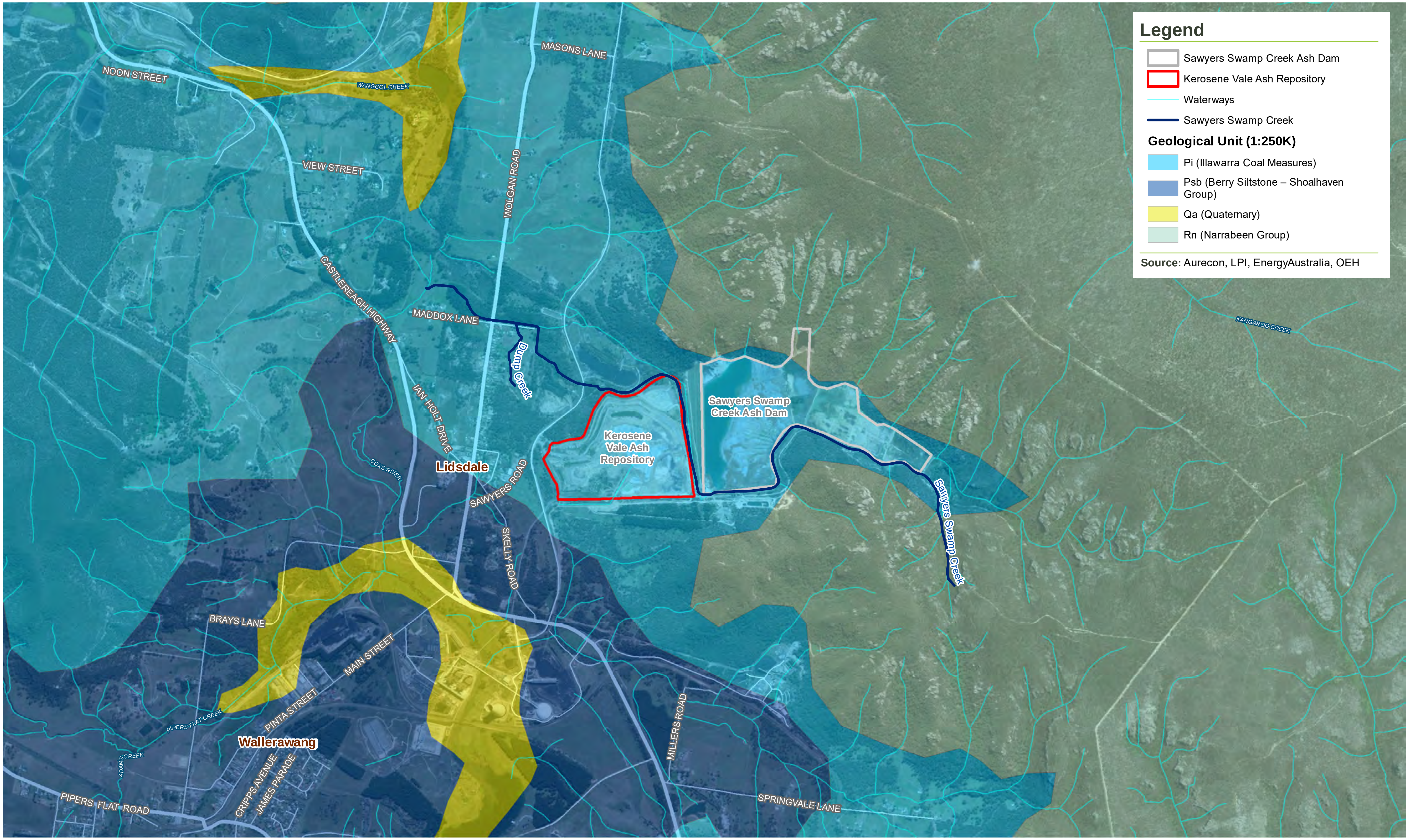
P:\GIS\Project-2\project\EnergyAustralia Western Power Stations\208562 - Wallerawang PS\Maps\208562 - Wallerawang Power Station - Figure 2-2 Local Surface Geology.mxd\JOB No.\30-05-18\Ross.Ma\Rev 3



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Projection: GDA 1994 MGA Zone 56

EnergyAustralia **Wallerawang Power Station**

Figure 2-2: Local Surface Geology

Creation of the Sawyers Swamp Creek Ash Dam (SSCAD) and Kerosene Vale Ash Repository has modified the catchment morphology. Upgradient and to the east of SSCAD, in the upper portions of the catchment valley, the topography has been modified from its original profile through emplacement of ash, to form a gently sloping (0.2% gradient) surface up to the SSCAD dam wall, which bisects the valley along a north-south axis.

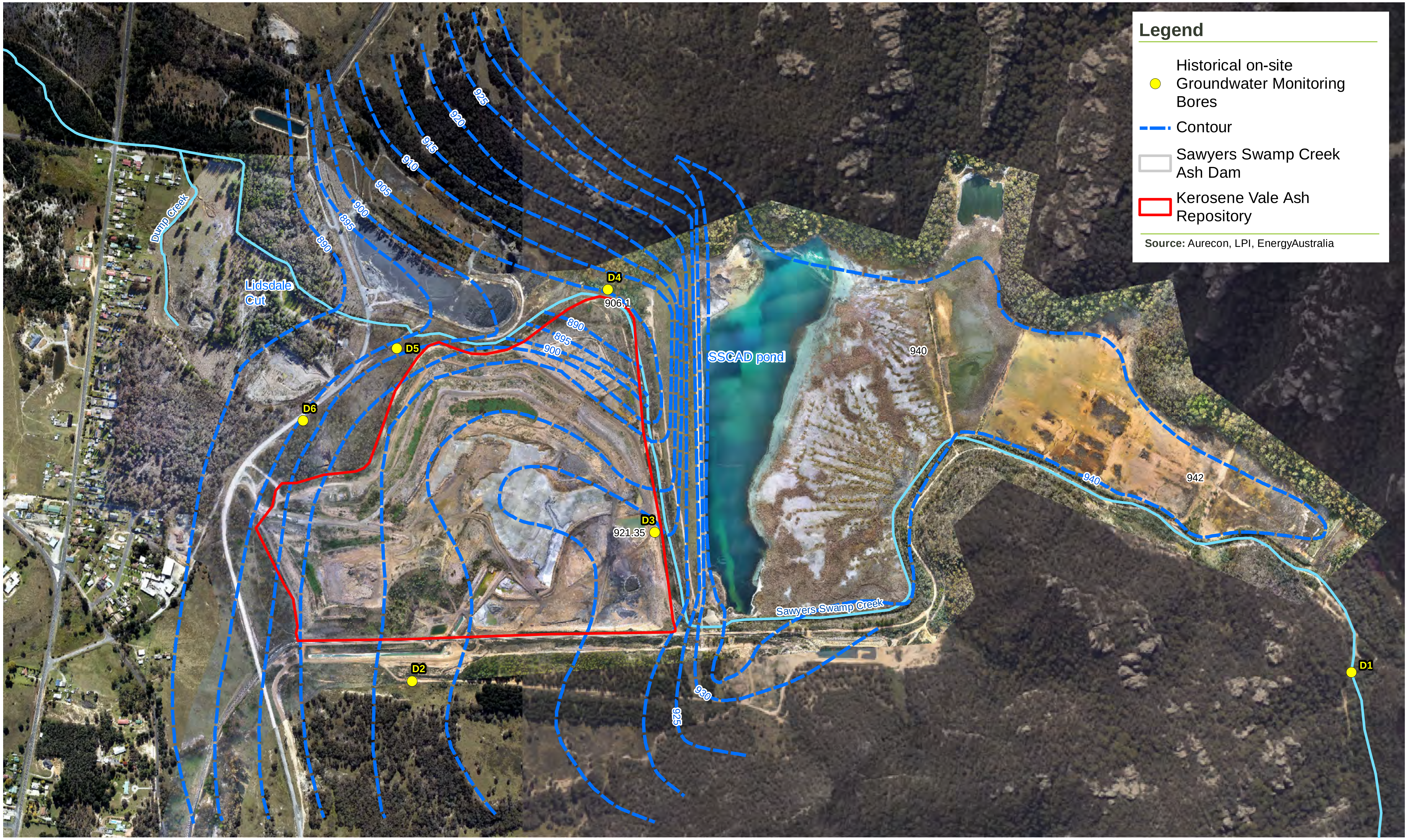
Ash emplacement in the eastern portion of the catchment forms a wedge shape above the original (palaeo) surface of the basin valley. The ash wedge ranges in depth from 0m in the vicinity of the Freshwater Diversion Dam, to approximately 22m at the eastern most portion of the SSCAD pond (adjacent to pond C), and likely extending to 25m+ near the SSCAD cut-off wall. Locally the ash wedge is overlain by a thin cap of silty clay (c. 0.5m thick) and underlain by a layer of alluvial / residual type material (silty sand / clayey sand) (c.2.0m thick), underlain in turn by bedrock material (siltstones, shales and coals) of the Illawarra Coal Measures (ICM).

The profile of the valley falls sharply (approximately 16% gradient) on the western side of the ash dam wall, from approximately 940m AHD to approximately 915m AHD at its base. At the base of the SSCAD ash dam wall, Sawyers Swamp Creek (SSC) cuts up to the north from its diversion at the southern portion of the SSCAD dam, before meandering to the west and out to the Coxs River. To the west of the SSCAD and SSC, the original topography has been further modified through emplacement of the Kerosene Vale Ash Repository (KVAR) and underlying Kerosene Vale Ash Dam (KVAD), which together form a mound, rising up to approx. 20m above the original ground surface to a height of approximately 940m AHD. The SSC has been modified to flow to the east of the KVAR, before cutting around the north of the mound on its path out to the Coxs River.

2.3 Hydrogeology

The hydrogeology of the project area is complex owing to the extensive modifications to the drainage basin landform as a result of construction of the SSCAD, KVAR and historical modification to channel routing of the Sawyers Swamp Creek.

A groundwater contour plot (Figure 2-3) was previously developed using recent (2017) groundwater monitoring data. The contour plots show that groundwater flows through the Narrabeen Group Sandstones and Upper Illawarra Coal Measures are generally to the west through the catchment, from the upper portions of the catchment, through / below the SSCAD and KVAR / KVAD and out towards Sawyers Swamp Creek, where groundwater flow paths turn to the south / south-east with the regional flow regime.



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Projection: GDA 1994 MGA Zone 56

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Figure 2-3: 5m Catchment Groundwater SSC Catchment

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2.4 Site History

2.4.1 Construction and Development

The Kerosene Vale Ash Repository (KVAR) area was originally constructed between 1960 and 1990, during which time it was filled with a combination of by-product (wet) ash from the Wallerawang Power Station and mining spoil from Springvale Colliery. Kerosene Vale was used as an ash dam during its operation and subsequent capping in 1990, hence it is distinguished as the Kerosene Vale Ash Dam (KVAD).

Between 1980 and 2003 wet ash from Wallerawang Power Station was emplaced within the Sawyers Swamp Creek Ash Dam (SSCAD) located east of and immediately upgradient of the KVAD. However, in 2001, Delta Electricity identified the need for additional storage capacity due to storage constraints within the SSCAD.

The KVAD area was identified as a suitable site, as it had been historically used for the purpose of ash placement for Wallerawang Power Station. However, placement of ash over the KVAD required a change from wet ash to a dry ash operation.

In 2002, approval was granted to Delta Electricity to change from wet ash to dry ash placement activities and to use the current KVAR area for dry ash storage. In 2003, placement of wet ash in the SSCAD ceased and placement of dry ash in the Stage 1 area of the KVAR commenced.

In November 2008, Delta Electricity received further project approval for extension of the KVAR. Subsequently the Stage 1 KVAR area was capped in February 2009 and placement in the Stage 2 KVAR area commenced in April 2009, with placement in the planned Stage 2A area outlined in the original ash placement strategy (Parsons Brinkerhoff, 2008).

With ash placement commencing in Stage 2A, Delta Electricity's contract structural engineers reviewed the ash placement strategy. Following this review, it was determined that previously planned construction activities were not required to facilitate the placement of ash in the Stage 2A. Subsequently a revised ash emplacement strategy was developed, which has been used in the design, construction and management of the recently decommissioned KVAR. Figure 2-4 presents a schematic of the placement strategy for Stage 1, 2A and 2B, with a Stage 2C placement area located between Stages 2A and 2B.

In January 2012, the Stage 2C area was excavated in preparation for ash placement, however ash placement did not proceed as a result of the subsequent decommissioning of Wallerawang in 2014.

In January 2014, Wallerawang Power Station's Unit 7 was removed from service and deregistered from the market; whilst in March 2014, Unit 8 was placed in long term storage. As a consequence, Wallerawang Power Station has not generated ash requiring disposal at KVAR since April 2014. Further, EnergyAustralia is currently negotiating with NSW Treasury to produce a plan for the decommission, deconstruction and rehabilitation of the entire operational facility at Wallerawang including the ash placement areas.

2.4.2 Key Events

Through the lifecycle of dry ash placement in the KVAR, several key events can be identified associated with environmental management of the site, which have subsequently affected the dynamics of surface water-groundwater interactions and water quality signals. These events are summarised alongside the construction and development activities associated with the site in Table 2-2, and are approximate only.

Table 2-2 Kerosene Vale Ash Repository – Record of Key Activities and Events

Approximate Date	Event Description
1960-1980	KVAD Wet Ash Emplacement
1980-2003	SSCAD Wet Ash Emplacement
1990	KVAD Capped
May 2003	Stage 1 Dry Ash Emplacement in Stage 1 KVAR
2006	KVAD Toe Drains Blocked
February 2009	Stage 1 Dry Ash Emplacement Complete and Capped
April 2009	Stage 2A Dry Ash Emplacement
February 2010	Stage 1 KVAD Toe Drains Unblocked to LC
May 2010	SSCAD Seepage Collection Installed
October 2010	Unblocked KVAD Toe Drains and Reinstated Seepage Collection and Diversion System to Lidsdale Cut.
October 2010	Sub-Surface Drains Installed for KVAD within KVAR Stage 2 Area and connected to KVAD Toe Drains
February 2011	Stage 2 Subsurface Unblocked to LC
July 2011	Springvale Mine Water Discharge Pipe Leak
January 2012	Stage 2C - Commenced, Never Emplaced
June 2012	Discharge from LC to SSC Stops
July 2012	Discharge from LC to SSCAD Via Canal Starts
July 2013	Springvale Mine Discharge 18ML/d to SSC Starts
March 2014	KVAR ceased operation and ash production
July 2015	Stage 2C Excavation and Clean Water Detention Pond

The key events affecting environmental conditions within the KVAR during its operational lifecycle, that are not related to general construction and development of the site include:

- 2006 - Blockage of the KVAD toe drains
- October 2010 – Unblocking of the KVAD toe drains
- October 2010 – Installation of subsurface drains for the Stage 2 KVAR area
- October 2010 – Reinstatement of seepage collection and diversion system to Lidsdale Cut
- February 2011 – Unblocking of the Stage 2 subsurface drains
- June 2011 – Springvale Mine Water Discharge Leak
- June 2012 – Discharge from Lidsdale Cut to Sawyers Swamp Creek via v-notch ceases
- July 2012 – Pumping from Lidsdale Cut to Sawyers Swamp Creek Ash Dam via the Return Canal commences
- July 2013 – Springvale Mine discharge (18ML/d) to Sawyers Swamp Creek commences
- July 2019 - Springvale Mine discharge diverted to new Water Treatment Facility and discharge to Sawyers Swamp Creek ceases

In addition to the above list of events EnergyAustralia NSW has advised Aurecon that extensive erosion of the dry ash surface on the eastern side of the Stage 2 area had occurred and the batter was repaired in 2017. Rainfall runoff flowed to the southern side of the KVAR and the various surface water collection ponds and overflows collected the ash before the runoff entered the return canal.

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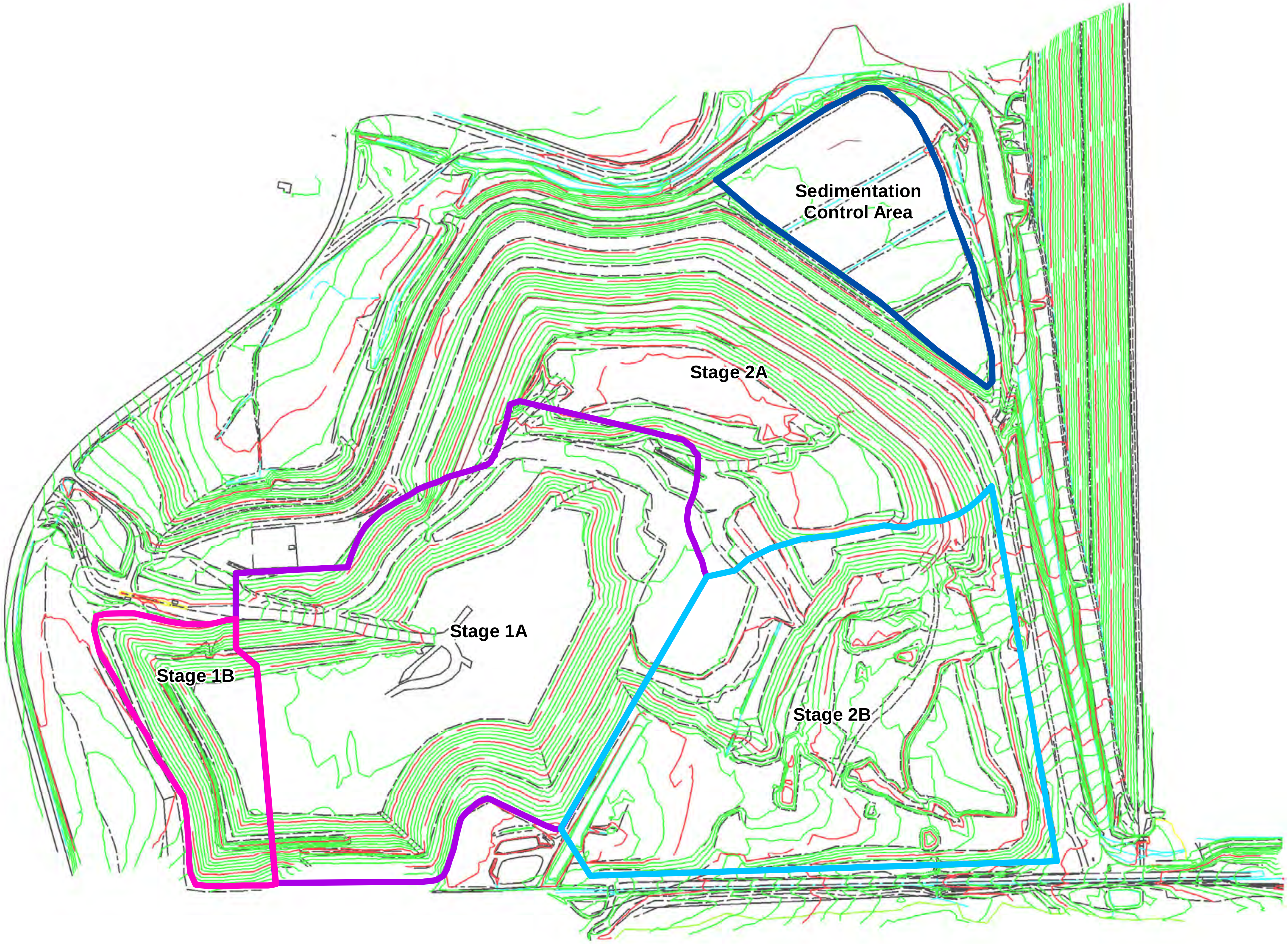

Legend

- 🟪 Stage 1A
- 🟪 Stage 1B
- 🟧 Stage 2A
- 🟦 Stage 2B
- 🟦 Sedimentation Control Area
- CAD survey data

Source: Aurecon, LPI, EnergyAustralia

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Projection: GDA 1994 MGA Zone 56

EnergyAustralia **Wallerawang Power Station**

Figure 2-4: Revised Ash Placement Strategy for KVAR - Stages 1, 2A and 2B

2.5 Site Layout and Design

The current layout, design and operations at the KVAR are a result of the long history of events and activities related to ash emplacement and environmental management, including construction of the original KVAR (KVAD) between 1960 and 1990, Construction of the SSCAD and emplacement of wet ash between 1980 and 2003, and subsequent construction and development of the recently decommissioned KVAR between 2003 and 2014. Figure 2-5 presents the current layout and design of the KVAR relative to the SSC catchment features, including the SSCAD and SSC. Key elements of the KVAR, SSC and SSCAD are discussed in the following sections.

2.5.1 Sawyers Swamp Creek

Sawyers Swamp Creek (SSC) is an ephemeral creek which drains the Sawyers Swamp Creek Catchment of the Newnes Plateau. SSC flows from east to west and forms a tributary to the Coxs River, which drains south towards Lake Wallace. Any overflow from Lake Wallace is transmitted to Lake Lyell, which is the water supply reservoir for Mt Piper Power Station and part of the Sydney Drinking Water Supply. The natural course of SSC has been diverted through artificial channel modifications so that flows bypass the SSCAD and KVAR.

The flow path of SSC is currently to the south of the SSCAD, before turning north, passing between SSCAD and the KVAR. At northernmost portion of the KVAR, (north of the sedimentation area), SSC bends to the west passing between the KVAR and Centennial's Coal Stockpile beyond the northern boundary of the site. Sawyers Swamp Creek subsequently flows out to Coxs River, past Lidsdale Cut and Dump Creek, which forms a tributary to SSC.

Discharge through SSC was periodically modified to a sustained flow in the lower portion of SSC catchment as a result of discharge from Springvale Colliery through LDP009, which is located adjacent to the SSCAD Spillway. The discharge through LDP009 was approximately 18ML/d before ceasing in July 2019, after the commissioning of the Springvale Water Treatment Facility.

2.5.2 SSCAD

The SSCAD is a major artificial surface water body located between Springvale Colliery and the KVAD. The dam was historically used for wet ash disposal from Wallerawang Power Station. The SSCAD is separated from SSC by a toe drain to the south and by a dam wall to the west, through which seepage is collected via a concrete drain and returned to the SSCAD via a pump-back system.

Water levels in SSCAD are controlled by a gravity overflow outlet weir located at the front of the spillway. From the weir, SSCAD water discharges through a HDPE pipe to the Return Water Canal where it is pumped back to the SSCAD.

Catchment runoff from upstream of the ash dam enters the creek, via a pipe, that discharges over the spillway and joins SSC. Mine water discharge from Springvale Colliery enters SSC upstream of the spillway and mixes with catchment runoff.

2.5.3 KVAR / KVAD

The KVAR / KVAD form an area characterised by an artificial mound of dry processed ash (KVAR) overlying a capped unit of wet processed ash (KVAD) which has been sequentially deposited in the KVAR area since the 1960s. Seepage and leachate within the KVAR / KVAD is controlled by a complex network of subsurface drains, connected to toe drains, leachate collection ponds and the Return Water Canal (which is pumped to SSCAD).

Rainfall runoff from the northern part of KVAR is collected by a perimeter drain which directs the runoff to a Collection Pond in the north-east of the Stage 2 area. Groundwater seepage collected in the subsurface drains is also collected in this pond and the water is sent to the Lidsdale Cut Pond via the pipeline. It is also understood that some of the water in the Collection Pond is reused for dust suppression by spraying on the dry ash deposit.

The KVAR / KVAD is hydraulically isolated from SSC by the KVAD toe drains which collect and transmit seepage / leachate to Lidsdale Cut Pond, local sumps, and / or the Return Water Canal.

2.5.4 Lidsdale Cut Pond

Lidsdale Cut Pond is an artificial waterbody formed as a result of historical mining activities. Seepage from the KVAD / KVAR is collected and sent to the Lidsdale Cut Pond via the existing KVAD toe drains. Historically, seepage from the KVAD was discharged directly to SSC from the Lidsdale Cut pond via a v-notch. However, in June 2012, the v-notch was sealed in order to halt discharge to SSC, and in July 2012 water from Lidsdale Cut Pond was re-circulated to SSCAD via the Return Water Canal located to the south of the Stage 1 KVAR emplacement area. In 2017 this process was modified so that water from Lidsdale Cut Pond is currently discharged to the Dirty Water Pond (identified in Figure 2-5), located near the KVAR / KVAD dump valves, prior to being discharged to the SSCAD.

EnergyAustralia NSW has advised Aurecon that the water in the Lidsdale Cut pond is regularly pumped to maintain a water level about 0.4 to 0.6m above the current void bottom.

2.5.5 Return Water Canal

The Return Water Canal is located to the south of the Stage 1 KVAR emplacement area and KVAD footprint. The Return Water Canal historically received pumped water from Lidsdale Cut Pond, until operations were modified in 2017. The Return Water Canal currently receives surface water runoff and seepage directly from the KVAR. Overflow water from the SSCAD is also discharged to the Return Water Canal via a HDPE pipe. Water within the Return Water Canal is discharged to the SSCAD via a pump-back system.

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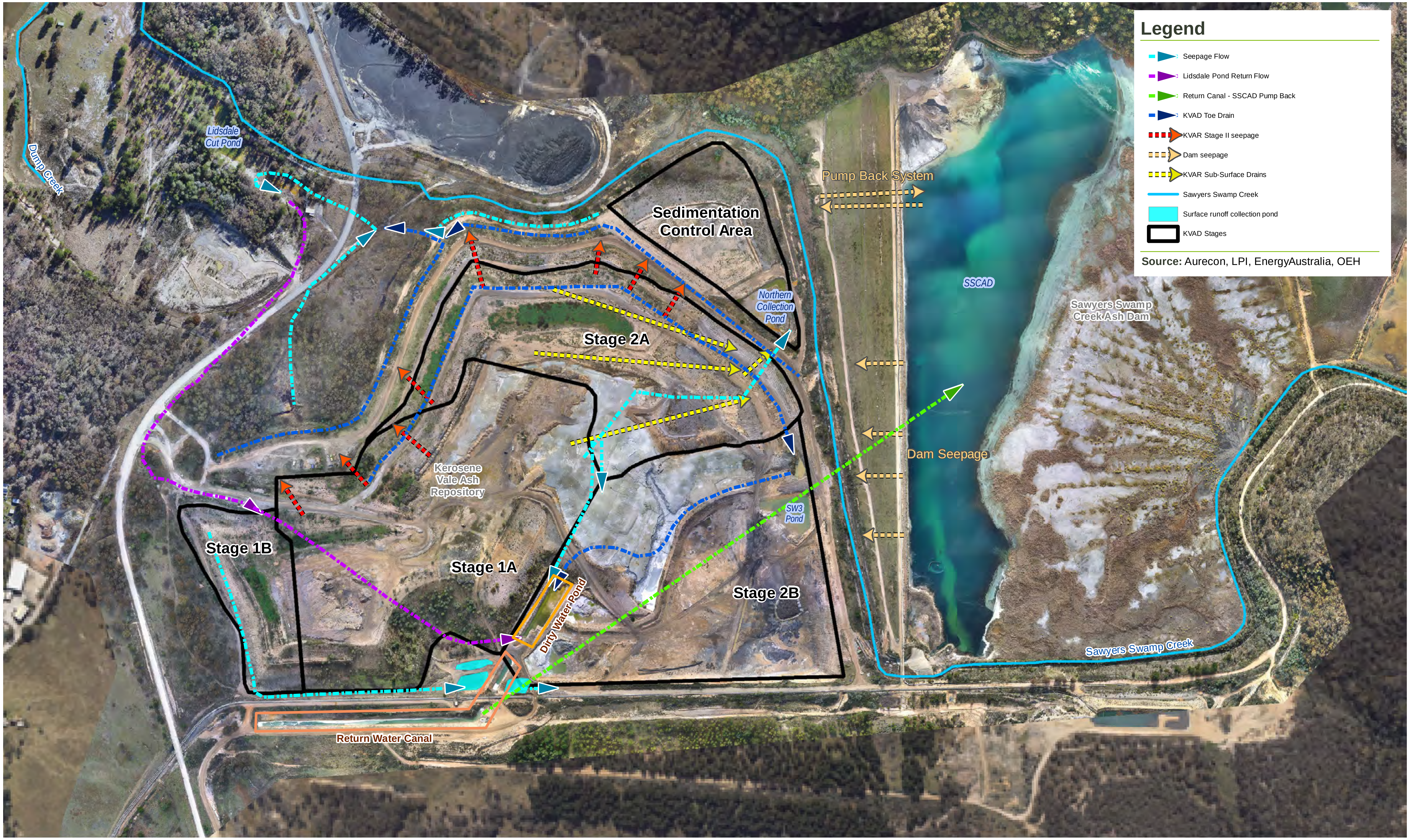

Source: Aurecon, LPI, EnergyAustralia, OEH

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Projection: GDA 1994 MGA Zone 56

EnergyAustralia **Wallerawang Power Station**

Figure 2-5: Site Layout and Design

3 Water Quality Guidelines

3.1 ANZECC Guidelines

As used in previous reports since 2008, the principle of the ANZECC (1995) guidelines for protection of groundwater, where the potential future use of the water resource is considered, has been taken into account. In this regard, the Irrigation, Ecosystem and additional guidelines for protection of livestock or drinking water has been used, where appropriate, to provide a wider context of the ANZECC (2000) guidelines, and to define acceptable ambient water quality at the KVAR Stage 2 receiving water sites.

Due to the mineralised conditions and long history of mining related activities within the SSC catchment and wider Wallerawang region, locally derived water quality guidelines have been applied to several water quality parameters that are likely to have been affected by the historical activities and local conditions.

The groundwater background concentrations were adopted from the pre-placement data from the background bore, WGM1/D2, and elevated concentrations at the seepage detection bore WGM1/D5 and Lidsdale Cut (WX5) were also taken into account. The surface water background concentrations use the pre- placement data at Dump Creek, WX11, which is the local background for the mineralised area. The pre-KVAR data at WX7 was also taken into account.

The water quality monitoring is undertaken to ascertain whether the local/ANZECC (2000) guidelines (as applicable) and groundwater investigation levels (GILs – NEPM 2013) are met in the groundwater receiving water bores D5 and D6 and in Sawyers Swamp Creek at the final surface water receiving site, WX7.

In accordance with ANZECC guidelines, the 95th percentile of concentrations in water quality monitoring results are compared against the adopted Water Quality Guideline Values (WQGVs), which include both ANZECC trigger values and locally derived guideline values.

3.2 NEPM Guidelines

Groundwater investigation levels (GILs) are the concentrations of a contaminant in groundwater above which further investigation (point of extraction) or a response (point of use) is required. GILs are based on Australian water quality guidelines and drinking water guidelines and are applicable for assessing human health risk and ecological risk from direct contact (including consumption) with groundwater. Further information is provided in Section 2.8 and Schedule B6.

The Groundwater investigation levels (GILs) are based on the Australian Water Quality Guidelines 2000 (AWQG), Australian Drinking Water Guidelines 2011 (ADWG) and Guidelines for Managing Risk in Recreational Waters 2008 (GMRRW) (NHMRC, 2008). The GILs are adopted in the National Environment Protection (Assessment of Site Contamination) Measure (NEPM) (NEPC, 2013) as investigation levels in the context of the framework for risk-based assessment of groundwater contamination (refer Schedule B6), i.e. levels above which further assessment is required.

The AWQG provide tabulated values based on percentage species protection for various aquatic environments and water uses. The appropriate settings for current and potential uses of groundwater need to be identified for the aquifer undergoing assessment. The guideline documents should be consulted for appropriate interpretation of guideline values, in consultation with relevant regulatory authorities if necessary.

3.3 Applicability of Water Quality Guidelines

The surface water guideline goals apply to the receiving waters of Sawyers Swamp Creek at WX7 (Site 41), only for the effects of the ash placement input concentrations (including the associated effects of coal waste/chitter leachates), but not for the effects of the Springvale Coal Mine input.

The groundwater goals apply to the seepage detection bore WGM1/D5 (Site 36), which monitors the surficial aquifer downstream of the KVAR/KVAD facility. This monitoring point is also used for early warning of potential effects on the Sawyers Swamp Creek receiving waters. These goals are used for assessment of the decommissioned KVAR effects in this report.

4 Surface Water and Groundwater Monitoring Results: 2019 - 2020

4.1 Surface Water

4.1.1 Monitoring Locations

To satisfy sampling requirements for the project, EnergyAustralia NSW undertook surface water sampling at the monitoring locations summarised in Table 4-1, below and presented in Figure 4-1.

Table 4-1 Surface Water Monitoring Locations

Site #	Site ID	Purpose	Monitoring Period	Easting	Northing
Springvale Discharge					
158	Springvale Mine Water	Springvale Mine Water Discharge	2011-2019 (ceased Jul 19)	230673	6301460
Surface Water Receiving Site					
41	Sawyers Swamp Creek Lower (WX7)	Receiving Water Site	1991-2020	228961	6302719
Sawyers Swamp Creek Additional Sites					
92	Upstream SSCAD (WX1)	Upgradient of SSCAD Surface Water	1992-2018 (dry 2020)	231969	6301582
93	SSC Downstream V-notch	SSC Downstream of SSCAD Seepage Collection	2010-2019 (dry 2020)	230166	6302340
83	SSC Downstream KVAR	SSC Downstream of KVAR Stage 2A	2010-2020	229650	6302246
225	SSCAD Spillway	SSCAD Water Outflow	2012-2020	230369	6302775
SSCAD					
38	Sawyers Swamp Creek Ash Dam (SSCAD 38)	SSCAD Water Input from Return Canal	1996-2020	229766	6301457
79	SSCAD V-notch	SSCAD Seepage Collection	2010-2020	230259	6302287
KVAR / KVAD					
81	West KVAD Wall subsurface Left	North-West Wall of KVAR / KVAD	2010-2017 (dry 2018-2020)	229684	6302194
80	West KVAD Wall Subsurface Right	North-West Wall of KVAR / KVAD	2010-2020	229660	6302179
86	North Wall Collection	North Wall of KVAR / KVAD	2010-2020	229909	6302201
87	Surface Water Runoff / West KVAD Wall Subsurface	North Wall Surface Water Runoff	2010-2020	229947	6302227
Lidsdale Cut Pond					
40	Lidsdale Cut (WX5)	Lidsdale Cut Monitoring	1992-2020	229402	6302329
Dump Creek					
39	Dump Creek (WX11)	Dump Creek Monitoring	1991-2020	229102	6302666

The monitoring locations were selected to represent surface water quality upstream, downstream and at several reference locations.

Routine long-term water quality data has been collected for SSC at the downstream receiving water location (WX7 / ID 41), as well as the upgradient location (WX1 / ID 92) since 1991 / 1992. Water quality data for additional sites upgradient and downgradient of the KVAR (Sites 83, 93, 225) are available from 2010. Long term water quality data has also been collected for Lidsdale Cut Pond at WX5 and Dump Creek at WX11. Water quality data is available for SSCAD from 1996, whilst data for KVAR / KVAD monitoring points is available from 2010.

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Projection: GDA 1994 MGA Zone 56

EnergyAustralia **Wallerawang Power Station**

Figure 4-1: Water Quality Monitoring Locations

4.1.2 Monitoring Methodology

Routine surface water monitoring is undertaken on a monthly basis on behalf of EnergyAustralia NSW by Nalco Analytical Resources who measure conductivity, pH and temperature in the field using calibrated instrumentation.

Aurecon understand that all surface water samples were collected in accordance with ANZECC (2000) monitoring guidelines (Chapter 4) for shallow waters, with samples collected from just below the surface (0.25m-0.5m) either directly to sample collection bottles by hand (using disposable nitrile gloves) or using a plastic bucket fixed to a rope – cleaned prior to use and between sampling sites and dispensed into sample collection bottles.

4.1.3 Monitoring Results

Surface water monitoring results for the 2019-2020 reporting period are presented in Appendix C along with a statistical summary of the data.

In accordance with ANZECC (2000) and ADWG (2011) guidelines, the 95th Percentile of the test results from surface water monitoring for toxicants and stressors have been compared against selected surface water guideline values that are based on ANZECC (2000) Trigger Values (ANZECC, 2000 Section 7.4.4.1, Step 2) or ADWG Values (ADWG, 2011 – Chapter 10), and against local WQGVs where locally derived WQGVs supplant ANZECC / ADWG Trigger Values. The results from this assessment are presented in Table 4-2 below.

Table 4-2 Summary Statistics 2019-2020 Surface Water Monitoring Results (mg/L) – 95th Percentiles

Sample Location	pH	Cond (µs/cm)	TDS	SO4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Springvale Discharge																							
Springvale (158)	8.6	1400	ND	82	27	8.7	0.028	0.001	0.024	0.001	0.12	0.0001	0.003	0.01	ND	1.76	0.00004	0.022	0.054	0.026	0.003	0.001	0.030
Sawyers Swamp Creek – Surface Water Receiving Site																							
WX7 (41)	5.9 (20th P) 8.6 (80th P)	2138	1776	1100	23	11	0.010	0.001	0.058	ND	0.94	0.007	0.080	0.007	1.92	2.86	0.000	42.2	0.047	1.664	0.002	0.002	4.37
Sawyers Swamp Creek – Additional Sites																							
Upstream SSCAD WX1 (92)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Spillway (225)	8.3	1805	1188	500	139	4.2	0.010	0.001	0.106	ND	0.36	0.0001	0.003	0.005	1.25	0.657	0.00004	0.33	0.040	0.022	0.006	0.001	0.023
Downstream V-Notch (93)	8.6	1330	929	48	13	0.4	0.011	0.001	0.018	ND	0.12	0.0001	0.001	0.0010	1.19	0.027	0.00004	0.03	0.045	0.005	0.001	0.001	0.012
Downstream KVAR (83)	8.6	3751	2583	2166	36	38	0.014	0.001	0.072	ND	7.3	0.007	0.003	0.027	5.05	15	0.0001	26.5	0.044	1.3	0.010	0.005	2.67
SSCAD																							
SSCAD (38)	8.4	123	96	21	4.9	0.4	0.001	0.001	0.120	ND	1.20	0.0001	0.001	0.001	0.9	0.062	0.00004	0.03	0.059	0.017	0.001	0.001	0.024
SSCAD V-Notch (79)	7.0	2928	2455	1631	63	7.5	0.002	0.001	0.064	ND	1.99	0.0005	0.005	0.0085	0.9	0.076	0.00004	2.32	0.003	0.049	0.006	0.0010	0.066
KVAR / KVAD																							
West KVAD seepage left (81)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
West KVAD seepage right (80)	3.0	4802	3880	2900	38	50	0.001	0.001	0.008	ND	17	0.0022	0.001	0.002	33	59	0.00005	23	0.001	2.61	0.002	0.001	3.70
North Wall Collection (86)	3.1	5380	4980	3418	32	65	0.008	0.001	0.0146	ND	13	0.0006	0.014	0.010	61	48	0.00004	21	0.001	1.58	0.006	0.010	4.17
Subsurface Throughflow (87)	3.2	5150	4932	3910	29	101	0.043	0.001	0.0048	ND	12	0.0013	0.004	0.005	89	115	0.00005	18	0.001	1.60	0.001	0.068	4.57
Lidsdale Cut																							
Lidsdale Cut WX5 (40)	3.3	4927.5	4570	4303	35	197	0.023	0.001	0.039	ND	19	0.0469	0.05	0.031	39	13	0.00004	19	0.0055	1.58	0.010	0.133	3.61
Dump Creek																							
Dump Ck WX11 (39)	3.6	2125	1755	1070	47	4.4	0.001	0.001	0.025	ND	3.66	0.0013	0.0015	0.010	1.45	24	0.00004	8.01	0.001	0.58	0.007	0.001	1.56
WQGVs																							
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

Notes:

Red:	Exceeds WQGV (receiving environment monitoring location)
Blue:	Exceeds WQGV (on-site monitoring location)
Purple:	Laboratory Limits of Reporting Exceed WQGV
Bold Underline:	Local Reference WQGV (using 90th percentile of pre-dry placement data)
+	Irrigation water moderately tolerant crops; irrigation. Note: Molybdenum drinking is 0.05 mg/L
++	Livestock ADWGV (ANZECC, 2000)
+++	Drinking Water ADWGV
^	Groundwater conductivity derived from TDS 90th percentile of 2000 mg/L TDS/0.77; Creek TDS derived from 0.68 x 2200 µS/cm, which is the ANZECC (2000) low land river conductivity for protection of aquatic life
^^	Aluminium surface water local goal from Dump Creek 90th Percentile and groundwater local goal from bore D6 90th percentile (data for both)
Note:	Cadmium, Chromium, Copper, lead, nickel and zinc adjusted for effects of hardness: Ca, Mg in WGM1/D5 22.3, 29.0 mg/L: in Sawyers Swamp Creek 51.6, 38.0 mg/L, respectively

WX7 – Receiving Site (Site 41)

As outlined in Section 3.3, the surface WQGVs apply only to the receiving waters of Sawyers Swamp Creek at WX7. The results presented in Table 4-2 indicate that a large number of the 95th percentile concentrations of key parameters of surface water samples at WX7 from the 2019-2020 monitoring period exceed the adopted WQGVs, these are:

- pH – 20th Percentile value exceeds lower limit and 80th Percentile exceeds upper limit
- TDS - Marginally exceeds the converted ANZECC WQGV (converted from specified conductivity limit)
- Sulfate - Marginally exceeds the Livestock drinking water guideline value
- Aluminium – Exceeds the surface water local goal from Dump Creek 90th Percentile
- Cadmium – Exceeds the ANZECC WQGV
- Chromium – Exceeds the ANZECC WQGV
- Copper – Marginally exceeds the ANZECC WQGV
- Fluoride – Exceeds the drinking water ADWGV
- Iron – Exceeds the drinking water ADWGV
- Manganese – Exceeds the ANZECC WQGV
- Molybdenum – Exceeds Irrigation WQGV
- Nickel – Exceeds the ANZECC WQGV
- Zinc – Exceeds the local reference WQGV

Considering the timeseries plots (Appendix A), the water quality profile started changing around July 2019, with all contaminants steadily rising. This coincides with the cessation of discharge from the Springvale Mine.

Due to the ephemeral nature of SSC, discharge from Springvale Mine previously dominated surface water in SSC and as a result water quality at WX7 (Site 41) was reflective of the Springvale Discharge sampled at Site 158.

The SSC upstream monitoring location (92) was dry throughout the analysis period, indicating that the water volumes passing through WX7 originate from the KVAR and SSCAD areas.

Sawyers Swamp Creek Additional Sites

Site 92 (WX1) was dry throughout the 2019-2020 monitoring period and as such no water quality data is available for assessment.

The results presented in Table 4-2 indicate that the 95th percentile concentrations of key parameters at site 225, from the 2019-2020 monitoring period are generally below the adopted WQGVs with the exception of the following:

- pH - Exceeds upper limit
- Copper – Marginally exceeds ANZECC WQGV
- Iron – Exceeds Drinking Water ADWGV
- Molybdenum – Exceeds Irrigation WQGVs
- Lead - Marginally exceeds ANZECC WQGV

The 95th percentile concentrations of key parameters at site 93, for the 2019-2020 monitoring period are generally below the adopted WQGVs with the exception of pH and Molybdenum.

Contradictory, the 95th percentile concentrations of key parameters at site 83, for the 2019-2020 monitoring period are generally above the adopted WQGVs, with 16 of the 23 parameters indicating exceedances.

SSCAD

The results presented in Table 4-2 indicate that 95th percentile concentrations of several key parameters from the 2019-2020 monitoring period SSCAD monitoring points (Sites 38 & 79) exceeded the adopted WQGVs, including:

- pH (Site 38 only) – Above higher limit
- Conductivity (Site 79 only) – Exceeds ANZECC (2000) WQGV
- TDS (Site 79 only) – Exceeds the pre-defined limit (derived from 0.68 x 2200 µS/cm, which is the ANZECC (2000) low land river conductivity for protection of aquatic life)
- Sulfate (Site 79 only) - Exceeds Livestock ADWGV
- Aluminium (Site 79 only) - Exceeds locally derived WQGV
- Boron (Site 79 only) – Exceeds locally derived WQGV
- Cupper (Site 79 only) - Exceeds locally derived WQGV
- Manganese (Site 79 only) – Exceeds ANZECC (2000) WQGV
- Molybdenum (Site 38 only) – Exceeds Irrigation WQGV
- Lead (Site 79 only) – Marginally exceeds ANZECC (2000) WQGV

The elevated concentrations of water quality parameters at these sites are attributed to the storage and recirculation of SSCAD overflow water and KVAR / KVAD leachate from / to the Return Water Canal for Site 38 and reflective of SSCAD pond water which has passed through the SSCAD wall for Site 79. The concentrations of trace metals and sulfate are indicative of a fly ash leachate with neutral (SSCAD) to acidic (KVAR) pH characteristics. The relatively neutral pH observed at Site 79 may also be as result of pH buffering by clays within the SSCAD wall.

Monitoring results from site 79 are consistent with the monitoring results from previous years and the results at site 38 continue the recent relatively static trend with low conductivity values and concentrations of Sulfate.

KVAR / KVAD

The results presented in Table 4-2 indicate that the 95th percentile concentrations of key parameters in surface water monitoring locations for the KVAR / KVAD over the 2019-2020 monitoring period generally exceeded the adopted WQGVs with the exceptions of Cl, As (excluding Site 87), Ba, Cd (excluding Site 80), Cr (excluding 86), Cu (excluding Site 86), Hg, Mo, Pb (excluding 86), and Se (excluding Site 86 and 87). pH was highly acidic (c. pH 3.0, indicative of an acidic fly ash).

It is noted that these locations sample both seepage and surface water runoff from the KVAR / KVAD and as such are indicative of seepage waters emanating from the KVAR / KVAD into the KVAD toe drains, which were designed to be hydraulically isolated from SSC. Water collected in the KVAD toe drains is transmitted to Lidsdale Cut, from where it is currently pumped to the dirty water pond (adjacent to the Return Water Canal) and back to the SSCAD.

Water quality results from these monitoring sites are consistent with water quality results from previous years.

Lidsdale Cut Pond (WX5/Site 40)

The results presented in Table 4-2 indicate that the 95th percentile concentrations of key parameters in surface water monitoring locations for Lidsdale Cut over the 2019-2020 monitoring period generally exceeded the adopted WQGVs, with the exceptions of Cl, As, Ba, Hg and Mo. Other than Cd, Fe and F, concentrations of water quality parameters are comparable with those sampled from the KVAR / KVAD sample points, indicative of the current drainage system from the KVAD toe drains to Lidsdale Cut. pH was highly acidic (pH 3.1), symptomatic of a dry, acidic fly ash (Ward et al., 2009).

The results for WX5 suggest the KVAR may potentially be affecting water quality in Lidsdale Cut Pond. It should be noted that Lidsdale Cut Pond is pumped back to the Dirty Water Pond adjacent to the Return Water Canal, before being pumped back to SSCAD.

Water quality results from these monitoring sites are consistent with water quality results from previous years, continuing the steady increasing trend.

Dump Creek (WX11/Site 39)

The results presented in Table 4-2 indicate that the 95th percentile concentrations of several key parameters in surface water monitoring locations for Dump Creek over the 2019-2020 monitoring period exceeded the adopted WQGVs, including:

- pH – Below lower limit
- TDS– Exceeds the pre-defined limit (derived from 0.68 x 2200 µS/cm, which is the ANZECC (2000) low land river conductivity for protection of aquatic life)
- Sulfate – Marginally exceeds Livestock ADWGV
- Boron – Exceeds locally derived WQGV
- Copper – Exceeds ANZECC (2000) WQGV
- Iron – Exceeds Drinking Water ADWGV
- Manganese – Exceeds ANZECC (2000) WQGV
- Nickel – Exceeds ANZECC (2000) WQGV
- Lead – Exceeds ANZECC (2000) WQGV
- Zinc – Exceeds locally derived WQGV

Concentrations of sulfate were elevated but marginally above the adopted WQGV. The origin of elevated concentrations of water quality parameters at Dump Creek requires further investigation, however may reflect leachate seepage from ash within the KVAR / KVAD (as indicated by the low pH of sampled waters) to groundwater and subsequent discharge to surface water at Dump Creek, which forms a tributary to Sawyers Swamp Creek upgradient of (east of) WX7 surface water receiving site. Indications of impacts to Dump Creek from the KVAR are also evident from historical records (discussed in Section 5.1.6) which indicates that impacts to water quality in Dump Creek occurred concurrent with (and not preceding) KVAR dry ash emplacement and subsequently modified by leakage and then discharge from Springvale Mine.

Due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD, it is not conclusive (based on the data set available) to directly attribute water quality impacts observed in Dump Creek solely to a single source such as the KVAR.

4.2 Groundwater

4.2.1 Monitoring Locations

To satisfy sampling requirements for the project, EnergyAustralia NSW undertook groundwater sampling at the monitoring locations summarized in Table 4-3 below and presented in Figure 4-1.

Table 4-3 Project Groundwater Monitoring Locations

Site #	Nalco Site ID	Purpose	Monitoring Period	Easting	Northing
Groundwater Receiving Site					
36	Groundwater Bore WGM1/D5	Regional Surficial – Downgradient KVAR / KVAD	1988-2020	229636	6302189
KVAR / KVAD					
37	Groundwater Bore WGM1/D6	Regional Coal Seam – Downgradient KVAR / KVAD	1988-2020	229415	6302029
77	Groundwater Bore AP09	KVAD North Wall	2010-2020	229837	6302182
78	Groundwater Bore AP17	KVAD North Wall	2010-2020	229916	6302192
94	KVAD Seepage	KVAD Seepage	2010-2020	229462	6302267
85	Groundwater Bore GW6	Seepage – Downgradient KVAR / KVAD	2010-2020 Dry from 2017	229753	6302222
75	Groundwater Bore GW10	KVAD West Wall	2010-2020 Dry from 2013	229612	6302000
76	Groundwater Bore GW11	KVAD West Wall	2010-2020 Dry from 2016	229648	6302092
Downgradient of SSCAD / Upgradient – Cross Gradient of KVAR / KVAD					
33	Groundwater Bore WGM1/D2	Regional - South East	1988-2020	229681	6301387
34	Groundwater Bore WGM1/D3	Regional - East below SSCAD, Upgradient KVAR / KVAD	1988-2020	230278	6301752
35	Groundwater Bore WGM1/D4	Regional – NE of SSC	1988-2020	230159	6302353
Upgradient of SSCAD					
32	Groundwater Bore WGM1/D1	Regional - Upstream – Upper Catchment	1988-2020	231992	6301405

The monitoring locations were selected to represent groundwater quality upstream, downstream and reference locations for KVAR / KVAD. Borehole logs for the selected monitoring wells are presented in Appendix D.

Groundwater levels are also recorded during collection of water quality samples. Groundwater levels often play an important role in the understanding of groundwater quality and the effects of groundwater levels on water quality are discussed later in this report. Figures E1-E6 Appendix E, present long-term graphs of groundwater levels for monitoring Bores D1-D6, which were installed and have subsequently been monitored since 1988. The logs for these bores are presented in Appendix D.

The bores GW6 (Site 85), AP09 (Site 77) and AP17 (Site 78), shown in Figure 4-1, sample the groundwater in the KVAD beneath the KVAR along the north wall of the KVAD / KVAR Stage 2A area. Records for AP09 and AP17 are available from 2010 to the current monitoring period (2020). No records are available for GW6 for the 2018-2019 and 2019-2020 monitoring periods.

The bores GW10 (Site 75) and GW11 (Site 76), shown in Figure 4-1, sample the groundwater in the KVAD beneath the KVAR along the western wall of the KVAD / KVAR Stage 2A area. Water quality records for GW10 are available from 2010 to 2012 with frequent gaps in available data. Water quality records for GW11 are available from 2010 to 2016, with frequent gaps in available data. Data for GW10 and GW11 are not available for the 2018-2019 and 2019-2020 monitoring periods.

The bore D6 (Site 37) samples groundwater within the Illawarra Coal Measures downgradient of the KVAR / KVAD, and SSCAD, but upgradient of Lidsdale Cut. Water quality records for D6 are available from 1988 to

2020 and are generally complete, but with missing data between February 1998 - November 2001 and October 2004 – July 2007. Data is available for the 2019-2020 monitoring period.

The bores D2 (Site 33), D3 (Site 34) and D4 (Site 35) sample groundwater within the Narrabeen Group and Illawarra Coal Measures upgradient / cross gradient of the KVAR / KVAD and downgradient of the SSCAD. Water quality records for D2, D3 and D4 are available from 1988 to 2020, including the 2019-2020 monitoring period. Water quality records for D2, D3 and D4 are generally complete, with the exception of missing data between September 1997 and November 2001.

The data from these bores was used to assess the potential effects of the KVAR and KVAD on groundwater quality at the receiving water bore MPGM4/D5.

4.2.2 Monitoring Methodology

Routine groundwater monitoring is undertaken on a monthly basis on behalf of EnergyAustralia NSW by Nalco Analytical Resources who measure conductivity, pH and temperature in the field using calibrated instrumentation.

Groundwater bores are bailed and sampled after allowing time for the water level in the bore to re-establish. The depth to the water level from the top of the bore pipe is measured using a dip meter and the water surface elevation is calculated to AHD(m) after allowing for the pipe height.

4.2.3 Monitoring Results

Groundwater monitoring results for the 2019-2020 reporting period are presented in Appendix C along with a statistical summary of the data.

In accordance with the National Water Quality Management Strategy (NWQMS) Guidelines for Groundwater Protection in Australia (2013) and National Environment Protection Council (NEPC, 1999 as amended in May, 2013), the 95th Percentile of the test results from groundwater monitoring for toxicants and stressors have been compared against selected groundwater investigation levels, that are based on NEPM (2013) Groundwater Investigation Levels (NEPM, 2013 – Schedule B1, Section 3.2.1), .Where GILs are absent, the 95th percentile of results have been compared against ANZECC (2000) WQGVs, (ANZECC, 2000 Section 7.4.4.1, Step 2), or ADWG Values (ADWG, 2011 – Chapter 10), and against local WQGVs, where locally derived WQGVs supplant NEPM GIL / ANZECC / ADWG Trigger Values. The results from this assessment are presented in Table 4-4 below.

Table 4-4 Summary Statistics 2019-2020 Groundwater Monitoring Results (mg/L) – 95th Percentiles

Site Name / ID	pH	Cond (µs/cm)	TDS	SO4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Groundwater Receiving Site																							
WGM1/D5 (36)	4.2	464	338	186	12.2	5.5	0.001	0.0010	0.03	ND	0.83	0.001	0.002	0.008	0.32	2.29	0.00004	2.01	0.001	0.124	0.013	0.001	0.29
KVAR / KVAD																							
WGM1/D6 (37)	4.3	2308	2062	1423	55.4	12.0	0.011	0.0010	0.05	ND	1.47	0.002	0.018	0.052	1.00	258	0.00007	12.8	0.002	0.56	0.049	0.002	2.48
AP09 (77)	6.0	2606	2100	1388	39.3	0.5	0.059	0.0010	0.02	ND	3.31	0.0002	0.001	0.001	7.5	81	0.00004	8.19	0.223	0.92	0.001	0.001	0.69
AP17 (78)	3.2	5630	5812	4286	28.2	155	0.104	0.0010	0.02	ND	17.5	0.002	0.013	0.01	85	168	0.00006	16.4	0.004	1.81	0.003	0.141	5.71
KVAD Seepage (94)	3.1	5495	5447	4823	38.3	253	0.042	0.0010	0.09	ND	23.7	0.069	0.029	0.06	60	121	0.00007	23.8	0.362	2.54	0.033	0.046	4.21
GW6 (85)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW10 (75)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW11 (76)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Downgradient of SSCAD / Upgradient – Cross Gradient of KVAR / KVAD																							
WGM1/D3 (34)	4.9	1278	974	565	43.0	3	0.007	0.0010	0.05	#N/A	0.98	0.009	0.003	0.014	0.9	24	0.00005	2.6	0.002	0.63	0.014	0.001	0.75
WGM1/D4 (35)	6.1	1511	1216	709	31.0	0.04	0.002	0.0010	0.02	#N/A	1.84	0.0001	0.001	0.001	0.77	51	0.00006	12.6	0.003	0.041	0.001	0.0002	0.035
WGM1/D2 (33)	4.4	610	434	105	37.6	0.40	0.001	0.0010	0.03	#N/A	0.17	0.0002	0.001	0.002	0.77	0.66	0.00008	0.64	0.001	0.087	0.002	0.0002	0.110
Upgradient of SSCAD																							
WGM1/D1 (32)	5.2	122	143	11.3	17.7	2.7	0.001	0.0010	0.05	#N/A	0.0595	0.0001	0.002	0.021	0.02	1.40	0.00004	0.10	0.001	0.006	0.008	0.0003	0.247
Groundwater WQGVs																							
Groundwater WQGV	6.5-8.0	2600	2000++	1000++	350+	**5.1^^**	0.024	0.00005	0.7+++	0.1	**1.7**	0.001	0.004	0.005	1.5+++	**1.7**	0.00006	1.9	0.01+	**0.137**	**0.01**	0.005	**0.505**

Red:	Exceeds WQGV (receiving environment monitoring location)
Blue:	Exceeds WQGV (on-site monitoring location)
Purple:	Laboratory Limits of Reporting Exceed WQGV
Bold Underline:	Local Reference WQGV (using 90th percentile of pre-dry placement data)
+	Irrigation water moderately tolerant crops; irrigation. Note: Molybdenum drinking is 0.05 mg/L
++	Livestock ADWGV
+++	Drinking Water ADWGV
^	Groundwater conductivity derived from TDS 90th percentile of 2000 mg/L TDS/0.77; Creek TDS derived from 0.68 x 2200 µS/cm, which is the ANZECC (2000) low land river conductivity for protection of aquatic life
^^	Aluminium surface water local goal from Dump Creek 90th Percentile and groundwater local goal from bore D6 90th percentile (data for both)
Note:	Cadmium, Chromium, Copper, lead, nickel and zinc adjusted for effects of hardness: Ca, Mg in WGM1/D5 22.3, 29.0 mg/L: in Sawyers Swamp Creek 51.6, 38.0 mg/L, respectively

Groundwater Bore D5 – Receiving Site (Site 36)

As outlined in Section 3.3, the groundwater WQGVs apply to bore D5 only, which is designated as the groundwater receiving site.

Only two samples were collected over the 2019/2020 monitoring period (May and June 2019), the remainder of the field events indicated dry conditions in the well.

The results presented in Table 4-4 indicate that concentrations of key parameters in groundwater water samples collected from Groundwater Bore D5 (from the 2019-2020 monitoring period) show a number of variable exceedances of the adopted WQGVs, including:

- pH - below ANZECC lower limit
- Aluminium - marginally exceeds Local WQGV
- Cadmium - marginally exceeds ANZECC WQGV
- Copper - marginally exceeds ANZECC WQGV
- Iron - marginally exceeds Local WQGV
- Manganese - marginally exceeds ANZECC WQGV
- Lead - marginally exceeds Local WQGV

The mechanisms affecting water quality in D5 are discussed in detail in Sections 5.2.1, and 6 of this report. The results from historic review and assessment of recent (2019-2020 results) indicate that placement of dry ash within the KVAR may potentially be affecting water quality in bore D5.

In general, the two samples analysed over the recent monitoring period indicated slightly improved groundwater conditions at this location.

Due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD, it is not conclusive (based on the data set available) to directly attribute water quality impacts observed in groundwater in Bore D5 solely to a single source such as the KVAR.

KVAR / KVAD

The concentrations of key parameters within Bores D6, AP09, AP17 and the KVAD seepage (Sites 37, 77, 78, 94 respectively) monitoring points mostly exceed the WQGVs, these parameters also indicate exceedances (in addition to those indicated above for D5):

- Conductivity (excluding D6)
- Total dissolved solids
- Sulfate
- Arsenic (excluding D6)
- Boron (excluding D6)
- Chromium (excluding AP09)
- Fluoride (excluding D6)
- Mercury (excluding AP09)
- Molybdenum (excluding D6 and AP09)
- Nickel
- Selenium (excluding AP09 and AP17)
- Zinc

Similar to D5, identification of the factors currently affecting water quality in bore D6 is not conclusive without consideration of baseline (pre-dry ash placement) conditions of long term water quality trends for D6, due to the long history of water quality impacting activities locally affecting the KVAR area, including wet ash / coal reject placement in the KVAD (1960-1980), and wet ash placement in the SSCAD (1980-2003).

The mechanisms affecting water quality in D6 are discussed in detail in Sections 5.2.2, and 6 of this report. The results from historic review and assessment of recent (2019-2020 results) indicate that placement of dry ash within the KVAR may currently be affecting water quality in bore D6.

Due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD, it is not conclusive (based on the data set available) to directly attribute water quality impacts observed in groundwater in Bore D6 solely to a single source such as the KVAR.

SSC / SSCAD and Boreholes Upgradient of KVAR (Sites 33, 34, 35)

Groundwater chemistry of two of the sample sites upgradient of the KVAR and downgradient of the SSCAD (Bores D2 & D4) show statistically comparable chemical signatures between sampling points. For these two monitoring bores the concentrations of key parameters are generally below the adopted WQGVs with the exception of:

- pH (below ANZECC lower limit)
- Boron at D4 (exceeds Local WQGV)
- Iron at D4 (exceeds Local WQGV)
- Mercury at D2 (exceeds ANZECC WQGV)
- Manganese at D4 (exceeds ANZECC WQGV)

A review of the historic water quality monitoring results for bore D2 (Site 33) (Section 5.2.3) indicates that low pH levels currently observed at this bore reflect current conditions from a long-term trend of declining pH. Long-term trends for other water quality parameters including the indicator parameters Mn, B, Ni, SO_4 and conductivity show that the current water quality at bore D2 does not show impacts from KVAR ash placement or associated activities.

Concentrations of the key parameters Cd, Cu, Fe, Ni, Mn, Pb and Zn are elevated to levels exceeding WQGVs within bore D3 (Site 34). The mechanisms affecting water quality in bore D3 are discussed in greater detail in Sections 5.2.3, & 6 of this report as the current concentrations of water quality parameters should be described in context with recent historical activities and mechanisms that currently affect water quality.

Current groundwater quality at bore D4 (Site 35) is complexly influenced by both cross-gradient groundwater flow from KVAR / KVAD and seepage from SSCAD. Historical influences of these factors are discussed in Sections 5.2.3, & 6 of this report. Due to the complexity of the water quality at D4, potential impacts from KVAR cannot be evaluated, however the current engineering mechanisms and near neutral pH indicate that the KVAR is unlikely to be affecting water quality at bore D4.

Borehole Upgradient of SSCAD (Site 32)

Two groundwater samples were collected over the 2019-2020 monitoring period from Borehole D1 – Located in the middle-upper portions of the SSC catchment, upgradient of the SSCAD. These samples were taken in February and March 2020. The bore was either dry or inaccessible for the period preceding and succeeding this.

The chemical signature of groundwater samples from Bore D1 are distinctly different from those within and downgradient of the KVAR area, with pH and copper being the only parameters not meeting the adopted WQGVs. Groundwater quality in D1 is reflective of the catchment conditions that are unaffected by the SSCAD, KVAR and KVAD.

5 Surface Water and Groundwater Trends

5.1 Surface Water Trends 1992 – 2020

To assess effects of the dry ash emplacement within the KVAR on surface water quality it is necessary to analyse both recent concentrations and long-term trends in concentrations of key physical and chemical stressors / toxicants within the selected surface water monitoring sites.

As outlined in Section 2.5, surface water and groundwater flows through the site are complexly modified by the extensive engineering aspects influencing the site, including:

- Diversion drains through the KVAR / KVAD draining surface water and groundwater to various sumps (i.e. Sumps 1-3), Ponds, Return Water Canal and to Lidsdale Cut
- Recirculation pumping of SSCAD seepage collected through the SSCAD V-notch back to the SSCAD Pond via the Return Canal
- Recirculation pumping of water from Lidsdale Cut to the SSCAD Pond via the Return Canal

The 95th Percentile of results have been tabulated for periods corresponding with pre-dry ash emplacement (1991-2003), syn-dry ash emplacement / pre-stoppage of pumping into SSC from LC (2003-2012) and post dry-ash emplacement (2012-2020) / LC to SSCAD recirculation. These key events mark periods of marked water quality changes for the surface water receiving site (WX7) and other surface water sampling points.

It is also noted that blockage of the KVAD toe drains (2006), unblocking of the KVAD toe drains (2010), commencement of pumping from Lidsdale Cut to SSCAD via the Return Canal (July 2012) and commencement and cessation of discharge from the Springvale Mine to SSC at LDP009 (July 2013-July 2019) have had marked effects on surface water quality, these aspects are discussed within the evaluation of the long-term surface water trends.

Table 5-1 Summary Statistics Long Term Surface Water Monitoring Results (mg/L) – 95th Percentiles

Sample Location	Date Range	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Springvale Discharge																								
Springvale (158)	2011-2020	8.3	1300	610	50	25.1	1.62	0.029	0.001	0.03145	0.0010	0.12	0.0001	0.0029	0.008	1.3	1.19	0.00004	0.022	0.05	0.016	0.002	0.001	0.026
Sawyers Swamp Creek (Receiving Site)																								
SSC WX7 (41)	1991-2003	7.8	847	603	345	48.4	0.57	0.001	0.001	0.04	ND	2.39	0.001	0.001	0.009	1.34	0.742	0.0002	0.92	ND	ND	0.003	0.003	0.18
	2003-2012	8.6	1494	1152	710	32.1	85.8	0.025	0.001	0.08	0.005	3.21	0.0054	0.005	0.010	2.12	0.224	0.0001	5.04	0.02	0.45	0.014	0.003	0.83
	2012-2020	8.8	1330	804	244	16.9	3.38	0.029	0.001	0.04	ND	0.45	0.0002	0.002	0.004	1.41	0.297	0.00005	1.31	0.04	0.045	0.002	0.002	0.18
Sawyers Swamp Creek (Additional Sites)																								
Upstream SSCAD WX1 (92) [Dry since April 2017]	1992*	6.2	300	ND	ND	8	0.12	ND	ND	ND	ND	0.042	ND	ND	ND	ND	0.435	ND	0.068	ND	ND	ND	ND	0.04
	2003-2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2012-2017	6.8	162	152	31.5	12	3.55	0.001	0.001	ND	ND	0.06	0.0002	0.003	0.009	0.1	2.98	0.00006	0.523	0.01	0.01	0.005	0.002	0.05
Downstream v-notch (93)	2012-2020	8.7	1260	787	61.5	13.8	0.86	0.03	0.001	0.036	ND	0.187	0.0002	0.002	0.0049	1.394	0.127	0.00005	0.5	0.05	0.006	0.002	0.001	0.03
Downstream KVAR (83)	2010-2012	8.6	1030	ND	346	33	1.7	0.004	0.001	0.09	0.002	1.23	0.0002	0.003	0.003	1.08	0.618	0.00005	1.5	0.02	0.01	0.002	0.002	0.04
	2012-2020	8.7	1340	816	142	15.4	0.76	0.03	0.001	0.035	ND	0.395	0.0001	0.002	0.002	1.627	0.208	0.00005	0.5	0.05	0.015	0.002	0.001	0.03
Spillway (225)	2013-2020	8.5	1297	792	59.4	23.7	1.03	0.03	0.001	0.037	ND	0.17	0.0001	0.002	0.004	1.464	0.105	0.00005	0.5	0.05	0.006	0.002	0.001	0.03
SSCAD																								
SSCAD (38)	1996-2003	6.5	1946	1514	980	58	ND	0.036	0.001	0.15	0.009	7.87	0.0141	0.015	0.017	11.2	0.345	0.0002	1.57	0.19	0.15	0.005	0.316	0.54
	2003-2012	7.2	2456	1941	1391	42.1	7.37	0.05	0.01	0.1	0.008	7.9	0.0108	0.01	0.03	10.15	ND	0.0001	1.82	0.09	0.14	0.01	0.171	0.47
	2012-2020	7.5	1700	1276	849	21	13.5	0.004	0.001	0.099	ND	3.48	0.0067	0.002	0.0177	4.5	0.234	0.00005	3.0	0.047	0.19	0.002	0.007	0.58
SSCAD V-Notch (79)	2010-2012	8	2015	1580	970	52.8	1.58	0.001	0.001	0.06	0.001	2.88	0.0009	0.002	0.005	1.5	0.03	0.00005	0.376	0.01	0.02	0.002	0.002	0.12
	2013-2020	7.8	2545	2069	1372	64.3	9.9	0.015	0.001	0.07	ND	2.30	0.0066	0.003	0.012	2.434	1.51	0.00005	8.42	0.03	0.23	0.005	0.001	0.39
KVAR / KVAD																								
West KVAD seepage left (81)	2010-2012	3.1	2949	2300	1500	30.8	71.1	0.003	0.001	0.02	0.017	8.9	0.0017	0.008	0.047	3.88	68.7	0.00005	16.8	0.01	1.2	0.009	0.002	1.59
	2015-2017	3.1	2794	2066	1392	27.1	39.7	0.006	0.0005	0.02	ND	5.92	0.0008	0.007	0.026	15.2	70.6	0.0001	8.54	0.0005	0.39	0.007	0.005	0.84
West KVAD seepage right (80)	2010-2012	3.2	3265	2580	1700	39.8	22.8	0.001	0.001	0.02	0.017	8.9	0.0013	0.001	0.007	7.1	13.8	0.00005	19	0.01	1.6	0.011	0.002	2.08
	2015-2020	3.0	4782	4176	2942	37	50.8	0.002	0.001	0.006	ND	15.32	0.0024	0.001	0.004	22.5	64.9	0.00004	24.4	0.002	2.67	0.002	0.002	3.79
Nth Wall collection (86)	2010-2012	4.8	1094	740	447	21.9	3	0.007	0.001	0.04	0.002	2.29	0.0002	0.001	0.005	0.4	10	0.00005	3.69	0.01	0.06	0.005	0.002	0.13
	2013-2020	3.0	5130	4424.	2970	41	78.4	0.017	0.001	0.02	ND	13.3	0.025	0.008	0.022	60	94.5	0.00005	18.3	0.003	1.4	0.002	0.005	3.63
Surface water runoff (87)	2010-2012	5	2395	1895	1580	25	126	0.001	0.001	0.07	0.002	3.18	0.002	0.009	0.013	1.97	22.6	0.00005	8.94	0.01	0.2	0.001	0.004	0.48
	2015-2020	3.3	5126	5060	3614	30.4	97.6	0.048	0.001	0.01	ND	12.7	0.001	0.003	0.006	90.5	189	0.00004	17.4	0.001	1.62	0.001	0.064	4.67
Lidsdale Cut																								
Lidsdale Cut WX5 (40)	1991-2003	6	1061	657	383	60.4	3.12	0.001	0.001	0.04	ND	2.17	0.001	0.008	0.005	2.11	0.85	0.0002	2.255	ND	ND	0.004	0.001	0.35
	2003-2012	7.3	2385	1920	1410	35.5	20.5	0.05	0.01	0.07	0.026	7.1	0.005	0.01	0.01	13.5	14.1	0.0001	11.1	0.038	0.94	0.01	0.006	1.22
	2012-2020	3.6	4893	4426	3760	34.3	190.9	0.027	0.001	0.08	ND	17.15	0.045	0.025	0.042	37.2	17.2	0.00005	17.5	0.001	1.6	0.032	0.113	3.60
Dump Creek																								
Dump Creek WX11 (39)	1991-2003	8	1025	900	458	59.3	0.34	0.001	0.001	0.05	ND	1.97	0.001	0.008	0.002	1.16	5.26	0.0002	1.89	ND	ND	0.001	0.003	0.28
	2003-2012	5.9	1695	1195	749	25	1.6	0.05	0.01	0.03	0.005	2.9	0.002	0.01	0.01	1.1	6.39	0.0001	7.26	0.01	0.45	0.01	0.006	1.1
	2012-2020	3.6	2125	1755	1070	46.5	4.43	0.001	0.001	0.025	ND	3.65	0.001	0.001	0.010	1.45	24.4	0.00004	8.01	0.001	0.58	0.007	0.0007	1.56
WQGVs																								
Surface Water WQGV		6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**
*Single sample Additional notes: See Table 4-2																								

5.1.1 WX7 – Surface Water Receiving Site

1991-2003

Sawyers Swamp Creek (WX7 / Site 41)

Surface water samples collected for WX7 during this period represent surface water quality of SSC receiving site concurrent with emplacement of wet ash within SSCAD, post KVAD wet ash emplacement and pre-KVAR dry ash emplacement.

The results presented in Table 5-1 indicate that the 95th percentile concentrations in surface waters of WX7 were generally below the adopted WQGVs during the 1991-2003 monitoring period, with the exception of B, Fe, and Zn which marginally exceeded the WQGVs.

Figure A1 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 1991 and 2020 for WX7. There is a gap in available data between January 1998 and April 2002. The chart shows a rising trend in conductivity and concentrations of SO_4, Mn and B in the period between 1991 and 1998. Additional parameters including Ca, Cl, F, K, Mg, & Na (not presented) show similar rising trends during this period.

Water quality trends in the 1998-2002 period cannot be determined due to the gap in available data. However, the elevated concentration of water quality parameters (including indicator parameters Conductivity, SO_4, B, and Mn) and reduced pH in 2002, relative to concentrations in 1991, indicates that land use activities pre-dating KVAR dry ash emplacement (i.e. SSCAD wet ash emplacement) have influenced surface water quality in SSC at WX7.

2003-2012

Sawyers Swamp Creek (WX7 / Site 41)

Surface water samples collected for WX7 during this period represent surface water quality of SSC receiving site concurrent with emplacement of dry ash for Stages 1 and 2 of the KVAR and up to the cessation of discharge from LC to SSC.

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters of WX7 generally increased from baseline values (1991-2003) during the 2003-2012 period including concentrations of SO_4, Cl, Al, As, B, Cu, F, Mn, and Zn. 95th Percentile concentrations of Al, As, Cd, Cu, F, Mn, and Pb now exceed the WQGVs, in addition to B and Zn. Additional parameters including Mo and Ni are now reported and noted to also exceed the WQGVs. Concentrations of Fe have dropped below the WQGV.

Figure A1 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 1991 and 2020 for WX7. The chart shows that concentrations of SO_4 increased gradually during the 2003-2012 monitoring period, whilst concentrations of B and Ni remained relatively stable and Mn gradually decreased up to 2009.The observed signal of indicator parameters from 2003 to 2009 indicates that dry ash placement within the KVAR did generally not affect water quality in SSC at WX7 during this period, as observed trends are consistent with pre-KVAR water quality trends.

Following April 2009 concentrations of indicator parameters conductivity, SO_4, Mn, B, and Ni fluctuate significantly relative to average variance resulting in higher average and 95th percentile concentrations. As, Ba, Cd, and F also show increased concentrations and rising trends following April 2009. There is also a significant increase in pH (pH 8.6) resulting in moderately alkaline conditions in SSC at WX7, which is indicative of a bottom ash type signature (Ward et al., 2009).

The observed shift in concentrations and increase in variability of water quality following is concurrent with completion and capping of the Stage 1 KVAR area and subsequent commencement of ash emplacement in the Stage 2 KVAR area. These results indicate that Stage 2A KVAR dry ash placement activities may have contributed to an increase in overall average and 95th percentile concentrations, and increased variability in concentrations of a number of water quality parameters in Sawyers Swamp Creek, at WX7 between 2009 and 2012 – which until June 2012 received water directly from Lidsdale Cut Pond.

Due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD, it is not considered conclusive to directly attribute any impacts observed to surface water quality changes in WX7 solely to a single source such as the KVAR without further investigation.

2012-2020

Sawyers Swamp Creek (WX7 / Site 41)

Surface water samples collected for WX7 during this period represent surface water quality of SSC receiving site at the cessation of discharge from LC to SSC and commencement of return circulation to LC to SSCAD via the Return Canal in June / July 2012. Commencement of discharge from Springvale colliery also occurred during this period along with completion of the Stage 2A KVAR.

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters of WX7 generally decreased following the cessation of discharge from LC to SSC in June 2012. As a result, the 95th percentile concentrations of all parameters were below WQGVs with the exception of Mo and As which remained marginally above the adopted WQGVs, and pH which exceeded the upper limit.

Figures A1 and A2 in Appendix A presents two time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 1991 and 2020 for WX7. The chart shows that concentrations of all water quality parameters dropped significantly immediately following the June 2012 event when discharge from Lidsdale Cut to SSC ceased. It is noted that the declining trends for Al, B, Ni and SO_4 are acutely interrupted, and/ or reversed (i.e. Aluminium) in July 2013, at which point discharge from Springvale Mine commenced and subsequently dominated the water quality characteristics at WX7.

With cessation of discharge from Lidsdale Cut to SSC in June 2012, indication of impacts on water quality at WX7 as a result of dry ash emplacement associated with the Stage 2A KVAR emplacement are no longer evident. Furthermore, due to the influence of discharge from Springvale Mine, the concentrations of several parameters, including indicator parameters Mn, B and SO_4 were lower than the pre-dry ash emplacement (1991-2003) values.

Since the cessation of discharge from the Springvale Mine, in July 2019, all indicator parameters have shown a steady increasing trend in concentration.

5.1.2 Sawyers Swamp Creek Additional Sites

1992

Upstream SSCAD - WX1 (Site 92)

A single surface water sample collected at WX1 in March 1992 represents water quality at the upper-middle portions of the SSC catchment, upgradient of the SSCAD adjacent to groundwater monitoring point D1, during wet ash emplacement in SSCAD. The site is located downgradient of Springvale Mine.

The results presented in Table 5-1 indicate that the concentrations in surface waters at WX1 were generally below the adopted WQGVs during the 1992 monitoring period, with the exception of Fe. pH was below the lower limits of the adopted WQGVs.

No data is available for WX1 between 1992 and March 2012.

Downstream SSCAD V-Notch (site 93), Downstream KVAR (Site 83), Spillway 225

No water quality data is available for these sample sites prior to 2010.

2003-2012

WX1 (Site 92), Downstream V-Notch (site 93), Spillway 225

No water quality data is available for these sites during the 2003-2012 monitoring period.

Downstream KVAR (Site 83)

Surface water quality data is available for Downstream KVAR (Site 83) during the period between 2010 and 2012, corresponding with Stage 2A dry ash emplacement. The site samples surface water immediately north of the KVAR and upgradient (east) of Lidsdale Cut and represents surface water in SSC.

The results presented in Table 5-1 indicate that the 95th percentile concentrations in surface waters of Downstream KVAR are all below the adopted WQGVs, with the exception of Fe and Mo, which are marginally elevated above the WQGV.

Figure A4 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 2010 and 2012 for the Downstream KVAR monitoring site (Site 83). The chart shows a variable trend in the concentration of water quality parameters during this period, characterised by a distinct decreasing trend in concentrations of water quality parameters between Feb 2010 and December 2010, followed by an overall rise in concentrations between December 2010 and November 2011.

Results from this period may reflect the particularly wet conditions in early 2011, which resulted in localised flooding of the KVAR and potential impacts on SSC at Site 83; or the installation of subsurface drains in the KVAR and unblocking of the KVAD toe drains causing subsequent limited seepage into SSC adjacent to the KVAD toe drains. Regardless of the cause, water quality parameters in SSC at Site 83 were generally below the adopted WQGVs during this period and therefore limited to negligible impact from KVAR on Site 83 are observed.

2012-2020

Upstream SSCAD WX1 (Site 92)

This site has been dry since April 2017. No water was observed in the Creek during any of the 12 field events conducted during the 2019/2020 monitoring period.

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters of WX1 were generally below the adopted WQGVs during the 2012-2020 monitoring period, with the exception of Cu, Fe and Hg, which marginally exceeded WQGVs.

Figures A3 and A4 in Appendix A presents the time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 1992 and 2017 for WX1. The charts show relatively stable trends for all parameters during this monitoring period, with a slight increase in concentrations of Aluminium and slight drop in concentrations of Nickel.

WX1 is located upgradient of both the KVAR and the SSCAD, therefore exceedances of water quality parameters and observed water quality trends are not influenced by the KVAR.

Spillway (Site 225)

Surface water samples collected for Spillway 225 represent surface water quality of the SSC at the SSCAD Spillway (Site 225).

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the SSCAD Spillway are generally below the adopted WQGVs with the exception of As and Mo, which are marginally above the WQGVs. pH is moderately alkaline at pH 8.7.

Figures A9 and A10 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 2013 and 2020 for Spillway 225 (2012 data not available). The chart shows generally stable to declining concentrations for key water quality parameters with the exception of conductivity which presented a slight increasing trend. Increasing conductivity is largely driven by rising concentrations of K, Cl and Na which show distinct increasing trends over the monitoring period (not presented) and potentially representing evaporative salinization of the SSCAD Pond due to recent dry (El Nino type) conditions.

The elevated water quality parameters and observed water quality trends at Site 225 during the 2013-2019 monitoring period are primarily attributed to discharge from Springvale Mine at LDP009, which since 2013 until 2019 dominated the water quality in SSC. As such the concentrations of water quality parameters at Site 225 were reflective of the water quality samples at the discharge point (Site 158).

Subsequent to cessation of discharge from the Springvale Mine, the water quality profiles indicate fluctuating conditions, this is likely due to sampling events following wetter and dryer periods which may result in varying concentrations of elements being flushed out or being diluted by clean runoff from the upstream catchment. No clear trend is identifiable as yet.

Downstream V-Notch (Site 93)

Surface water samples collected for Downstream V-Notch (Site 93) represent surface water quality of SSC cross-gradient and north of the KVAR Sedimentation Area and downgradient and west of the SSCAD / downgradient-north of the Springvale Mine Discharge Point (LDP009).

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the Downstream V-Notch monitoring point (Site 93) are generally below the adopted WQGVs, with the exception of As, Cu and Mo which are marginally elevated above the WQGVs. pH is moderately alkaline at pH 8.7.

Figures A5 and A6 in Appendix A presents time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 2012 and 2020 for Downstream V-Notch. The charts show relatively stable to slightly decreasing trends of all indicator parameters, with the exception of conductivity, which shows a slight increasing trend that corresponds with increasing concentrations of K, Na and F.

The elevated water quality parameters and observed water quality trends at Site 93 during the 2012-2020 monitoring period are attributed to discharge from Springvale Mine at LDP009, which since 2013 dominated the water quality in SSC. As such the concentrations of water quality parameters at Site 93 are reflective of the water quality sample at the discharge point (Site 158). No water quality samples have been taken since the cessation of discharge from the Springvale Mine as the site has remained dry.

Downstream KVAR (Site 83)

The 95th percentile concentrations of water quality parameters in surface waters at the Downstream KVAR monitoring point generally decreased during the 2012-2020 monitoring period, compared to 2010-2012 records for Downstream KVAR, with the exception of As, Mo, F and overall conductivity, which increased marginally. The increase in conductivity is attributed to a general increase in the concentrations of potassium, which is not considered in the current key water quality parameters. pH is moderately alkaline at pH 8.7.

Figures A7 and A8 in Appendix A presents the time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 2012 and 2020 for Downstream KVAR. The charts show relatively stable to decreasing trend for all parameters before the cessation of discharge from the Springvale Mine, but with slight increase in conductivity as a result of increasing potassium (K) concentrations.

The elevated water quality parameters and observed water quality trends at Site 83 during the 2012-2019 monitoring period are attributed to discharge from Springvale Mine at LDP009, which since 2013 until 2019 dominated the water quality in SSC. As such the concentrations of water quality parameters at Site 83 are reflective of the water quality sample at the discharge point (Site 158).

All key parameters have shown fluctuating but increasing trends in concentrations since the cessation of discharge from the Springvale Mine, with all showing at least a single sample above the WQGV's.

5.1.3 SSCAD Sites

1996-2003

SSCAD (Site 38)

Surface water samples collected for SSCAD 38 represent surface waters of the return canal that have been pumped from LC or have been received from the SSCAD v-notch and are to be pumped to the SSCAD. Surface water samples collected for this monitoring period represent conditions pre-KVAR dry ash placement.

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the SSCAD 38 monitoring site generally exceeded the adopted WQGVs during the 1996-2003 monitoring period, including concentrations of As, B, Cd, Cr, Cu, F, Fe, Mo, Ni, Se and Zn.

Figures A11 and A12 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 1996 and 2020 for SSCAD 38. The results show generally increasing concentrations up to 2003 for SO_4, Mn, B, Ni and conductivity (SO_4 being the primary contributor to salinity). No data is available for aluminium trends during this monitoring period.

Water quality trends for the 1996-2003 monitoring period indicated generally elevated concentrations of water quality parameters and increasing concentrations in several indicator parameters up to 2003 and preceding dry ash placement in the KVAR.

SSCAD V-Notch (Site 79)

Surface water samples collected for SSCAD V-Notch (Site 79) represent surface water quality representative of the SSCAD Seepage Collection System. No data is available for the SSCAD V-Notch (Site 79) prior to 2010.

2003-2012

SSCAD (Site 38)

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the SSCAD 38 monitoring site were generally higher during the 2003-2012 monitoring period than preceding 1996-2003 monitoring period, including concentrations of SO_4, As, B, Cu, Mn, and conductivity. Concentrations of other water quality parameters remained stable or decreased marginally. It is noted that although 95th percentile concentrations are higher during the 2003-2012 monitoring period than the preceding 1996-2003 monitoring period, the elevated concentrations are a result of the increasing trends during the 1996-2003 monitoring period, and therefore do not directly reflect an influence by the KVAR, but are coincident with SSCAD ash placement activities.

Figures A11 and A12 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 1996 and 2020 for SSCAD 38. The results show a steady decreasing trend in all parameters between 2003 and February 2010, following which point concentrations of Mn, Ni, Al, and B become stable to increasing in trend with greater variability in concentrations.

The shift in trends and increased variability in concentrations of indicator parameters is coincident with unblocking of the KVAD toe drains being and commencement of Stage 2 dry ash emplacement and suggests leachate migration through sub-surface drains directly to the Return Canal, where the SSCAD 38 sample point is located.

SSCAD V-Notch (Site 79)

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the SSCAD V-Notch (Site 79) monitoring point (available for the period between 2010 and 2012) indicate that concentrations of water quality parameters were generally below the adopted WQGVs during 2010-2012, with the exception of B, and overall TDS.

Figures A13 and A14 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 2010 and 2020 for SSCAD V-Notch (Site 79). Concentrations of indicator water quality parameters are generally stable with minor fluctuations during the 2010-2012 monitoring period for SSCAD V-Notch (Site 79).

The water quality at the SSCAD V-Notch Site is reflective of the SSCAD and is not directly affected by the KVAR.

2012-2020

SSCAD (Site 38)

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the SSCAD 38 monitoring site generally decreased during the 2012-2020 monitoring period, with the exception of Al, Mn, Ni, and Zn. Concentrations of Al, B, Cd, Cu, F, Mn, Mo, Ni, Se and Zn were above the WQGVs.

Figures 11 and 12 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 2013 and 2020 for SSCAD 38. Data is not available for the period between February 2012 and April 2013.

The results show a decrease in SO_4 and overall conductivity continuing the trend from the 2003-2012 monitoring period, however rising trends in Mn, Ni, Al and B are observed in the 2012-2018 monitoring period, in contrast to earlier declining trends. Review of the available data indicates an alternate or combination of two possible causes of the rising trend: a) Stage 2 dry ash emplacement; and/or b) discharge from LC to SSCAD via the Return Canal from July 2012.

Following July 2013, the concentrations of water quality parameters become highly volatile within the observed rising / falling trends. This volatility is attributed to the commencement of discharge from Springvale Mine at LDP009, affecting water quality in SSCAD 38.

As of January 2018, the observed concentrations of all key water quality parameters have been declining, with Sulfate and conductivity reaching stable values around January 2020.

SSCAD V-Notch (Site 79)

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the SSCAD V-Notch (Site 79) monitoring site generally increased during the 2012-2020 monitoring period in comparison to the 2003-2012 monitoring period for conductivity, SO_4, Cl, Al, As, Cd, Cr, Cu, F, Fe, Mn, Mo, Ni, Pb, and Zn. Other water quality parameters remained stable or decreased during this monitoring period.

Figures A13 and A14 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 2012 and 2020 for SSCAD V-Notch (Site 79). Data is not available for the period between February 2012 and April 2013. Results show that concentrations of water quality parameters are generally stable up to July 2013, following which point the concentrations of indicator parameters become highly volatile with an overall stable trend.

5.1.4 KVAR / KVAD Sites

1988-2010

No information is available for KVAR/KVAD monitoring sites during this period.

2010-2012

West KVAD Wall Seepage Left (Site 81)

Surface water samples collected for KVAD Seepage Left (Site 81) sample the KVAD Toe Drain along the north-western wall of the Stage 2 KVAR area. The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at Site 81, during the 2010-2012 monitoring period, generally exceeded WQGVs (by a significant amount) with the exceptions of Cl, As, Ba, Be, Hg and Se, which were below the adopted WQGVs. pH was below the lower limit of the WQGVs and highly acidic with pH 3.1.

Figures A15 and A16 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between February 2010 and July 2017 for Site 81. For the period between March 2010 and February 2012, the chart shows broad fluctuations for all indicator parameters during this monitoring period with a noticeable decline in all parameters (with the exception of Al) in October 2010 – corresponding with installation of subsurface drains to the Stage 2 area in 2010 and unblocking of the KVAD toe drains in 2011. With the exception of aluminium, concentrations of indicator parameters rose gradually following October 2010 up to February 2012.

The results from Site 81 between 2010 and 2012 indicate that the KVAR dry ash possibly affecting water quality at Site 81. This is evident from the low pH values, typical of a fresh dry ash along with elevated concentration of Al, B, Cr, Zn and relatively low Mo (Ward et al., 2009).

West KVAD Wall Seepage Right (Site 80)

Surface water samples collected for KVAD Seepage Right (Site 80) sample the KVAD Toe Drain along the north-western wall of the Stage 2 KVAR area. The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at Site 80 generally exceeded the WQGVs, with the exceptions of Cl, As, Ba, Be, Cd, Cr, Hg, Mo and Se, which were below the WQGVs. pH was below the lower limit of the WQGVs and highly acidic with pH 3.2.

Figures A17 and A18 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between February 2010 and March 2020 for Site 80. For the period between March 2010 and February 2012, the chart shows a broad fluctuation for all indicator parameters during this monitoring period, characterised by a declining trend up to October 2010 which is followed by a rising limb up to February 2012. The shift in trend is attributed to installation of subsurface drains to the Stage 2 area and unblocking of the KVAD toe drains, which took place between October 2010 / February 2011.

The results from Site 80 between 2010 and 2012 indicate that the KVAR dry ash possibly affecting water quality at Site 80. This is evident from the low pH values, typical of a fresh dry ash along with elevated concentration of Al, B, Cr, Ni, Zn and relatively low Mo (Ward et al., 2009).

North Wall Collection (Site 86)

Surface water samples collected for North Wall Collection (Site 86) sample groundwater through flow and subsequent seepage along the northern wall of the KVAD, north of the Stage 2 KVAR. The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at Site 86 were historically generally below the WQGVs, with the exceptions of B, Fe, Mn, and Ni. pH was below the lower limit of the WQGVs and moderately acidic with pH 4.78. The water quality seems to have significantly deteriorated over the recent years.

Figures A19 and A20 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between March 2010 and March 2020 for Site 86. For the period between March 2010 and February 2012, the chart shows a variable series of rising (Al, Mn), falling (SO_4, B, Cond), and stable (Ni) trends up to November 2010 at which point there is a significant temporary drop in concentrations of all parameters. Following this event, concentrations recover and SO_4, B and conductivity begin a rising trend, Al and Mn continue to rise, whilst Ni recovers before beginning a gradual declining trend. The shift in trend is attributed to installation of subsurface drains to the Stage 2 area and unblocking of the KVAD toe drains, which took place in October 2010 - February 2011.

The results from Site 86 between 2010 and 2012 indicate that the KVAD is likely to be the primary influence on water quality at Site 86. This is indicated by the relatively less acidic pH value (pH 4.78), and generally lower concentration of water quality parameters, which is indicative of long stored ash (Ward et al., 2009). The observed rising trend in water quality parameters since October 2010 is indicative of increasing influence of the KVAR on water quality at Site 86.

Surface Water Runoff / West KVAD Wall Subsurface (Site 87)

Surface water samples collected for Surface Water Runoff (Site 87) sample groundwater through flow and subsequent seepage for the West KVAD wall. The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at Site 87 historically generally exceeded the adopted WQGVs with the exceptions of Cl, Ba, Be, Hg, Mo, Pb and Se. pH was below the lower limit of the WQGVs and moderately acidic with pH 4.99.

Figures A21 and A22 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between April 2010 and March 2020 for Site 87. For the period between April 2010 and February 2012, the chart shows a broad fluctuation for the majority of indicator parameters (excluding SO_4 and Cond) characterised by stable / declining trends up to October 2010, following which point concentrations of water quality parameters shift into steady rising trends at variable rates of rise. SO_4 and conductivity exhibit a rising trend throughout the monitoring period. The shift from stable / falling to rising trends in concentrations of indicator parameters is attributed to installation of subsurface drains to the Stage 2 area and unblocking of the KVAD toe drains, which took place in October 2010.

The results from Site 87 between 2010 and 2012 indicate that the KVAD is likely to be the primary influence on water quality at Site 87. This is indicated by the relatively less acidic pH value (pH 4.99), and generally lower concentration of water quality parameters, which is indicative of long stored ash (Ward et al., 2009). The observed rising trend in water quality parameters since October 2010 is indicative of increasing influence of the KVAR on water quality at Site 87.

2012-2020

West KVAD Wall Seepage Left (Site 81)

No data is available for Site 81 between the end of January 2012 and start of April 2015, and after July 2017 (dry). The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at Site 81 (for the period between April 2015 and March 2018) generally decreased in comparison to 2010-2012 concentrations, with the exceptions of As, Ba, F, Fe, and Se, which increased slightly. Despite the overall shift to lower concentrations, the majority of water quality parameters remained above the WQGVs, with the exceptions of (as previous) Cl, As, Ba, Cd, Mo and Se. pH increased slightly but remained highly acidic at pH 3.14.

Figures A15 and A16 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between April 2010 and July 2017 for Site 81. For the period between April 2015 and July 2017, the chart shows that concentrations of key parameters remained relatively stable or with slight decreasing trends with subordinate fluctuations.

The results from Site 81 between 2015 and 2017 indicate that the KVAR dry ash is affecting water quality at Site 81. This is evident from the low pH values, typical of a fresh dry ash along with elevated concentration of Al, B, Cr, Zn and relatively low Mo (Ward et al., 2009).

West KVAD Wall Seepage Right (Site 80)

No data is available for Site 80 between the end of January 2012 and start of April 2015. The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at Site 80 (for the period between April 2015 and February 2020) generally increased in comparison to 2010-2012 concentrations, with the exceptions of pH, Cl, Ba, Cr, Cu, Hg, Mo, and Pb. Due to changes in water quality, concentrations of Cd rose above WQGVs, whilst Cu and Pb dropped below the WQGVs.

Figures A17 and A18 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between February 2010 and February 2020 for Site 80. For the period between April 2015 and February 2020, the chart shows generally stable concentrations of all indicator parameters. However, it is noted that concentrations of all indicator parameters are higher than 2010-2012 concentrations, indicating a rising trend occurring during the data gap between the end of February 2010 and start of April 2012, likely as a result of installation of subsurface drains to the Stage 2 area and unblocking of the KVAD toe drains, which took place in October 2010-February 2011, at which time rising trends commenced.

The results from Site 80 between 2015 and 2020 indicate that the KVAR dry ash is affecting water quality at Site 80. This is evident from the low pH values, typical of a fresh dry ash along with elevated concentration of Al, B, Cr, Ni, Zn and relatively low Mo (Ward et al., 2009).

North Wall Collection (Site 86)

No data is available for Site 86 between the end of January 2012 and start of April 2013. The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at Site 86 (for the period between April 2014 and February 2020) significantly increased in comparison to 2010-2012 concentrations with the exceptions of Ba, Mo and Pb, which decreased slightly. pH decreased to highly acidic conditions at pH 2.9. The shift in water quality between the 2010-2012 and 2014-2020 monitoring periods is considerable at site 86. During the 2010-2012 monitoring period, the majority of water quality parameters were below the adopted WQGVs, whereas, during the 2014-2020 monitoring period, the majority of water quality parameters exceeded the WQGVs, with the exceptions of Cl, As, Ba, Hg, Mo, Pb and Se.

Figures A19 and A20 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between February 2010 and February 2020 for Site 86. For the period between April 2014 and February 2020, the chart shows rising trends in all water quality indicator parameters which appear to be levelling off toward the end of 2017 / start of 2018 (with the exception of aluminium, which appears to be rising steadily). The rising trends observed in the majority of indicator parameters (nickel excluded) may be attributed to installation of subsurface drains to the Stage 2 area and unblocking of the KVAD toe drains, which took place in October 2010 - February 2011.

The results from Site 86 between 2013 and 2020 indicate that the KVAR dry ash possibly affecting water quality at Site 86. This is evident from the low pH values, typical of a fresh dry ash along with elevated concentration of Al, B, Cr, Ni, Zn and relatively low Mo (Ward et al., 2009).

Surface Water Runoff (Site 87)

No data is available for Site 87 between the end of January 2012 and start of April 2015. The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at Site 87 (for the period between April 2015 and February 2020) generally increased significantly, with the exceptions of Al, Ba, Cd, Cr, Cu, Hg and Mo. pH decreased significantly to highly acidic conditions at pH 3.3. As a result of the increased concentrations in water quality parameters, As and Se joined other water quality parameters exceeding the WQGVs; whilst Cd and Cr concentrations decreased to below the WQGVs.

Figures A21 and A22 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between April 2010 and February 2020 for Site 87. For the period between April 2015 and February 2020, the chart shows stable to shallow rising trends for all indicator parameters. The rate of rise in concentrations of indicator parameters is shallower than the rate of rise observed during the 2010-2012 period indicating a shift towards system equilibrium. The rising trends observed in the majority of indicator parameters may be attributed to installation of subsurface drains to the Stage 2 area and unblocking of the KVAD toe drains, which took place in October 2010 - February 2011.

The results from Site 87 between 2013 and 2020 indicate that the KVAR dry ash possibly affecting water quality at Site 87. This is evident from the low pH values, typical of a fresh dry ash along with elevated concentration of Al, B, Cr, Ni, Zn and relatively low Mo (Ward et al., 2009).

5.1.5 Lidsdale Cut (WX5)

During the first two periods (1991-2012), water sampling was actually performed at the discharge v-notch from Lidsdale Cut Pond. Once the v-notch was sealed, to halt discharges into SSC, samples were taken from the inlet to the pond.

1991-2003

Lidsdale Cut (WX5 / Site 40)

Surface water samples collected for Lidsdale Cut at Site WX5 represent water quality within the Lidsdale Cut Pond, sampled at the discharge v-notch from Lidsdale Cut Pond to SSC for the 1992-2003 monitoring period.

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the WX5 sampling site were generally below the WQGVs for the period between 1992-2003, with the exception of B, Cr, F, Fe, Mn and Zn. pH was below the lower limit of the WQGVs and mildly acidic at pH 5.98.

Figures A23 and A24 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between April 1992 and February 2020.There is a significant data gap between the end of August 1992 and start of February 2002. No data is available for nickel prior to 2006. For the period between August 1992 and October 2002, the chart shows generally stable concentrations of key water quality parameters. Between 2002 and 2003, recorded concentrations of all key parameters are broadly equivalent to 1992 concentrations, indicating minimal historical changes to water quality at WX5, concurrent with wet ash emplacement within the SSCAD.

The results from WX5 during the 1991-2003 monitoring period reflect water quality conditions in Lidsdale Cut Pond at the outlet to SSC preceding dry ash placement in the KVAR, which commenced in 2003. Accordingly, the observed exceedances of the WQGVs can be attributed to other land uses (i.e. KVAD / SSCAD / Chitter) locally affecting water quality in WX5, and therefore not representative of influences from the KVAR.

2003-2012

Lidsdale Cut (WX5 / Site 40)

Surface water samples collected for Lidsdale Cut at Site WX5 represent water quality within the Lidsdale Cut Pond, sampled at the discharge v-notch from Lidsdale Cut Pond to SSC for the 2003-2012 monitoring period.

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the WX5 sampling site, for the period between January 2003 and June 2012, increased relative to the 1991-2003 concentrations, with the exception of chloride, which decreased relative to 1991-2003 concentrations. As a result of the change in water quality the majority of water quality parameters increased to levels exceeding the adopted WQGVs, with the exception of Cl, Ba, and Be which remained below the WQGVs. pH became more neutral at pH 7.3.

Figures A23 and A24 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between April 1992 and February 2020. For the period between January 2003 and June 2012, there are significant fluctuations in water quality within an overall rising trend. Noticeably, concentrations of all water quality indicator parameters drop immediately following capping of the KVAD and commencement of Stage 1 dry ash emplacement and fluctuate with high volatility but stable trend between January 2003 and January 2006. Following January 2006, the volatility continues but an underlying rising trend in concentration of water quality indicator parameters is observed. The shift to increasing trends is concurrent with blockage of the KVAD toe drains in 2006, and is also concurrent with a rise in groundwater levels in D3 to an elevation greater than 920m, indicating potential groundwater migration into the KVAR dry ash affecting water quality in Lidsdale Cut as a result of leachate generation.

In 2009, there is a sharp rise and increase in variability in concentrations of water quality indicator parameters, concurrent with commencement of Stage 2 dry ash emplacement. In May 2010, there is a sharp drop in concentrations of water quality indicator parameters, concurrent with installation of SSCAD seepage collection system.

In February 2011, there is another rise in concentrations of water quality indicator parameters, concurrent with unblocking the KVAR toe drains to LC, which is subsequently followed by a decline in overall concentrations, likely associated with the Springvale Mine Discharge Water Leak and subsequent dilution effects in WX5.

Overall and based on the available data set, the results for the monitoring period (2003-2012) appear to suggest that the KVAR placement is considered likely to have influenced water quality in Lidsdale Cut Pond (WX5) as a result of groundwater migration into the KVAR at Bore D3. The KVARs possible role as a source of impact to Lidsdale Cut pond (WX5) is identified through both timing of changes to water quality in Lidsdale Cut, along with the elevated concentration of key indicator parameters.

Historical impacts on Lidsdale Cut cannot be discounted, however it is noted that concentrations increased beyond and in contrast to historical trends and concentrations, and pH decreased to highly acidic conditions following KVAR emplacement and groundwater rise in bore D3. However, due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD, it is not suitable (based on the data set available) to directly attribute water quality impacts observed in groundwater in Lidsdale Cut solely to a single source such as the KVAR.

2012-2020

Lidsdale Cut (WX5 / Site 40)

There is a large gap in available data between June 2012 and October 2013. During which time, both pumping from LC to SSCAD, and discharge from Springvale Mine to SSC at LDP009 commenced.

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the WX5 sampling site, for the period between October 2012 and February 2020, increased relative to the 2003-2012 values, with the exceptions of Cl, As, and Mo, with Mo dropping below the WQGV trigger value. pH became significantly more acidic, becoming highly acidic at pH 3.1.

Figures A23 and A24 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between April 1992 and February 2020. For the period between October 2012 and February 2020, values of all indicator parameters increased significantly and are entering into relatively stable (e.g. SO_4, Cond, B, Al) to gradually rising trends (e.g. Ni, Mn).

Overall and based on the available data set, the results for the monitoring period (2012-2020) appear to suggest that the KVAR placement may have influenced water quality in Lidsdale Cut Pond (WX5) as a result of groundwater migration into the KVAR at Bore D3. The KVARs possible role as a source of impact to Lidsdale Cut is identified through both timing of changes to water quality in Lidsdale Cut, along with the elevated concentration of key indicator parameters, low pH and Mo.

The cause of the noted shift in concentrations is a result of a change in the sampling location from the outlet which leads to SSC, to the inlet to Lidsdale Cut Pond. As a result, the observed water quality from 2012-2020 represents water entering the Lidsdale Cut Pond.

Due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD, it is not considered conclusive to directly attribute any impacts observed in WX5 solely to a single source such as the KVAR without further investigation.

5.1.6 Dump Creek (WX11) – Site 39

1991-2003

Dump Creek (WX11) – Site 39

Surface water samples collected for Dump Creek (WX11) – Site 39 represent catchment surface water quality at the catchment outlet / discharge point within a creek that discharges to SSC (WX7), downgradient and west of the KVAR and Lidsdale Cut.

There is a significant gap in available data for the 1991-2003 monitoring period, between the end of September 1992 and November 2001. The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the WX11 sampling site are generally below the WQGVs for the 1991-2003 monitoring period, with the exceptions of B, Cr, Fe, and Zn.

Figures A25 and A26 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between October 1991 and March 2020 at WX11. As previously stated, there is a significant data gap between the end of September 1992 and start of November 2001. No data is available for nickel prior to 2006.

For the period between October 1991 and October 2002, the chart shows generally low concentrations of key water quality parameters between 1991 and 1992. Between 2002 and 2003, recorded concentrations of all key parameters are higher than 1991-1992 records. Historical changes to water quality at WX11 associated with the 1992-2003 monitoring period are concurrent with wet ash emplacement within the SSCAD and pre-date the KVAR dry ash emplacement.

2003-2012

Dump Creek (WX11) – Site 39

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the WX11 sampling site for the period between January 2003 and June 2012 generally increased relatively to 1991-2003 concentrations, with the exceptions of Cl, Ba, and F. pH decreased to mildly acidic conditions at pH 5.9. As a result of the changes in water quality As, Cd, Cu, Mn, Pb, and Se rose above their respective WQGVs. Concentrations of nickel (available from 2006) show values exceeding the WQGV.

It is noted that although 95th percentile concentrations are higher during the 2003-2012 monitoring period than the preceding 1996-2003 monitoring period, the elevated concentrations at the start of the 2003-2012 monitoring period are a result of the increasing trends during the 1996-2003 monitoring period.

Figures A25 and A26 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between October 1991 and February 2020 at WX11. For the period between January 2003 and June 2012, there is a broad fluctuation in water quality, characterised by a falling limb between 2003 and 2006 (Boron excepted), and rising limb between 2006 and 2012. The shift in trend to rising concentrations may be attributed to a rise in groundwater levels in D3 to an elevation greater than 920 mAHD, resulting in potential groundwater migration into the KVAR dry ash and therein potentially affecting water quality in Dump Creek as a result of leachate generation.

The increase in concentrations of water quality parameters from 2006 – 2012 continues through Stage 2A dry ash placement in the KVAR. There is increased variability in concentrations of key water quality parameters within the rising trend following commencement of Stage 2A dry ash emplacement in April 2009.

Overall, the results for the 2003-2012 monitoring period appear to suggest that the KVAR placement may have potentially influenced water quality in Dump Creek (WX11) as a result of groundwater migration into the KVAR at Bore D3. The KVARs possible role as a source of impact to Dump Creek is identified through both timing of changes to water quality in Dump Creek, along with the elevated concentration of key indicator parameters, low molybdenum and low pH (pH c. 3.7 post 2009) (Ward et al., 2009).

Historical impacts on Dump Creek cannot be discounted, however it is noted that concentrations increased beyond and in contrast to historical trends and concentrations, and pH decreased to highly acidic conditions following KVAR emplacement and groundwater rise in D3. However, due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD, it is not considered conclusive to directly attribute any impacts observed in groundwater in Dump Creek solely to a single source such as the KVAR without further investigation.

2012-2020

Dump Creek (WX11) – Site 39

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the WX11 sampling site for the period between June 2012 and March 2020 generally increased relative to 2003-2012 values, with the exceptions of As, Ba, Cd, Cr, Pb and Se. pH decreased to highly acidic conditions at pH 3.6. SO_4, Al, and F rose above their respective WQGVs, whilst As, Cd, Cr, and Se dropped below their respective WQGVs.

Figures A25 and A26 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between October 1991 and March 2020 at WX11. For the period between June 2012 and March 2020, concentrations of indicator parameters fluctuated with significant volatility within overall stable trends. The shift to volatile swings in water quality coincide with the unblocking of toe drains to LC in Feb 2011 and with further volatility introduced by the commencement of discharge from Springvale Mine to SSC via LDP009, which is believed to have further raised groundwater levels in D3 resulting in lateral groundwater migration and subsequent surface water discharge at WX11.

Overall, the results for the 2012-2020 monitoring period appear to suggest that the KVAR placement may have influenced water quality in Dump Creek (WX11) as a result of groundwater migration into the KVAR. The KVARs possible role as a source of impact to Dump Creek is identified through both timing of changes to water quality in Dump Creek, along with the elevated concentration of key indicator parameters, low molybdenum and low pH (pH c. 3.6 post 2009) (Ward et al., 2009).

Historical impacts on Dump Creek cannot be discounted, however it is noted that concentrations increased beyond and in contrast to historical trends and concentrations, and pH decreased to highly acidic conditions following KVAR emplacement and groundwater rise in D3. Due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD, it is not considered suitable to directly attribute any impacts observed in groundwater in Dump Creek solely to a single source such as the KVAR without further, more detailed investigation.

5.1.7 Springvale 158

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the Springvale Mine Discharge (Site 158) sampling point for the period between 2011 and 2019 were generally below the adopted WQGVs, with the exception of pH, As, Cu, Fe and Mo, which marginally exceeded the WQGVS.

Figures A27 and A28 in Appendix A present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between July 2011 and July 2019. The charts show that concentrations have remained relatively stable over time.

Water quality at Springvale (Site 158) is not affected by the KVAR.

5.2 Groundwater Trends 1988 - 2020

To assess the effects of dry ash emplacement within the KVAR on groundwater quality, it is necessary to analyse both recent concentrations and long-term trends in concentrations of key physical and chemical stressors / toxicants within the selected groundwater monitoring sites.

As outlined in Section 2.5, surface water and groundwater flows through the site are complexly modified by the extensive engineering aspects influencing the site, including:

- Diversion drains through the KVAR / KVAD draining surface water and groundwater to various sumps (i.e. Sumps 1-3), Ponds, Dirty Water Pond, Return Water Canal and to Lidsdale Cut
- Recirculation pumping of SSCAD seepage collected through the SSCAD V-notch back to the SSCAD Pond via the Return Canal
- Recirculation pumping of water from Lidsdale Cut to the SSCAD Pond via the Dirty Water Pond

The 95th Percentile of results have been tabulated for periods corresponding with pre-dry ash emplacement (1991-2003), dry ash emplacement / pre-unblocking of the KVAD toe drains (2003-2010) and post un-blocking of the KVAD toe drains / post dry-ash emplacement (2010-2020). These key events mark periods of marked water quality changes for the groundwater receiving site (D5) and other groundwater sampling points.

It is also noted that blockage of the KVAD toe drains (2006), unblocking of the KVAD toe drains (2010), commencement of pumping from Lidsdale Cut to SSCAD via the Return Canal (July 2012) and commencement of discharge from Springvale Mine to SSC at LDP009 (July 2013) have had marked effects on groundwater quality, these aspects are discussed within the evaluation of the long-term groundwater trends.

Table 5-2 Summary Statistics Long Term Groundwater Monitoring Results (mg/L) – 95th Percentiles

Sample Location	Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Groundwater Receiving Site																								
Groundwater Bore WGM1/D5 (36)	1988-2003	4.7	864	576	336	26	ND	0.011	0.001	0.622	0.006	1.76	0.042	0.05	0.07	0.77	15.9	0.0006	3.04	ND	0.137	0.07	0.002	0.69
	2003-2010	4.1	2341	1995	1490	27.6	41.2	0.048	0.009	0.038	0.029	6.3	0.011	0.005	0.04	1.3	25.9	0.0001	13.85	0.01	1	0.03	0.006	2.09
	2010-2020	3.7	1397	1100	719	35.8	30.7	0.010	0.001	0.082	ND	2.88	0.067	0.013	0.055	1.199	5.97	0.0001	8.58	0.01	0.568	0.109	0.005	3.19
KVAR / KVAD																								
Groundwater Bore WGM1/D6 (37)	1988-2003	5.6	1220	770	400	80	ND	0.006	0.001	0.78	0.001	1	0.006	0.03	0.036	0.35	130	0.0008	5.01	ND	0.2	0.017	0.071	0.32
	2003-2010	4.6	1423	784	440	70.5	6.0	0.05	0.01	0.04	0.016	0.89	0.002	0.016	0.01	0.7	85.7	0.0001	4.65	0.066	0.55	0.015	0.006	1.95
	2010-2020	3.2	2210	1990	1280	58.4	7.0	0.012	0.001	0.028	ND	1.41	0.004	0.004	0.024	0.7	240	0.00005	11.75	0.01	0.62	0.024	0.002	1.836
Groundwater Bore AP09 (77)	2010-2020	5.9	2968	2536	1630	41.7	0.6	0.086	0.001	0.031	ND	3.35	0.0004	0.001	0.004	5.25	121	0.00005	12	0.209	1.37	0.003	0.002	1.328
Groundwater Bore AP17 (78)	2010-2020	3.3	5580	5782	4128	26.2	142	0.109	0.001	0.026	ND	14.57	0.0021	0.01	0.039	108	237	0.00008	16.44	0.097	1.89	0.004	0.155	5.84
KVAD Seepage (94)	2015-2020	3.1	5564	6361	4749	43.1	291	0.047	0.001	0.0314	ND	20.59	0.076	0.035	0.065	58.7	46.5	0.00004	24.6	0.003	2.46	0.007	0.059	4.69
Groundwater Bore GW10 (75)	2010-2013	6.6	1745	1345	866	168.0	50.2	0.04	0.001	0.354	ND	1.59	0.01	0.011	0.055	7.79	6.38	0.00007	9.78	0.24	2.08	0.17	0.01	2.97
Groundwater Bore GW11 (76)	2010-2016	7.4	1040	744	436	27.1	20	0.015	0.001	0.202	ND	1.51	0.0004	0.01	0.025	0.44	4.81	0.00009	4.42	0.04	0.03	0.06	0.002	0.238
Downgradient SSCAD - Upgradient KVAR																								
Groundwater Bore WGM1/D3 (34)	1988-2003	5.8	740	487	124	86	ND	0.03	0.001	0.254	0	0.2	0.001	0.02	0.01	0.46	11	0.0008	0.731	ND	0.09	0.017	0.002	0.14
	2003-2010	6.1	807	526	130	110	0.72	0.05	0.01	0.129	0.001	0.049	0.002	0.01	0.01	0.1	4.89	0.0001	1.095	0.01	0.2	0.01	0.006	0.11
	2010-2020	5.1	1412	1064	640	150	5.0	0.01	0.001	0.11	ND	1.6	0.010	0.003	0.017	0.96	17.7	0.0001	3.3	0.010	0.73	0.008	0.0001	0.75
Groundwater Bore WGM1/D4 (35)	1988-2003	6.8	730	520	222	56.2	ND	0.008	0.001	0.514	0.0009	0.5	0.004	0.016	0.05	0.37	93.5	0.003	7.24	0	0.02	0.014	0.046	0.098
	2003-2010	6.3	1582	1300	954	35	0.1	0.05	0.01	0.069	0.01	1.6	0.002	0.01	0.01	0.1	70.8	0.0001	20	0.01	0.05	0.01	0.006	0.1
	2010-2020	5.8	1691	1381	888	45.5	0.1	0.003	0.001	0.027	ND	1.94	0.0002	0.0015	0.004	0.1	61.1	0.00005	19	0.01	0.05	0.001	0.002	0.085
Groundwater Bore WGM1/D2 (33)	1988-2003	4.2	320	277	67.1	61.1	ND	0.002	0.001	0.144	ND	0.14	0.001	0.045	0.038	0.32	2.26	0.00080	0.534	ND	0.03	0.031	0.001	0.13
	2003-2010	4.1	461	309	158	43.9	ND	0.05	0.01	0.071	0.001	0.129	0.002	0.01	0.01	0.19	5.29	0.00010	0.624	0.01	0.06	0.01	0.006	0.13
	2010-2020	3.6	645	391	50.2	38.8	0.4	0.001	0.001	0.045	ND	0.203	0.0002	0.003	0.006	0.1	3.20	0.00008	0.787	0.01	0.09	0.003	0.002	0.128
Upgradient of SSCAD and KVAR / KVAD																								
Groundwater Bore WGM1/D1 (32)	1988-2003	6.2	322	247	13.7	82.6	ND	0.005	0.009	0.185	0	0.175	0.003	0.043	0.054	0.55	7.7	0.0005	0.747	ND	ND	0.019	0.003	0.15
	2003-2010	6.1	141	179	11.7	21	7.4	0.003	0.001	0.105	0.001	0.047	0.0015	0.006	0.028	0.1	2.24	0.00009	0.498	0.01	0.01	0.013	0.002	0.144
	2010-2020	5.2	149	168	18.8	28.7	6.9	0.001	0.001	0.091	ND	0.07	0.0002	0.005	0.021	0.1	1.56	0.00005	0.671	0.01	0.01	0.013	0.002	0.193
Groundwater WQGVs																								
Groundwater WQGV		6.5-8.0	2600	2000++	1000++	350+	**5.1 ^^**	0.024	0.00005	0.7+++	0.1	**1.7**	0.001	0.004	0.005	1.5 +++	**1.7**	0.00006	1.9	0.01+	**0.137**	**0.01**	0.005	**0.505**
Additional notes: See Table 4-4																								

5.2.1 Groundwater Bore D5 – Receiving Site (Site 36)

1988-2003

Groundwater samples collected for D5 during this period represent groundwater quality concurrent with emplacement of wet ash within SSCAD, post KVAD wet ash emplacement, and pre-date dry ash emplacement in the KVAR.

The results presented in Table 5-2 indicate that the 95th percentile concentrations of a number of key parameters in groundwaters of the receiving site (D5) exceeded the adopted WQGV's for B, Cd, Cr, Cu, Fe, Hg, Mn, Pb, Zn, and for pH (below lower limits). Conductivity, SO_4, Cl, As, Ba, Be, F, Ni and Se were below the adopted WQGVs.

Figures B1 and B2 in Appendix B presents time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity, along with the recorded groundwater levels, for the period between 1988 and 2019 for D5, which show that concentrations of key parameters in groundwater are relatively stable during the period between 1988 and 2003.

2003-2010

Groundwater quality results in Table 5-2 indicate that the 95th percentile concentrations of key parameters increased from baseline values (1988-2003) during the 2003-2010 period for SO_4, Cl, As, Be, B, F, Fe, Mn, Ni, Se, and Zn resulting in an increase in overall conductivity and rise in acidity (reduced pH). Changes for Al and Mo cannot be determined due to lack of data during the baseline period.

Indicator parameters shown in Figures B1 and B2 in Appendix B indicate increased concentrations of key parameters and a rising trend of concentrations in groundwater between 2007 and 2010 for groundwaters in receiving site D5. The noted increase in concentrations of water quality parameters and rising trend in water quality parameters corresponds with the timing of and therefore may be directly attributed to) a rise in groundwater levels in Bore D3, (located upgradient of the KVAR / downgradient of the SSCAD) to an elevation greater than 920 mAHD. The rise in groundwater levels around Bore D3 potentially resulted in groundwater migration into the KVAR dry ash resulting in generation of dry ash leachate.

Due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD, it is not considered conclusive to directly attribute any impacts observed in groundwater in Bore D5 solely to a single source such as the KVAR without further investigation.

Influence from the KVAR on groundwater quality in D5 during this period is evident from the shift in concentration of water quality parameters, including reduced pH, and elevated SO_4, Ca, and Zn and other parameters, at concentrations significantly above pre-KVAR levels.

2010-2020

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key parameters in D5 decrease for TDS, SO_4, Al, As, B, F, Fe, Mn, Mo, Ni, & Se during the 2010-2020 period. Concentrations of Cl, Ba, Cd, Cr, Cu and Pb increased in 95th percentile concentrations. pH becomes slightly more acidic (pH 3.7), while overall conductivity decreases.

Time series records for indicator parameters (presented in Figures B1 and B2 in Appendix B) show that concentrations of Mn, B, SO_4, Ni, and overall conductivity decrease initially following completion of Stage 1 dry ash emplacement in the KVAR (February 2009), and again in Feb 2010 following the unblocking of the toe drains. The trend of decreasing concentrations is interrupted in July 2013, following commencement of discharge from Springvale Mine to SSC at LDP009. It is observed that concentrations of key parameters fluctuate significantly following July 2013, with stable to rising trends for key parameters.

Overall, the results for the 2003-2010 monitoring period appear to suggest that the KVAR placement may have potentially influenced water quality in Bore D5 as a result of groundwater migration into the KVAR. The KVARs possible role as a source of impact to Bore D5 is identified through both timing of changes to water quality in

Bore D5, along with the elevated concentration of indicator parameters, above historic background concentrations, and rising groundwater levels in Bore D3.

Water quality in Bore D5 generally improved following February 2010, indicating possible unblocking of the Stage 1 KVAD toe drains resulted in an improvement of groundwater quality. Subsequently, the concentrations of water quality parameters in Bore D5 generally decreased towards pre-KVAR concentrations until July 2013, following which point there are significant fluctuations in water quality, with 95th percentile concentrations of water quality parameters greater than historical background (1988-2003) values. The observed fluctuations in water quality parameters are observed in conjunction with fluctuations and an overall rise in groundwater levels in bore D3, which is considered likely to be attributed discharge from Springvale Mine upgradient of the KVAR.

The results at Bore D5 are interpreted to be potentially influenced by seepage from SSC, however this is likely to have a dilutive rather than additive effect on the concentrations of water quality parameters as SSC is relatively reduced in concentrations of indicator parameters. The relative effect of SSC dilution on groundwater quality downgradient of the KVAR / KVAD can be observed comparison of Bore D5 with Bore D6, which is located downgradient of the Stage 1 KVAR area and away from SSC, and shows a similar relationship between groundwater levels in Bore D3 and water quality trends post 2007.

This borehole has been dry since July 2019.

Due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD, it is not considered suitable to directly attribute any impacts observed in groundwater in Bore D5 solely to a single source such as the KVAR without further, more detailed investigation.

5.2.2 KVAR / KVAD Monitoring Bores

1988-2003

D6 – Site 37

Bore D6 is a seepage detection bore for the KVAD. Groundwater quality data for D6 is available from 1988.

Groundwater samples collected for D6 during this period represent groundwater quality concurrent with emplacement of wet ash within SSCAD, post KVAD wet ash emplacement, and pre-date dry ash emplacement in the KVAR.

The groundwater quality data for D6, presented in Table 5-2 shows that the 95th percentile concentrations of a number of key water quality parameters in groundwater exceeded the adopted WQGVs for Ba, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, and pH (below lower limits). Conductivity, TDS, SO_4, Cl, As, Be, B, F, and Zn did not exceed WQGVs. No data was available for Al or Mo.

Figures B3 and B4 in Appendix B presents time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 1988 and 2020 for D6, which show that concentrations of key parameters in groundwater are relatively stable during the period between 1988 and 2003, with no significant fluctuations.

AP09 (77), AP17 (78), GW10 (75), GW11 (76)

Groundwater quality data for GW10, GW11, AP9 and AP17 are only available for the period between 2010 and 2020.

2003-2010

D6 – Site 37

The Groundwater quality results in Table 5-2 indicate that the 95th percentile concentrations of key parameters increased from baseline values (1988-2003) at D6 during the 2003-2010 period for SO_4, As, F, Be, Ni, Zn and conductivity, with As, Zn subsequently exceeding WQGVs and pH becoming more acid (pH 4.6). Other water quality parameters including Cl, Ba, B, Cd, Cr, Cu, Fe, Hg, Mn, Pb, and Se reduced in concentration, however remained above WQGVs with the exception of Ba which dropped below its WQGV and B which remained below its WQGV. Relative changes for Al and Mo cannot be determined due to lack of baseline data, however are noted to exceed WQGVs during the 2003-2010 period.

Time series records of indicator parameters Al, Mn, B, Ni, SO_4, and conductivity for the period between 2003 and 2010 for D6 (presented in Figures B3 and B4 in Appendix B), show a sudden drop in concentrations directly after Feb 2003, potentially associated with additional capping of the KVAD (through stage 1 Ash emplacement) and reduction of infiltration to groundwater at D6. A large data gap is present between 2004 and 2007. However, records indicate concentrations of key indicator parameters similar to baseline concentrations between 2007 and 2009.

From 2009 to 2010 there is a noted trend of reduced pH and increasing concentrations and variability in water quality parameters. The observed shift in trends to rising concentrations of key parameters is coincident with both Stage 2A dry ash emplacement, and a rise in groundwater levels in Bore D3, (located upgradient of the KVAR / downgradient of the SSCAD) to an elevation greater than 920 mAHD. The rise in groundwater levels around Bore D3 potentially resulted in groundwater migration into the KVAR dry ash resulting in generation of dry ash leachate.

Due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD it is not considered conclusive to directly attribute any impacts observed in groundwater in Bore D6 solely to a single source such as the KVAR without further investigation.

2010-2020

D6 – Site 37

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key water quality parameters in groundwater of D6 increased for SO_4, Al, B, Cd, Cu, Fe, Mn, Ni, and Pb during the 2010-2020 monitoring period with a corresponding increase in conductivity and TDS and a decrease in pH (pH 3.2). Concentrations of Cl, As, Ba, Cr, Mo, Se, and Zn dropped in the same period.

Time series records of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity for the period between 2010 and 2020 for D6 (presented in Figures B3 and B4 in Appendix B) show volatile fluctuations but relatively stable concentrations up to July 2012 for heavy metals and an increasing trend for SO_4 and conductivity. Following July 2012 and the commencement of pumping from LC to the Return Water Canal, there is greater volatility in water quality parameters, along with increased concentrations and stable to increasing trends. From July 2013, following commencement of discharge from Springvale Mine at LDP009, there is a further increase in trend, volatility and concentrations of indicator parameters in Bore D6.

Overall, the results for the 2010-2020 monitoring period appear to suggest that the KVAR placement may have potentially influenced water quality in Bore D6 as a result of groundwater migration into the KVAR. The KVARs possible role as a source of impact to Bore D6 is identified through both timing of changes to water quality in Bore D6, along with the elevated concentration of indicator parameters, above historic background concentrations, and rising groundwater levels in Bore D3. Additional fluctuations and a continued rise in both groundwater levels in Bore D3 and concentrations of water quality parameters in Bore D6 may be associated with discharge from Springvale Mine and subsequent groundwater mounding upgradient of / migration into the KVAR, resulting in dry ash leachate impacts on groundwater quality in Bore D6.

Due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD it is not considered conclusive to directly attribute any impacts observed in groundwater in Bore D6 solely to a single source such as the KVAR without further investigation.

AP09 (77), AP17 (78), GW10 (75), GW11 (76), and KVAD Seepage (94)

The bores GW10, GW11, AP9 and AP17, sample the groundwater in the KVAD beneath the KVAR.

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key parameters in AP09, AP17, GW10, GW11 and KVAD Seepage are highly variable and strongly affected by relative position to the various toe drains that drain the KVAR, with AP09, AP17, GW6 and KVAD Seepage showing close similarities.

No data has been available for GW10 from 2013, for GW6 from Nov 2016 and for GW11 from Sept 2016 due to drying out of the monitoring points.

Concentrations of key water quality parameters in AP09, AP17, GW6, GW11 and KVAD Seepage generally exceed the WQGVs for SO_4, Al, As, B, Cd, Cr, Cu, F, Fe, Mn, Ni, and Zn, along with variable exceedances of Hg, Mo, Pb and Se.

Figures B5 through B16 in Appendix B present time series records for indicator parameters for AP09, AP17, GW6, GW11 and KVAD Seepage. Consistent records of water quality data are available for 2010-2020 for AP09 and AP17. Records for GW6 present significant data gaps, whilst records for KVAD Seepage are only available for years 2015-2020.

Figures B5 through B8 in Appendix B present the time series records for AP09 and AP17, located along the northern catchment of the KVAR Stage 2 Area and west of the Sedimentation Control Area. Records indicate rising concentrations of key parameters for AP09 from February 2010 up to February 2011, corresponding with Stage 2 and Stage 2A dry ash emplacement, and generally stable or declining concentrations in AP17.

Following February 2011, there is a decline in concentrations of indicator parameters for AP09 and AP17 in correspondence with the timing of the clearing of the KVAD toe drains for the Stage 2 Area.

There is a gap in available data between June 2013 and April 2015, however concentrations of key parameters are notably higher at the start of April 2015, with a reversal of the decreasing trend to increasing concentrations of indicator parameters. The marked increase in concentrations and reversal to rising trends correlates with the commencement of pumping from LC to the SSCAD via the return Canal, indicating potential subsequent seepage back into the KVAR. However, it is noted that concentrations appear to rise prior to this event for AP17 (Feb 2012), which suggests another mechanism has affected water quality at these monitoring points.

5.2.3 Downgradient of SSCAD / Upgradient of KVAR

1988-2003

D2 – Site 33

Groundwater monitoring point D2 is located south (cross-gradient) of the KVAR Stage 1 area, downgradient of the SSCAD and adjacent to the Return Water Canal. Groundwater samples collected for D2 during this period represent groundwater quality concurrent with emplacement of wet ash within SSCAD, post KVAD wet ash emplacement, and pre-date dry ash emplacement in the KVAR.

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key parameters in D2 were generally below the adopted WQGVs with the exceptions of Cr, Cu, Fe and Pb. pH was also below the lower limit of the WQGVs at pH 5.51. The greatest exceedance of WQGVs included concentrations of Cr and Cu which were up to 10 times their corresponding WQGVs.

Figures B17 and B18 in Appendix B present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity for the period of 1988-2020 for D2. The results show a gradual rising trend at D2 for conductivity, SO_4 and Mn during the 1988-2003 monitoring period, potentially corresponding with effects from Stage 1 dry ash emplacement.

D3 – Site 34

Groundwater monitoring point D3 is located east of the KVAR, adjacent to the Stage 2B emplacement area and immediately west / downgradient of SSCAD and SSC proximal to LDP009. Groundwater samples collected for D3 during this period represent groundwater quality concurrent with emplacement of wet ash within SSCAD, post KVAD wet ash emplacement, and pre-date dry ash emplacement in the KVAR.

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key parameters in D3 were generally below the adopted WQGVs with the exceptions of As, Cr, Cu, Fe, Hg and Pb, which variably exceeded the WQGVs. The greatest exceedance of WQGVs included concentrations of Fe, Cr and Cu which are observed at up to 10 times their corresponding WQGVs.

Figures B19 and B20 in Appendix B present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity for the period of 1988-2020 for D3. The results show that concentrations of key water quality parameters were relatively stable during the 1988-2003 monitoring period at D3.

D4 – Site 35

Groundwater monitoring point D4 is located north of the KVAR, beyond SSC and west of / downgradient of SSCAD. Groundwater samples collected for D4 during this period represent groundwater quality concurrent with emplacement of wet ash within SSCAD, post KVAD wet ash emplacement, and pre-date dry ash emplacement in the KVAR.

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key parameters in D4 were generally below the adopted WQGVs with the exceptions of Cd, Cr, Cu, Fe, Hg, Mn, Pb, and Se, which variably exceeded the WQGVs. The greatest exceedances of the WQGVs included concentrations of Cr, Cu, Fe, Mn and Se which were generally 10 times their respective WQGV, with the exception of Fe which is observed at over 50 times the WQGV. pH was below the lower limit at pH 5.51.

Figures B21 and B22 in Appendix B present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity for the period of 1988-2020 for D4. The results show that concentrations of key water quality parameters SO_4, Mn and B gradually increased over the 1988-2003 monitoring period at D4, similar to bores D5 and D6. No records are available for Al during this period. The noted increase in concentration of key water quality parameters at D4 corresponds with the timing of ash emplacement within SSCAD.

2003-2010

D2 – Site 33

The Groundwater quality results in Table 5-2 indicate that the 95th percentile concentrations of key parameters increased from baseline values (1988-2003) at D2 during the 2003-2010 for Fe, SO_4, Mn, Ni and Se, with a relative drop in pH towards more acidic condition (pH 4.99). Remaining parameters dropped or remained stable during this period. Accordingly, fewer parameters exceeded the WQGVs with only Cr, Fe, Hg, Se and pH exceeding / failing the WQGVs. No records are available for Al during this period.

Time series records of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity or the period between 1988 and 2020 for D2 (presented in Figures B17 and B18 in Appendix B), continue to show a gradual rising trend during the 2003-2010 monitoring period, consistent with the rising trend observed during the 1988-2003 monitoring period.

The groundwater quality trends in Bore D2 do not exhibit any shifts in quality between 2003 and 2010 that may indicate effects on groundwater quality as a result of dry ash emplacement in the KVAR.

D3 – Site 34

The Groundwater quality results in Table 5-2 indicate that the 95th percentile concentrations of key parameters increased marginally from baseline values (1988-2003) at D3 during the 2003-2010 for SO_4, Cl, As, Cd, Mn, Ni, and Se, and an overall increase in conductivity, with other parameters showing decreasing or stable trends. Cd, Ni and Se increased to concentrations exceeding WQGVs, whilst Pb dropped below.

Time series records of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity for the period between 2003 and 2010 for D3 (Figures B19 and B20 in Appendix B), show a generally stable to indistinctly increasing trend in key water quality parameters.

The groundwater quality trends in Bore D3 do not exhibit any shifts in quality between 2003 and 2010 that may indicate effects on groundwater quality as a result of dry ash emplacement in the KVAR.

D4 – Site 35

The Groundwater quality results in Table 5-2 indicate that the 95th percentile concentrations of key parameters increased from baseline values (1988-2003) at D4 during the 2003-2010 for SO_4, As, B, Be, Ni and Mn, but with a relative decrease or stable trend in other parameters, with Pb and Se dropping below their respective WQGV trigger values. pH decreased to marginally below lower limit of WQGV range at pH 6.3.

Time series records of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity for the period between 1988 and 2020 for D4 (Figures B21 and B22 in Appendix B), show a continuation of the rising trend in concentrations of SO_4, Mn and B with corresponding rise in overall groundwater conductivity at D4 for the 2003-2010 monitoring period.

The groundwater quality trends in Bore D4 do not exhibit any shifts in quality between 2003 and 2010 that are likely to be attributed to the KVAR. The increasing trend preceding and up to 2010 appear to be concurrent with ash emplacement in SSCAD and likely reflect seepage to bore D4, until the SSCAD seepage collection system was installed, following which point stable to decreasing trends are observed for many contaminants.

2010-2020

D2 – Site 33

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key water quality parameters in groundwater at D2 increased marginally for SO_4, B, Mn, and Ni during the 2010-2020 monitoring period, with a corresponding increase in overall conductivity. Remaining parameters generally decreased or remained stable with a decrease in overall pH (pH 3.6) and Cr and Se dropped to concentrations below their relevant WQGVs.

Figures B7 and B18 in Appendix B presents time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity for the period of 1988-2020 for D2. The results show a noticeable increase in the rate of the rising trend at D2 for conductivity, SO_4, Mn, Ni and B during the period between July 2012 and March 2014, corresponding with the timing of pumping from LC to SSCAD via the Return Canal, which is proximal to D2. Following March 2014, KVAR ceased operation and ash production and concentrations of key water quality parameters in D2 subsequently stabilised.

D3 – Site 34

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key water quality parameters in groundwater at D3 increased for SO_4, Cl, Al, B, Cu, F, Fe, Mn, Ni, and Zn during 2010-2020 monitoring period, with a corresponding increase in overall conductivity. Remaining parameters generally decreased or remained stable with a drop in overall pH (pH 5.1). As, Ba, Cr, Pb and Se dropped to concentrations below the WQGVs.

Figures B19 and B20 in Appendix B present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity for the period of 1988-2020 for D3. The results show a drop in SO_4 and overall conductivity between October 2011 and Feb 2012, corresponding with pipe leakage from Springvale Mine and subsequent localised groundwater recharge. Following July 2013, and the commencement of discharge from Springvale Mine at LDP009, there is a gradual increase in concentrations of SO_4, Ni, Al and conductivity along with a trend of rising groundwater levels at D3, contrary to general trends.

The water quality results for D3 from the 2010-2020 monitoring period indicate that the commencement of discharge from Springvale Mine at LDP009, has likely resulted in increased mixing between the SSCAD / KVAR / KVAD and groundwaters at D3. This has resulted in increasing concentrations of water quality parameters in D3 and decreasing pH.

Since February 2017, concentrations of key water quality parameters in groundwater from D3 have risen substantially at a significant rate, however, generally remain below the WQGVs. The cause of the recent increase in concentrations is currently unknown, however may be related to the continuing rise in groundwater levels and subsequent interactions with groundwaters of the KVAR / KVAD and / or SSCAD.

D4 – Site 35

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key water quality parameters in groundwater at D4 have generally remained stable or decreased during the 2010-2020 monitoring period, with the exception of Cl, Al and B, which have increased marginally with B increasing to concentrations above its WQGV.

Figures B21 and B22 in Appendix B present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity for the period of 1988-2020 for D4. The results show stable to decreasing trends for SO_4, Mn, and Ni during the 2010-2020 monitoring period.

The timing of erratic signals observed in Al at D4 correspond with the timing of decreasing concentrations of SO_4, Mn, and Ni, which in turn correspond with the timing of commencement of discharge of Springvale Mine Water at LDP009. These results indicate that the discharge from Springvale Mine is locally influencing groundwater quality at D4.

The groundwater quality trends in Bore D4 do not exhibit shifts in quality that can be directly attributed to the KVAR due to the trend of increasing concentrations in the preceding monitoring period.

5.2.4 Upgradient of SSCAD and KVAR / KVAD

1988-2003

D1 – Site 32

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key parameters in D1 were generally below the adopted WQGVs with the exceptions of Cd, Cr, Cu, Fe and Pb. pH was also below the lower limit of the WQGVs at pH 6.16. The greatest exceedance of WQGVs included Cr, Cu and Fe, which were up to 10 times their corresponding WQGVs. The results also show that unlike locations proximal / within and downgradient of the KVAR / KVAD, SO_4, Mn, B, and Ni are not significant components of the composition of groundwater.

Figures B23 and B24 in Appendix B present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity for the period of 1988-2020 for D1. The results show that concentrations of key water quality parameters are generally stable to decreasing during the 1988-2003 monitoring period. Water quality in D1 is not affected by the KVAR.

2003-2010

D1 – Site 32

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key water quality parameters in groundwater at D1 generally remained stable or decreased marginally during the 2003-2010 monitoring period. Records for concentrations of Al become available during this monitoring period and are recorded at levels exceeding the WQGVs.

Figures B23 and B24 in Appendix B present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity for the period of 1988-2020 for D1, with the exception of SO_4 which shows a slight increasing trend towards the latter half of the monitoring period. The results show that concentrations of key water quality parameters are generally stable to decreasing during the 2003-2010 monitoring period. Water quality in D1 is not affected by the KVAR.

2010-2020

D1 – Site 32

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key water quality parameters in groundwater at D1 generally remained relatively stable or decreased during the 2010-2020 monitoring period, with the exception of SO_4, Cl, B, Mn and Zn which increased marginally alongside overall conductivity. Concentrations of Cd and Fe subsequently dropped below the adopted WQGVs as a result of the declining trend.

Figures B23 and B24 in Appendix B present time-series charts of the concentrations of indicator parameters Al, Mn, B, Ni, SO_4 and conductivity for the period of 1988-2020 for D1. In general, concentrations of indicator parameters show decreasing trends but higher volatility in results during the 2010-2020 monitoring period, likely as a result of declining groundwater levels and increasing importance of rainfall recharge on groundwater quality at D1. Contrary to general trends of declining concentrations of water quality indicator parameters, SO_4 and B show slightly increasing trends. The noted increase in these parameters may be as a result of oxidation of local pyrite bearing strata and subsequent development of sulfuric, acidic leachate, however the exact cause of the trend is not yet known. Water quality in D1 is not affected by the KVAR.

6 Summary

This 2019-2020 water quality monitoring report is required for the NSW Department of Planning and Environment's Development Consent Conditions for the Wallerawang Ash Repository and because the Wallerawang Power Station's Environment Protection Licence (EPL 766) as of 1 January 2019 has been retained.

6.1 KVAR Impacts on Surface Water Quality

In general, the surface water quality monitoring over the last year (2019-2020) indicates quasi-stable or slight worsening trends in all the key water quality parameters observed at the various surface water monitoring locations.

Surface Water Receiving Site

Review of the historical (1991-2019) data for surface water monitoring associated with the KVAR has identified that the KVAR was not having a measurable impact on surface water quality in Sawyers Swamp Creek (SSC) at the designated surface water receiving site (WX7). Results previously indicated that the water quality in SSC at WX7 (site 41) was dominated by discharge from Springvale Mine at LDP009, which discharged approximately 18ML/d to SSC.

Upon (or shortly before) the cessation of the Springvale Mine discharge the concentrations of all key parameters started an inclining trend, with the February 2020 sample indicating exceedances for all key parameters.

The recent historical available data indicates that the 95th percentile concentrations of arsenic, molybdenum and zinc exceed the adopted water quality guidelines. This is similar to exceedances observed within the Springvale Discharge water, as this has been the overwhelming contributor to flow in the Creek over the largest portion of this monitoring period.

Trends and qualities within the remaining water sources will need to be monitored to ensure exceedances not directly correlated to external sources, do not become more frequent.

Additional Sites

Review of additional surface water monitoring sites associated with the KVAR has identified that the KVAR is having a quantifiable impact to surface water quality at the Lidsdale Cut, along with the surface water seepage sites (Sites 80, 81, 86 and 87). It is noted however that these sites do not represent identified receiving water sites and therefore the surface water quality results are not directly relevant to development consent conditions or water quality in SSC.

Review of the long-term water quality data (Table 5-1) for Dump Creek (WX11/monitoring point 39) indicates that concentrations of B, Cr, Fe, and Zn exceeded WQGVs during the pre-KVAR period (1991-2003), whilst pH was relatively neutral (pH 8.0). Between 2003 and 2010 there is a noted trend of increasing concentrations in water quality parameters in Dump Creek, including SO_4, Al, B, Cd, Cr, Cu, Fe, Mn, Ni, Pb, Se and Zn, resulting in further exceedances of water quality parameters. The increasing trend in water quality parameters occurs in conjunction with rising groundwater levels in Bore D3 (monitoring point 34), located upgradient of the KVAR / KVAD.

Between 2012 and 2020 concentrations of water quality parameters continue to rise in apparent correlation with groundwater levels in bore D3. Accordingly, the 95th percentile concentrations of water quality parameters at Dump Creek currently exceed water quality parameters for TDS, SO_4, B, Cu, Fe, Mn, Ni, Pb and Zn, whilst pH is now highly acidic (pH 3.6) (Table 4-2).

The long-term water quality and recent monitoring results (2019-2020) for Dump Creek indicate a possible impact from the KVAR on surface water quality. However, due to the complexity of current and historic land use activities, including local chitter deposits, pumping and discharge regimes for the KVAD and SSCAD, it is not considered suitable to directly attribute any impacts observed to a single source such as the KVAR. The observed results do however suggest that further hydrogeological investigation is required to provide an improved resolution on the factors contributing to water quality in Dump Creek, including isolating potential contributions from SSC, SSCAD, and the KVAD to groundwater and surface water quality.

Interpretation of long-term water quality data (Table 5-1) for Lidsdale Cut Pond (WX5/monitoring point 40) is complicated by the re-location of sampling points used to sample Lidsdale Cut Pond. It is noted however that an overall similar trend of rising concentrations is observed in Lidsdale Cut Pond (WX5), with an overall increase in the number of parameters exceeding WQGVs along with an increased relative magnitude of exceedances. Similar to Dump Creek, the complexity of current and historic land use activities, including local chitter deposits, the KVAD and SSCAD suggest that it is not suitable (based on the data set available) to directly attribute any impacts observed solely to a single source such as the KVAR. It should be noted however that the Lidsdale Cut Pond forms part of the operational water reticulation system and is not classified as a “receiving environment” location.

SSC: The KVAR did not appear to be affecting water quality for sites 225 and 93 (which were dominated by discharge from Springvale Mine). However, site 83, like site 41, also shows increasing concentrations in key parameters post cessation of Springvale Discharge. Site 92 which is located in the middle-upper portions of the catchment upgradient of the SSCAD and the KVAR has been dry since January 2017 but indicated concentration levels lower than the WQGV’s before this.

SSCAD: The KVAR does also not appear to be affecting water quality for sites 38 and 79 (which are dominated by water quality from SSCAD). Water quality data collected at Site 38 (representing the SSCAD Water Input from the Return Canal) has shown a significant improvement since December 2017, with the concentrations of all tracked parameters (Figures A11 and A12) steadily decreasing over this time. Operational discharge into this canal has ceased and natural runoff has now become the dominant contributor to the flows observed.

Both the recorded SO_4 concentrations and the conductivity levels have been stabilising and potentially decreasing slightly at Site 86 (KVAR / KVAD North Wall runoff collection) since May 2018 (Figure A19). Further investigation into this improvement would be required to determine the cause.

6.2 KVAR Impacts on Groundwater Quality

In general, the groundwater quality trends have been less consistent compared to the surface water quality trends over the last year. A mix of steady, fluctuating and upward/downward trends have been observed on the site. The demarcated “receiving environment” location (D5 / 36) has shown a fluctuating but stable trend with regards to the key parameters which are being tracked before drying up in June 2019.

Groundwater Receiving Site

A review of groundwater quality in Bore D5 (Site 36) in correlation with groundwater levels in Bore D3 (Site 34) has found that:

- Between 1988 and 2003 (pre-KVAR emplacement) 95th percentile concentrations of water quality indicator parameters Mn, B, and Al exceeded water quality guideline values (WQGVs), whilst SO_4 and Ni were notably elevated above background, and pH was moderately acidic at pH 4.7. Time series data on groundwater elevations in D3 indicates a rise and fall in groundwater elevations during this period (1988-1994), which show little effect on the concentrations of water quality parameters.
- Concentrations of water quality parameters in Bore D5 generally remained stable until 2008, following which point there is a noted rise in concentrations of water quality indicator parameters SO_4, Mn, B, Al, Ni, and conductivity (to concentrations greater than historic results), along with a drop in pH to more acidic conditions (pH 4.09). The observed rise in concentrations in Bore D5 occurs in conjunction with a groundwater level rise in Bore D3 to elevations exceeding 920 mAHD. As this pattern is not observed in historic data for Bore D5, the results indicate a possible influence from the KVAR, associated with groundwater migration into the KVAR upgradient of Bore D5.
- Water quality in Bore D5 generally improved following February 2010, indicating possible unblocking of the Stage 1 KVAD toe drains resulted in an improvement of groundwater quality. Subsequently, the

concentrations of water quality parameters in Bore D5 generally decreased towards pre-KVAR concentrations until July 2013, following which point there are significant fluctuations in water quality, with 95th percentile concentrations of water quality parameters greater than historical background (1988-2003) values. The observed fluctuations in water quality parameters are observed in conjunction with fluctuations and an overall rise in groundwater levels in bore D3, which is likely to be attributed to the discharge from Springvale Mine upgradient of the KVAR.

- The results at Bore D5 are also interpreted to be influenced by seepage from SSC, however this is likely to have a dilutive rather than additive effect on the concentrations of water quality parameters as SSC is relatively reduced in concentrations of indicator parameters. The relative effect of SSC dilution on groundwater quality downgradient of the KVAR / KVAD can be observed through comparison of Bore D5 with Bore D6, which is located downgradient of the Stage 1 KVAR area and away from SSC, and shows a similar relationship between groundwater levels in Bore D3 and water quality trends post 2007.
- For the current monitoring period (2019-2020) the 95th percentile values for groundwater at D5 exceeds WQGVs for Al, Cd, Cu, Fe, Mn, and Pb.

The concentrations of indicator parameters in Bore D5 are notably elevated above pre-KVAR values following the rise in groundwater levels in 2008 to elevations >920 mAHD. Decreased pH, and increased Ni and SO_4 are potentially indicative of a fresh dry ash source. Comparison of water quality data in Bore D5 with that of Bore D6 suggests that discharge through SSC as a result of Springvale Mine Discharge from LDP009 was having an effect (likely dilutive) on water quality in D5 through local seepage to groundwater adjacent to SSC.

Additional Sites: D1, D2, D3, D4, D6, AP09, AP17

Review of additional groundwater monitoring sites associated with the KVAR has identified elevated concentrations of water quality parameters in Bore D6, along with KVAD monitoring bores AP09, AP17 and KVAD Seepage.

The long-term water quality monitoring results for Bore D6 show a recent rising trend in concentrations of key water quality parameters in the period following 2008 and in conjunction with a groundwater level rise in Bore D3 (located upgradient of the KVAD / KVAR). The observed trend in rising concentrations in Bore D6 has continued since 2008 in conjunction with a trend of rising groundwater levels in Bore D3, which is sustained artificially by discharge from Springvale Mine at LDP009.

Similar to bore D5, historic pre-KVAR water quality (1988-2003) in D6 was elevated with respect to a number of water quality parameters including indicator parameters Ni and Mn and displayed a relatively reduced pH (pH 5.6). An increasing trend for several indicator parameters is subsequently observed for D6 between 2003 and 2010, concurrent with the start of rising groundwater levels in Bore D3. Between 2010 and 2020 with the continued rising trend groundwater at Bore D3, there is a correlated rising trend in water quality parameter concentrations at Bore D6, including concentrations of SO_4, Al, B, Mn and Ni between, along with a further reduction in pH. Subsequently the 95th percentile concentrations of water quality parameters within bore D6 currently exceed WQGVs for several parameters, including indicator parameters TDS, SO_4, Al, Mn, Ni, and conductivity. Zinc is above WQGVs and pH is below the lower WQGVs limits (pH 4.5).

Groundwater quality within the KVAR / KVAD shows variable response due to the complex system of toe drains, canals and pumping regimes. Overall groundwater quality at AP09 and AP17 representing the northern wall of the KVAD has deteriorated since 2010, along with groundwater quality at D6 located downgradient of the KVAR / KVAD. This is attributed to recirculation and concentration of water through the Return Water Canal in July 2012 for D6 and rise in water levels, flooding the KVAR as a result of Springvale Mine Discharge for AP09 and AP17.

Groundwater monitoring site D4 appears to have historic water quality impacts, potentially associated with the KVAR, however, has recently been dominated by water quality from SSC and Springvale Mine Discharge.

Groundwater monitoring Site D2 is not quantifiably impacted by the KVAR and concentrations of key water quality parameters are generally below the WQGVs, with the exception of pH which is below the lower limits.

Groundwater quality at site D1 reflects conditions in the middle-upper portions of the catchment, upgradient of the SSCAD and KVAR. pH is below the lower limit and the 95th percentile concentrations of Al, Cr, Cu and Pb generally exceeded the WQGVs over the last decade.

7 Limitations

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The report should not be applied for any purpose other than that originally specified at the time the report was issued.

8 References

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Appendix A

Surface Water Quality Trends 1991-2020

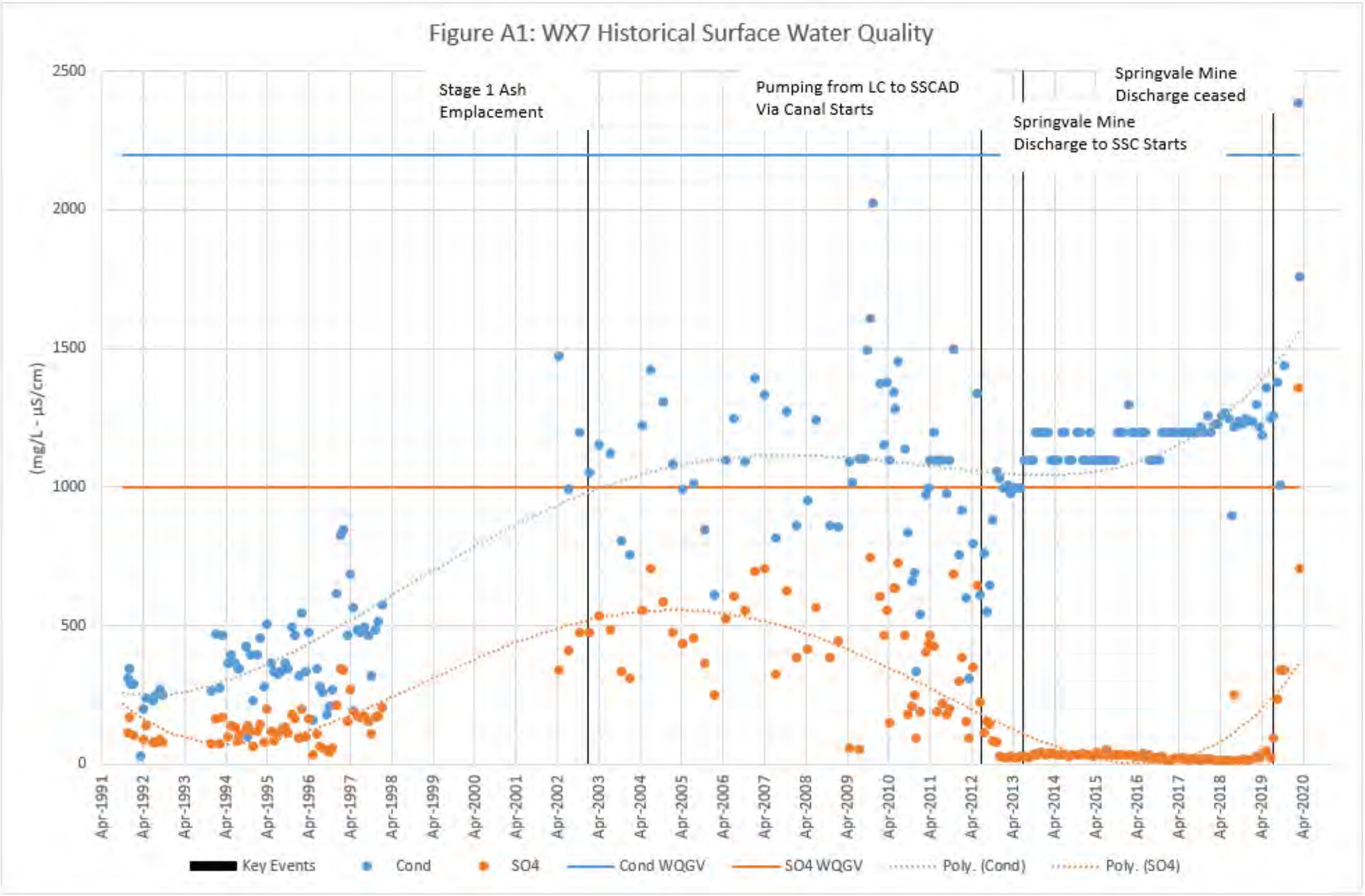


Figure A1: WX7 Historical Surface Water Quality

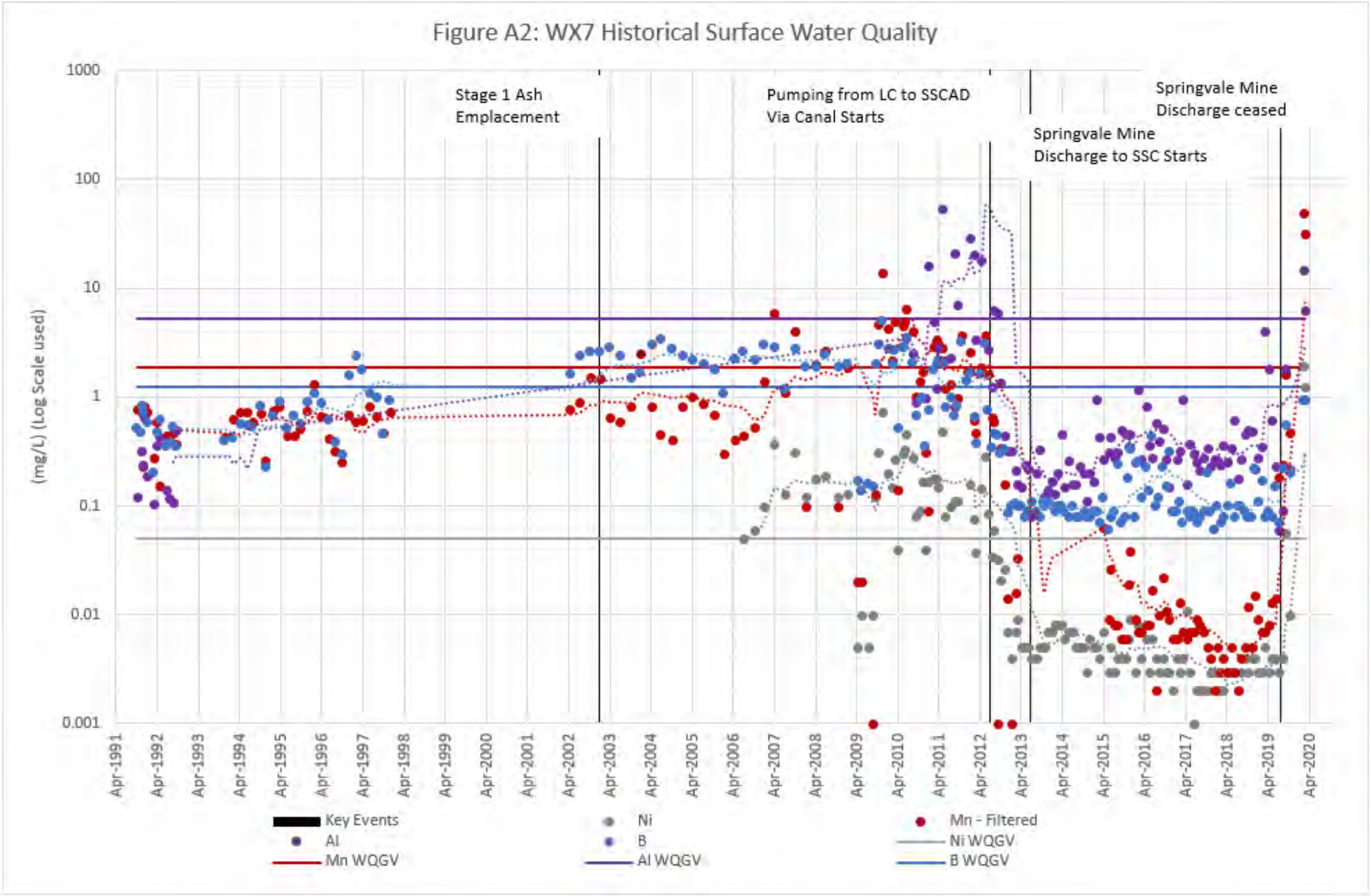


Figure A2: WX7 Historical Surface Water Quality

Figure A3: WX1 Historical Surface Water Quality

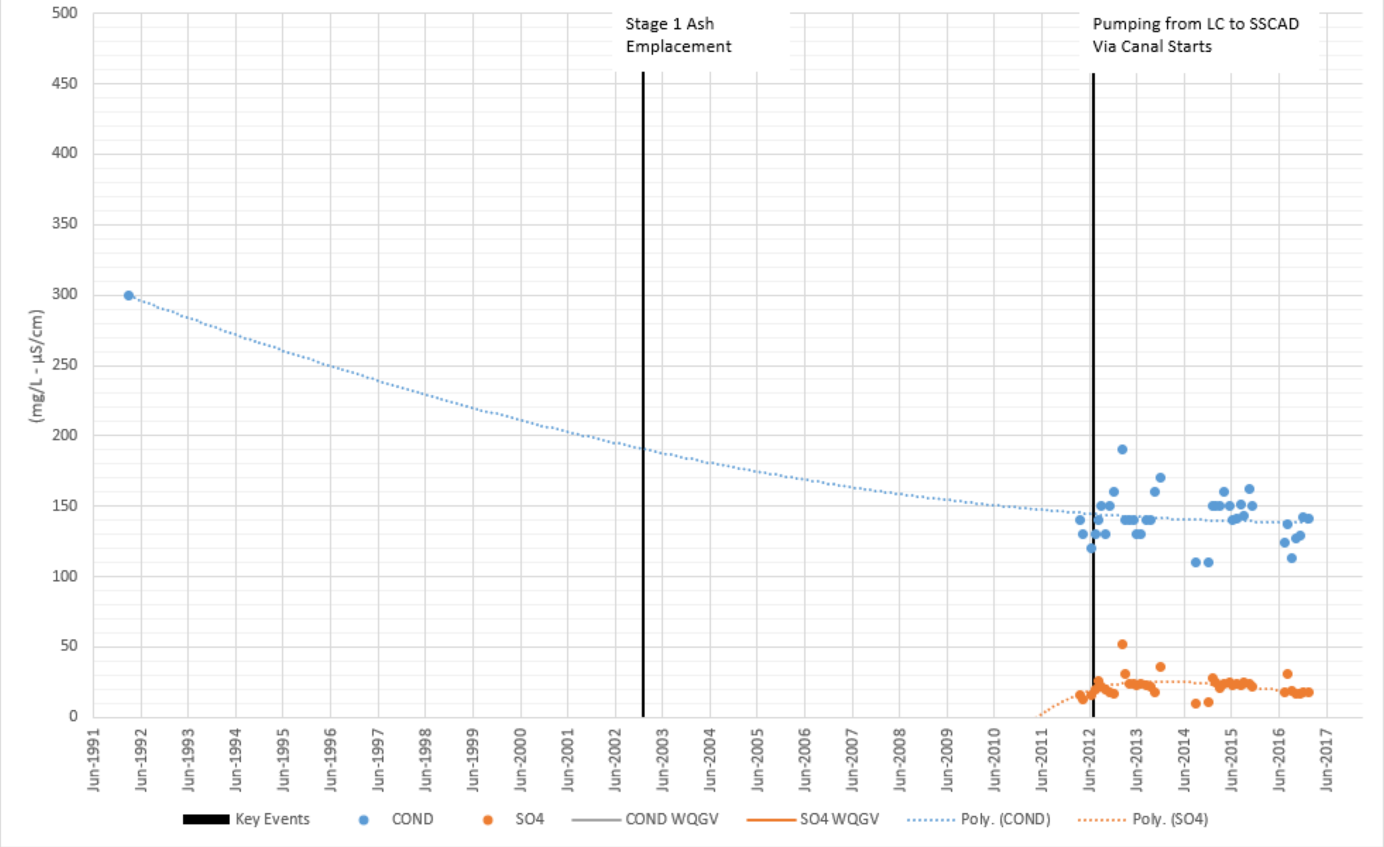
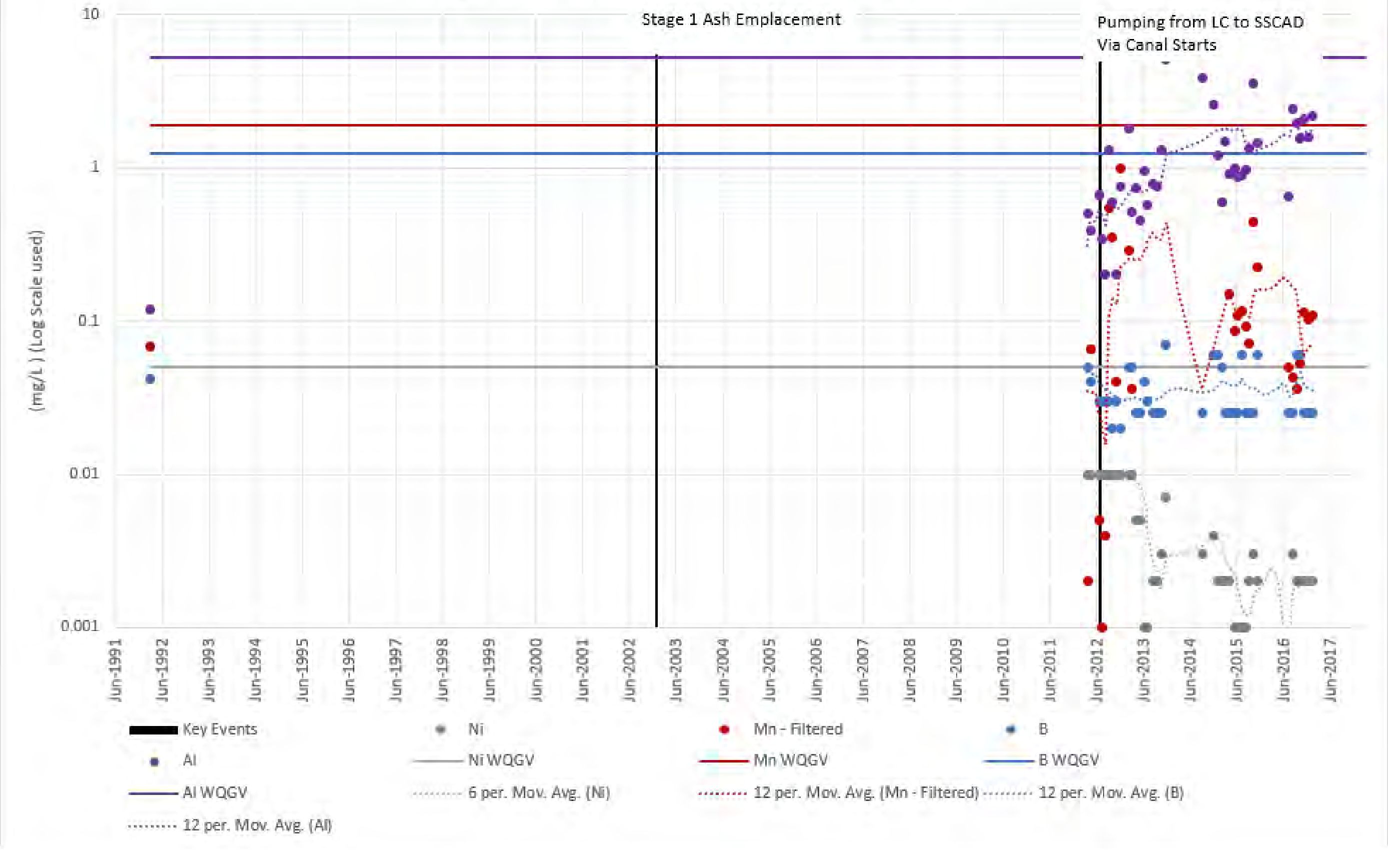


Figure A4: WX1 Historical Surface Water Quality



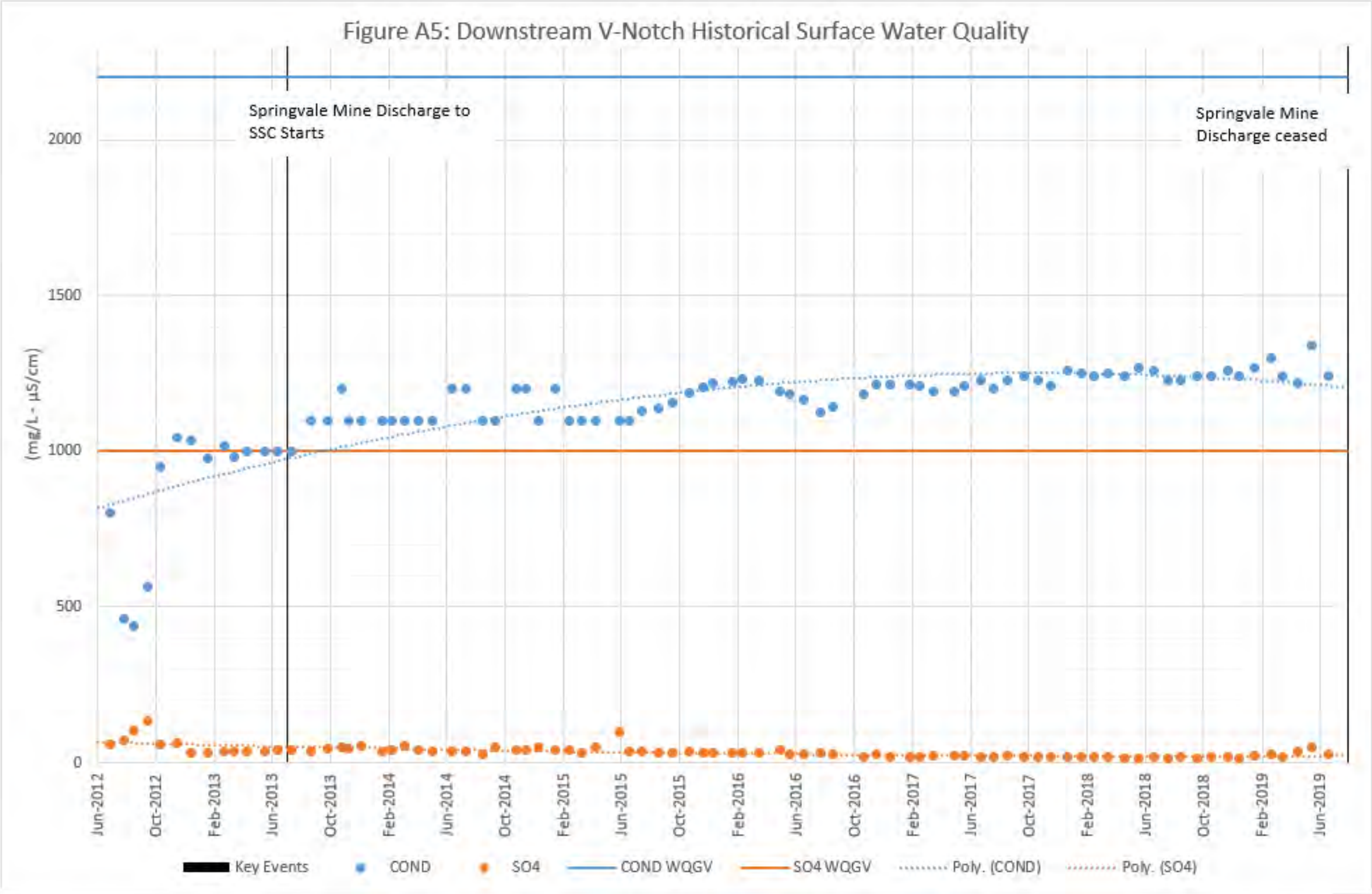


Figure A5: Downstream V-Notch Historical Surface Water Quality

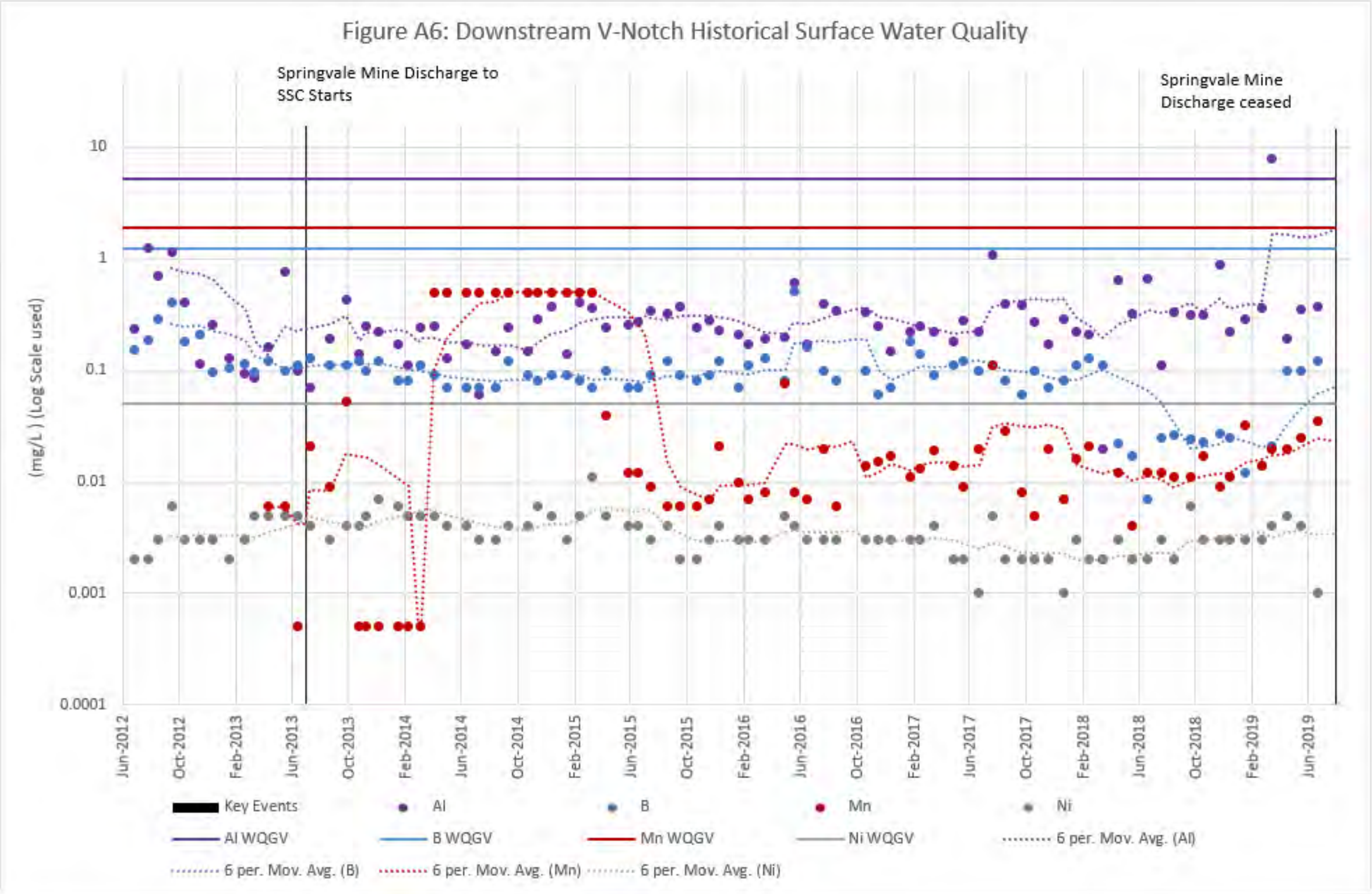


Figure A6: Downstream V-Notch Historical Surface Water Quality

Figure A7: Downstream KVAR Historical Surface Water Quality

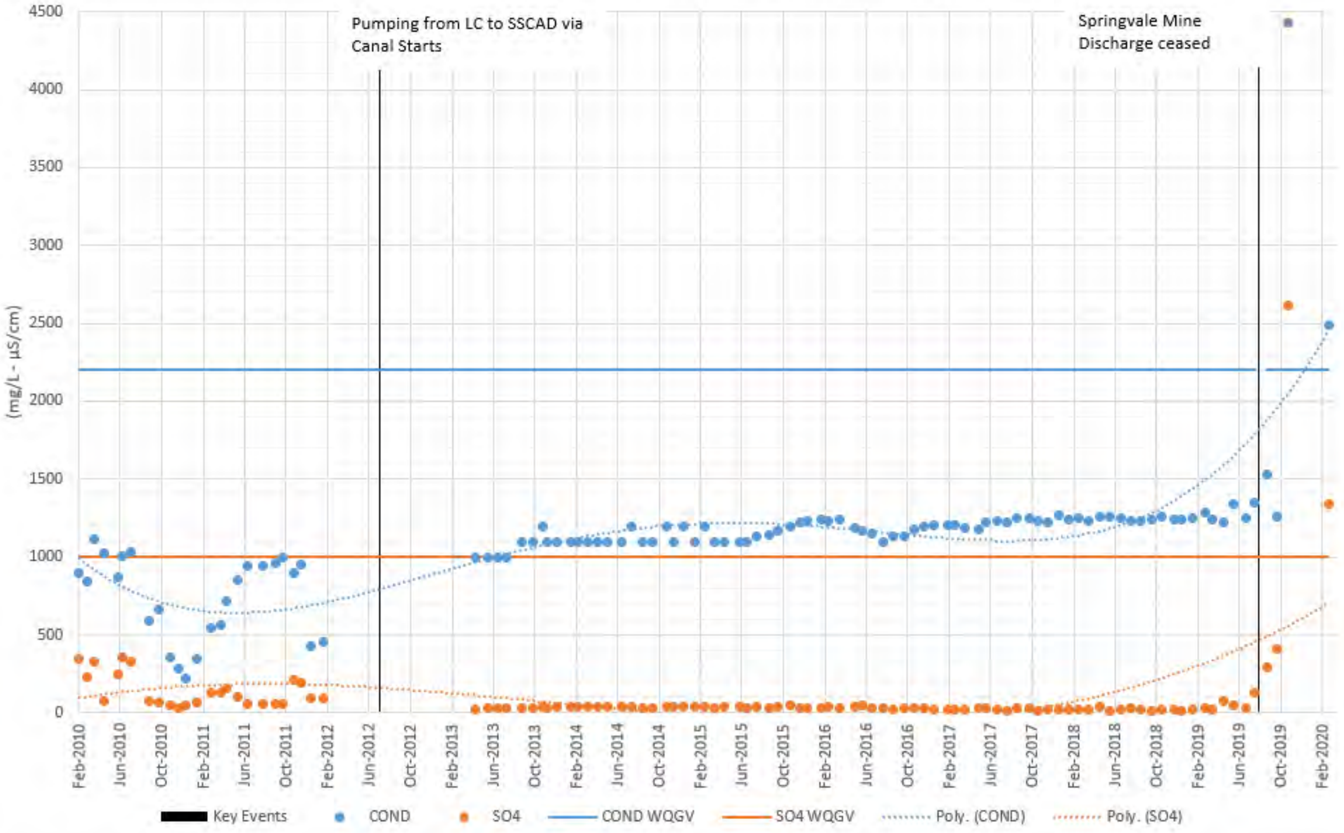


Figure A8: Downstream KVAR Historical Surface Water Quality

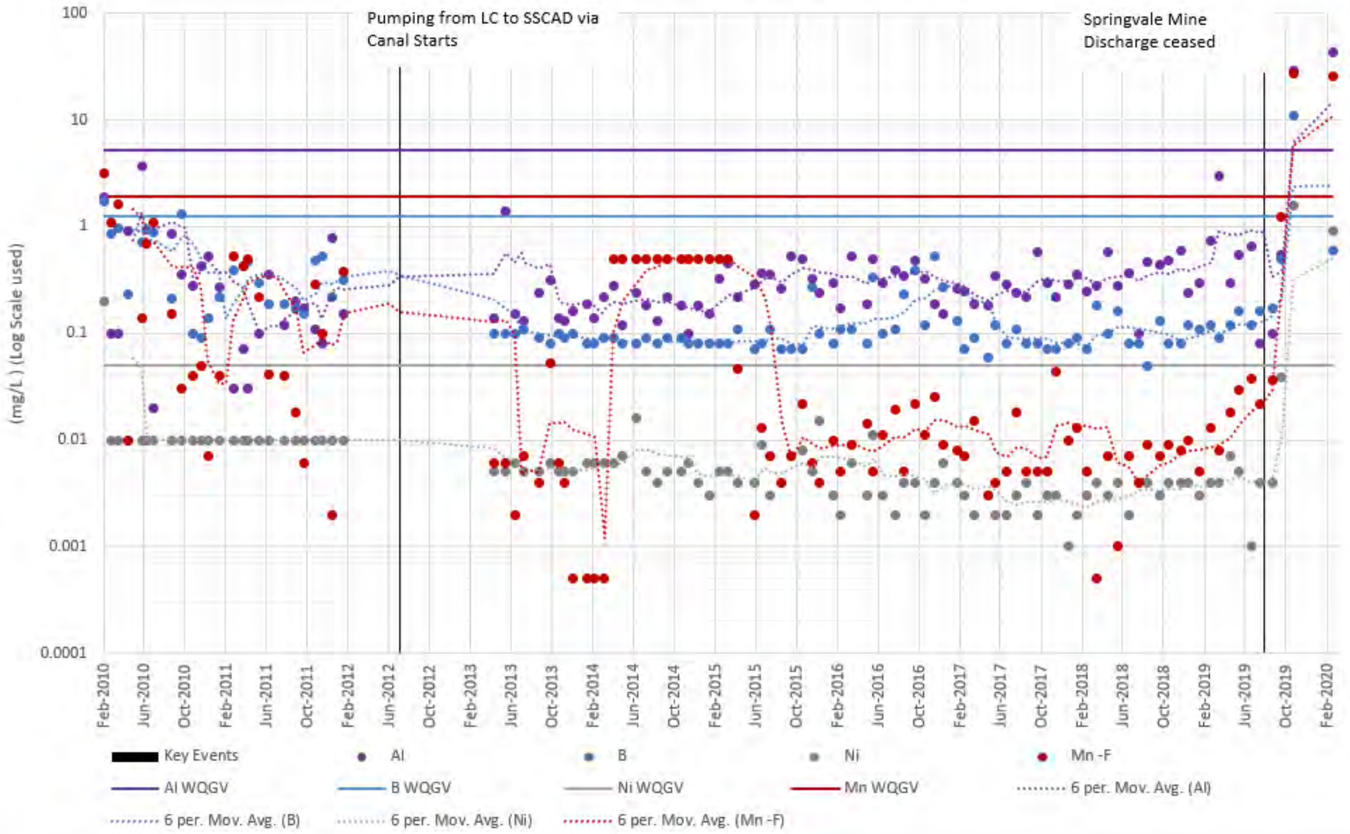


Figure A9: Spillway 225 Historical Surface Water Quality

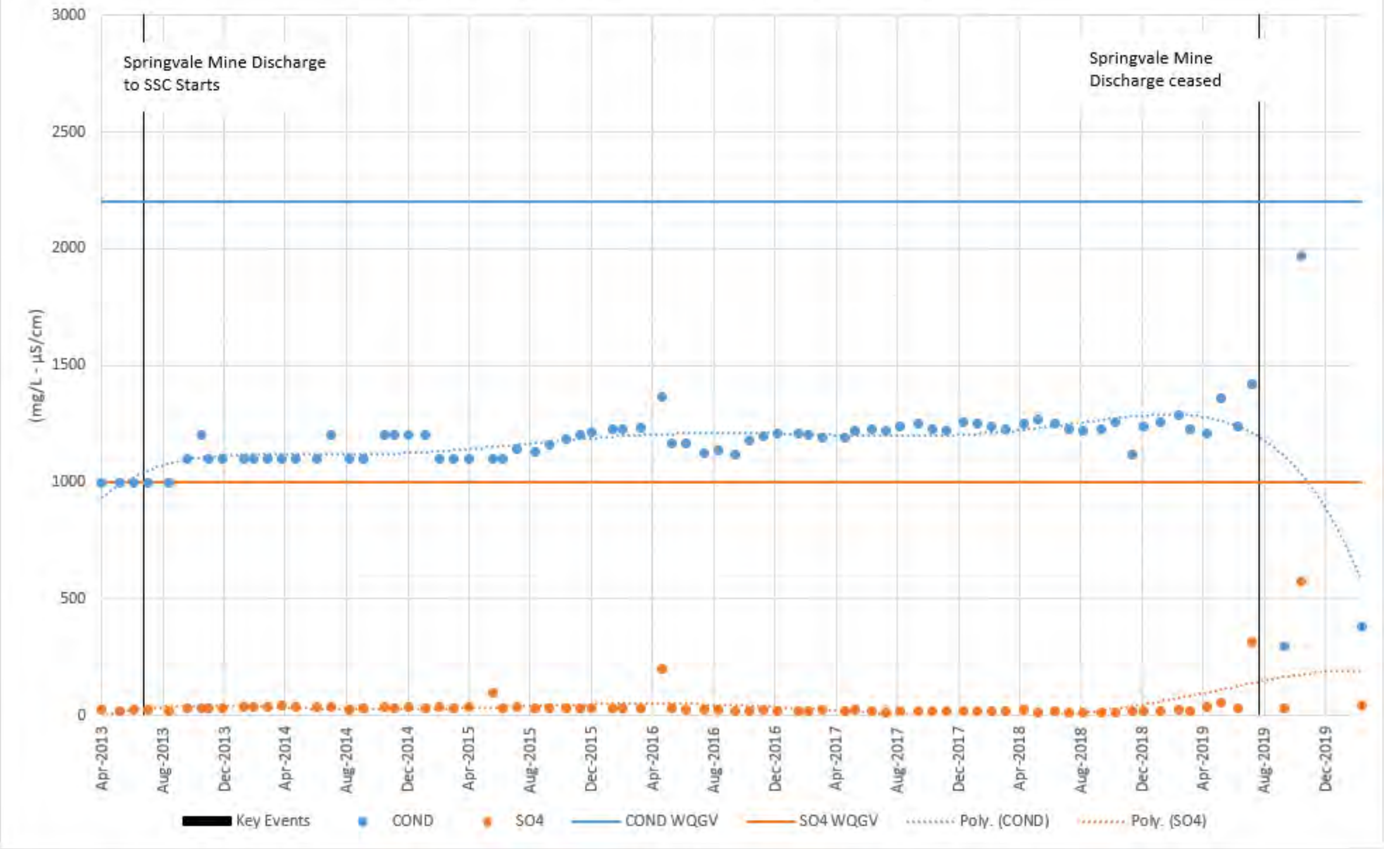


Figure A10: Spillway 225 Historical Surface Water Quality

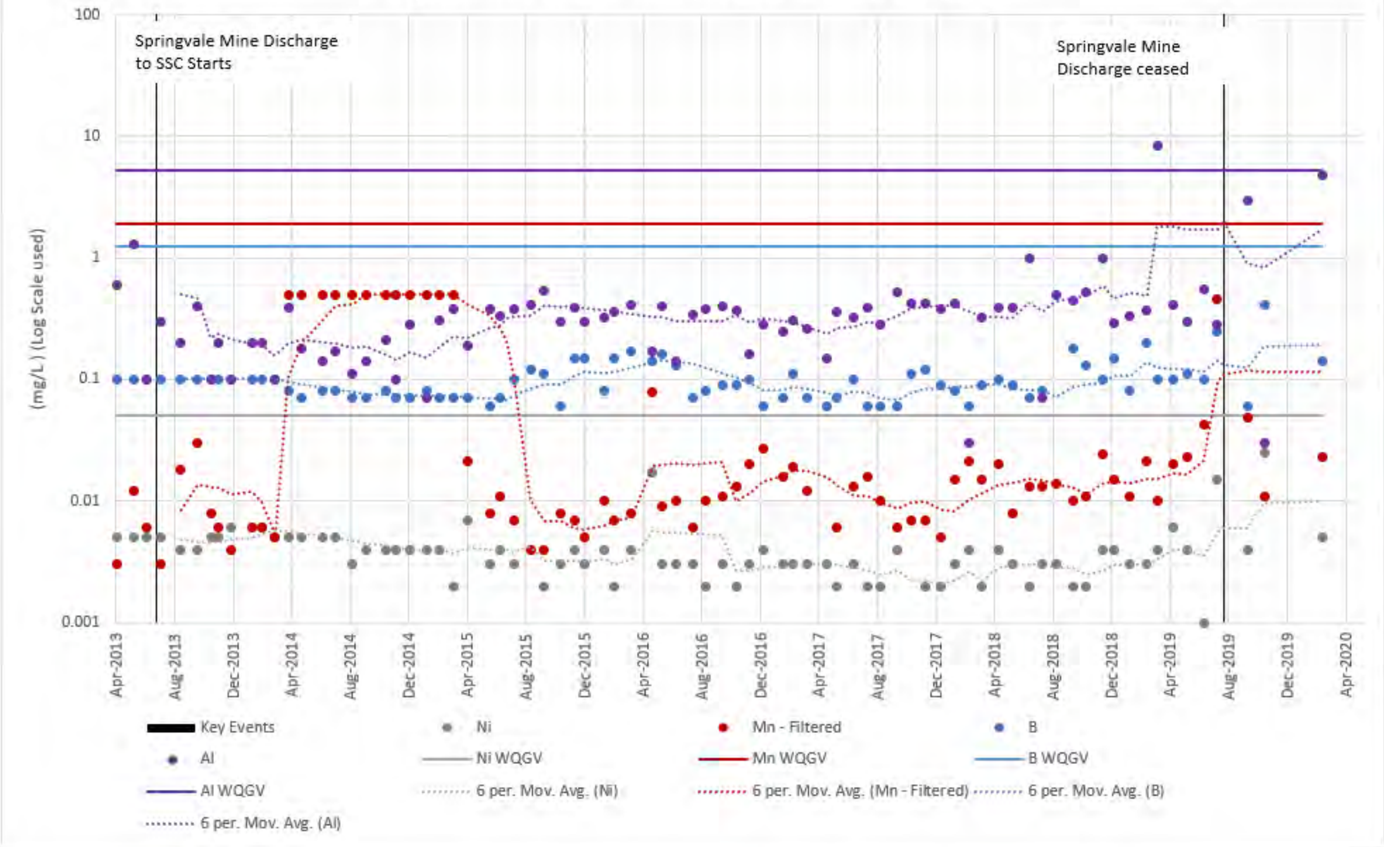


Figure A11: SSCAD 38 Historical Surface Water Quality

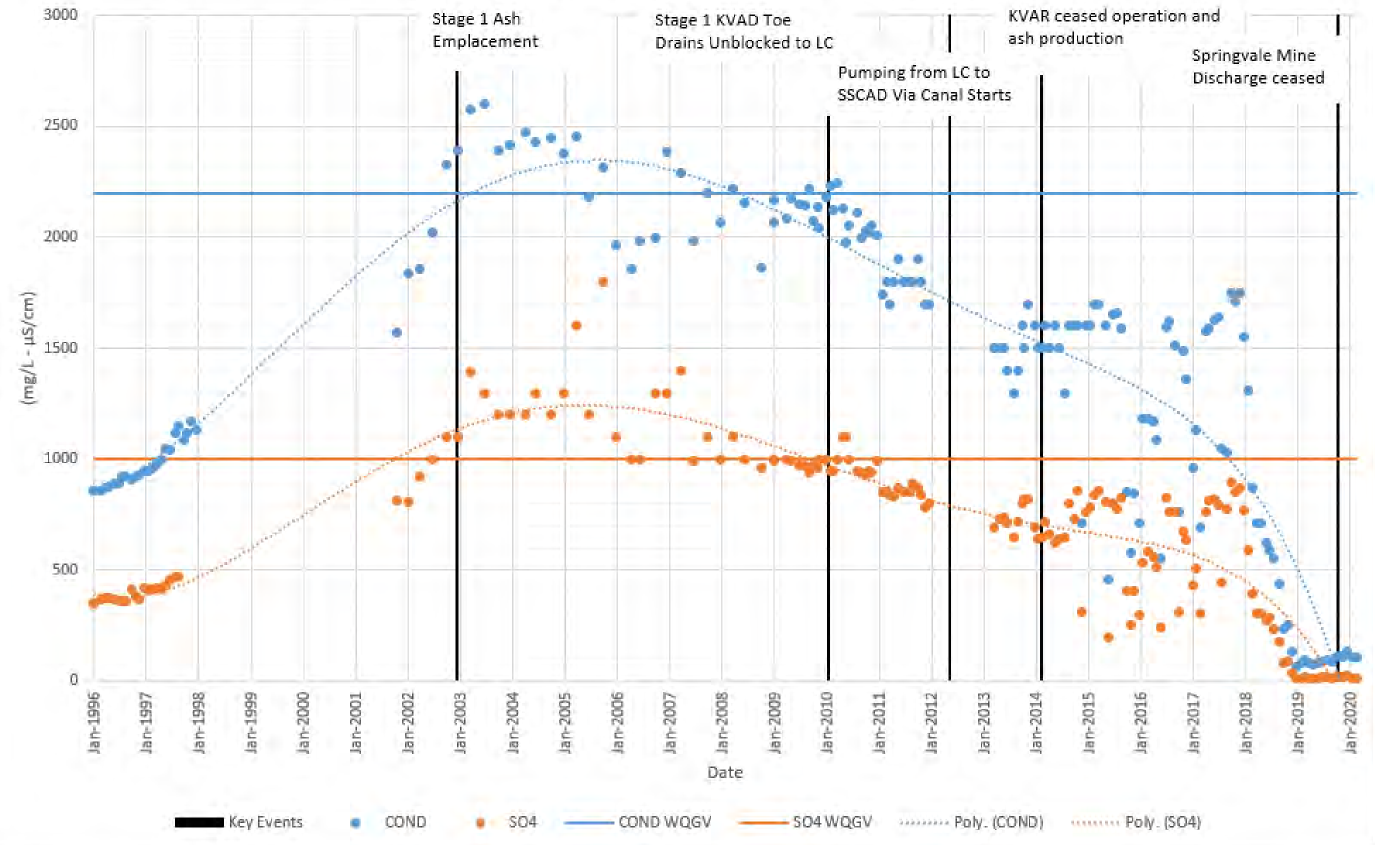


Figure A12: SSCAD 38 Historical Surface Water Quality

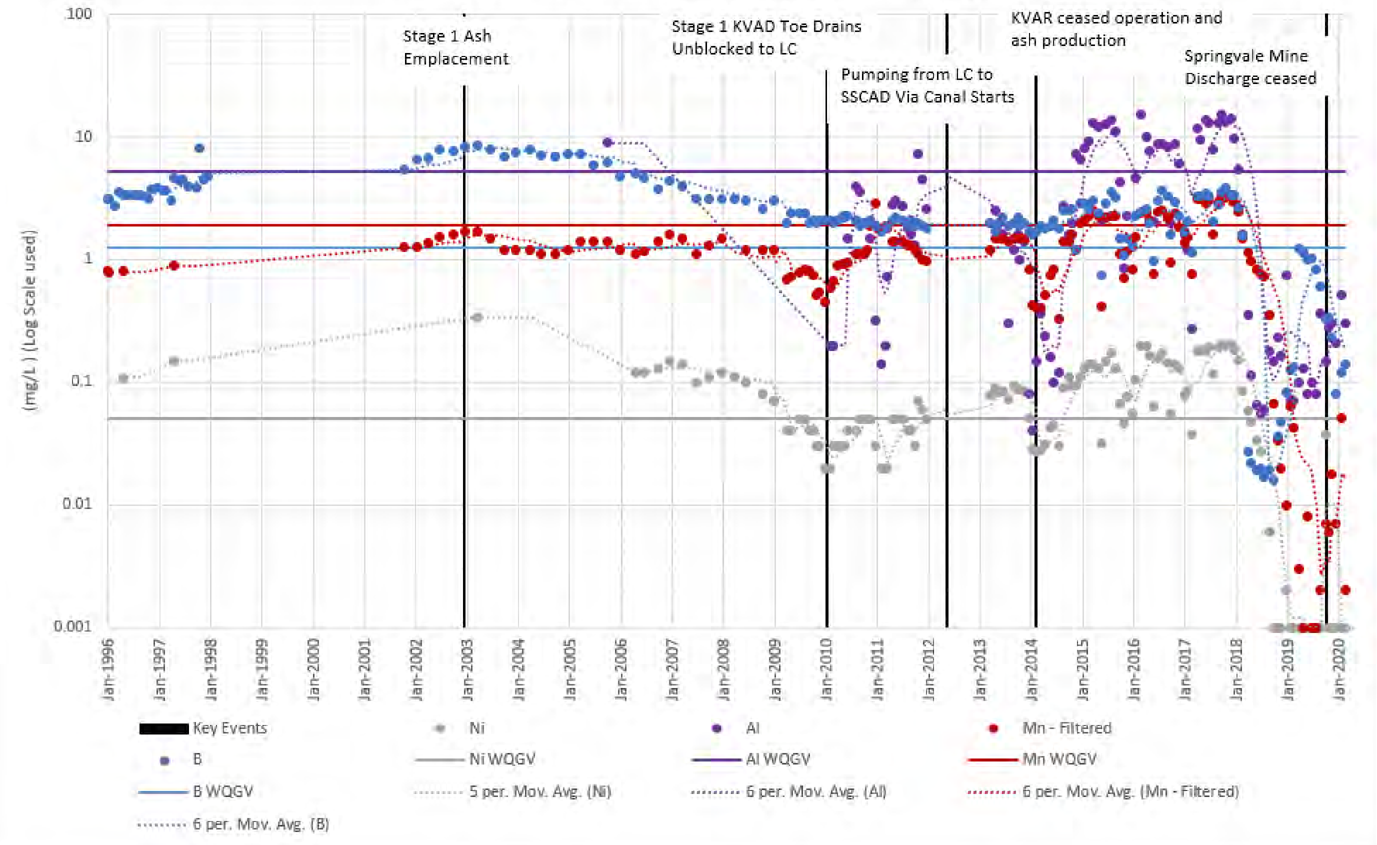


Figure A13: SSCAD V-Notch Historical Surface Water Quality

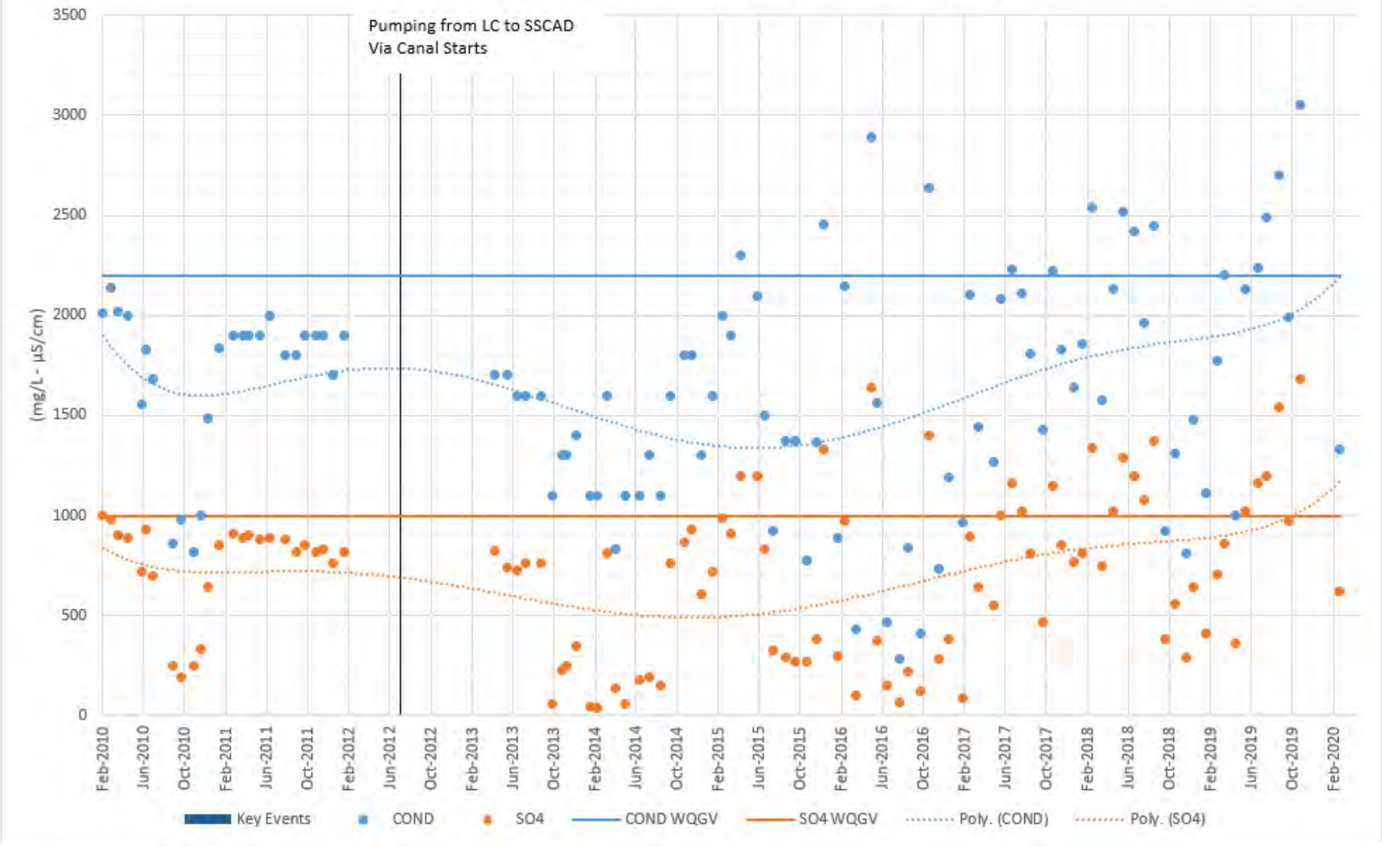


Figure A14: SSCAD V-Notch Historical Surface Water Quality

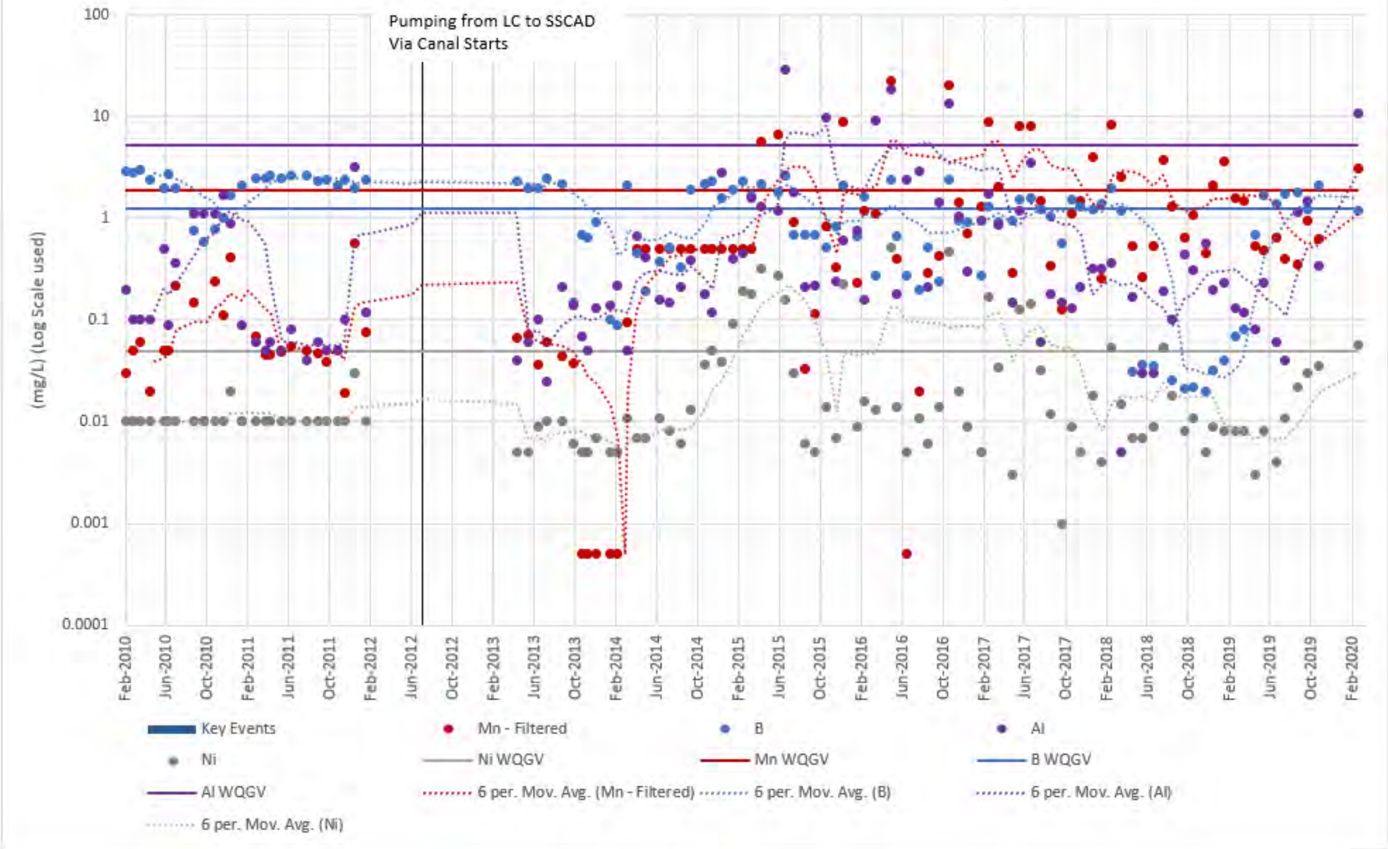


Figure A15: West KVAD Seepage Left Historical Surface Water Quality

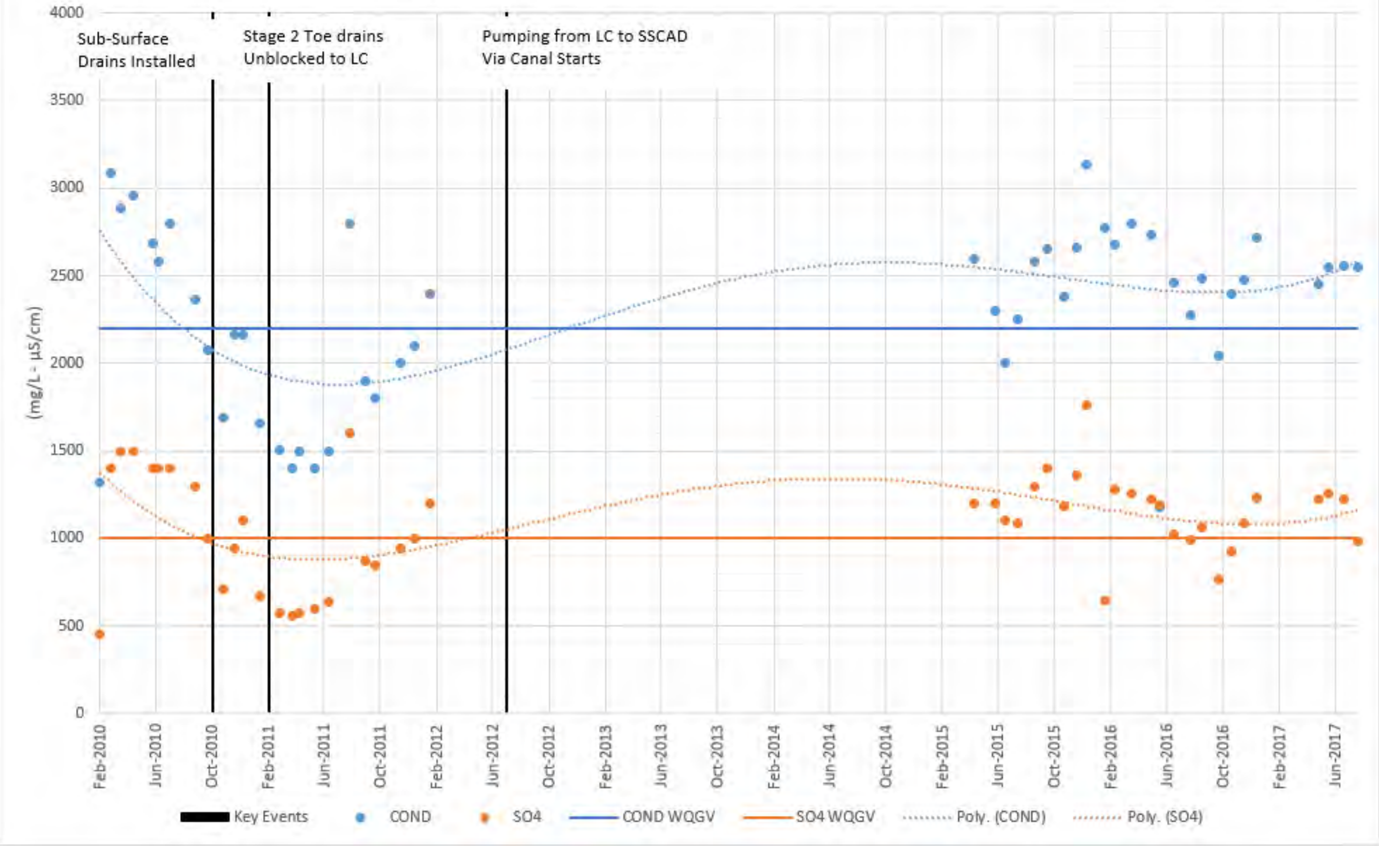
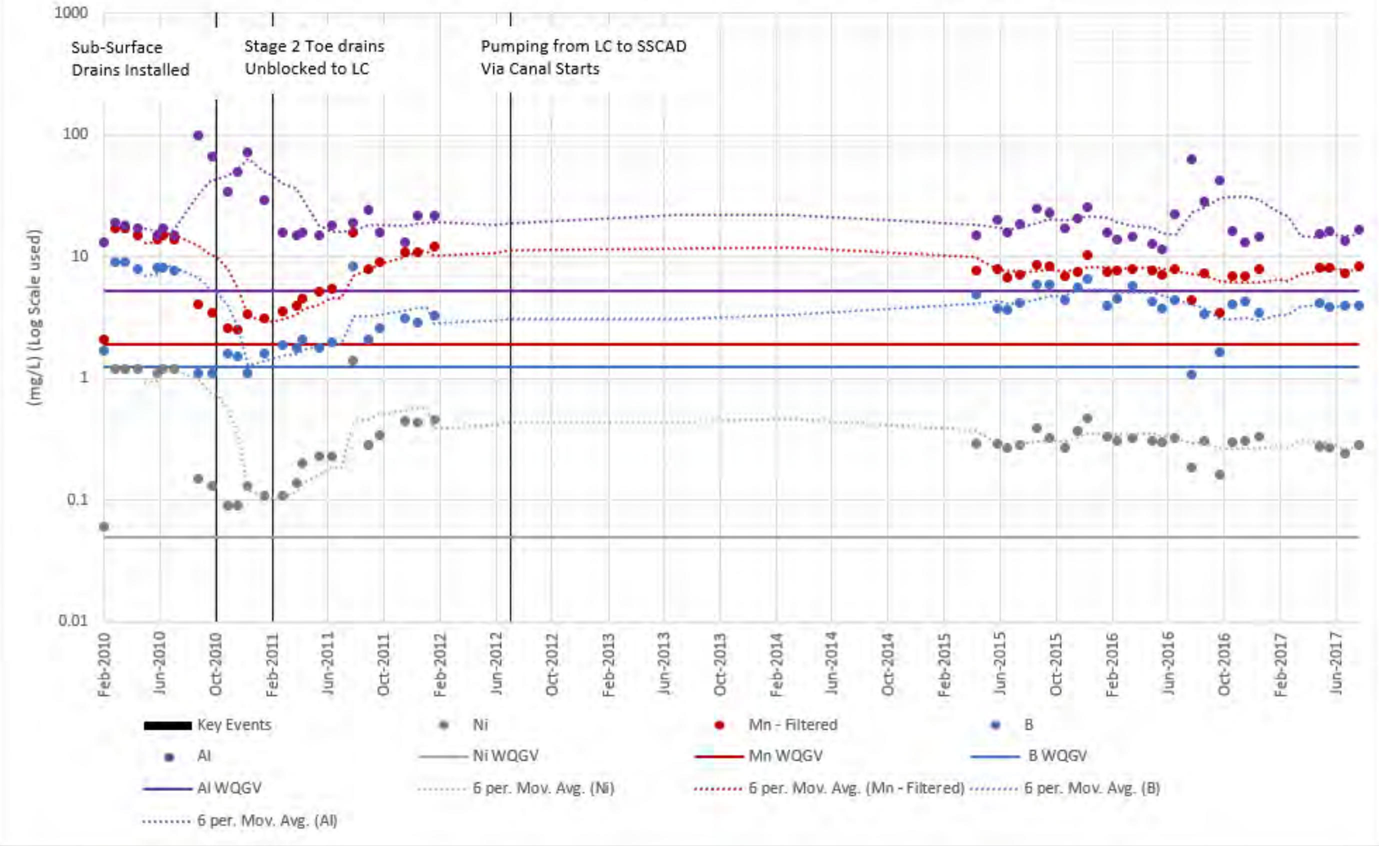


Figure A16: West KVAD Seepage Left Historical Surface Water Quality



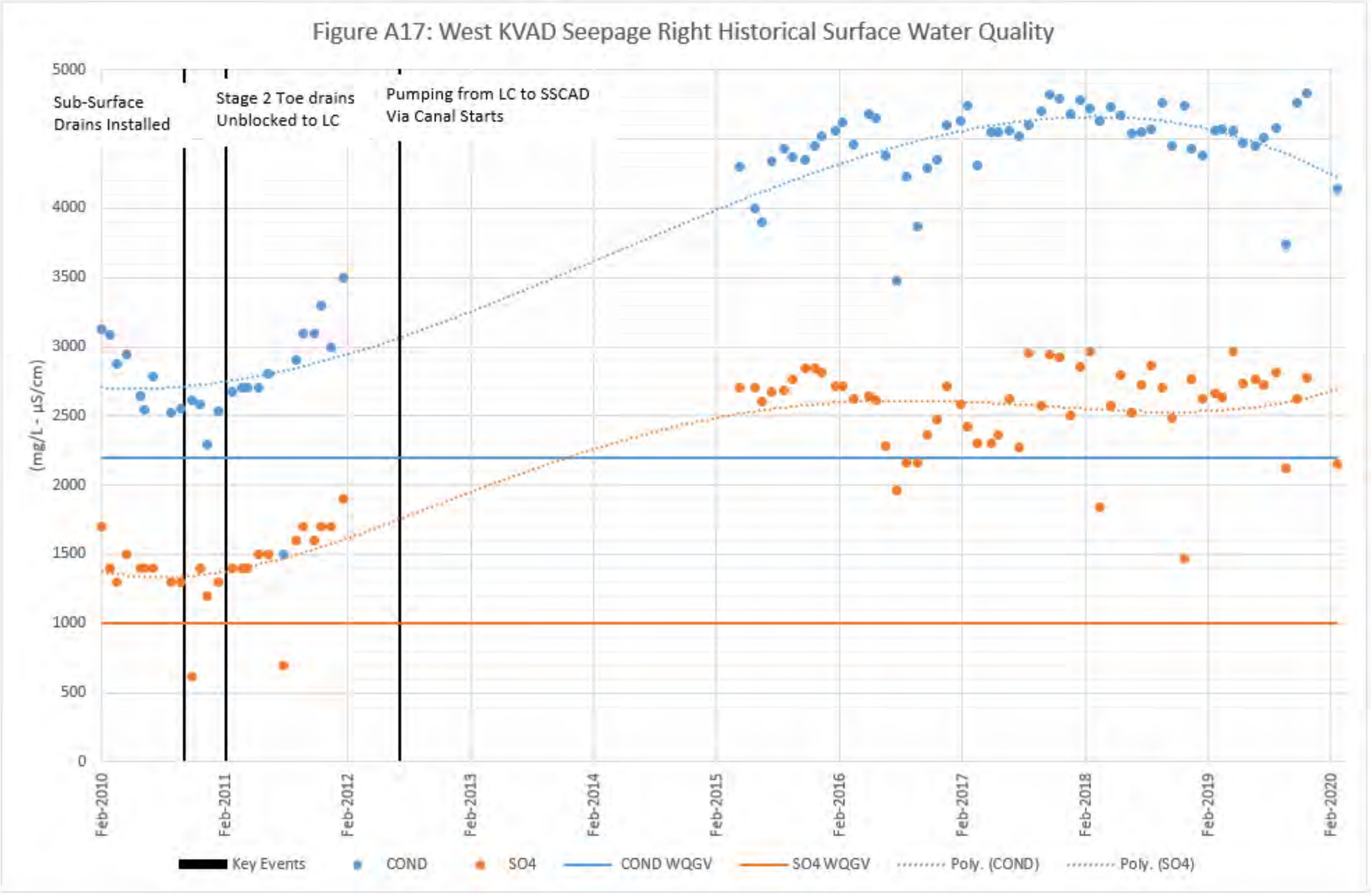


Figure A17: West KVAD Seepage Right Historical Surface Water Quality

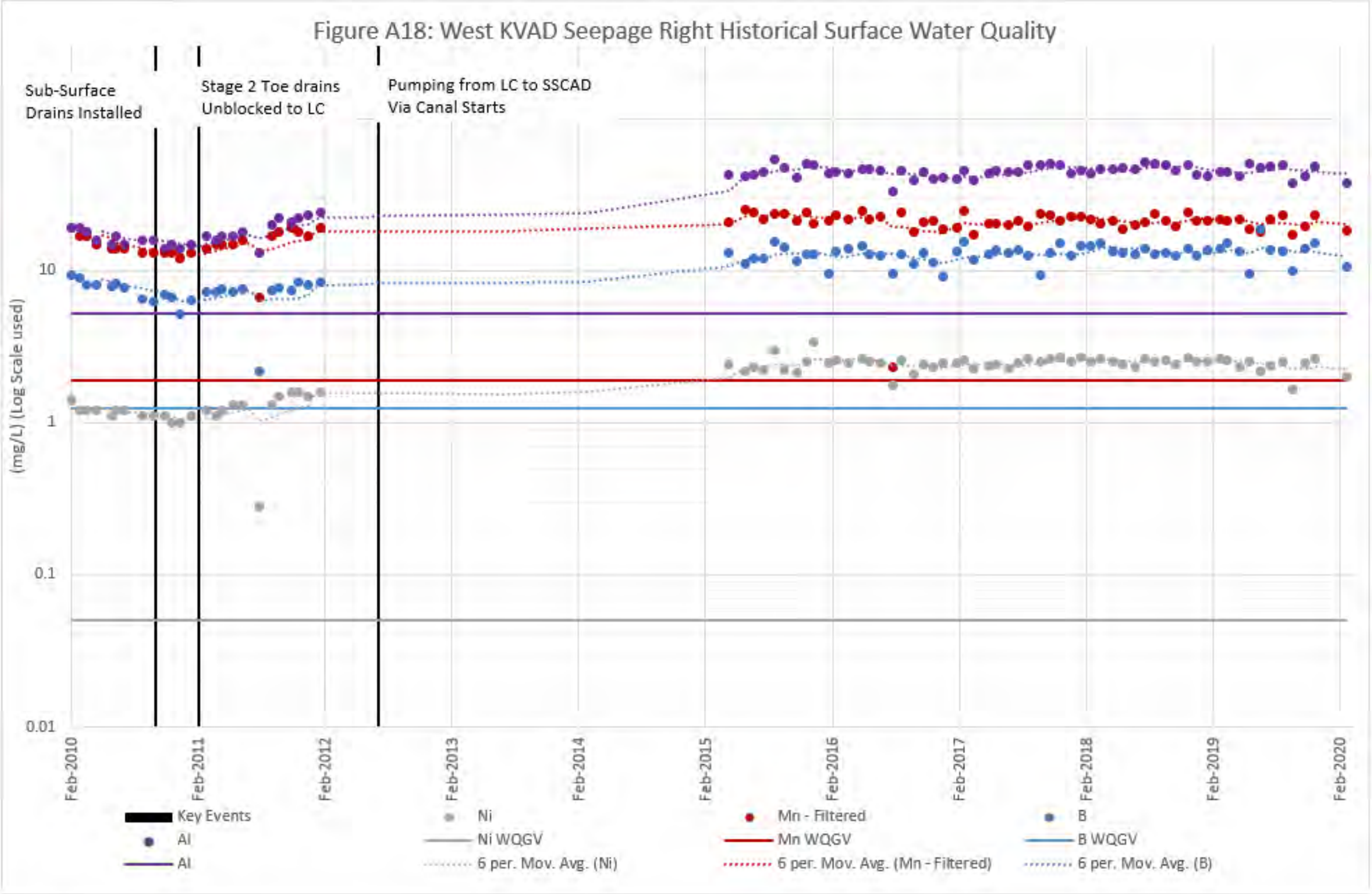


Figure A18: West KVAD Seepage Right Historical Surface Water Quality

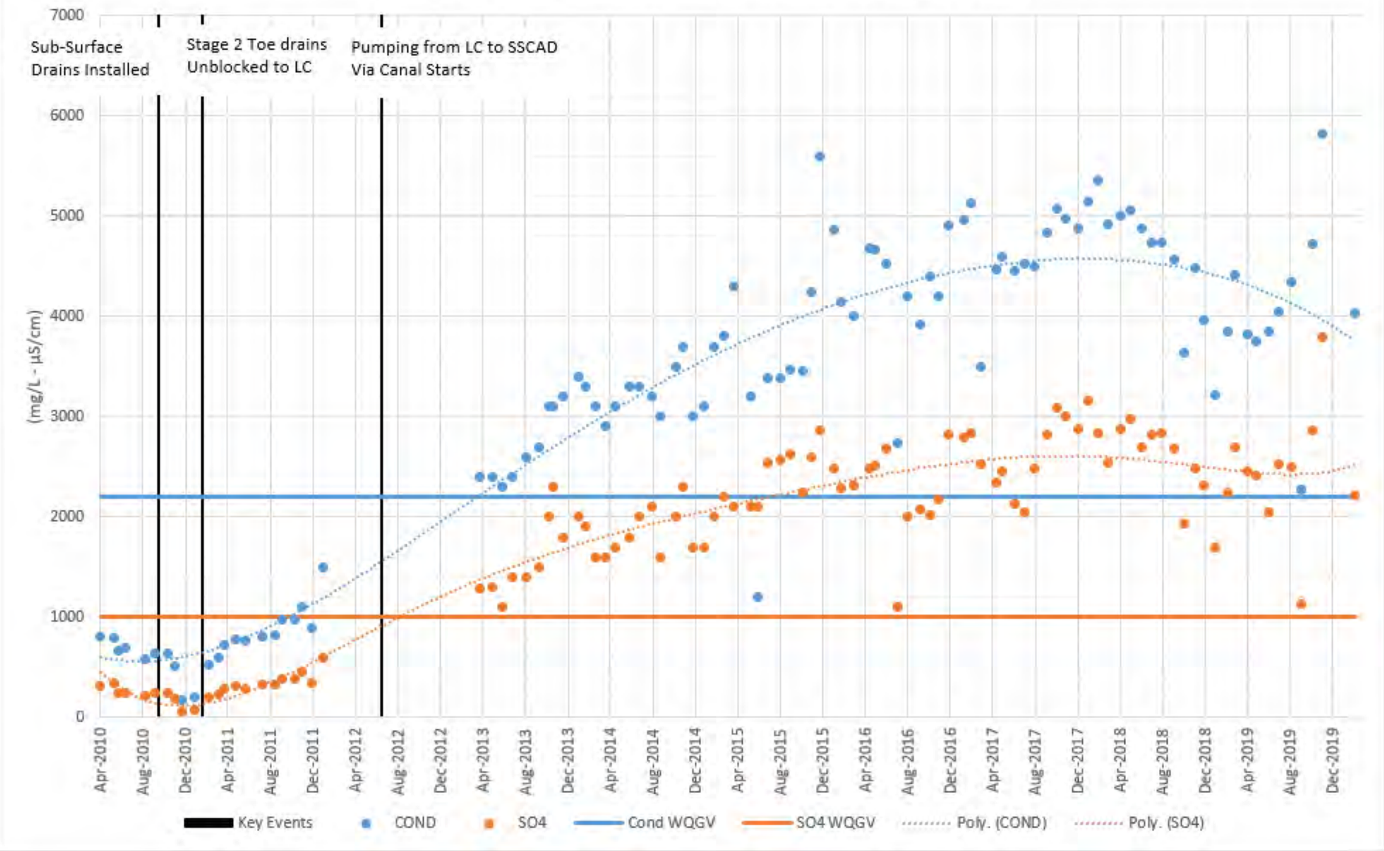


Figure A19: North Wall Collection Historical Surface Water Quality

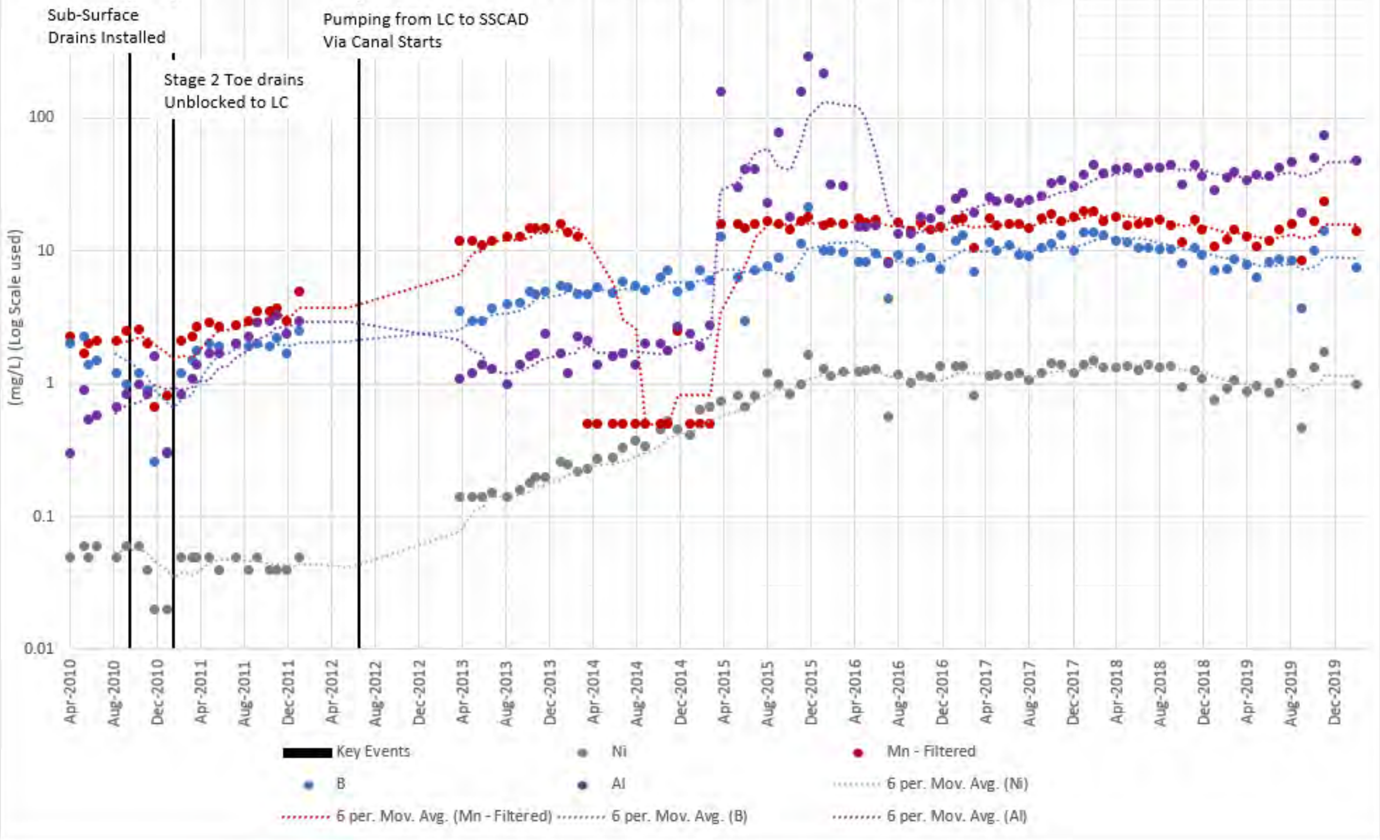


Figure A20: North Wall Collection Historical Surface Water Quality

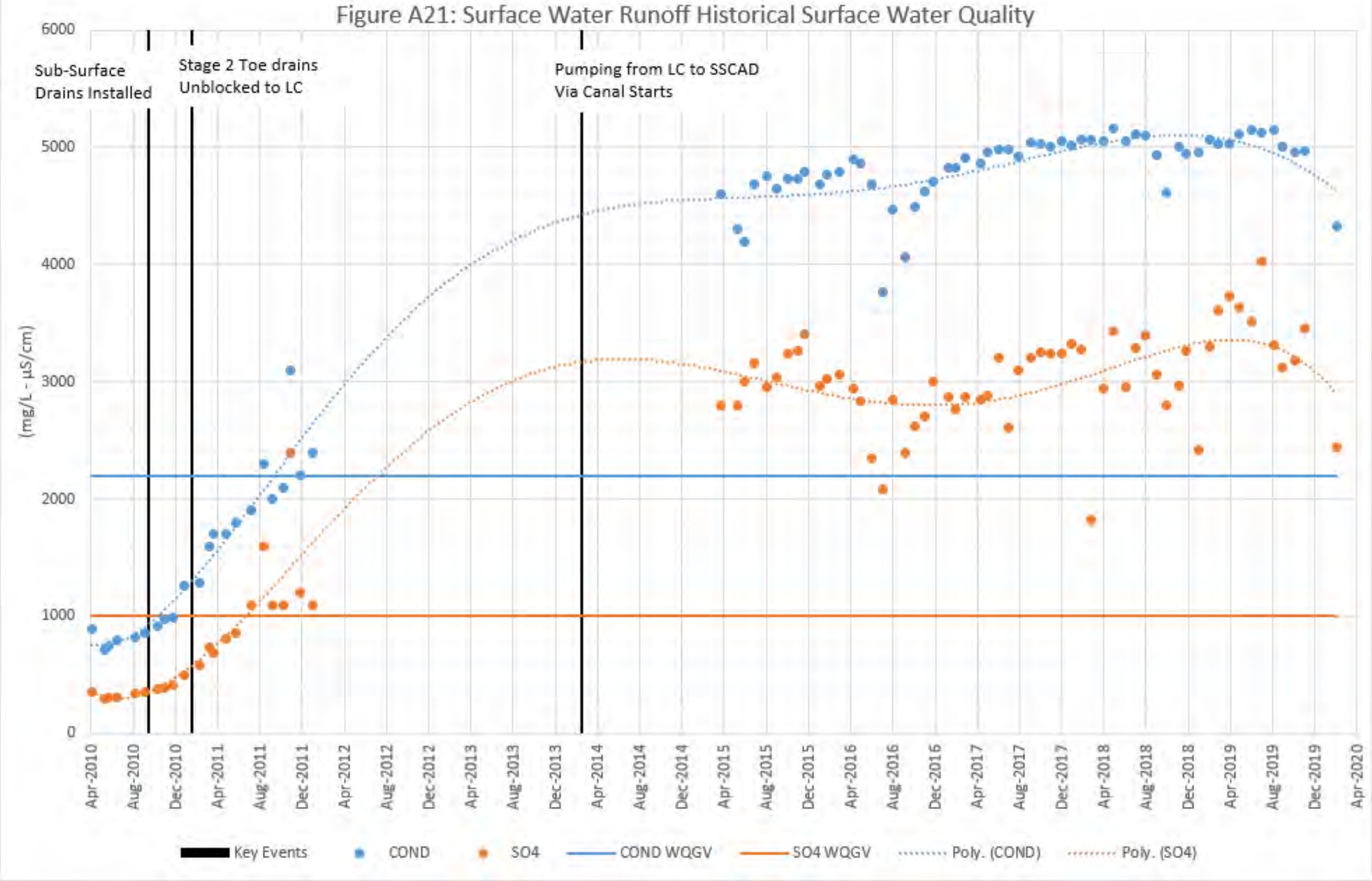


Figure A21: Surface Water Runoff Historical Surface Water Quality

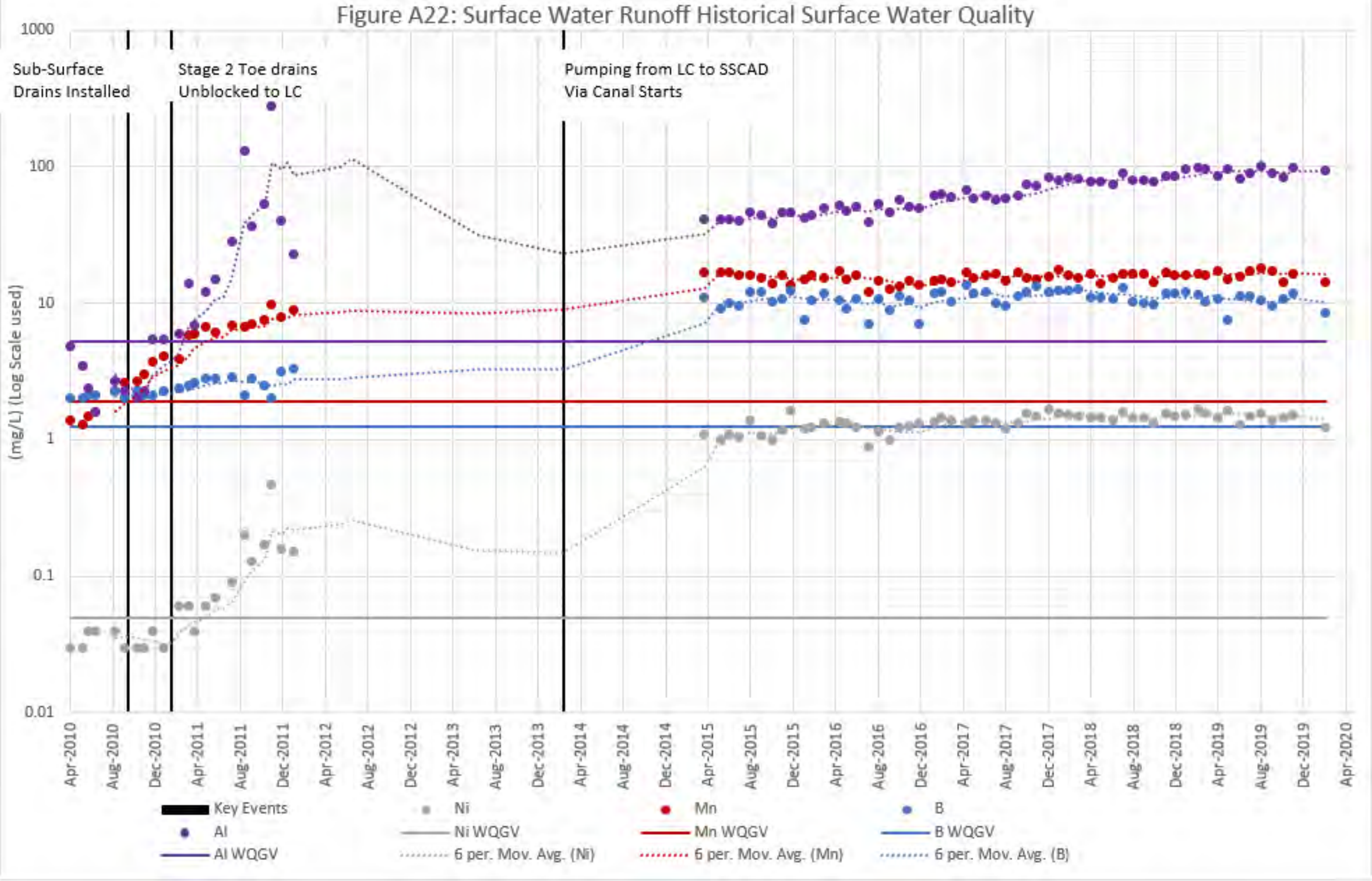


Figure A22: Surface Water Runoff Historical Surface Water Quality

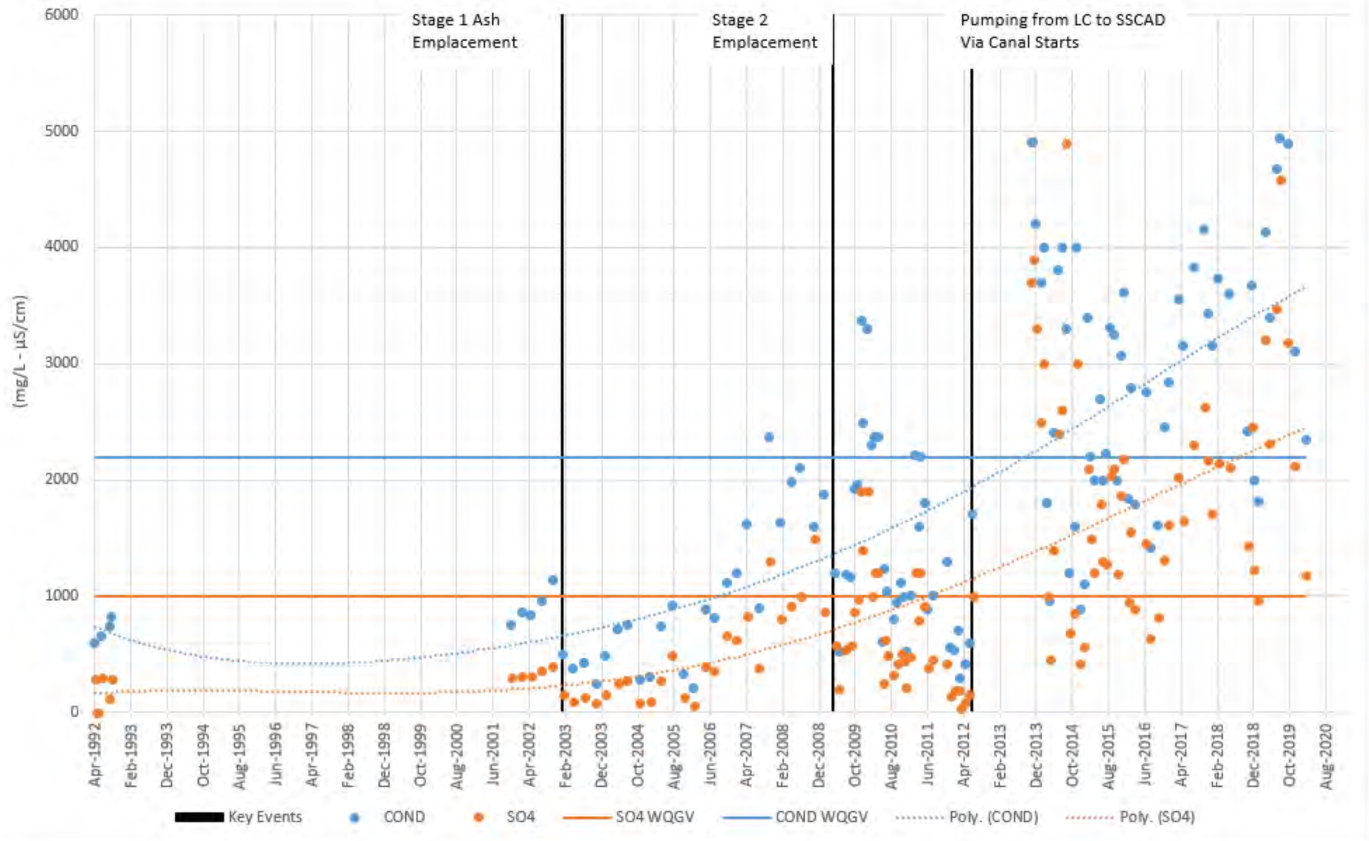


Figure A23: Lisdale Cut (WX5) Historical Surface Water Quality

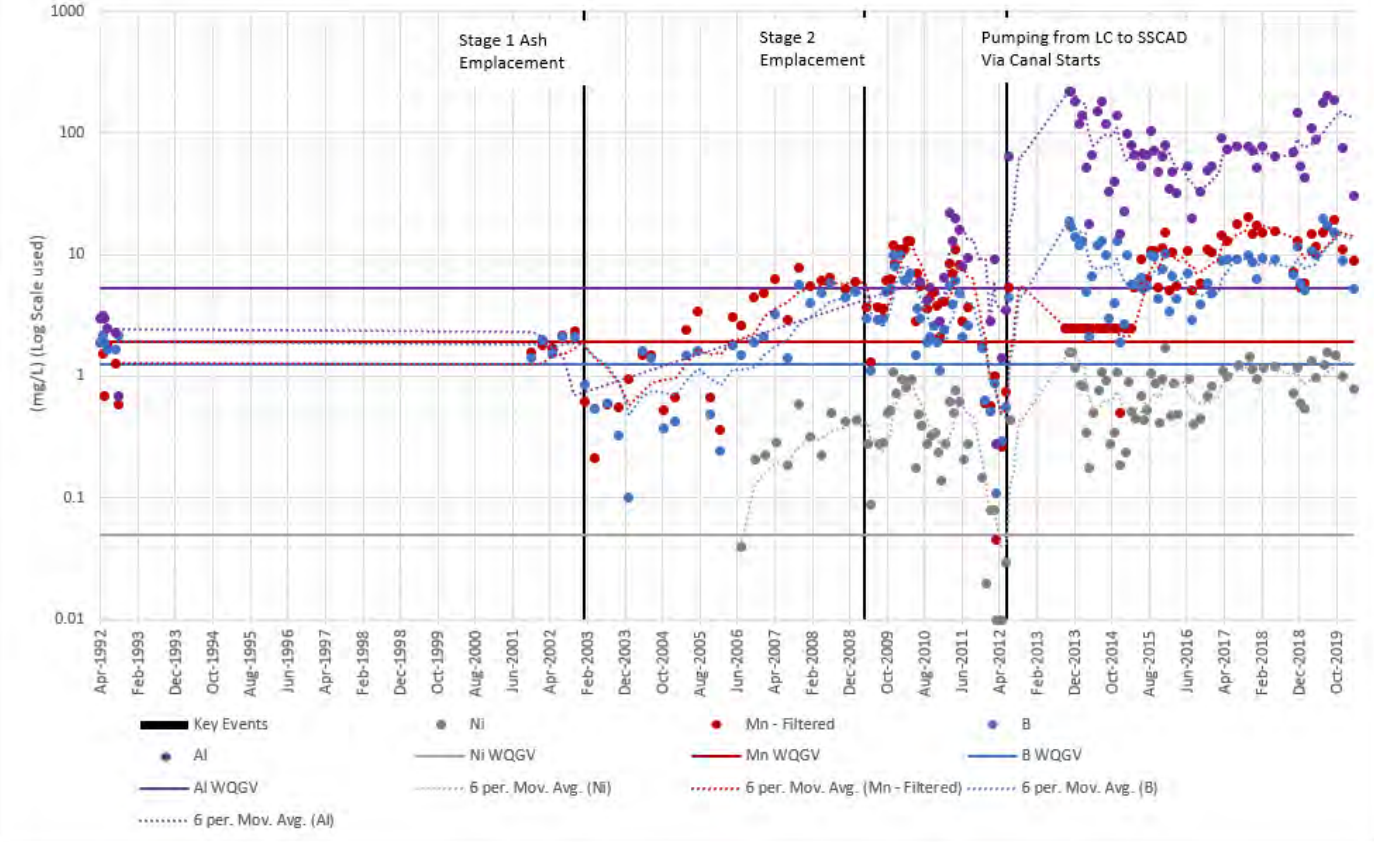


Figure A24: Lisdale Cut (WX5) Historical Surface Water Quality

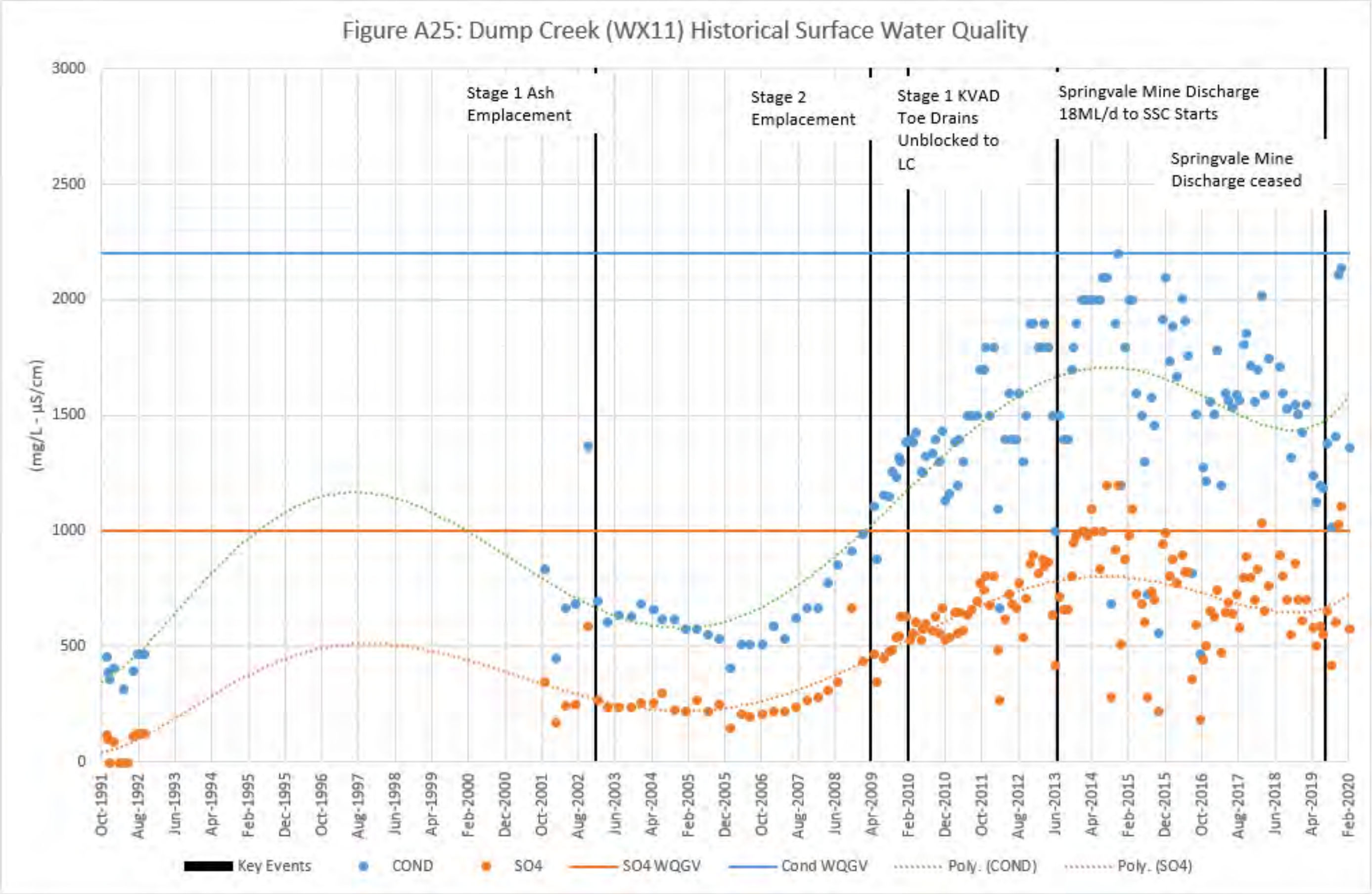


Figure A25: Dump Creek (WX11) Historical Surface Water Quality

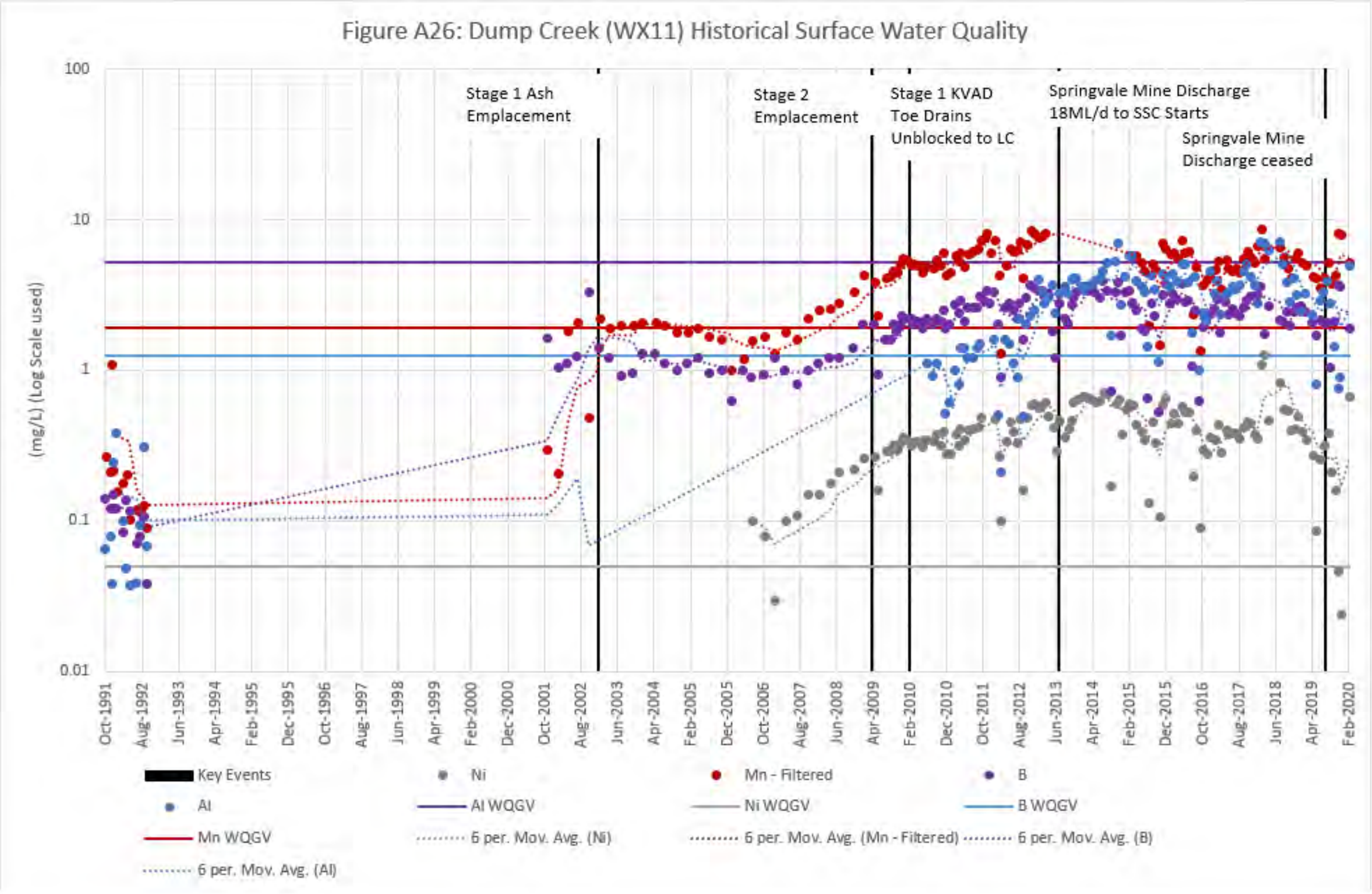


Figure A26: Dump Creek (WX11) Historical Surface Water Quality

Figure A27: Springvale (158) Historical Surface Water Quality

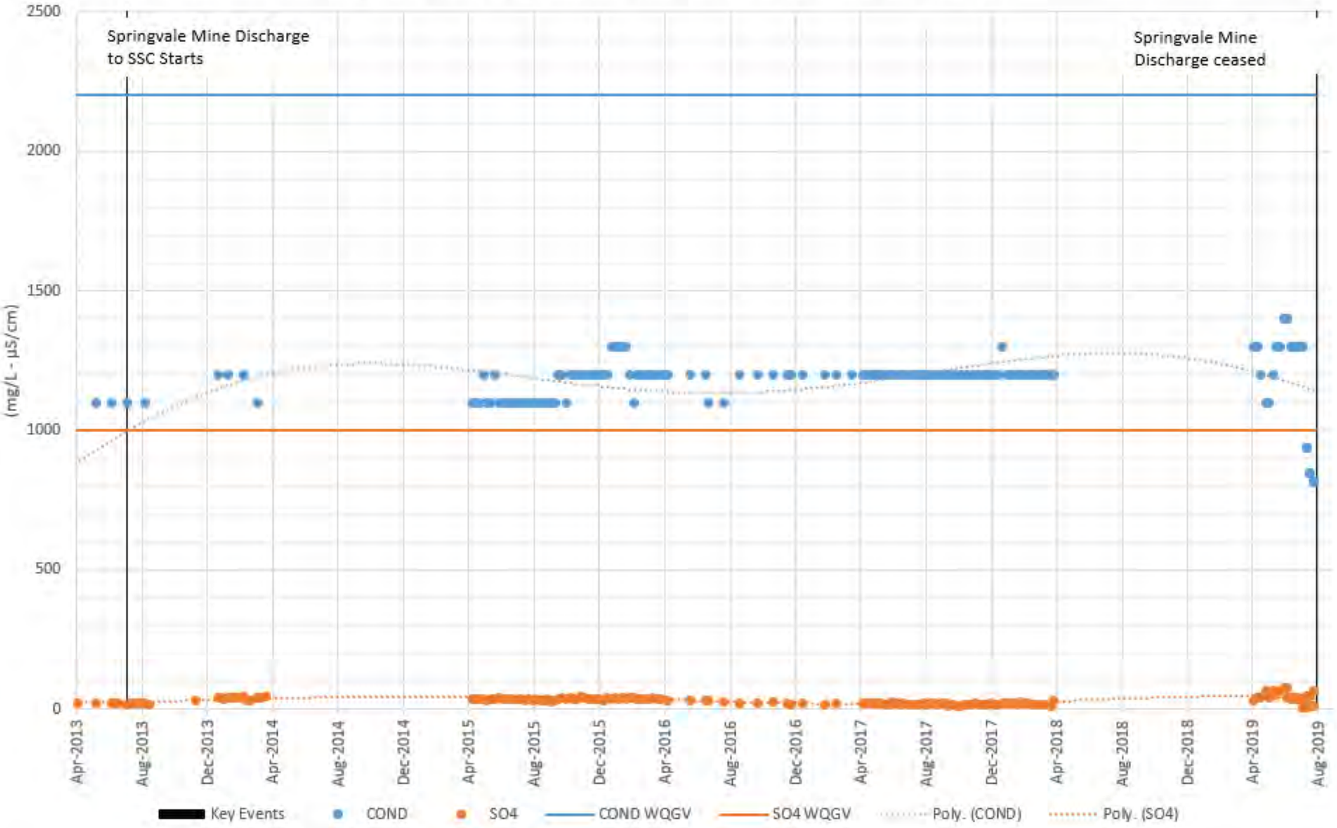
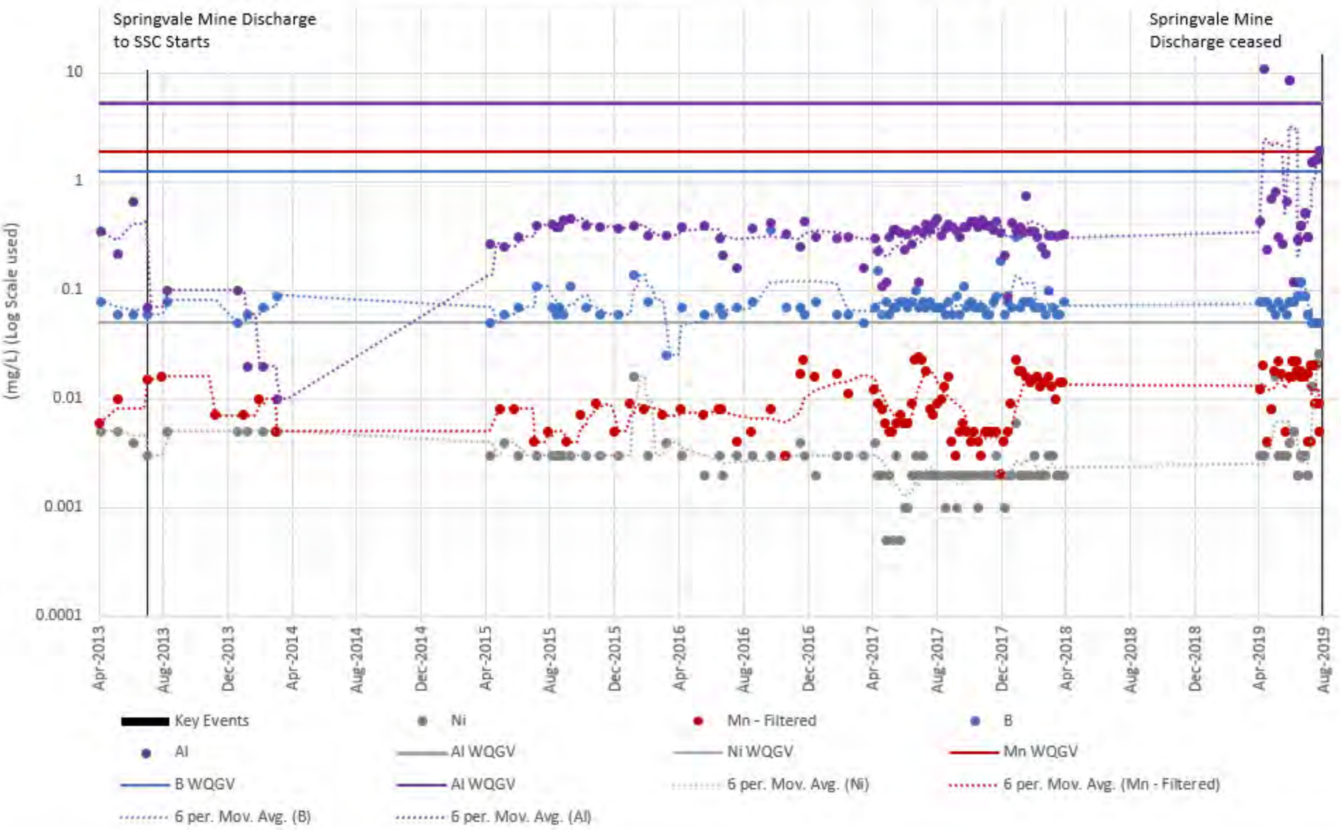


Figure A28: Springvale (158) Historical Surface Water Quality



Appendix B

Groundwater Quality Trends 1988-2020

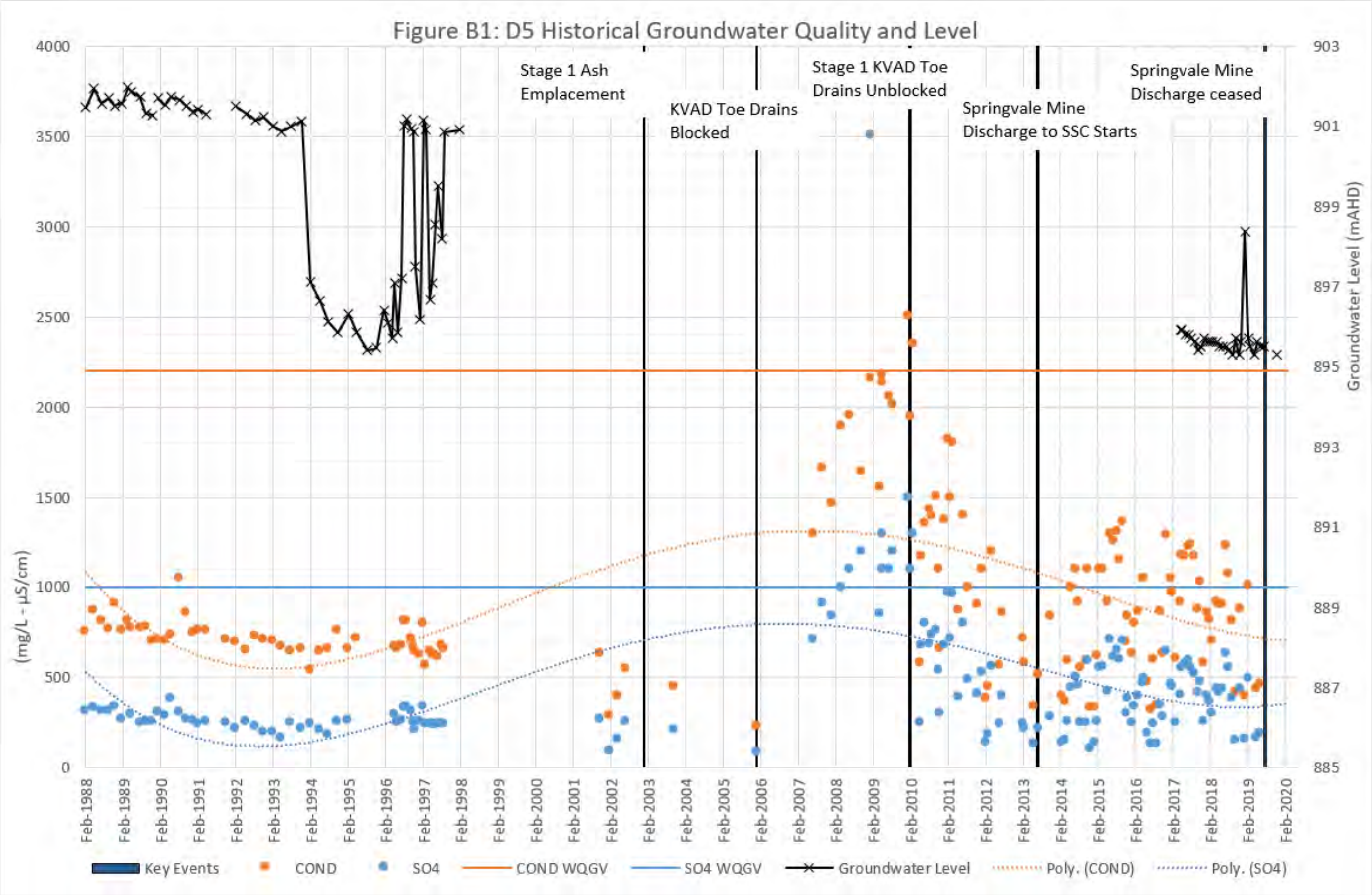


Figure B1: D5 Historical Groundwater Quality and Level

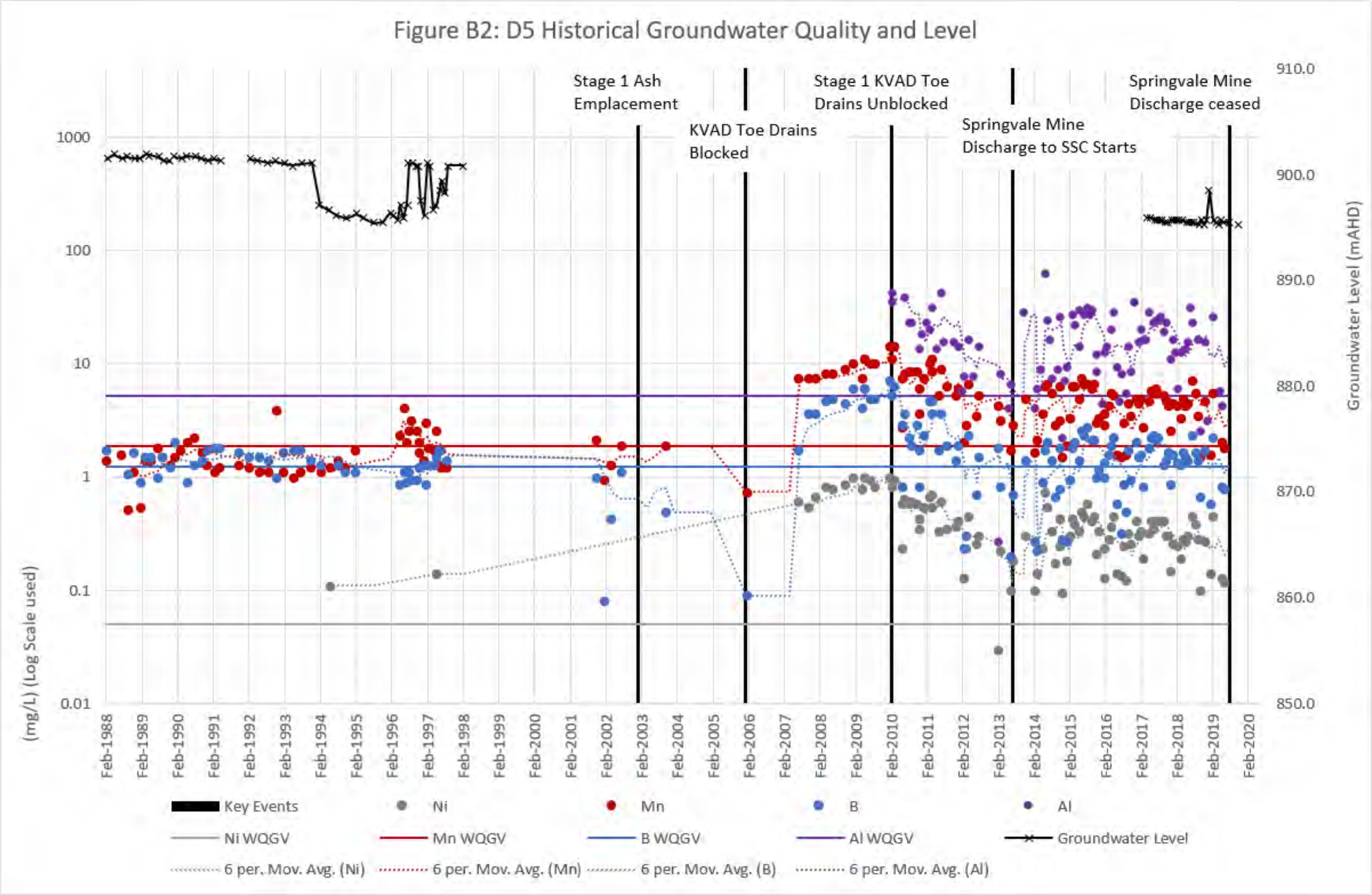


Figure B2: D5 Historical Groundwater Quality and Level

Figure B3: D6 Historical Groundwater Quality and Level

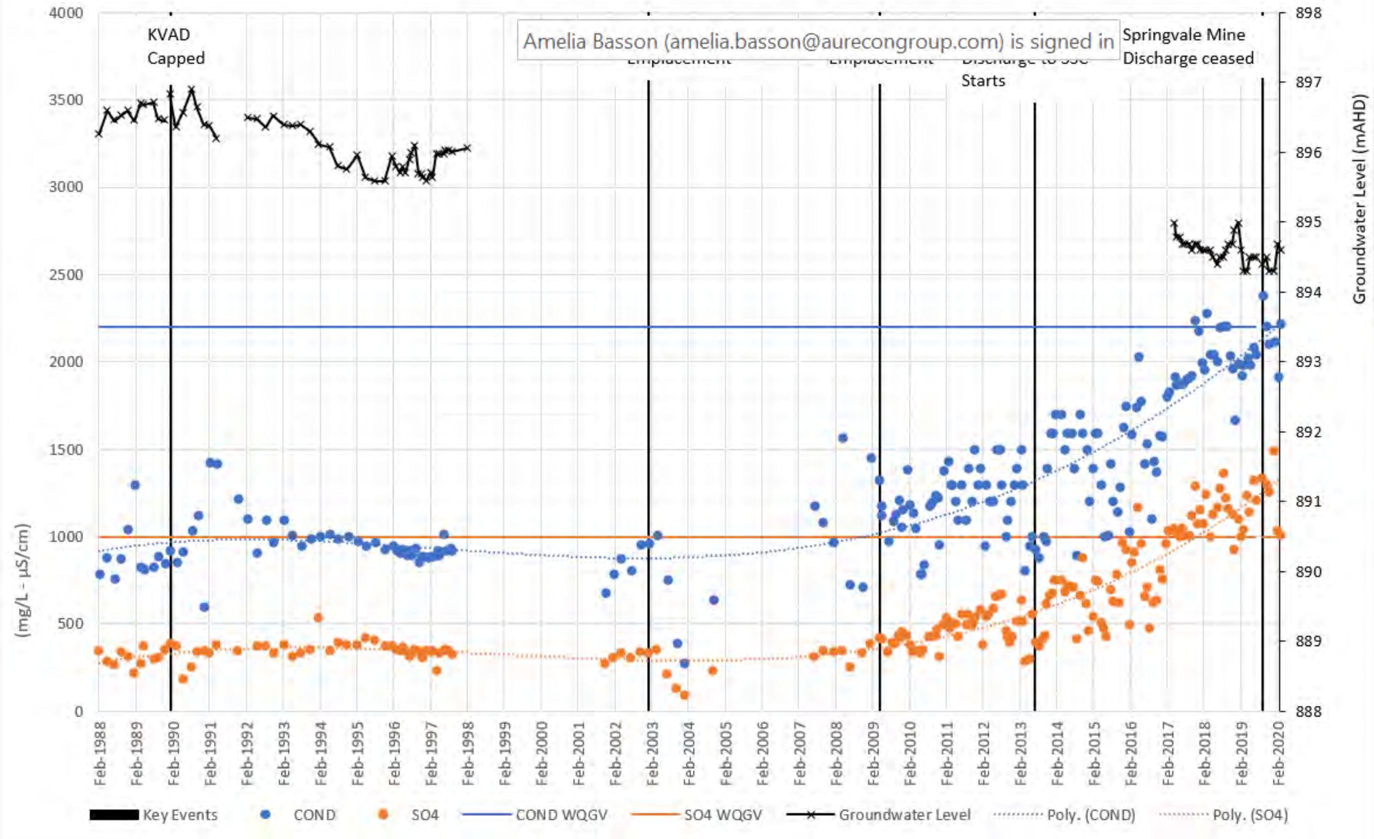


Figure B4: D6 Historical Groundwater Quality and Level

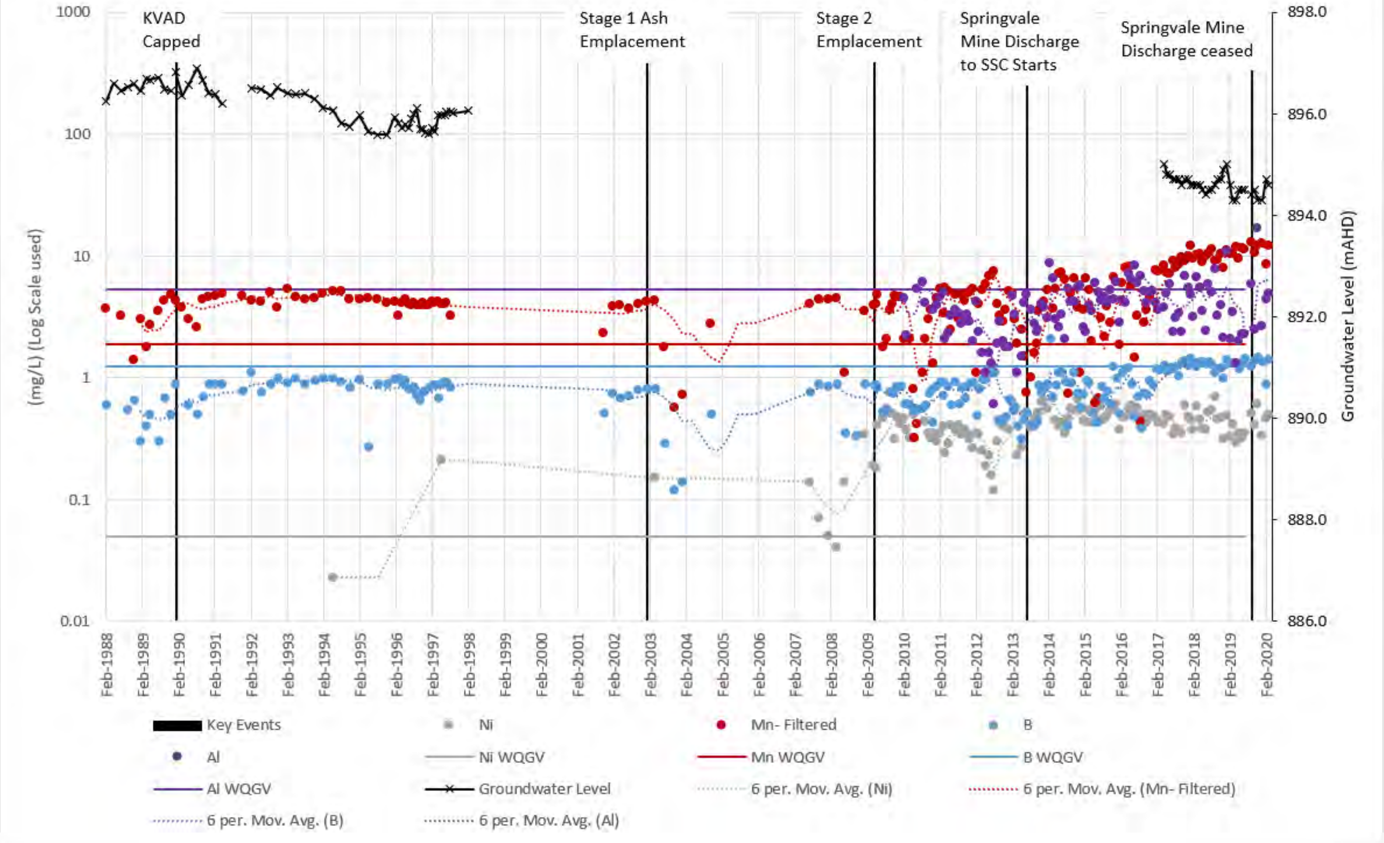


Figure B5: AP09 Historical Groundwater Quality and Level

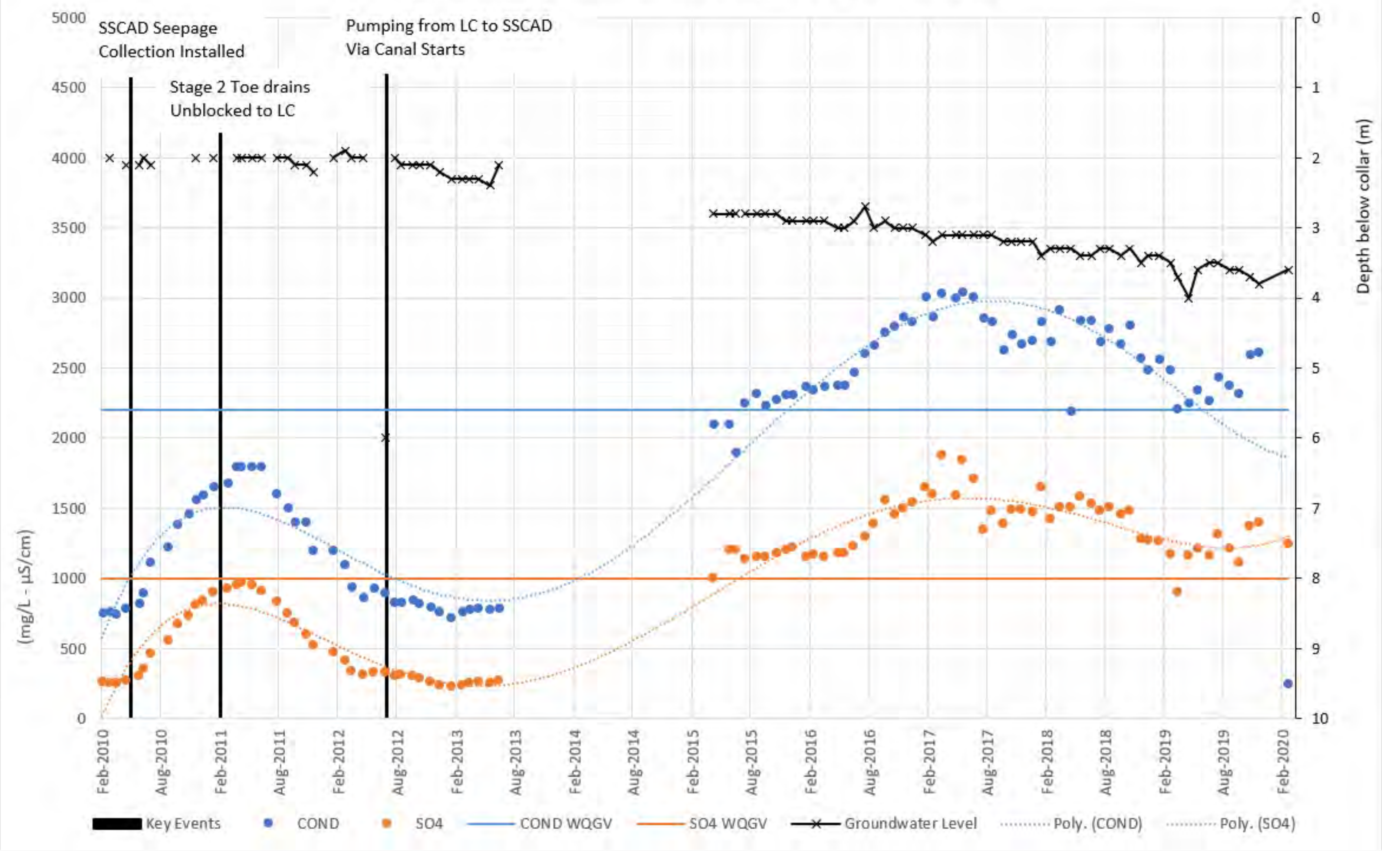


Figure B6: AP09 Historical Groundwater Quality and Level

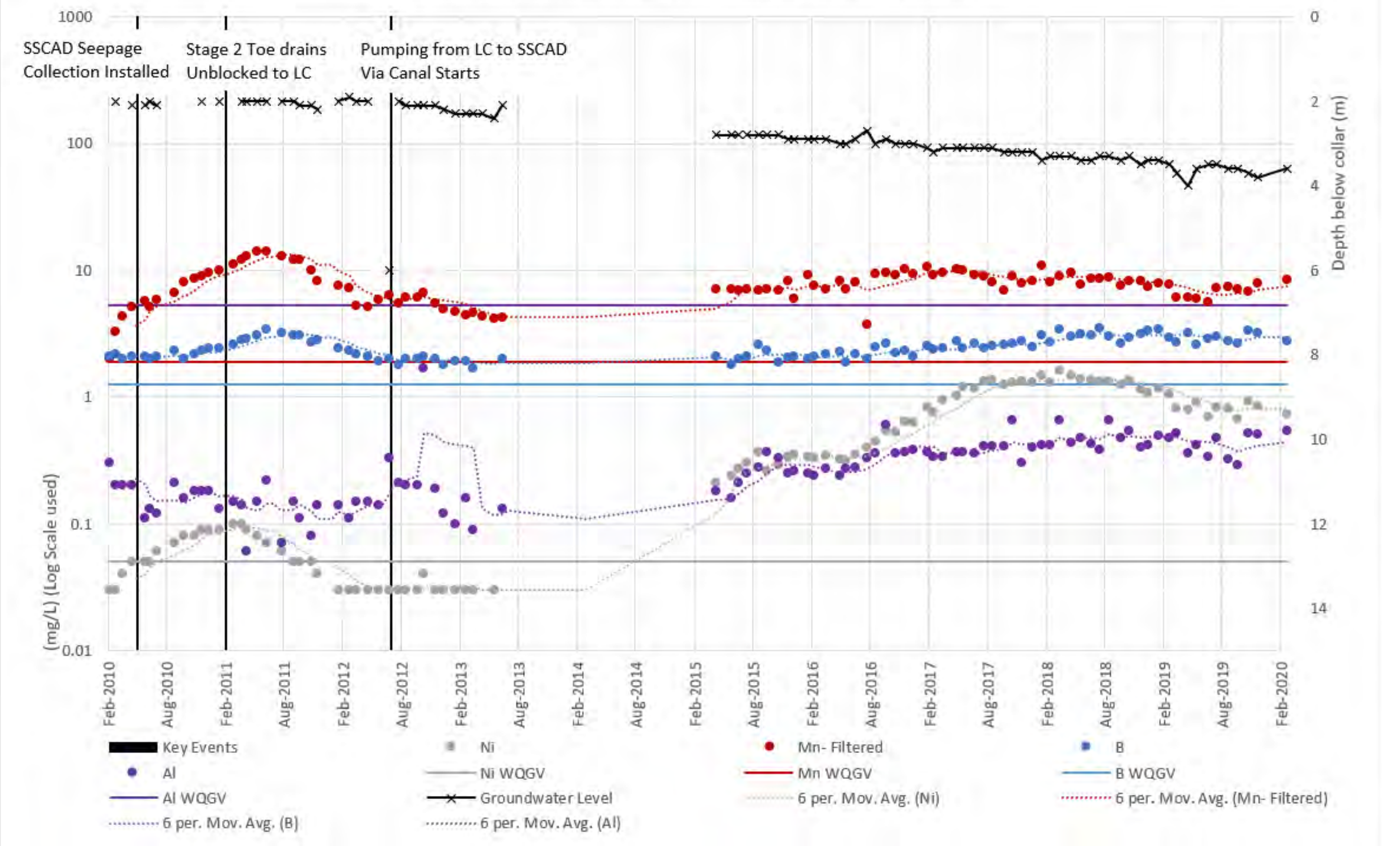


Figure B7: AP17 Historical Groundwater Quality and Level

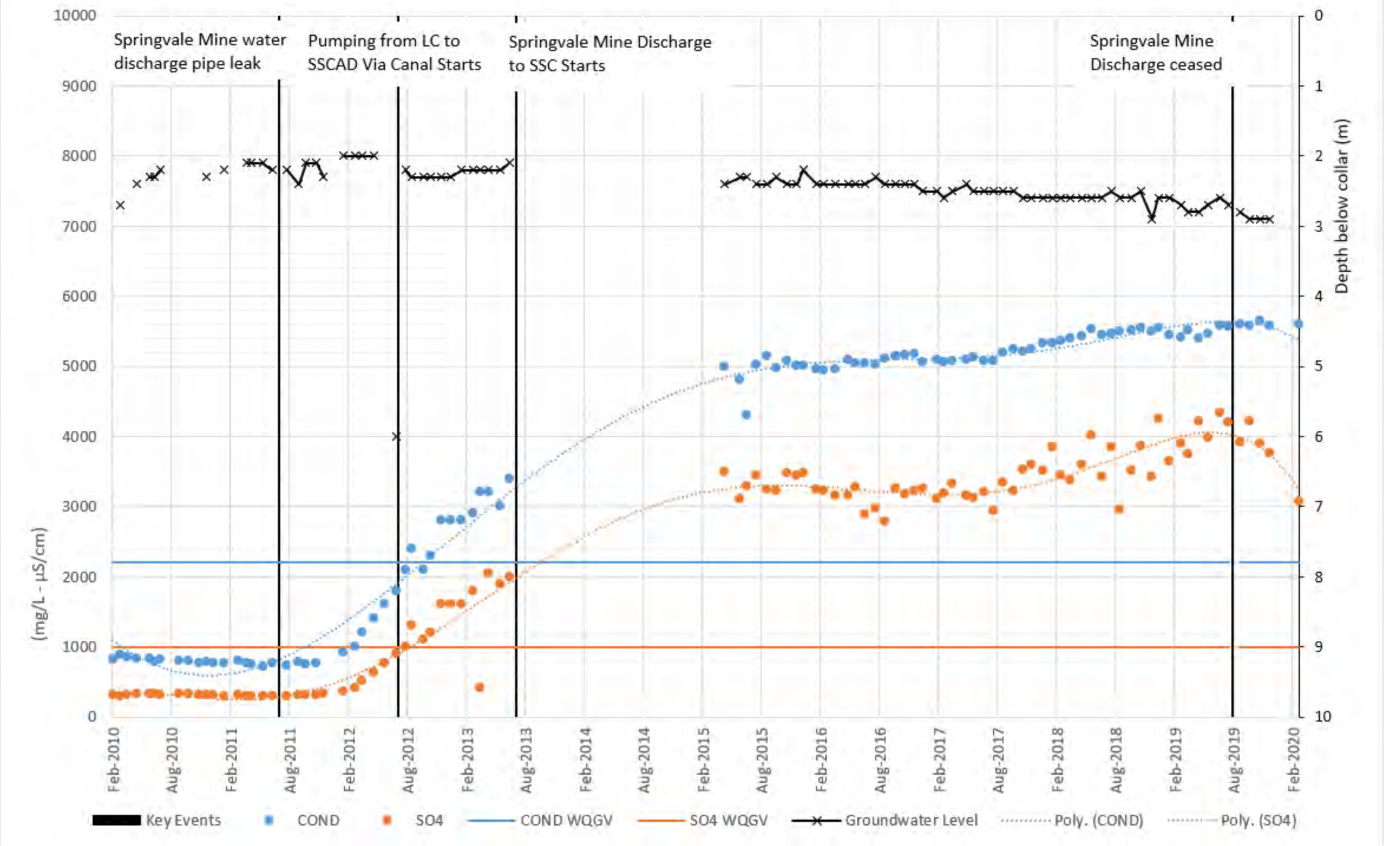
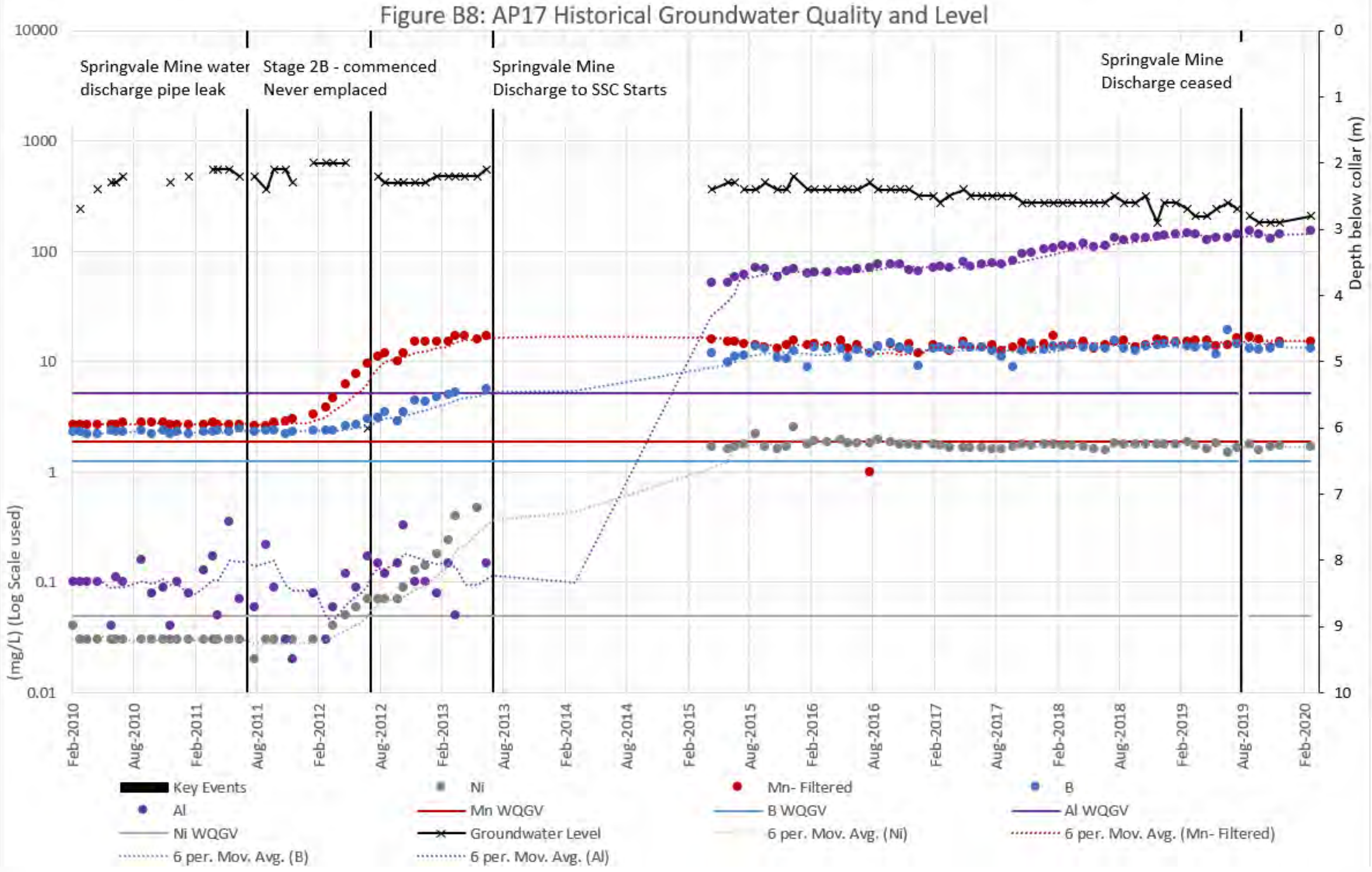


Figure B8: AP17 Historical Groundwater Quality and Level



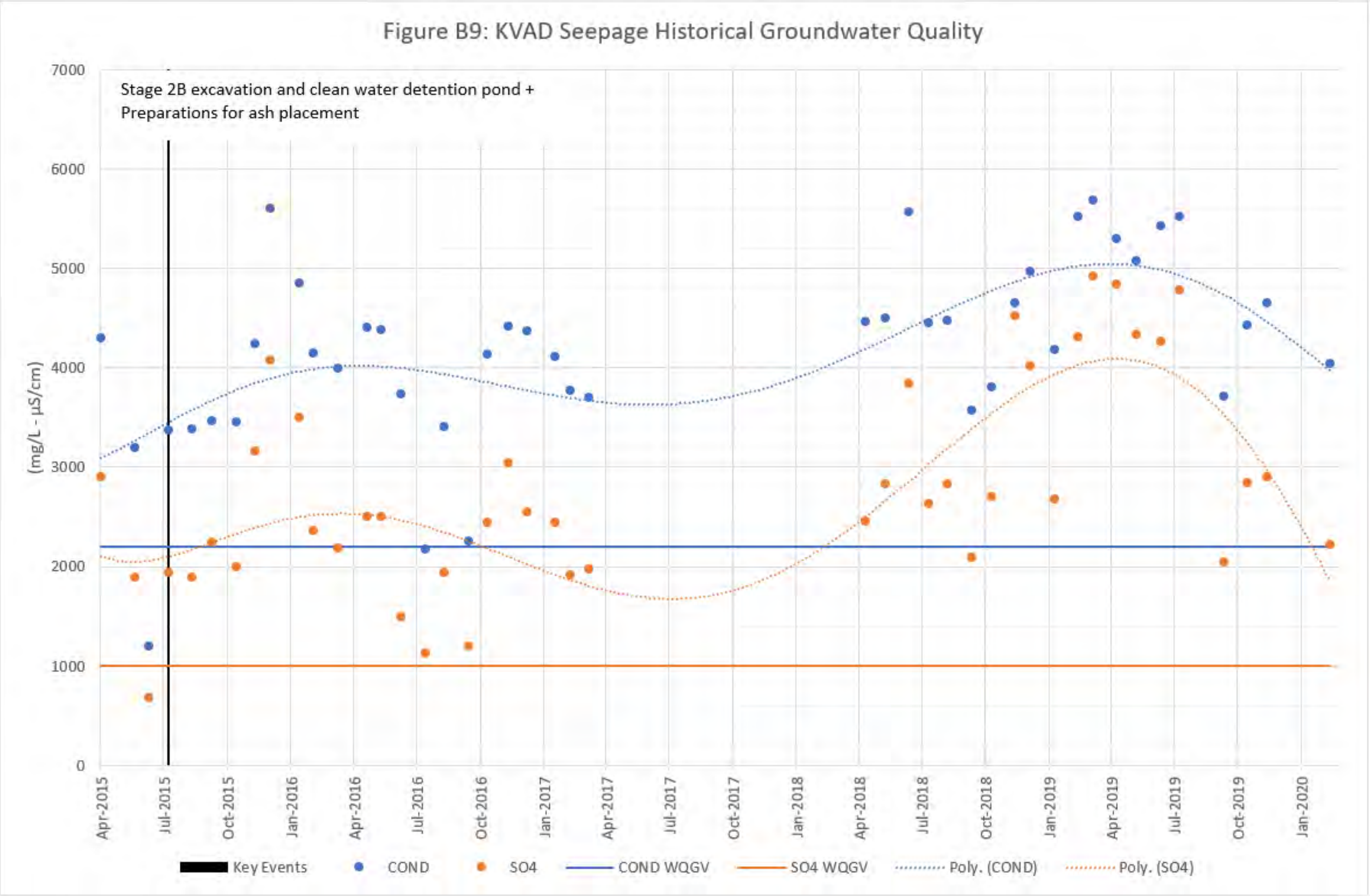


Figure B9: KVAD Seepage Historical Groundwater Quality
Stage 2B excavation and clean water detention pond +
Preparations for ash placement
(mg/L - µS/cm)
7000
6000
5000
4000
3000
2000
1000
0
Apr-2015
Jul-2015
Oct-2015
Jan-2016
Apr-2016
Jul-2016
Oct-2016
Jan-2017
Apr-2017
Jul-2017
Oct-2017
Jan-2018
Apr-2018
Jul-2018
Oct-2018
Jan-2019
Apr-2019
Jul-2019
Oct-2019
Jan-2020
Key Events
COND
SO4
COND WQGV
SO4 WQGV
Poly. (COND)
Poly. (SO4)

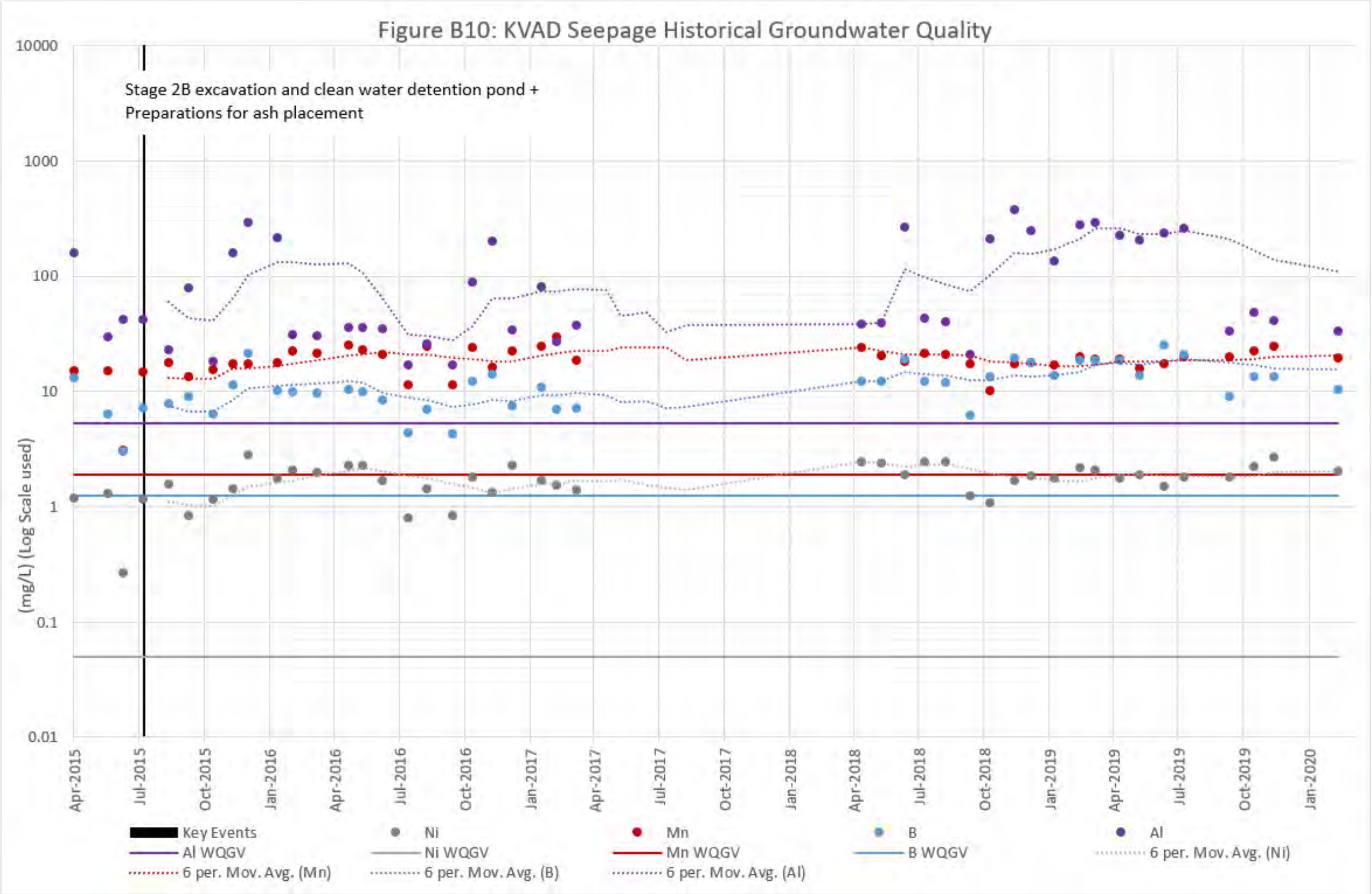


Figure B10: KVAD Seepage Historical Groundwater Quality
Stage 2B excavation and clean water detention pond +
Preparations for ash placement
(mg/L) (Log Scale used)
10000
1000
100
10
1
0.1
0.01
Apr-2015
Jul-2015
Oct-2015
Jan-2016
Apr-2016
Jul-2016
Oct-2016
Jan-2017
Apr-2017
Jul-2017
Oct-2017
Jan-2018
Apr-2018
Jul-2018
Oct-2018
Jan-2019
Apr-2019
Jul-2019
Oct-2019
Jan-2020
Key Events
Ni
Mn
B
Al
Al WQGV
Ni WQGV
Mn WQGV
B WQGV
6 per. Mov. Avg. (Ni)
6 per. Mov. Avg. (Mn)
6 per. Mov. Avg. (B)
6 per. Mov. Avg. (Al)

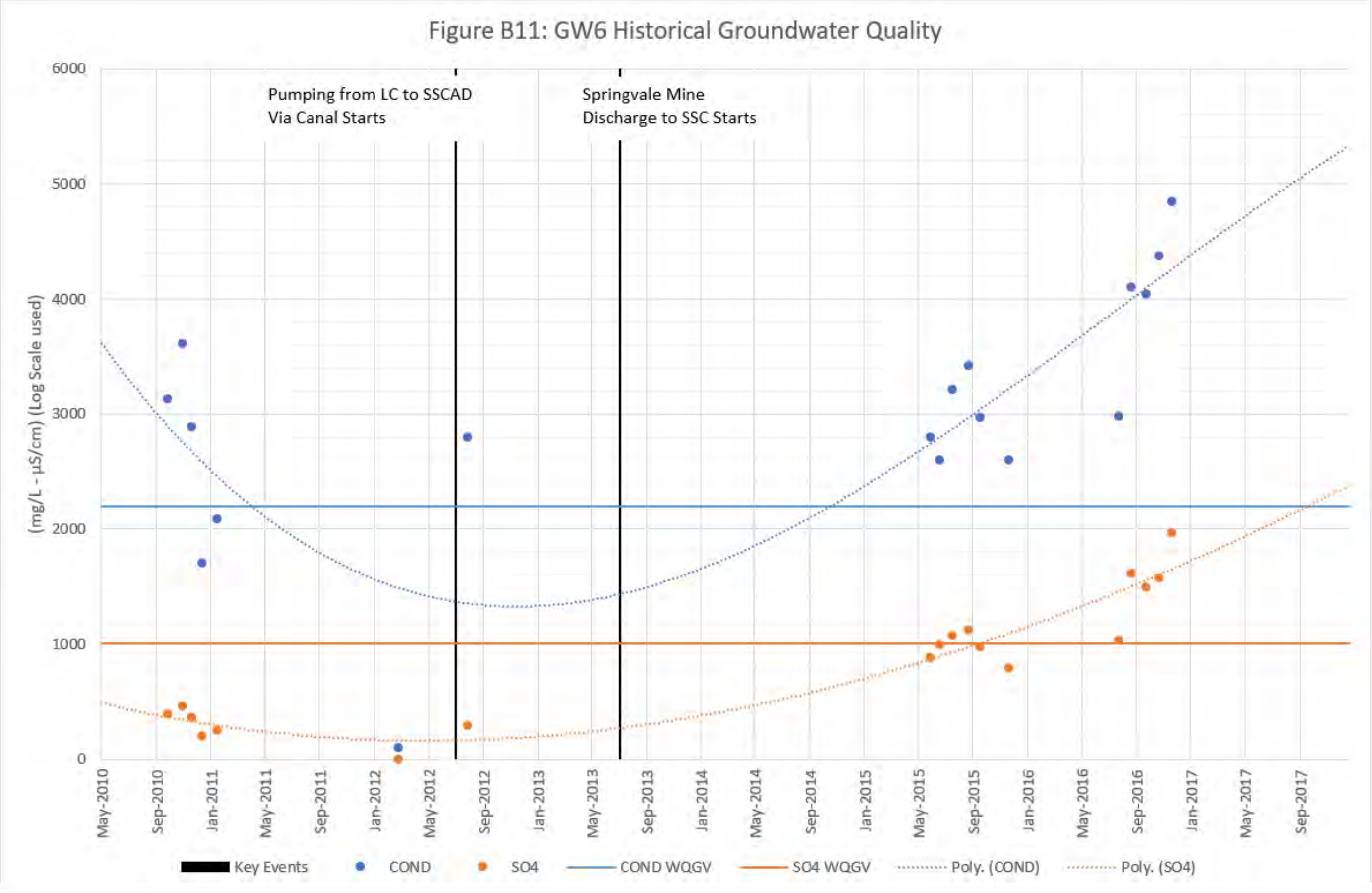


Figure B11: GW6 Historical Groundwater Quality
6000
5000
4000
3000
2000
1000
0
(mg/L - µS/cm) (Log Scale used)
Pumping from LC to SSCAD
Via Canal Starts
Springvale Mine
Discharge to SSC Starts
May-2010
Sep-2010
Jan-2011
May-2011
Sep-2011
Jan-2012
May-2012
Sep-2012
Jan-2013
May-2013
Sep-2013
Jan-2014
May-2014
Sep-2014
Jan-2015
May-2015
Sep-2015
Jan-2016
May-2016
Sep-2016
Jan-2017
May-2017
Sep-2017
Key Events
COND
SO4
COND WQGV
SO4 WQGV
Poly. (COND)
Poly. (SO4)

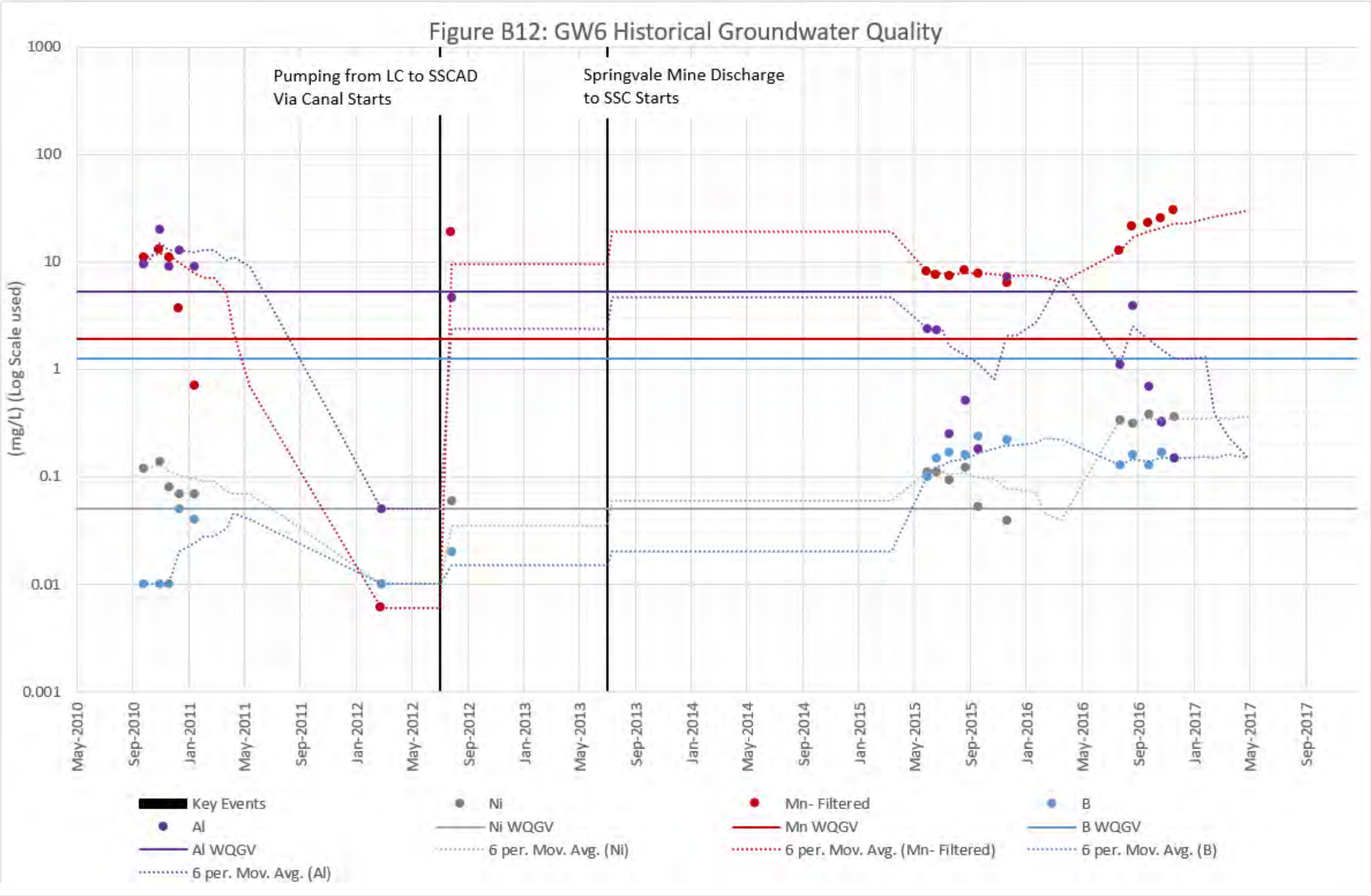


Figure B12: GW6 Historical Groundwater Quality
1000
100
10
1
0.1
0.01
0.001
(mg/L) (Log Scale used)
Pumping from LC to SSCAD
Via Canal Starts
Springvale Mine Discharge
to SSC Starts
May-2010
Sep-2010
Jan-2011
May-2011
Sep-2011
Jan-2012
May-2012
Sep-2012
Jan-2013
May-2013
Sep-2013
Jan-2014
May-2014
Sep-2014
Jan-2015
May-2015
Sep-2015
Jan-2016
May-2016
Sep-2016
Jan-2017
May-2017
Sep-2017
Key Events
Al
Al WQGV
6 per. Mov. Avg. (Al)
Ni
Ni WQGV
6 per. Mov. Avg. (Ni)
Mn- Filtered
Mn WQGV
6 per. Mov. Avg. (Mn- Filtered)
B
B WQGV
6 per. Mov. Avg. (B)

Figure B13: GW10 Historical Groundwater Quality

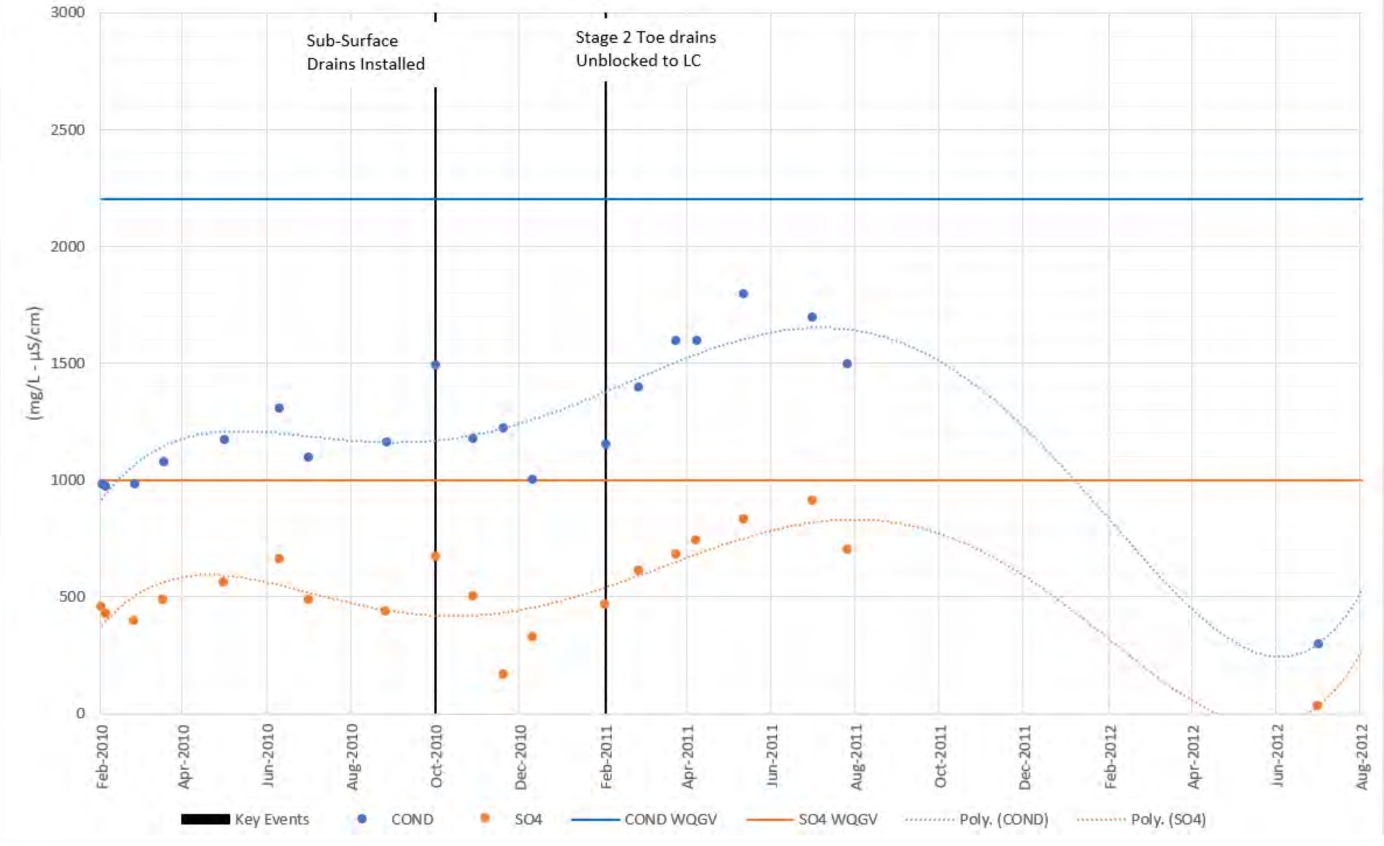


Figure B14: GW10 Historical Groundwater Quality

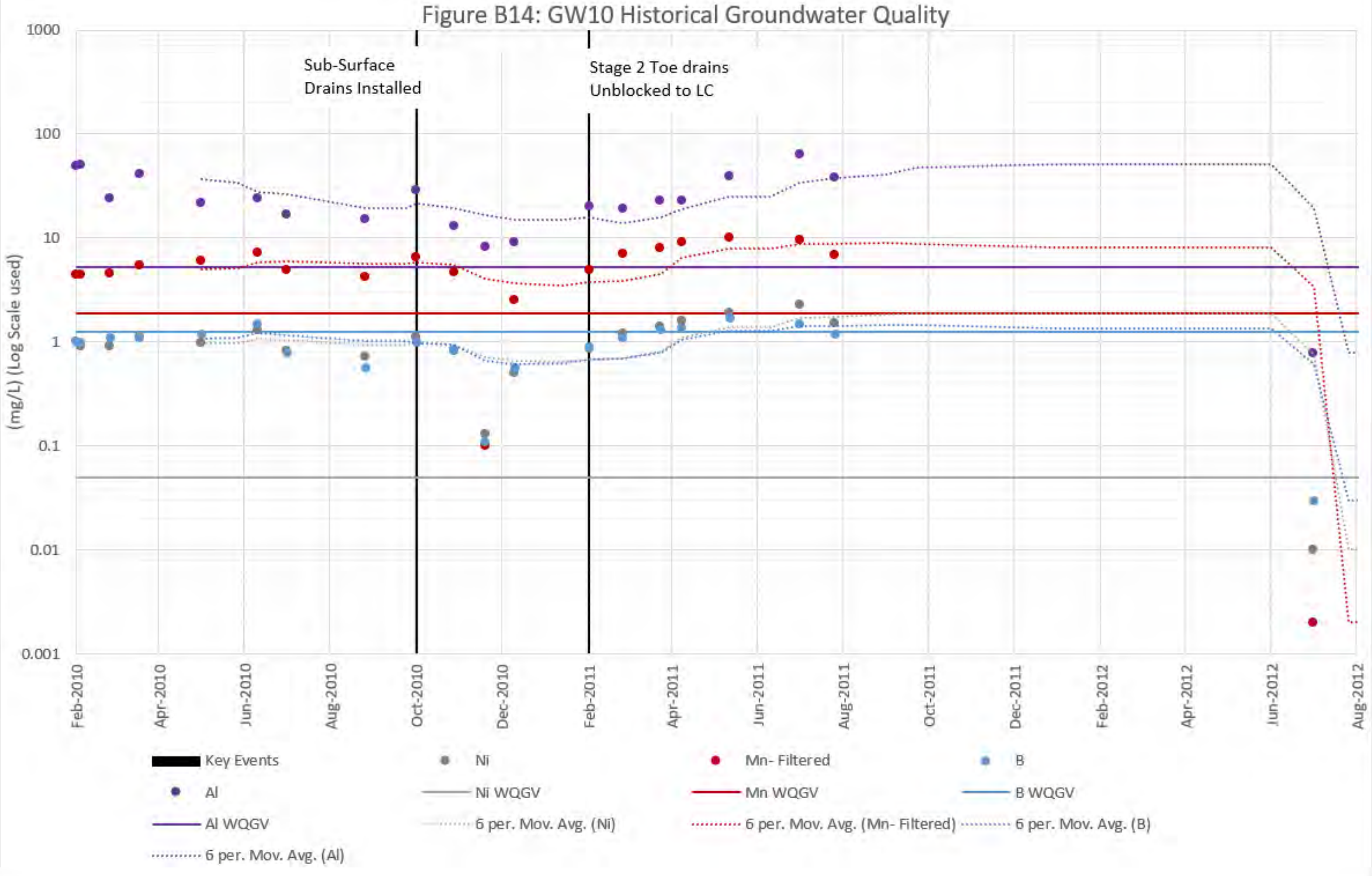


Figure B15: GW11 Historical Groundwater Quality

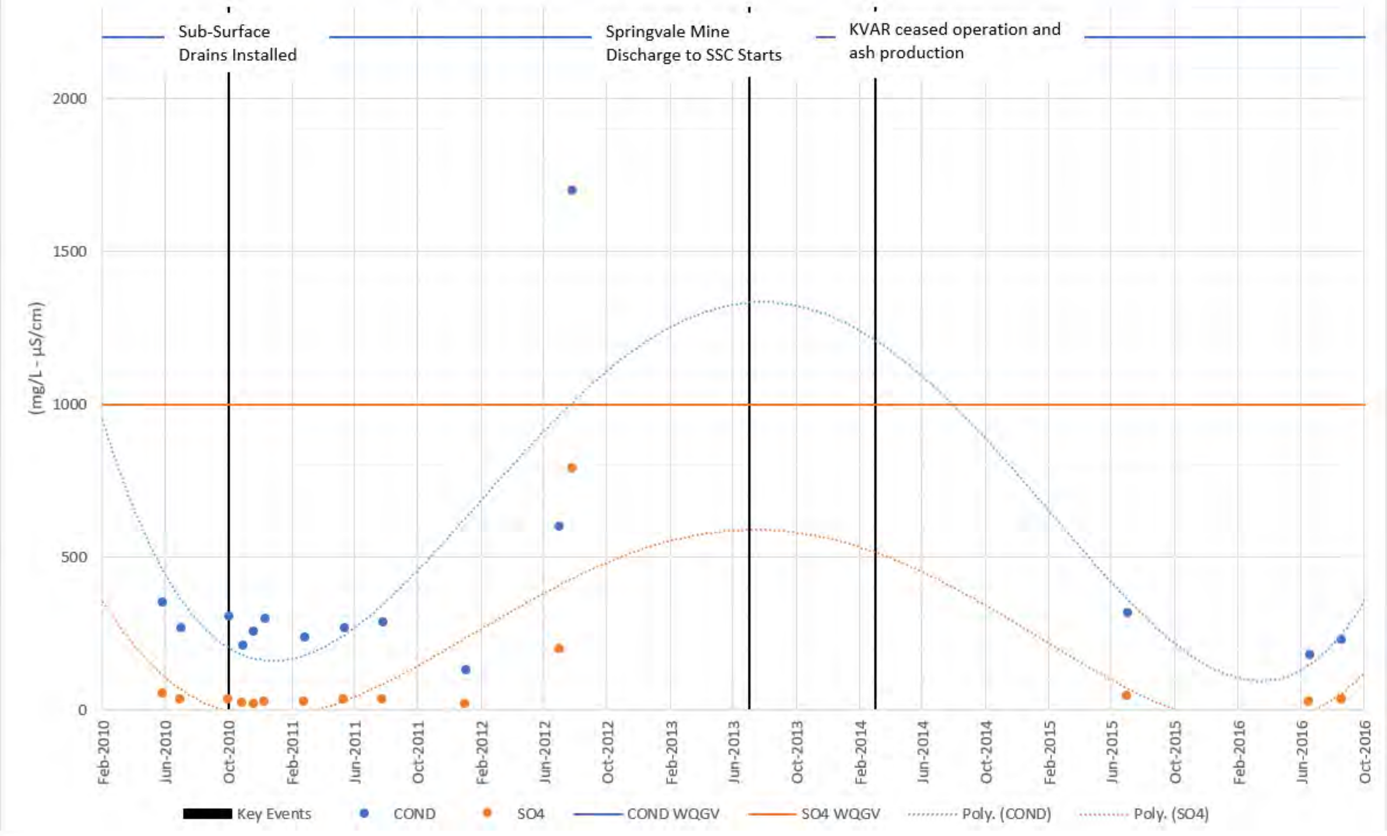
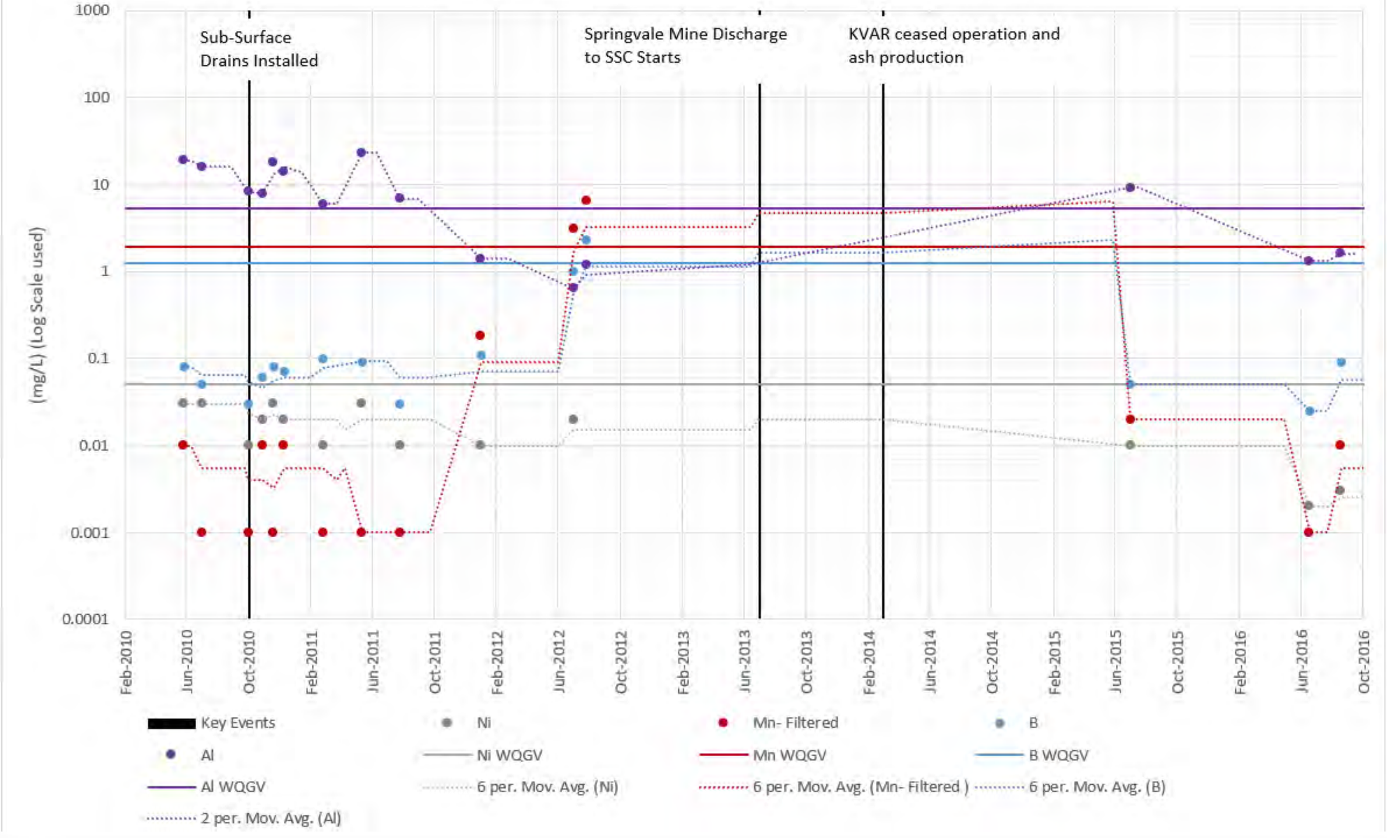


Figure B16: GW11 Historical Groundwater Quality



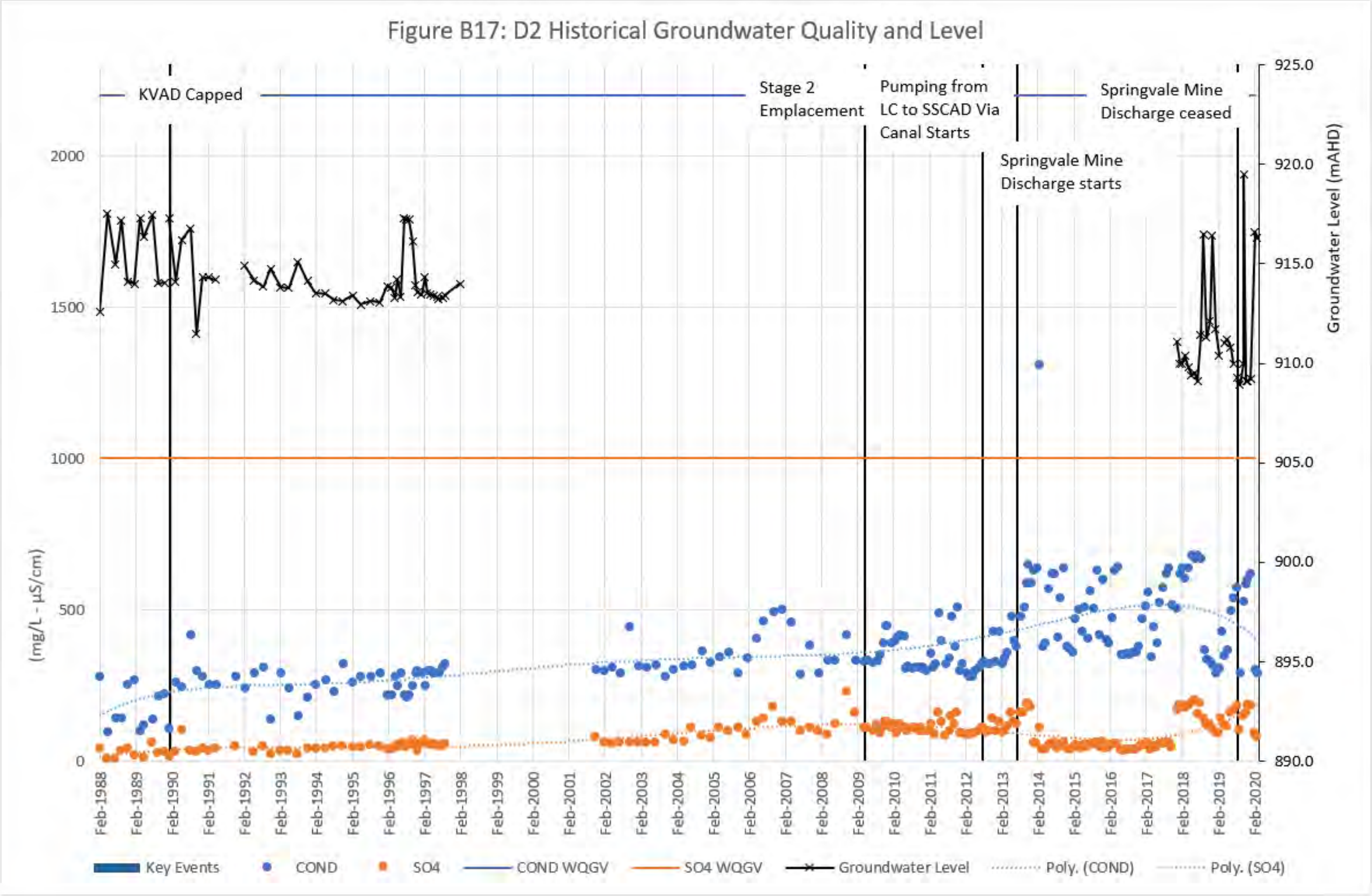


Figure B17: D2 Historical Groundwater Quality and Level

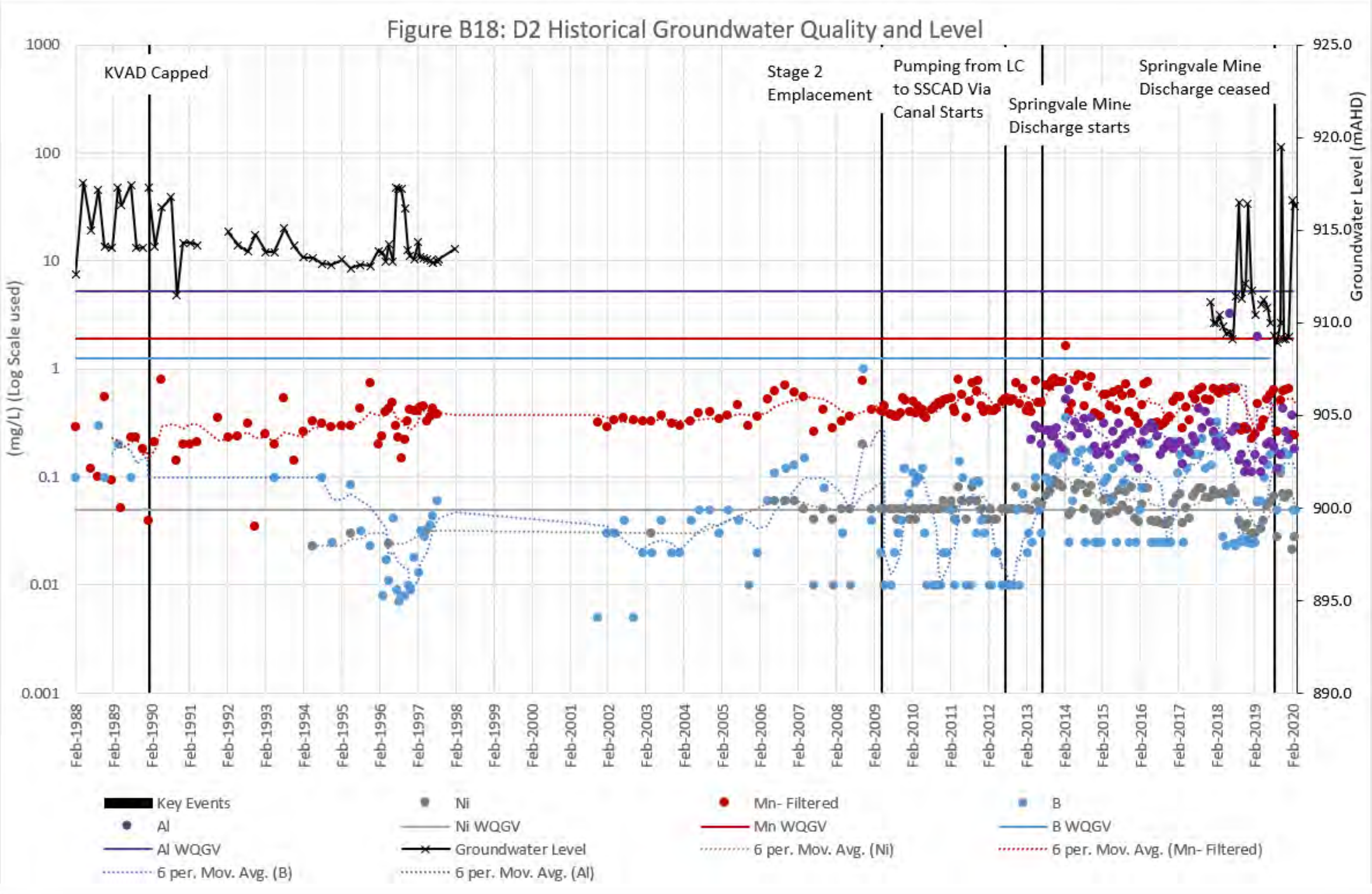


Figure B18: D2 Historical Groundwater Quality and Level

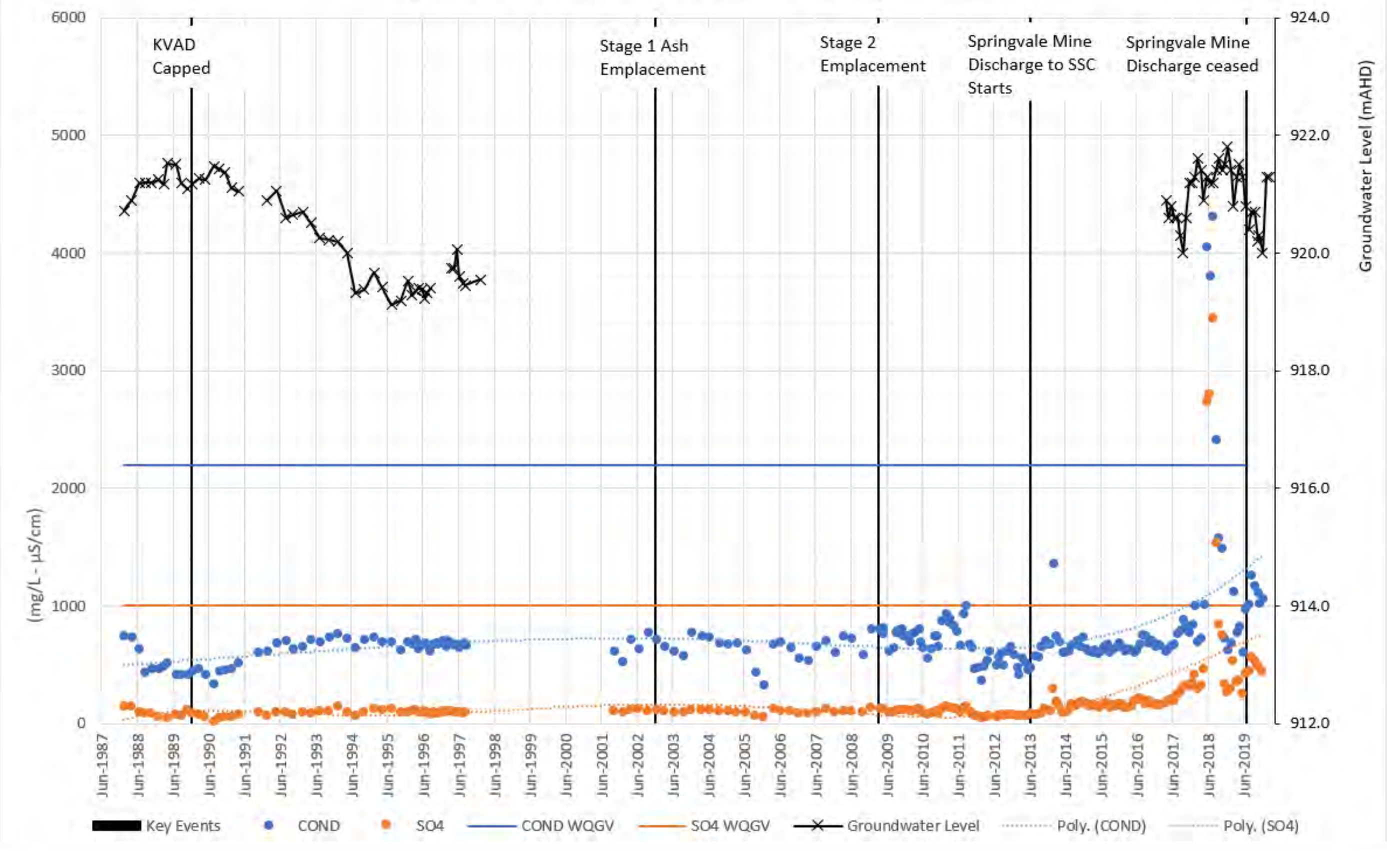


Figure B19: D3 Historical Groundwater Quality and Level

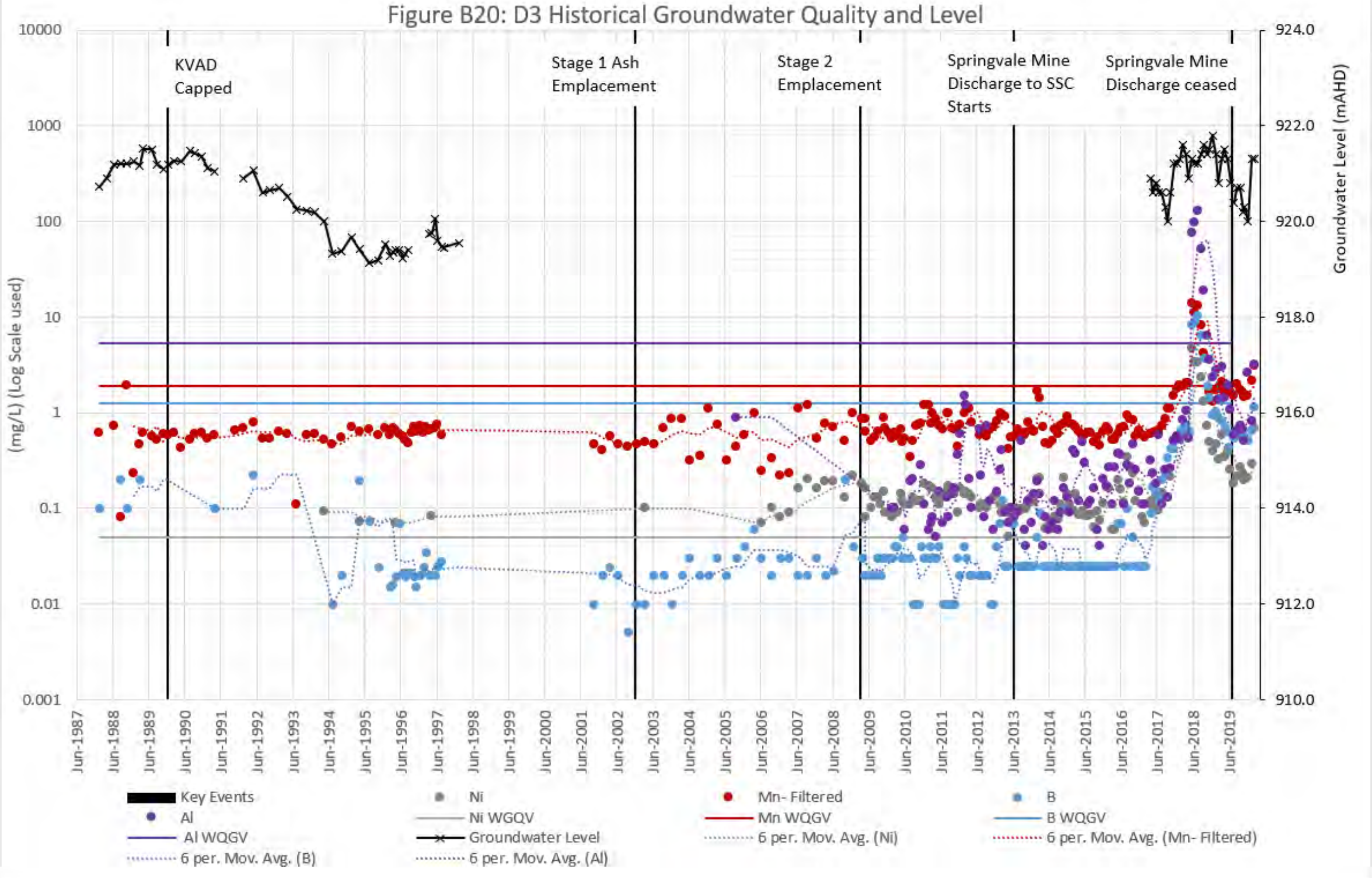


Figure B20: D3 Historical Groundwater Quality and Level

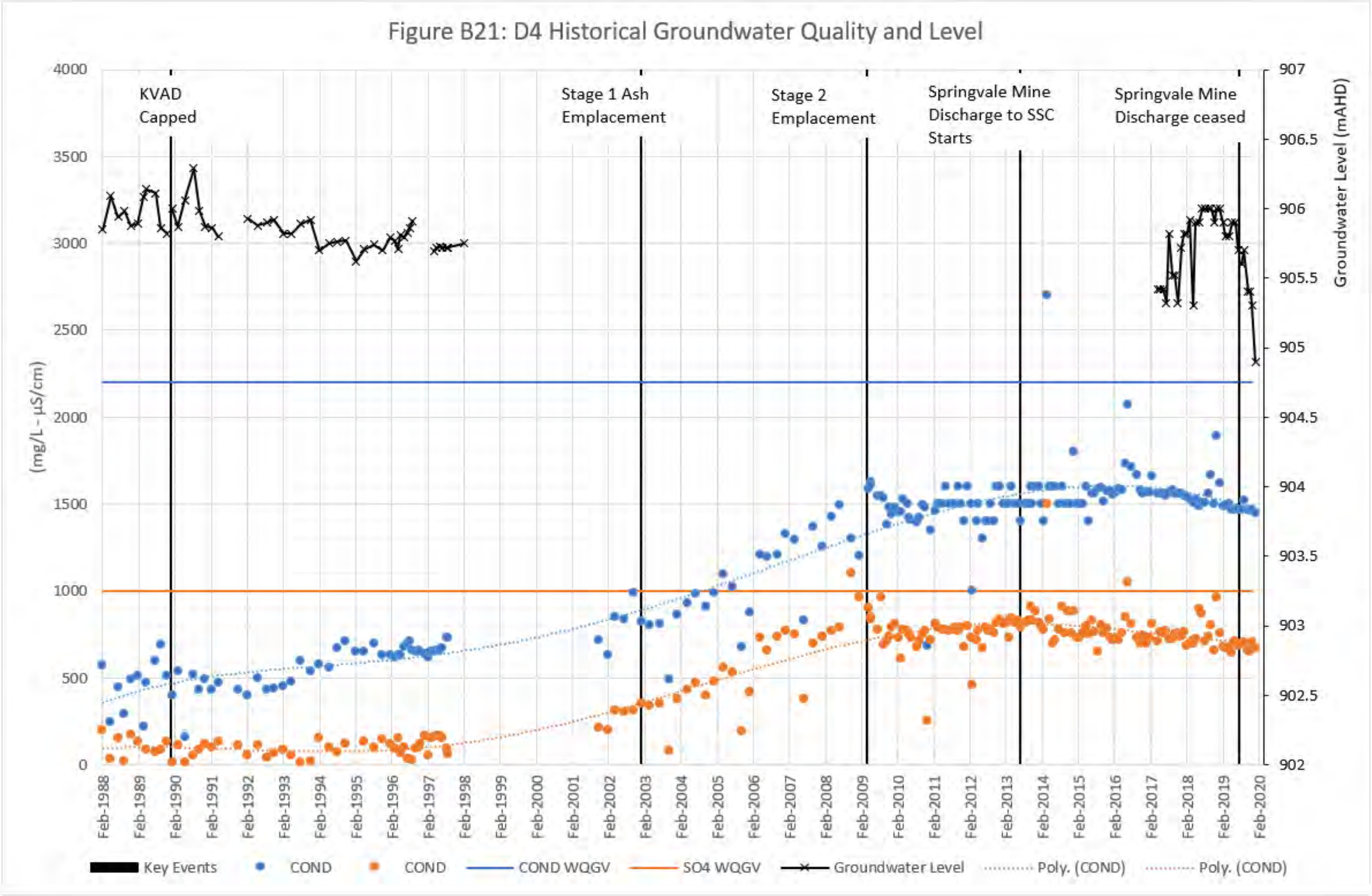


Figure B21: D4 Historical Groundwater Quality and Level

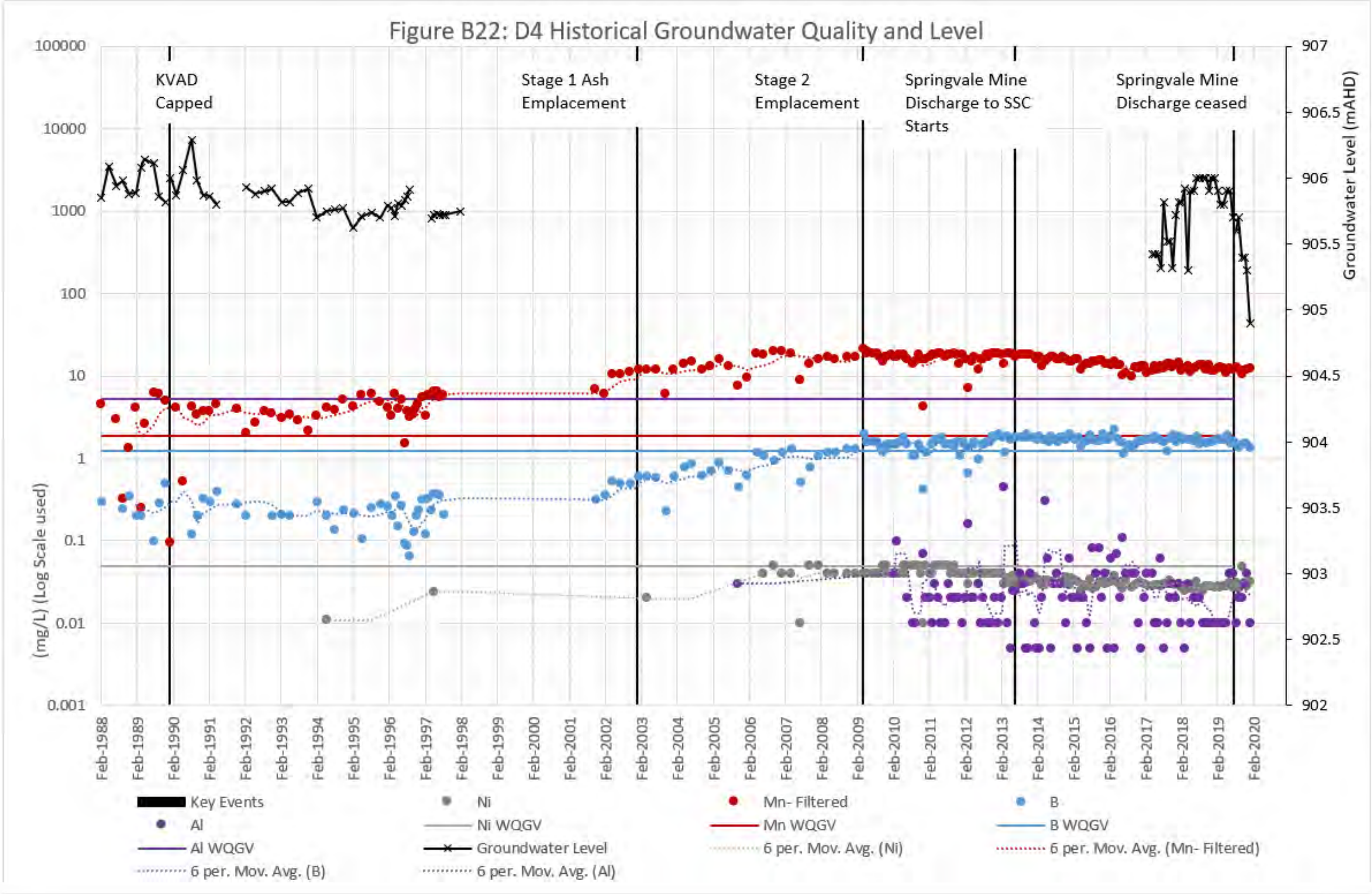


Figure B22: D4 Historical Groundwater Quality and Level

Figure B23: D1 Historical Groundwater Quality and Level

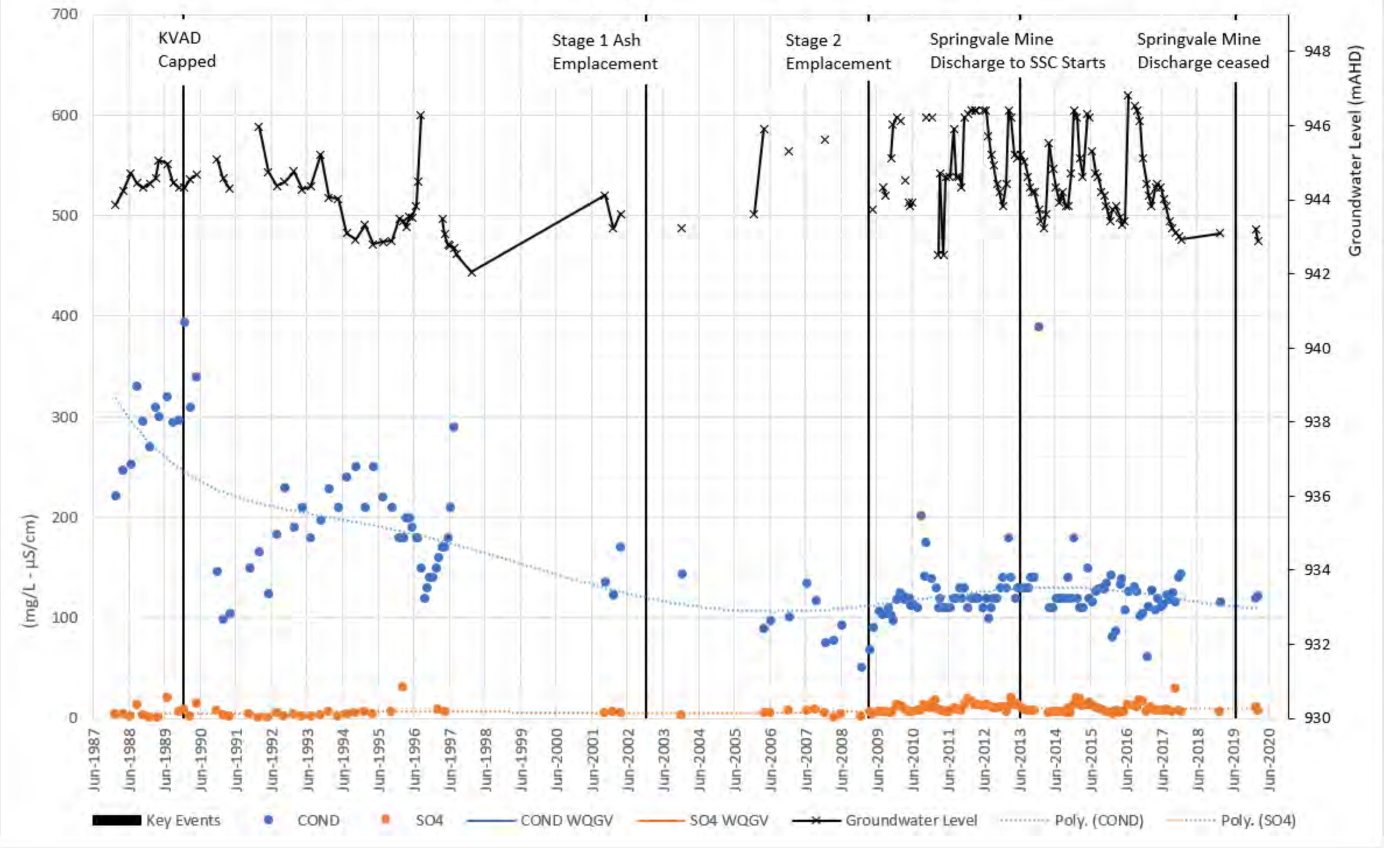
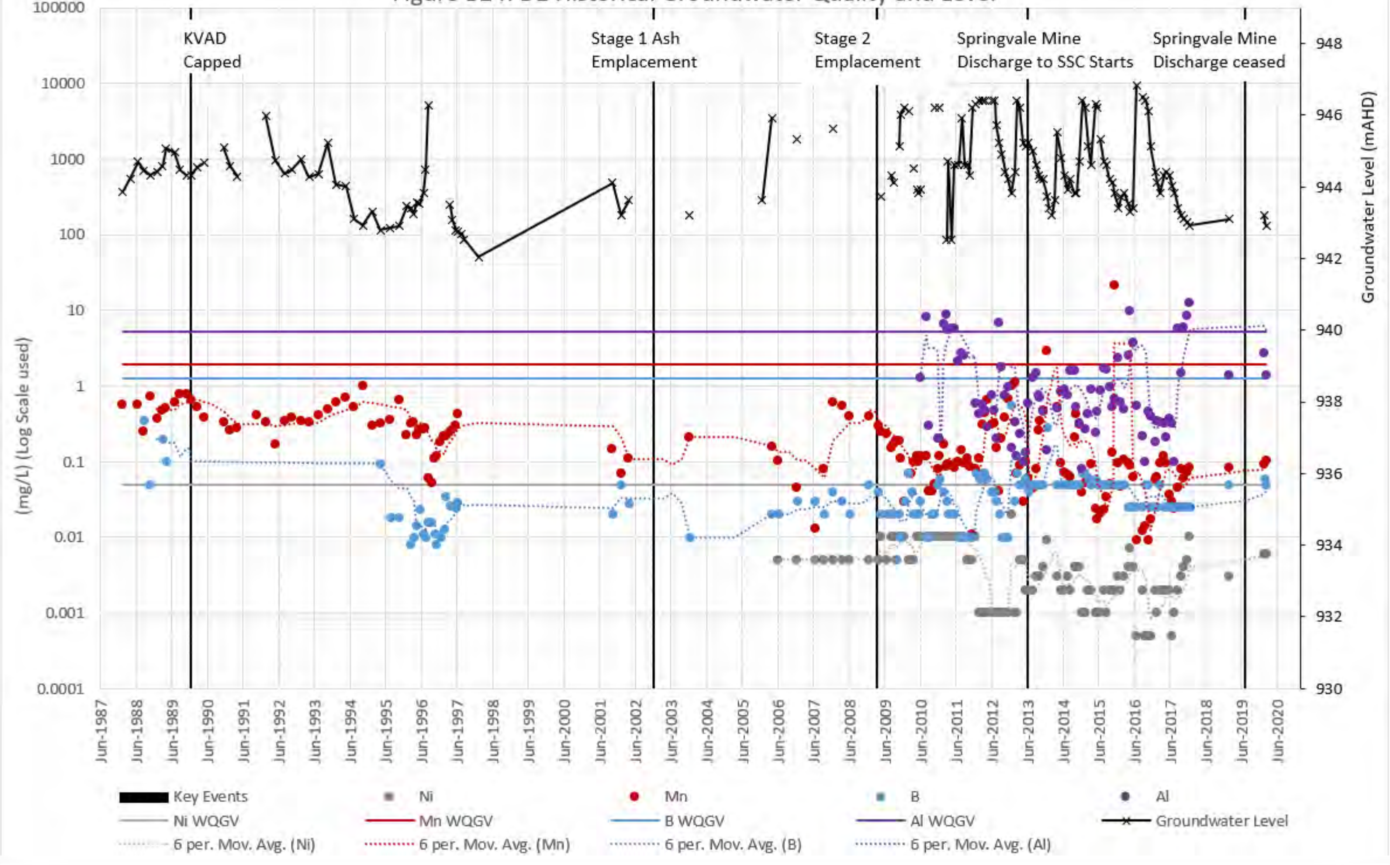


Figure B24: D1 Historical Groundwater Quality and Level



Appendix C

2019 – 2020 Surface Water / Groundwater Monitoring Results and Summary Statistics

41. Sawyers Swamp Creek Lower (WX7)

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
18/04/2019	8.53	1190	746	43.9	14.4	0.03	0.008	<0.001	0.012	ND	0.09	<0.0001	<0.001	<0.001	1	0.049	<0.00004	0.008	0.033	0.003	0.002	0.0005	<0.005
16/05/2019	8.7	1360	749	52.7	5	0.04	0.01	<0.001	0.017	ND	0.08	<0.0001	<0.001	<0.001	0.916	0.032	<0.00004	0.013	0.047	0.004	0.002	0.001	0.01
20/06/2019	8.73	1250	696	26.3	6.81	0.02	0.01	<0.001	0.016	ND	0.15	<0.0001	<0.001	<0.001	1.24	0.007	<0.00004	0.014	0.047	0.004	<0.001	0.0005	0.007
18/07/2019	7.82	1260	684	96.3	11.5	0.02	0.004	<0.001	0.024	ND	0.07	<0.0001	<0.001	<0.001	0.729	0.183	<0.00004	0.183	0.026	0.003	<0.001	<0.0002	<0.005
22/08/2019	7.78	1380	798	237	16.9	<0.01	0.002	<0.001	0.036	ND	0.22	<0.0001	<0.001	<0.001	0.785	0.291	<0.00004	0.236	0.019	0.004	<0.001	<0.0002	<0.005
19/09/2019	7.02	1010	593	344	19.6	0.09	0.003	<0.001	0.054	ND	0.55	0.0002	<0.001	<0.001	<1.00	0.087	<0.00004	1.6	0.006	0.056	0.001	0.0003	0.102
24/10/2019	7.44	1440	862	342	19.5	0.01	0.003	<0.001	0.06	ND	0.2	<0.0001	0.084	<0.001	0.552	0.299	<0.00004	0.463	0.02	0.010	<0.001	0.0003	0.006
20/02/2020	4.15	2390	2100	1360	25.5	14.8	0.002	<0.001	0.039	ND	0.93	0.0096	0.074	0.006	2.37	2.43	<0.00004	49	0.01	1.94	0.002	0.003	5.29
11/03/2020	4.23	1760	1290	711	16.9	5.92	<0.001	<0.001	0.031	ND	0.94	0.0041	<0.001	<0.001	<0.200	3.14	<0.00004	32	<0.001	1.25	<0.001	0.0013	2.69

41. Sawyers Swamp Creek Lower (WX7)

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	4.15	1010	593	26	5.00	0.01	0.002	<0.001	0.012	ND	0.070	<0.0001	<0.001	<0.001	0.6	0.007	<0.00004	0.008	0.006	0.003	<0.001	<0.0002	<0.005
Maximum	8.73	2390	2100	1360	25.50	14.80	0.010	<0.001	0.060	ND	0.940	<0.0001	<0.001	0.006	2.4	3.140	<0.00004	49.000	0.047	1.940	0.002	0.0030	5.290
Mean	7.16	1449	946	357	15.12	2.62	0.005	<0.001	0.032	ND	0.359	<0.0001	<0.001	<0.001	1.1	0.724	<0.00004	9.280	0.026	0.364	0.001	0.0004	0.006
Median	7.78	1360	749	237	16.90	0.04	0.004	<0.001	0.031	ND	0.200	<0.0001	<0.001	<0.001	0.9	0.183	<0.00004	0.236	0.023	0.004	0.001	0.0002	0.005
95th Percentile		2188	1841	1152	23.61	12.31	0.010	<0.001	0.058	ND	0.937	<0.0001	<0.001	<0.001	2.1	2.913	<0.00004	43.560	0.047	1.719	0.001	0.0010	0.009
20th Percentile	5.90																						
80th Percentile	8.60																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

93. SSC Downstream V-notch

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	8.57	1220	691	36.8	13.9	0.19	0.007	<0.001	0.007		0.1	<0.0001	<0.001	<0.001	0.793	0.008	<0.00004	0.02	0.033	0.005	<0.001	0.0004	0.006
15/05/2019	8.55	1340	949	49.7	5.48	0.35	0.01	<0.001	0.017		0.1	<0.0001	<0.001	<0.001	1.01	0.029	<0.00004	0.025	0.043	0.004	<0.001	0.0007	0.01
20/06/2019	8.69	1240	752	26.8	7.01	0.37	0.011	<0.001	0.018		0.12	<0.0001	<0.001	0.001	1.21	0.008	<0.00004	0.035	0.045	<0.001	<0.001	0.0005	<0.005

93. SSC Downstream V-notch

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	8.55	1220	691	26.8	5.48	0.19	0.007	<0.001	0.007	ND	0.100	<0.0001	<0.001	<0.001	0.8	0.008	<0.00004	0.020	0.033	0.004	<0.001	<0.0002	<0.005
Maximum	8.69	1340	949	49.7	13.90	0.37	0.011	<0.001	0.018	ND	0.120	<0.0001	<0.001	0.001	1.2	0.029	<0.00004	0.035	0.045	0.005	<0.001	0.0007	0.010
Mean	8.60	1267	797	37.8	8.80	0.30	0.009	<0.001	0.014	ND	0.107	<0.0001	<0.001	0.001	1.0	0.015	<0.00004	0.027	0.040	0.005	<0.001	0.0005	0.008
Median	8.57	1240	752	36.8	7.01	0.35	0.010	<0.001	0.017	ND	0.100	<0.0001	<0.001	0.001	1.0	0.008	<0.00004	0.025	0.043	0.005	<0.001	0.0005	0.008
95th Percentile		1332	933	48.7	13.35	0.37	0.011	<0.001	0.018	ND	0.118	<0.0001	<0.001	0.001	1.2	0.027	<0.00004	0.034	0.045	0.005	<0.001	0.0007	0.010
20th Percentile	8.56																						
80th Percentile	8.64																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

83. SSC Downstream KVAR

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	8.48	1220	720	75.6	15.1	0.3	0.007	<0.001	0.009	ND	0.12	<0.0001	<0.001	<0.001	0.977	0.032	<0.00004	0.018	0.03	0.007	<0.001	0.0004	0.008
15/05/2019	8.62	1340	756	51	5.39	0.55	0.011	<0.001	0.019	ND	0.16	<0.0001	<0.001	0.002	1.06	0.019	<0.00004	0.029	0.047	0.005	<0.001	0.0007	0.012
19/06/2019	8.65	1250	716	33.1	6.43	0.65	0.01	<0.001	0.009	ND	0.12	<0.0001	<0.001	0.001	1.32	0.026	<0.00004	0.038	0.037	<0.001	<0.001	0.0004	0.009
17/07/2019	8.31	1350	645	134	13	0.08	0.005	<0.001	0.03	ND	0.16	<0.0001	<0.001	<0.001	0.951	0.101	<0.00004	0.022	0.02	0.004	<0.001	0.0002	<0.005
21/08/2019	8.31	1530	921	295	20.5	0.1	0.003	<0.001	0.046	ND	0.17	<0.0001	<0.001	<0.001	0.662	0.04	<0.00004	0.036	0.015	0.004	<0.001	0.0002	<0.005
18/09/2019	7.68	1260	816	408	28.4	0.55	0.001	<0.001	0.058	ND	0.49	<0.0001	<0.001	<0.001	1.99	0.031	<0.00004	1.24	0.01	0.039	<0.001	0.0004	0.03
24/10/2019	3.64	4430	2800	2610	40.2	29.1	0.015	<0.001	0.079	ND	10.9	0.0015	0.004	0.007	6.34	4.14	0.0001	27	0.004	1.55	0.012	0.002	1.52
19/02/2020	3.1	2490	2180	1340	26.70	43..1	0.003	<0.001	0.026	ND	0.600	0	<0.001	0.038	2.65	21.5	<0.00004	25.7	<0.001	0.923	0.006	0.0063	3.18

83. SSC Downstream KVAR

Sample Date	pH	Cond (µs/cm)	TDS	SO4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	3.10	1220	645	33	5.39	0.08	0.001	<0.001	0.009	ND	0.120	<0.0001	<0.001	<0.001	0.7	0.019	<0.00004	0.018	0.004	0.004	<0.001	<0.0002	<0.005
Maximum	8.65	4430	2800	2610	40.20	29.10	0.015	<0.001	0.079	ND	10.900	<0.0001	<0.001	0.038	6.3	21.500	<0.00004	27.000	0.047	1.550	0.012	0.0063	3.180
Mean	7.10	1859	1194	618	19.47	4.48	0.007	<0.001	0.035	ND	1.590	<0.0001	<0.001	0.012	2.0	3.236	<0.00004	6.760	0.023	0.362	0.009	0.0013	0.793
Median	8.31	1345	786	215	17.80	0.55	0.006	<0.001	0.028	ND	0.165	<0.0001	<0.001	0.005	1.2	0.036	<0.00004	0.037	0.020	0.007	0.009	0.0004	0.021
95th Percentile		3887	2626	2254	36.90	22.27	0.014	<0.001	0.073	ND	8.016	<0.0001	<0.001	0.034	5.3	16.639	<0.00004	26.636	0.045	1.400	0.012	0.0051	2.848
20th Percentile	5.26																						
80th Percentile	8.56																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

225. SSCAD Spillway

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	7.99	1210	686	39.1	14.7	0.41	0.008	<0.001	0.007	ND	0.1	<0.0001	<0.001	<0.001	0.908	0.01	<0.00004	0.02	0.034	0.006	<0.001	0.0004	<0.005
15/05/2019	8.23	1360	972	54.9	5.65	0.3	0.009	<0.001	0.013	ND	0.11	<0.0001	<0.001	<0.001	1.11	0.016	<0.00004	0.023	0.041	0.004	<0.001	0.0008	0.012
19/06/2019	8.32	1240	717	30.2	6.27	0.55	0.01	<0.001	0.006	ND	0.1	<0.0001	<0.001	<0.001	1.31	0.004	<0.00004	0.043	0.039	<0.001	<0.001	0.0004	0.007
17/07/2019	7.91	1420	864	318	96.6	0.28	0.003	<0.001	0.099	ND	0.25	<0.0001	<0.001	0.001	0.266	0.015	<0.00004	0.455	0.004	0.015	<0.001	0.0002	0.014
18/09/2019	7.45	298	271	31.4	23.8	2.98	0.004	<0.001	0.055	ND	0.06	<0.0001	0.002	0.002	<1.00	0.755	<0.00004	0.048	0.002	0.004	0.004	0.0006	<0.005
23/10/2019	8.37	1970	1280	578	157	0.03	0.003	<0.001	0.076	ND	0.41	<0.0001	<0.001	0.006	0.354	0.081	<0.00004	0.011	0.008	0.025	<0.001	0.0004	<0.005
19/02/2020	8.03	382	402	46.5	23.7	4.76	0.005	<0.001	0.109	ND	0.14	<0.0001	0.003	0.004	<0.050	0.427	<0.00004	0.023	0.002	0.005	0.007	0.0011	<0.005

225. SSCAD Spillway

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	7.45	298	271	30	5.65	0.03	0.003	<0.001	0.006	ND	<0.05	<0.0001	<0.001	<0.001	0.3	0.004	<0.00004	0.011	0.002	0.004	<0.001	<0.0002	<0.005
Maximum	8.37	1970	1280	578	157.00	4.76	0.010	<0.001	0.109	ND	0.410	<0.0001	<0.001	0.006	1.3	0.755	<0.00004	0.455	0.041	0.025	0.007	0.0011	0.014
Mean	8.04	1126	742	157	46.82	1.33	0.006	<0.001	0.052	ND	0.167	<0.0001	<0.001	0.003	0.8	0.187	<0.00004	0.089	0.019	0.010	0.006	0.0006	0.011
Median	8.03	1240	717	47	23.70	0.41	0.005	<0.001	0.055	ND	0.110	<0.0001	<0.001	<0.001	0.9	0.016	<0.00004	0.023	0.008	0.006	0.006	0.0004	0.012
95th Percentile		1838	1206	516	142.50	4.33	0.010	<0.001	0.107	ND	0.372	<0.0001	<0.001	<0.001	1.3	0.676	<0.00004	0.357	0.041	0.023	0.007	0.0010	0.014
20th Percentile	7.93																						
80th Percentile	8.30																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

38. Sawyers Swamp Creek Ash Dam (SSCAD 38)

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	7.42	80	39	11.9	2.44	0.06	<0.001	<0.001	0.098	ND	0.09	<0.0001	<0.001	<0.001	0.481	0.045	<0.00004	0.003	0.029	<0.001	<0.001	0.0004	<0.005
15/05/2019	7.47	78	77	11.7	2.27	0.06	<0.001	<0.001	0.099	ND	0.1	<0.0001	<0.001	<0.001	0.474	0.032	<0.00004	<0.001	0.033	<0.001	<0.001	0.0004	<0.005
20/06/2019	6.97	82	47	13.7	2.3	0.03	<0.001	<0.001	0.093	ND	0.08	<0.0001	<0.001	0.002	0.613	0.022	<0.00004	0.008	0.042	<0.001	<0.001	0.0005	<0.005
17/07/2019	7.12	89	40	16.1	2.44	0.03	<0.001	<0.001	0.096	ND	0.13	<0.0001	<0.001	<0.001	0.646	0.021	<0.00004	<0.001	0.042	<0.001	<0.001	0.0003	<0.005
21/08/2019	7.15	94	48	18.2	2.5	0.05	<0.001	<0.001	0.09	ND	0.12	<0.0001	<0.001	<0.001	0.749	0.025	<0.00004	<0.001	0.05	<0.001	<0.001	0.0003	<0.005
18/09/2019	7.51	89	57	15.5	2.78	0.06	<0.001	<0.001	0.058	ND	0.07	<0.0001	<0.001	<0.001	<1.00	0.037	<0.00004	0.002	0.031	<0.001	<0.001	0.0004	<0.005
23/10/2019	8.28	106	72	18.9	3.8	0.12	<0.001	<0.001	0.079	ND	0.08	<0.0001	<0.001	<0.001	0.457	0.017	<0.00004	0.007	0.049	0.037	<0.001	0.0006	<0.005
20/11/2019	8.26	114	66	20.4	3.82	0.2	<0.001	<0.001	0.099	ND	0.13	<0.0001	<0.001	<0.001	0.152	0.034	<0.00004	0.006	0.055	<0.001	<0.001	0.0006	0.006
5/12/2019	8.44	111	101	19.8	3.88	0.13	<0.001	<0.001	0.101	ND	0.12	<0.0001	<0.001	<0.001	0.765	0.045	<0.00004	0.018	0.051	<0.001	<0.001	0.0008	<0.005
9/01/2020	9.01	134	92	22.8	4.55	0.15	<0.001	<0.001	0.144	ND	0.14	<0.0001	<0.001	<0.001	0.75	0.06	<0.00004	0.007	0.064	<0.001	<0.001	0.0009	<0.005
19/02/2020	8.04	110	73	15.7	5.32	0.09	<0.001	<0.001	0.065	ND	0.06	<0.0001	<0.001	<0.001	0.378	0.065	<0.00004	0.051	0.019	<0.001	<0.001	0.0005	<0.005
12/03/2020	8.38	109	68	13.5	4.51	0.09	<0.001	<0.001	0.08	ND	0.06	<0.0001	<0.001	<0.001	0.344	0.037	<0.00004	0.002	0.02	<0.001	<0.001	0.0006	<0.005

38. Sawyers Swamp Creek Ash Dam (SSCAD 38)

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	6.97	78	39	12	2.27	0.03	<0.001	<0.001	0.058	ND	0.060	<0.0001	<0.001	<0.001	0.2	0.017	<0.00004	0.002	0.019	0.037	<0.001	0.0003	<0.005
Maximum	9.01	134	101	23	5.32	0.20	<0.001	<0.001	0.144	ND	0.140	0.0000	0.001	0.002	0.8	0.065	<0.00004	0.051	0.064	0.037	<0.001	0.0009	0.006
Mean	7.84	100	65	17	3.38	0.09	<0.001	<0.001	0.092	ND	0.098	0.0005	<0.001	0.001	0.5	0.037	<0.00004	0.012	0.040	0.037	<0.001	0.0005	0.006
Median	7.78	100	67	16	3.29	0.08	<0.001	<0.001	0.095	ND	0.095	0.0002	<0.001	<0.001	0.5	0.036	<0.00004	0.007	0.042	0.037	<0.001	0.0005	0.006
95th Percentile		125	97	22	4.98	0.18	<0.001	<0.001	0.125	ND	0.136	0.0015	<0.001	<0.001	0.8	0.063	<0.00004	0.040	0.060	0.037	<0.001	0.0009	0.006
20th Percentile	7.20																						
80th Percentile	8.36																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

79. SSCAD V-notch

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	6.93	1000	602	362	18.9	0.08	<0.001	<0.001	0.053	ND	0.7	<0.0001	<0.001	<0.001	0.481	0.034	<0.00004	0.53	<0.001	0.003	<0.001	<0.0002	0.008
15/05/2019	7.22	2130	1800	1020	45.6	0.23	<0.001	<0.001	0.064	ND	1.71	<0.0001	<0.001	<0.001	0.23	0.046	<0.00004	0.48	<0.001	0.008	<0.001	0.0003	0.006
20/06/2019	6.71	2240	1700	1160	54.1	0.06	<0.001	<0.001	0.049	ND	1.37	<0.0001	<0.001	0.002	0.262	0.091	<0.00004	0.649	<0.001	0.004	<0.001	0.0004	<0.005
17/07/2019	7.06	2490	1820	1200	56.6	0.04	<0.001	<0.001	0.047	ND	1.74	<0.0001	<0.001	<0.001	0.238	0.047	<0.00004	0.405	<0.001	0.011	<0.001	0.0002	0.009
21/08/2019	6.97	2700	2240	1540	58.5	1.14	<0.001	<0.001	0.052	ND	1.79	0.0001	<0.001	<0.001	0.344	0.04	<0.00004	0.353	<0.001	0.022	<0.001	0.0004	0.01
19/09/2019	6.63	1990	1400	970	55.5	1.47	<0.001	<0.001	0.035	ND	1.21	0.0002	0.001	0.001	1.09	0.04	<0.00004	0.952	<0.001	0.03	0.001	0.0004	0.013
24/10/2019	7.01	3050	2570	1680	64.8	0.34	0.001	<0.001	0.045	ND	2.1	0.0003	<0.001	0.002	0.28	0.034	<0.00004	0.627	0.004	0.035	<0.001	0.0005	0.005
19/02/2020	6.72	1330	1020	623	23.6	10.8	0.003	<0.001	0.064	ND	1.19	0.0006	0.007	0.012	<0.100	0.035	<0.00004	3.06	<0.001	0.057	0.008	0.0013	0.035

79. SSCAD V-notch

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	6.63	1000	602	362	18.90	0.04	<0.001	<0.001	0.035	ND	0.700	<0.0001	<0.001	<0.001	0.2	0.034	<0.00004	0.353	<0.001	0.003	<0.001	<0.0002	<0.005
Maximum	7.22	3050	2570	1680	64.80	10.80	0.003	<0.001	0.064	ND	2.100	0.0006	<0.001	0.012	1.1	0.091	<0.00004	3.060	0.004	0.057	<0.001	0.0013	0.035
Mean	6.91	2116	1644	1069	47.20	1.77	0.002	<0.001	0.051	ND	1.476	0.0001	<0.001	0.004	0.4	0.046	<0.00004	0.882	0.004	0.021	<0.001	0.0005	0.012
Median	6.95	2185	1750	1090	54.80	0.29	0.002	<0.001	0.051	ND	1.540	0.0001	<0.001	0.002	0.3	0.040	<0.00004	0.579	0.004	0.017	<0.001	0.0004	0.009
95th Percentile		2952	2478	1641	63.04	8.19	0.003	<0.001	0.064	ND	2.013	0.0003	<0.001	0.011	0.9	0.079	<0.00004	2.470	0.004	0.051	<0.001	0.0011	0.030
20th Percentile	6.71																						
80th Percentile	7.04																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

80. West KVAD Wall Subsurface Right

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	2.91	4560	3300	2960	36.4	42	0.001	<0.001	<0.001	ND	13.4	0.0019	<0.001	<0.001	15.3	30.7	<0.00004	21.8	<0.001	2.33	<0.001	0.0011	3.34
15/05/2019	2.9	4470	3670	2730	30.4	50.1	0.001	<0.001	0.002	ND	9.55	0.0022	<0.001	<0.001	15.8	28.3	<0.00004	18.6	<0.001	2.51	<0.001	0.0013	3.6
19/06/2019	3	4450	2300	2760	38.6	47.2	<0.001	<0.001	0.002	ND	18.8	0.0022	<0.001	<0.001	20.8	34	<0.00004	17.8	<0.001	2.19	<0.001	0.0012	3.42
17/07/2019	2.98	4510	3510	2720	32.6	48.2	<0.001	<0.001	0.002	ND	13.8	0.002	<0.001	<0.001	12.7	33.4	<0.00004	21.8	<0.001	2.36	<0.001	0.0009	3.56
21/08/2019	2.96	4580	3850	2810	34.5	50	0.001	<0.001	0.002	ND	13.3	0.0022	<0.001	<0.001	13.6	34.8	<0.00004	23.3	<0.001	2.53	<0.001	0.0008	3.62
18/09/2019	3.29	3740	3120	2120	28	37.4	<0.001	<0.001	0.011	ND	9.98	0.0016	<0.001	<0.001	5.35	45.4	<0.00004	17.2	<0.001	1.64	0.003	0.001	2.57
24/10/2019	2.94	4760	3640	2620	34.9	42	<0.001	<0.001	0.002	ND	13.9	0.0019	<0.001	0.002	18.6	36.7	0.00006	19.6	<0.001	2.45	<0.001	0.0009	3.41
20/11/2019	2.89	4830	3900	2770	36.4	48.5	<0.001	<0.001	0.003	ND	15.1	0.002	<0.001	0.001	40.3	68.6	<0.00004	23.1	<0.001	2.66	<0.001	0.001	3.75
19/02/2020	2.9	4140	3030	2150	29.9	37.4	<0.001	<0.001	<0.001	ND	10.5	0.002	<0.001	<0.001	14.2	20.2	<0.00004	18.2	<0.001	1.99	<0.001	0.0014	3.07

80. West KVAD Wall Subsurface Right

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	2.89	3740	2300	2120	28.00	37.40	0.001	<0.001	<0.001	ND	9.6	0.0016	<0.001	<0.001	5.4	20.2	0.00006	17.2	<0.001	1.640	<0.001	0.0008	2.570
Maximum	3.29	4830	3900	2960	38.60	50.10	0.001	<0.001	0.011	ND	18.8	0.0022	<0.001	0.002	40.3	68.6	0.00006	23.3	<0.001	2.660	0.003	0.0014	3.750
Mean	2.97	4449	3369	2627	33.52	44.76	0.001	<0.001	0.003	ND	13.1	0.0020	<0.001	0.002	17.4	36.9	0.00006	20.2	<0.001	2.296	<0.001	0.0011	3.371
Median	2.94	4510	3510	2730	34.50	47.20	0.001	<0.001	0.002	ND	13.4	0.0020	<0.001	0.002	15.3	34.0	0.00006	19.6	<0.001	2.360	<0.001	0.0010	3.420
95th Percentile		4808	3884	2912	37.90	50.07	0.001	<0.001	0.009	ND	17.6	0.0022	<0.001	0.002	34.1	61.2	0.00006	23.2	<0.001	2.618	<0.001	0.0014	3.708
20th Percentile	2.90																						
80th Percentile	2.99																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

86. North Wall Collection

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	2.91	3820	3010	2450	19	33.8	0.006	<0.001	<0.001	ND	7.96	0.0004	0.003	0.002	66.6	30.6	<0.00004	12.9	<0.001	0.87	<0.001	0.0042	2.35
15/05/2019	2.86	3750	2910	2410	17.3	38.1	0.007	<0.001	<0.001	ND	6.42	0.0004	0.003	0.002	53.6	22	<0.00004	10.9	<0.001	0.973	<0.001	0.0054	2.63
19/06/2019	2.94	3850	1840	2050	23.8	36.4	0.005	<0.001	<0.001	ND	8.27	0.0004	0.003	0.002	39.3	23.6	<0.00004	11.9	<0.001	0.86	<0.001	0.0045	2.41
17/07/2019	2.93	4040	3130	2530	18.6	42.7	0.004	<0.001	<0.001	ND	8.66	0.0004	0.003	0.002	46	24.2	<0.00004	14.4	<0.001	1.02	<0.001	0.0034	2.87
21/08/2019	2.92	4340	3620	2500	21.8	46.4	0.006	<0.001	<0.001	ND	8.58	0.0004	0.004	<0.001	45.8	31.9	<0.00004	16.1	<0.001	1.2	<0.001	0.0046	3.17
18/09/2019	3.22	2270	1710	1130	9.65	19.5	0.003	<0.001	0.005	ND	3.71	0.0002	0.002	0.002	17.1	7.53	<0.00004	8.52	<0.001	0.47	0.003	0.003	1.31
23/10/2019	3.03	4720	4170	2860	26.7	50.8	0.005	<0.001	0.002	ND	10.2	0.0005	0.02	0.005	42.5	26.1	<0.00004	16.7	<0.001	1.32	0.001	0.0046	3.3
20/11/2019	2.92	5820	5520	3790	34.9	74.5	0.009	<0.001	<0.001	ND	14.1	0.0007	0.005	0.002	23.8	57.9	<0.00004	23.6	<0.001	1.76	<0.001	0.0054	4.75
19/02/2020	3.13	4030	3110	2220	24.4	48.4	0.007	<0.001	0.021	ND	7.62	0.0005	<0.001	0.014	39.9	5.58	<0.00004	14.2	<0.001	1	0.008	0.0124	2.91

86. North Wall Collection

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	2.86	2270	1710	1130	9.65	19.50	0.003	<0.001	0.002	ND	3.7	0.0002	0.002	0.002	17.1	5.6	<0.00004	8.5	<0.001	0.470	<0.001	0.0030	1.31
Maximum	3.22	5820	5520	3790	34.90	74.50	0.009	<0.001	0.021	ND	14.1	0.0007	0.020	0.014	66.6	57.9	<0.00004	23.6	<0.001	1.760	<0.001	0.0124	4.75
Mean	2.98	4071	3224	2438	21.79	43.40	0.006	<0.001	0.009	ND	8.4	0.0004	0.005	0.004	41.6	25.5	<0.00004	14.4	<0.001	1.053	<0.001	0.0053	2.86
Median	2.93	4030	3110	2450	21.80	42.70	0.006	<0.001	0.005	ND	8.3	0.0004	0.003	0.002	42.5	24.2	<0.00004	14.2	<0.001	1.000	<0.001	0.0046	2.87
95th Percentile		5468	5088	3492	32.28	66.92	0.008	<0.001	0.020	ND	12.9	0.0006	0.016	0.011	62.4	49.6	<0.00004	21.4	<0.001	1.619	<0.001	0.0102	4.29
20th Percentile	2.92																						
80th Percentile	3.07																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

87. Surface Water Runoff / West KVAD Wall Subsurface

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	3.13	5030	4460	3730	26.5	86.5	0.038	<0.001	<0.001	ND	10.7	0.0011	0.004	0.003	90.4	90.1	<0.00004	17.2	<0.001	1.45	<0.001	0.053	4.23
15/05/2019	3.05	5110	4030	3630	23.5	97.4	0.047	<0.001	<0.001	ND	7.53	0.0011	0.003	0.003	87.8	78.9	<0.00004	15.1	<0.001	1.62	<0.001	0.0642	4.66
19/06/2019	3.15	5150	3530	3510	30.4	81.7	0.022	<0.001	0.001	ND	11.4	0.001	0.003	0.002	66.7	114	<0.00004	15.7	<0.001	1.3	<0.001	0.0484	4.05
17/07/2019	3.13	5120	4400	4030	25.7	90.5	0.024	<0.001	<0.001	ND	11.2	0.0009	0.002	0.002	79.2	103	<0.00004	17.4	<0.001	1.5	<0.001	0.0337	4.44
21/08/2019	3.15	5150	4890	3310	25.7	102	0.034	<0.001	0.003	ND	10.4	0.0008	0.003	<0.001	62.9	115	<0.00004	18.3	<0.001	1.56	<0.001	0.0391	4.44
18/09/2019	3.19	5010	4640	3120	25	89.3	0.029	<0.001	0.001	ND	9.68	0.0008	0.003	0.002	24.6	109	<0.00004	17.4	<0.001	1.38	0.001	0.0493	4.08
23/10/2019	3.25	4960	4960	3180	25	82.8	0.019	<0.001	0.002	ND	10.7	0.0008	0.003	0.003	84.9	57.5	0.00005	14.4	<0.001	1.46	<0.001	0.0311	3.87
20/11/2019	3.09	4970	4780	3460	27.4	98.6	0.029	<0.001	0.006	ND	11.9	0.001	0.004	0.003	28.7	39.7	<0.00004	16.4	<0.001	1.54	<0.001	0.0137	4.31
19/02/2020	3.21	4330	3650	2440	26.3	93.7	0.024	<0.001	0.002	ND	8.54	0.0014	<0.001	0.006	53.2	1.52	<0.00004	14.3	<0.001	1.22	<0.001	0.07	3.79

87. Surface Water Runoff / West KVAD Wall Subsurface

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	3.05	4330	3530	2440	23.5	81.70	0.019	<0.001	0.001	ND	7.5	0.0008	0.002	0.002	24.6	2	<0.00004	14.3	<0.001	1.22	<0.001	0.014	3.79
Maximum	3.25	5150	4960	4030	30.4	102.00	0.047	<0.001	0.006	ND	11.9	0.0014	0.004	0.006	90.4	115	<0.00004	18.3	<0.001	1.62	<0.001	0.070	4.66
Mean	3.15	4981	4371	3379	26.2	91.39	0.030	<0.001	0.003	ND	10.2	0.0010	0.003	0.003	64.3	79	<0.00004	16.2	<0.001	1.45	<0.001	0.045	4.21
Median	3.15	5030	4460	3460	25.7	90.50	0.029	<0.001	0.002	ND	10.7	0.0010	0.003	0.003	66.7	90	<0.00004	16.4	<0.001	1.46	<0.001	0.048	4.23
95th Percentile		5150	4938	3934	29.44	100.91	0.044	<0.001	0.005	ND	11.7	0.0013	0.004	0.005	89.6	115	<0.00004	18.0	<0.001	1.60	<0.001	0.068	4.59
20th Percentile	3.11																						
80th Percentile	3.20																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

40. Lidsdale Cut (WX5)

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	3.07	3400	2920	2320	21.3	93.1	0.015	<0.001	0.007	ND	9.83	0.0203	0.007	0.015	37.6	10.6	<0.00004	11.8	<0.001	0.999	0.01	0.14	2.24
19/06/2019	3.15	4680	4330	3470	30.5	163	0.016	<0.001	0.004	ND	20	0.0433	0.018	0.023	28.4	13.9	<0.00004	15.1	<0.001	1.26	0.009	0.1	3.09
17/07/2019	3.1	4940	4000	4580	25.4	185	0.021	<0.001	0.004	ND	17.5	0.0481	0.019	0.028	39.6	10.6	<0.00004	17	<0.001	1.6	0.006	0.11	3.35
18/09/2019	3.19	4890	4650	3180	37	181	0.024	<0.001	0.005	ND	15.1	0.0417	0.017	0.029	13.2	9.46	<0.00004	19.2	<0.001	1.53	0.005	0.1	3.53
20/11/2019	3.39	3100	2740	2120	24	74.7	0.008	<0.001	0.016	ND	8.86	0.0131	0.002	0.006	16.1	1.54	<0.00004	11.1	<0.001	1	0.006	0.04	2.02
19/02/2020	3.28	2340	1790	1180	16.4	26.8	0.004	<0.001	0.047	ND	5.2	0.0045	0.056	0.008	10.1	5.2	<0.00004	8.86	0.007	0.798	0.005	0.02	1.42

40. Lidsdale Cut (WX5)

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	3.07	2340	1790	1180	16.40	26.80	0.004	<0.001	0.004	ND	5.20	0.005	0.002	0.006	10.1	1.540	<0.00004	8.860	<0.001	0.798	0.005	0.0200	1.420
Maximum	3.39	4940	4650	4580	37.00	185.00	0.024	<0.001	0.047	ND	20.00	0.048	0.056	0.029	39.6	13.900	<0.00004	19.200	<0.001	1.600	0.010	0.1400	3.530
Mean	3.20	3892	3405	2808	25.77	120.60	0.015	<0.001	0.014	ND	12.75	0.029	0.020	0.018	24.2	8.550	<0.00004	13.843	<0.001	1.198	0.007	0.0850	2.608
Median	3.17	4040	3460	2750	24.70	128.05	0.016	<0.001	0.006	ND	12.47	0.031	0.018	0.019	22.3	10.030	<0.00004	13.450	<0.001	1.130	0.006	0.1000	2.665
95th Percentile		4930	4586	4358	35.70	184.20	0.023	<0.001	0.041	ND	19.50	0.047	0.049	0.029	39.2	13.240	<0.00004	18.760	<0.001	1.586	0.010	0.1340	3.494
20th Percentile	3.10																						
80th Percentile	3.28																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

39. Dump Creek (WX11)

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
18/04/2019	4.07	1240	862	587	25.3	2.17	<0.001	<0.001	0.025	ND	2.08	<0.0001	<0.001	<0.001	0.83	10.7	<0.00004	4.24	<0.001	0.274	<0.001	<0.0002	0.488
16/05/2019	6.04	1130	836	503	24.7	0.68	<0.001	<0.001	0.017	ND	1.7	0.0002	<0.001	0.003	0.337	17.4	<0.00004	4.09	<0.001	0.086	<0.001	<0.0002	0.089
20/06/2019	5.31	1200	988	592	27.4	2.72	<0.001	<0.001	0.022	ND	2.17	0.0002	<0.001	0.002	1.26	3.1	<0.00004	3.58	<0.001	0.258	<0.001	0.0002	0.472
18/07/2019	4.39	1190	804	557	26.1	2.98	<0.001	<0.001	0.018	ND	2.05	0.0002	<0.001	0.003	0.489	1.3	<0.00004	4.1	<0.001	0.317	<0.001	0.0002	0.631
22/08/2019	3.64	1380	957	658	28.1	3.68	<0.001	<0.001	0.02	ND	2.08	0.0004	<0.001	0.006	0.967	5.21	<0.00004	5.19	<0.001	0.388	0.002	0.0003	0.87
19/09/2019	3.66	1020	678	419	23.4	2.6	<0.001	<0.001	0.021	ND	1.04	0.0009	<0.001	0.008	<1.00	1.62	<0.00004	3.76	<0.001	0.214	0.002	0.0003	0.878
24/10/2019	3.91	1410	946	610	30.6	1.09	<0.001	<0.001	0.025	ND	2.09	<0.0001	<0.001	0.002	0.104	28	<0.00004	4.28	<0.001	0.162	0.002	0.0003	0.042
21/11/2019	6	2110	1630	1030	44.6	0.34	0.001	<0.001	0.022	ND	3.69	<0.0001	<0.001	0.002	0.675	20.8	<0.00004	8.09	<0.001	0.047	0.001	<0.0002	0.017
6/12/2019	6.1	2140	1880	1110	48.4	0.18	<0.001	<0.001	0.024	ND	3.62	<0.0001	<0.001	<0.001	0.425	3.73	<0.00004	7.93	<0.001	0.024	0.001	0.0003	0.016
20/02/2020	3.31	1360	680	576	19.9	4.62	0.001	<0.001	0.024	ND	1.9	0.0017	0.002	0.009	1.64	10.4	<0.00004	5.18	<0.001	0.674	0.008	0.0008	1.82
11/03/2020	3.25	1350	700	430	17	3.66	0.001	<0.001	0.025	ND	1.99	0.0008	<0.001	0.002	0.599	6.73	<0.00004	5.04	<0.001	0.484	0.006	0.0006	1.18

39. Dump Creek (WX11)

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	3.25	1020	678	419	17.00	0.18	<0.001	<0.001	0.017	ND	1.04	0.0002	<0.001	0.002	0.1	1.300	<0.00004	3.580	<0.001	0.024	0.001	0.0002	0.016
Maximum	6.10	2140	1880	1110	48.40	4.62	0.001	<0.001	0.025	ND	3.69	0.0017	0.001	0.009	1.6	28.000	<0.00004	8.090	<0.001	0.674	0.008	0.0008	1.820
Mean	4.52	1412	996	643	28.68	2.25	0.001	<0.001	0.022	ND	2.22	0.0006	<0.001	0.004	0.7	9.908	<0.00004	5.044	<0.001	0.266	0.003	0.0004	0.591
Median	4.07	1350	862	587	26.10	2.60	0.001	<0.001	0.022	ND	2.08	0.0004	<0.001	0.003	0.6	6.730	<0.00004	4.280	<0.001	0.258	0.002	0.0003	0.488
95th Percentile		2128	1780	1078	46.88	4.24	0.001	<0.001	0.025	ND	3.66	0.0015	<0.001	0.009	1.5	25.120	<0.00004	8.026	<0.001	0.598	0.008	0.0007	1.564
20th Percentile	3.64																						
80th Percentile	6.00																						

36. Groundwater Bore WGM1/D5

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	insufficient volume to sample																						
16/05/2019	4.48	434	295	170	9.08	5.53	0.001	<0.001	0.035	ND	0.83	0.0014	0.002	0.008	0.135	2.32	<0.00004	2.02	<0.001	0.125	0.013	0.0009	0.277
20/06/2019	4.18	466	340	187	12.4	4.07	<0.001	<0.001	0.024	ND	0.76	0.0011	<0.001	0.005	0.326	1.68	<0.00004	1.81	<0.001	0.114	0.005	0.0009	0.293

36. Groundwater Bore WGM1/D5

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	4.18	434	295	170	9.1	4.07	0.001	<0.001	0.024	ND	0.76	0.0011	<0.001	0.005	0.14	1.68	<0.00004	1.81	<0.001	0.11	0.005	0.0009	0.28
Maximum	4.48	466	340	187	12.4	5.53	0.001	<0.001	0.035	ND	0.83	0.0014	0.001	0.008	0.33	2.32	0.00000	2.02	<0.001	0.13	0.013	0.0009	0.29
Mean	4.33	450	318	179	10.7	4.80	0.001	<0.001	0.030	ND	0.80	0.0013	<0.001	0.007	0.23	2.00	<0.00004	1.92	<0.001	0.12	0.009	0.0009	0.29
Median	4.33	450	318	179	10.7	4.80	0.001	<0.001	0.030	ND	0.80	0.0013	<0.001	0.007	0.23	2.00	<0.00004	1.92	<0.001	0.12	0.009	0.0009	0.29
95th Percentile		465	338	186	12.3	5.47	0.001	<0.001	0.035	ND	0.83	0.0014	<0.001	0.008	0.32	2.29	<0.00004	2.01	<0.001	0.12	0.013	0.0009	0.29
20th Percentile	4.24																						
80th Percentile	4.42																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

37. Groundwater Bore WGM1/D6

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
18/04/2019	4.81	2020	1790	1230	50.3	1.3	0.001	<0.001	0.012	ND	1.32	<0.0001	0.003	0.002	0.229	259	<0.00004	11.8	<0.001	0.292	0.001	0.0003	0.444
16/05/2019	4.54	1980	1990	1140	42.2	1.98	<0.001	<0.001	0.013	ND	1.18	0.0004	0.003	0.004	0.103	192	<0.00004	9.6	<0.001	0.348	0.004	0.0002	0.643
20/06/2019	4.38	2090	1940	1320	46.4	2.27	<0.001	<0.001	0.014	ND	1.35	0.0006	0.002	0.006	0.147	235	<0.00004	11.7	<0.001	0.321	0.005	0.0002	0.562
18/07/2019	4.43	2050	1590	1210	45	2.27	<0.001	<0.001	0.014	ND	1.46	0.0005	0.003	0.005	0.154	214	<0.00004	11.4	<0.001	0.35	0.005	<0.0002	0.72
19/09/2019	3.83	2380	2080	1340	59.5	5.85	<0.001	<0.001	0.015	ND	1.25	0.0012	0.002	0.018	<1.00	234	<0.00004	12.9	<0.001	0.508	0.01	0.0005	1.28
24/10/2019	4.4	2210	2040	1300	48.3	2.51	<0.001	<0.001	0.013	ND	1.4	0.0004	0.003	0.005	0.119	214	0.00008	10.6	<0.001	0.412	0.004	0.0002	0.711
21/11/2019	4.77	2100	1910	1260	42.7	17	0.017	<0.001	0.078	ND	1.47	0.0031	0.028	0.08	<1.00	251	0.00006	12.2	0.002	0.606	0.074	0.0022	3.2
10/01/2020	4.6	2120	1930	1490	45.5	2.68	0.001	<0.001	0.024	ND	1.36	0.0005	0.004	0.009	0.574	256	<0.00004	12.7	<0.001	0.333	0.007	0.0004	0.672
20/02/2020	4.21	1920	1660	1030	43.4	4.36	<0.001	<0.001	0.017	ND	0.9	0.0011	<0.001	0.01	<0.200	167	<0.00004	8.52	<0.001	0.464	0.013	0.0005	1.39
12/03/2020	4.72	2220	1990	1010	39.3	4.96	0.004	<0.001	0.021	ND	1.43	0.0012	0.005	0.015	<0.200	254	<0.00004	12	<0.001	0.498	0.018	0.0014	1.61

37. Groundwater Bore WGM1/D6

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	3.66	1920	1590	1010	39.3	1.30	<0.001	<0.001	0.012	ND	0.90	0.0004	0.002	0.002	<0.100	167.00	<0.00004	8.52	<0.001	0.29	0.001	0.0002	0.44
Maximum	4.51	2380	2080	1490	59.5	17.00	0.017	<0.001	0.078	ND	1.47	0.0031	0.028	0.080	0.57	259.00	0.00008	12.90	0.002	0.61	0.074	0.0022	3.20
Mean	4.12	2109	1892	1233	46.3	4.52	0.006	<0.001	0.022	ND	1.31	0.0010	0.006	0.015	0.22	227.60	0.00007	11.34	0.002	0.41	0.014	0.0007	1.12
Median	4.13	2095	1935	1245	45.3	2.60	0.003	<0.001	0.015	ND	1.36	0.0006	0.003	0.008	0.15	234.50	<0.00004	11.75	0.002	0.38	0.006	0.0004	0.72
95th Percentile		2322	2066	1436	56.2	12.99	0.015	<0.001	0.059	ND	1.47	0.0025	0.021	0.058	0.51	257.92	<0.00004	12.83	0.002	0.57	0.054	0.0019	2.63
20th Percentile	3.99																						
80th Percentile	4.29																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

77. Groundwater Bore AP09

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	6.04	2250	1620	1160	36.1	0.36	0.052	<0.001	0.018	ND	3.22	<0.0001	<0.001	<0.001	2.03	60.2	<0.00004	6.1	0.178	0.787	<0.001	0.0002	0.598
15/05/2019	5.99	2340	1750	1210	32	0.42	0.057	<0.001	0.02	ND	2.61	0.0001	<0.001	<0.001	2.39	63.8	<0.00004	5.91	0.207	0.907	<0.001	0.0004	0.701
20/06/2019	6.04	2270	1590	1160	35.9	0.34	0.057	<0.001	0.022	ND	2.87	<0.0001	<0.001	<0.001	0.896	62.5	<0.00004	5.56	0.21	0.705	<0.001	0.0003	0.518
17/07/2019	6	2440	1730	1310	34.6	0.48	0.06	<0.001	0.02	ND	2.99	0.0001	<0.001	<0.001	3.96	74	<0.00004	7.18	0.206	0.825	<0.001	0.0002	0.665
21/08/2019	6	2380	1820	1210	38.3	0.32	0.052	<0.001	0.023	ND	2.75	<0.0001	0.001	<0.001	1.2	73.8	<0.00004	7.34	0.188	0.804	<0.001	0.0003	0.512
19/09/2019	6.09	2320	1770	1110	37	0.29	0.048	<0.001	0.02	ND	2.65	<0.0001	<0.001	<0.001	1.3	74.9	<0.00004	7.01	0.163	0.667	<0.001	0.0003	0.455
24/10/2019	5.98	2600	2100	1370	36.8	0.52	0.043	<0.001	0.018	ND	3.36	<0.0001	<0.001	<0.001	2.05	68.5	<0.00004	6.75	0.229	0.932	<0.001	0.0005	0.619
21/11/2019	5.95	2610	2100	1400	39.2	0.51	0.05	<0.001	0.02	ND	3.23	0.0001	<0.001	<0.001	9.88	85.8	<0.00004	7.82	0.187	0.842	<0.001	0.0004	0.587
20/02/2020	6.01	253	1940	1250	39.4	0.54	0.047	<0.001	0.018	ND	2.77	0.0003	<0.001	<0.001	<0.200	71.3	<0.00004	8.43	0.213	0.737	<0.001	0.0008	0.637

77. Groundwater Bore AP09

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	5.95	253	1590	1110	32.0	0.29	0.043	<0.001	0.018	ND	2.61	<0.0001	<0.001	<0.001	0.90	60.20	<0.00004	5.56	0.16	0.67	<0.001	0.0002	0.46
Maximum	6.09	2610	2100	1400	39.4	0.54	0.060	<0.001	0.023	ND	3.36	0.0003	0.001	<0.001	9.88	85.80	<0.00004	8.43	0.23	0.93	<0.001	0.0008	0.70
Mean	6.01	2163	1824	1242	36.6	0.42	0.052	<0.001	0.020	ND	2.94	0.0002	<0.001	<0.001	2.96	70.53	<0.00004	6.90	0.20	0.80	<0.001	0.0004	0.59
Median	6.00	2340	1770	1210	36.8	0.42	0.052	<0.001	0.020	ND	2.87	0.0001	<0.001	<0.001	2.04	71.30	<0.00004	7.01	0.21	0.80	<0.001	0.0003	0.60
95th Percentile		2607	2100	1390	39.3	0.53	0.059	<0.001	0.023	ND	3.32	0.0003	<0.001	<0.001	8.22	82.31	<0.00004	8.23	0.22	0.92	<0.001	0.0007	0.69
20th Percentile	5.99																						
80th Percentile	6.04																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

78. Groundwater Bore AP17

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
18/04/2019	3.72	5390	5240	4220	25.7	125	0.094	<0.001	0.007		13.8	0.002	0.008	0.006	82	164	<0.00004	15.6	0.002	1.6	<0.001	0.11	5.15
16/05/2019	3.67	5460	5540	3980	22.8	132	0.11	<0.001	0.009		11.5	0.0023	0.01	0.007	86.9	137	<0.00004	13.8	0.002	1.83	<0.001	0.126	5.73
20/06/2019	4.07	5580	5710	4330	27.9	132	0.058	<0.001	0.018		19.5	0.002	0.01	0.011	67.3	170	<0.00004	14.2	0.005	1.51	<0.001	0.0988	5.04
18/07/2019	3.72	5560	5340	4200	22.3	142	0.063	<0.001	0.012		14.6	0.0019	0.01	0.011	62.1	160	<0.00004	16.2	0.003	1.66	<0.001	0.0652	5.45
22/08/2019	3.26	5600	5710	3910	26.5	154	0.088	<0.001	0.005		13.1	0.0019	0.012	0.012	62.7	112	<0.00004	16.6	0.002	1.79	<0.001	0.0806	5.52
19/09/2019	3.09	5580	5390	4210	28.4	142	0.073	<0.001	0.001		12.9	0.002	0.01	0.01	18.4	71	<0.00004	16.1	<0.001	1.58	0.003	0.0959	5.13
24/10/2019	3.38	5650	5840	3900	22	128	0.047	<0.001	0.006		13.2	0.0019	0.012	0.009	79.7	116	0.00008	13.5	<0.001	1.68	<0.001	0.0601	4.91
21/11/2019	3.22	5580	5770	3770	23.8	144	0.065	<0.001	0.004		14.5	0.0021	0.014	0.008	7.47	107	<0.00004	15	0.003	1.74	0.002	0.0908	5.43
20/02/2020	3.65	5590	5420	3080	20.2	155	0.062	<0.001	0.009		13.1	0.0019	0.004	0.007	59.2	142	<0.00004	15	0.002	1.68	<0.001	0.151	5.69

78. Groundwater Bore AP17

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	3.09	5390	5240	3080	20.2	125	0.047	<0.001	0.001	ND	11.5	0.0019	<0.001	0.006	7.47	71	<0.00004	13.5	0.00	1.51	<0.001	0.060	4.91
Maximum	4.07	5650	5840	4330	28.4	155	0.110	<0.001	0.018	ND	19.5	0.0023	0.001	0.012	86.90	170	<0.00004	16.6	0.01	1.83	0.003	0.151	5.73
Mean	3.53	5554	5551	3956	24.4	139	0.073	<0.001	0.008	ND	14.0	0.0020	<0.001	0.009	58.42	131	<0.00004	15.1	0.00	1.67	0.003	0.098	5.34
Median	3.65	5580	5540	3980	23.8	142	0.065	<0.001	0.007	ND	13.2	0.0020	<0.001	0.009	62.70	137	<0.00004	15.0	0.00	1.68	<0.001	0.096	5.43
95th Percentile		5634	5818	4295	28.2	155	0.105	<0.001	0.016	ND	17.9	0.0022	<0.001	0.012	85.33	168	<0.00004	16.5	0.00	1.82	<0.001	0.143	5.72
20th Percentile	3.24																						
80th Percentile	3.72																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

94. KVAD Seepage

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	3.24	5300	5060	4840	30	224	0.037	<0.001	0.011	ND	18.6	0.0619	0.024	0.051	59.7	23	<0.00004	19.1	<0.001	1.78	0.002	0.0446	3.95
15/05/2019	3.28	5080	5200	4340	28.9	208	0.041	<0.001	0.013	ND	13.8	0.0616	0.028	0.061	50.4	21	<0.00004	15.8	0.003	1.88	0.003	0.0464	4.05
19/06/2019	3.35	5430	5580	4270	37.4	236	0.022	<0.001	0.011	ND	25.2	0.0677	0.03	0.047	28.4	24.3	<0.00004	17.3	0.001	1.5	0.003	0.0426	3.61
17/07/2019	3.33	5530	4230	4790	26.9	262	0.028	<0.001	0.011	ND	20.8	0.07	0.028	0.059	59.8	26.8	<0.00004	20.1	0.001	1.83	0.003	0.0335	4.29
18/09/2019	3.31	3720	3040	2050	29.6	33.3	0.002	<0.001	0.022	ND	8.99	0.005	0.004	0.021	5.45	46	<0.00004	20	<0.001	1.81	0.006	0.0031	2.88
23/10/2019	4.04	4430	4500	2850	38.2	48.8	0.043	<0.001	0.125	ND	13.6	0.0013	0.017	0.023	35	159	0.00008	22.6	0.556	2.24	0.047	0.0027	2.85
20/11/2019	2.89	4650	4110	2900	38.4	41	0.003	<0.001	0.004	ND	13.6	0.0036	<0.001	0.004	24.5	51	<0.00004	24.4	<0.001	2.7	0.003	0.003	3.93
19/02/2020	3	4040	3350	2220	33.5	33.5	0.002	<0.001	0.003	ND	10.4	0.0028	<0.001	0.004	18.9	30.2	<0.00004	19.7	<0.001	2.04	0.002	0.0046	3.2

94. KVAD Seepage

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	2.89	3720	3040	2050	26.9	33.30	0.002	<0.001	0.003	ND	8.99	0.0013	<0.001	0.004	5.45	21.00	<0.00004	15.80	<0.001	1.50	0.002	0.0027	2.85
Maximum	4.04	5530	5580	4840	38.4	262.00	0.043	<0.001	0.125	ND	25.20	0.0700	0.001	0.061	59.80	159.00	<0.00004	24.40	0.556	2.70	0.047	0.0464	4.29
Mean	3.31	4773	4384	3533	32.9	135.83	0.022	<0.001	0.025	ND	15.62	0.0342	<0.001	0.034	35.27	47.66	<0.00004	19.88	0.140	1.97	0.009	0.0226	3.60
Median	3.30	4865	4365	3585	31.8	128.40	0.025	<0.001	0.011	ND	13.70	0.0333	<0.001	0.035	31.70	28.50	<0.00004	19.85	<0.001	1.86	0.003	0.0191	3.77
95th Percentile		5502	5474	4826	38.3	254.72	0.042	<0.001	0.096	ND	23.97	0.0694	<0.001	0.060	59.77	128.76	<0.00004	23.90	<0.001	2.57	0.036	0.0459	4.22
20th Percentile	3.10																						
80th Percentile	3.34																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

33. Groundwater Bore WGM1/D2

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	4.53	348	208	118	23.1	0.11	<0.001	<0.001	0.025	ND	0.06	<0.0001	<0.001	<0.001	0.019	0.021	<0.00004	0.287	<0.001	0.033	<0.001	<0.0002	0.054
16/05/2019	4.26	366	348	113	20.5	0.14	<0.001	<0.001	0.028	ND	0.1	0.0002	<0.001	<0.001	<0.100	0.033	<0.00004	0.338	<0.001	0.039	<0.001	<0.0002	0.05
20/06/2019	3.89	496	322	160	29	0.2	<0.001	<0.001	0.032	ND	0.13	0.0002	<0.001	0.002	0.038	0.836	<0.00004	0.518	<0.001	0.054	0.001	0.0003	0.087
18/07/2019	3.73	540	317	168	31.7	0.21	<0.001	<0.001	0.03	ND	0.16	<0.0001	<0.001	<0.001	<0.100	0.45	<0.00004	0.577	<0.001	0.058	0.002	<0.0002	0.1
22/08/2019	3.59	575	294	181	36.3	0.19	<0.001	<0.001	0.03	ND	0.18	<0.0001	<0.001	<0.001	0.015	0.144	0.00004	0.638	<0.001	0.066	0.002	<0.0002	0.1
19/09/2019	4.68	293	170	103	14.1	0.12	<0.001	<0.001	0.032	ND	<0.05	<0.0001	<0.001	<0.001	1.1	0.036	<0.00004	0.259	<0.001	0.028	<0.001	<0.0002	0.038
24/10/2019	3.87	527	444	150	32.4	0.16	<0.001	<0.001	0.028	ND	0.12	0.0001	<0.001	0.002	0.012	0.287	<0.00004	0.504	<0.001	0.107	0.001	<0.0002	0.074
21/11/2019	3.56	586	306	161	34	0.43	<0.001	<0.001	0.032	ND	0.17	0.0001	<0.001	0.001	<0.500	0.31	<0.00004	0.62	<0.001	0.069	0.002	<0.0002	0.104
5/12/2019	3.58	602	390	185	37.4	0.26	<0.001	<0.001	0.03	ND	0.16	0.0001	<0.001	<0.001	<0.050	0.508	0.00012	0.634	<0.001	0.065	0.002	<0.0002	0.1
10/01/2020	3.53	620	425	183	37.8	0.22	<0.001	<0.001	0.029	ND	0.16	0.0002	<0.001	<0.001	0.064	0.139	<0.00004	0.648	<0.001	0.07	0.002	<0.0002	0.118
19/02/2020	4.04	303	212	89.7	14.1	0.37	<0.001	<0.001	0.03	ND	<0.05	<0.0001	<0.001	<0.001	<0.050	0.021	<0.00004	0.241	<0.001	0.021	<0.001	<0.0002	0.033
11/03/2020	4.46	290	159	78.6	12.2	0.18	<0.001	<0.001	0.032	ND	<0.05	0.0001	<0.001	<0.001	<0.010	0.015	<0.00004	0.245	<0.001	0.028	<0.001	0.0002	0.034

33. Groundwater Bore WGM1/D2

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	3.53	290	159	79	12.2	0.11	<0.001	<0.001	0.025	ND	<0.05	0.0001	<0.001	<0.001	<0.010	0.02	<0.00004	0.24	<0.001	0.02	<0.001	<0.0002	0.03
Maximum	4.68	620	444	185	37.8	0.43	<0.001	<0.001	0.032	ND	0.18	0.0002	0.001	0.002	0.05	0.84	<0.00004	0.65	<0.001	0.11	0.002	0.0003	0.12
Mean	3.98	462	300	141	26.9	0.22	<0.001	<0.001	0.030	ND	0.14	0.0001	0.002	0.002	0.02	0.23	<0.00004	0.46	<0.001	0.05	0.002	0.0003	0.07
Median	3.88	512	312	155	30.4	0.20	<0.001	<0.001	0.030	ND	0.16	0.0001	<0.001	<0.001	0.01	0.14	<0.00004	0.51	<0.001	0.06	0.002	0.0003	0.08
95th Percentile		612	436	184	37.6	0.40	<0.001	<0.001	0.032	ND	0.18	0.0002	<0.001	<0.001	0.05	0.69	<0.00004	0.64	<0.001	0.09	0.002	0.0003	0.11
20th Percentile	3.58																						
80th Percentile	4.42																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

34. Groundwater Bore WGM1/D3

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
18/04/2019	4.39	780	508	354	17.2	3.03	<0.001	<0.001	0.019	ND	0.83	0.005	<0.001	0.014	0.739	0.291	<0.00004	2.08	<0.001	0.578	0.002	0.0005	0.709
16/05/2019	4.86	830	674	362	19.5	1.41	<0.001	<0.001	0.018	ND	0.69	0.0027	<0.001	0.005	0.269	7.67	<0.00004	1.62	<0.001	0.343	0.001	0.0003	0.354
20/06/2019	4.42	610	394	255	12.4	1.91	0.001	<0.001	0.018	ND	0.43	0.0022	<0.001	0.004	0.502	0.049	<0.00004	1.74	<0.001	0.383	0.001	0.0002	0.482
18/07/2019	5.03	980	652	424	35.9	1.07	<0.001	<0.001	0.021	ND	0.6	0.0016	<0.001	0.004	0.409	13.7	<0.00004	1.61	<0.001	0.251	<0.001	0.0003	0.256
22/08/2019	5.19	1010	672	446	42.3	0.58	<0.001	<0.001	0.021	ND	0.54	0.0012	<0.001	<0.001	0.303	16.7	<0.00004	1.48	<0.001	0.181	<0.001	<0.0002	0.14
19/09/2019	5.12	1260	884	563	43.8	0.65	<0.001	<0.001	0.021	ND	0.64	0.0008	<0.001	<0.001	<1.00	26.4	<0.00004	1.97	<0.001	0.214	<0.001	0.0002	0.149
24/10/2019	5.16	1170	936	538	32.5	0.73	<0.001	<0.001	0.021	ND	0.57	0.0009	<0.001	<0.001	0.409	22.2	0.00006	1.7	0.002	0.269	<0.001	0.0002	0.214
21/11/2019	5.1	1110	668	496	34.5	0.66	<0.001	<0.001	0.021	ND	0.57	0.0008	<0.001	0.002	0.771	18.9	<0.00004	1.63	<0.001	0.234	<0.001	<0.0002	0.172
6/12/2019	5.19	1020	898	487	29.4	0.5	<0.001	<0.001	0.02	ND	0.56	0.0006	<0.001	<0.001	0.052	17.7	<0.00004	1.46	<0.001	0.199	<0.001	<0.0002	0.156
10/01/2020	5.5	1060	844	447	40.5	2.59	0.01	<0.001	0.07	ND	0.51	0.0116	0.004	0.015	0.196	19.8	<0.00004	1.51	0.002	0.209	0.021	0.0008	0.417
20/02/2020	5.19	1150	892	529	30.2	0.81	<0.001	<0.001	0.021	ND	0.66	0.0006	<0.001	<0.001	<0.100	22	<0.00004	2.13	<0.001	0.288	<0.001	0.0004	0.242
12/03/2020	5	1300	1020	567	23.4	3.2	0.005	<0.001	0.042	ND	1.16	0.0067	0.002	0.006	<0.200	17.1	<0.00004	3.08	0.001	0.694	0.009	0.0013	0.799

34. Groundwater Bore WGM1/D3

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	4.39	610	394	255	12.4	0.50	<0.001	<0.001	0.018	ND	0.43	0.0006	<0.001	0.002	<0.010	0.05	<0.00004	1.46	<0.001	0.18	<0.001	0.0002	0.14
Maximum	5.50	1300	1020	567	43.8	3.20	0.010	<0.001	0.070	ND	1.16	0.0116	0.004	0.015	0.77	26.40	<0.00004	3.08	0.002	0.69	0.021	0.0013	0.80
Mean	5.01	1023	754	456	30.1	1.43	0.005	<0.001	0.026	ND	0.65	0.0029	<0.001	0.007	0.41	15.21	<0.00004	1.83	0.002	0.32	0.007	0.0005	0.34
Median	5.11	1040	759	467	31.4	0.94	0.005	<0.001	0.021	ND	0.59	0.0014	<0.001	0.005	0.41	17.40	<0.00004	1.67	0.002	0.26	0.002	0.0003	0.25
95th Percentile		1282	983	565	43.1	3.13	0.010	<0.001	0.058	ND	1.01	0.0094	<0.001	0.015	0.76	24.55	<0.00004	2.66	0.002	0.64	0.019	0.0011	0.76
20th Percentile	4.89																						
80th Percentile	5.19																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

35. Groundwater Bore WGM1/D4

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
17/04/2019	6.14	1500	1060	677	26.4	<0.01	<0.001	<0.001	0.015	ND	1.7	<0.0001	<0.001	<0.001	<0.100	22.3	<0.00004	12.4	<0.001	0.028	<0.001	<0.0002	0.034
15/05/2019	6.17	1470	1210	645	23.9	<0.01	0.001	<0.001	0.016	ND	1.96	<0.0001	<0.001	<0.001	0.023	33.9	<0.00004	10.9	<0.001	0.028	<0.001	<0.0002	0.03
20/06/2019	6.13	1470	1020	711	26.4	0.04	0.001	<0.001	0.017	ND	1.57	<0.0001	<0.001	<0.001	<0.050	25.9	<0.00004	12.3	<0.001	0.031	<0.001	<0.0002	0.032
17/07/2019	6.2	1470	1020	685	27.8	0.04	0.002	<0.001	0.015	ND	1.63	<0.0001	<0.001	<0.001	<0.100	49.2	<0.00004	12.1	0.001	0.027	<0.001	<0.0002	0.032
21/08/2019	6.22	1470	1070	699	27.8	<0.01	0.001	<0.001	0.015	ND	1.48	<0.0001	<0.001	<0.001	0.03	40.6	<0.00004	12.7	<0.001	0.031	<0.001	<0.0002	0.034
18/09/2019	6.14	1520	1180	706	33	0.02	0.001	<0.001	0.016	ND	1.36	<0.0001	<0.001	<0.001	<1.00	52.1	<0.00004	12.1	<0.001	0.026	<0.001	<0.0002	0.031
24/10/2019	6.24	1470	1080	660	26	0.02	<0.001	<0.001	0.016	ND	1.48	<0.0001	<0.001	<0.001	0.09	30.1	0.00007	10.6	0.004	0.049	<0.001	<0.0002	0.028
20/11/2019	6.04	1460	1050	654	24.2	0.03	0.002	<0.001	0.016	ND	1.53	0.0001	<0.001	<0.001	<0.500	49.8	<0.00004	11.7	<0.001	0.031	<0.001	<0.0002	0.033
5/12/2019	6.14	1470	1130	706	28.6	0.04	0.001	<0.001	0.016	ND	1.52	<0.0001	<0.001	<0.001	<0.100	9.11	<0.00004	11.8	<0.001	0.028	<0.001	<0.0002	0.036
10/01/2020	6.18	1450	1220	674	27.1	0.01	0.001	<0.001	0.016	ND	1.37	<0.0001	<0.001	<0.001	0.032	31.5	<0.00004	12.2	<0.001	0.032	<0.001	<0.0002	0.033

35. Groundwater Bore WGM1/D4

Sample Date	pH	Cond (µs/cm)	TDS	SO_4	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	6.04	1450	1020	645	23.9	<0.01	<0.001	<0.001	0.015	ND	1.36	<0.0001	<0.001	<0.001	<0.100	9.1	<0.00004	10.60	<0.001	0.03	<0.001	<0.0002	0.03
Maximum	6.24	1520	1220	711	33.0	0.04	0.002	<0.001	0.017	ND	1.96	<0.0001	0.001	<0.001	0.09	52.1	<0.00004	12.70	<0.001	0.05	<0.001	<0.0002	0.04
Mean	6.16	1475	1104	682	27.1	0.03	0.001	<0.001	0.016	ND	1.56	<0.0001	<0.001	<0.001	0.04	34.5	<0.00004	11.88	<0.001	0.03	<0.001	<0.0002	0.03
Median	6.16	1470	1075	681	26.8	0.03	0.001	<0.001	0.016	ND	1.53	<0.0001	<0.001	<0.001	0.03	32.7	<0.00004	12.10	<0.001	0.03	<0.001	<0.0002	0.03
95th Percentile		1513	1216	709	31.4	0.04	0.002	<0.001	0.017	ND	1.87	<0.0001	<0.001	<0.001	0.08	51.3	<0.00004	12.59	<0.001	0.04	<0.001	<0.0002	0.04
20th Percentile	6.14																						
80th Percentile	6.20																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

32. Groundwater Bore WGM1/D1

Sample Date	pH	Cond (µs/cm)	TDS	SO$_4$	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
20/02/2020	5.14	119	144	11.5	17.8	2.74	<0.001	0.0003	0.054	ND	0.06	0.0001	0.002	0.021	<0.020	1.22	<0.00004	0.092	<0.001	0.006	0.008	0.0003	0.247
12/03/2020	5.26	122	123	8.06	16.4	1.4	<0.001	0.0003	0.042	ND	0.05	<0.0001	0.001	0.013	<0.010	1.41	<0.00004	0.103	<0.001	0.006	0.002	0.0003	0.239

32. Groundwater Bore WGM1/D1

Sample Date	pH	Cond (µs/cm)	TDS	SO$_4$	Cl	Al*	As	Ag	Ba	Be	B*	Cd	Cr	Cu	F	Fe-F	Hg	Mn	Mo	Ni	Pb	Se	Zn*
Minimum	5.16	116	108	6	19.5	1.37	<0.001	<0.001	0.042	ND	<0.05	<0.0001	<0.001	0.005	0.01	1.56	<0.00004	0.08	<0.001	0.00	0.002	<0.0002	0.11
Maximum	5.16	116	108	6	19.5	1.37	<0.001	<0.001	0.042	ND	<0.05	<0.0001	<0.001	0.005	0.01	1.56	<0.00004	0.08	<0.001	0.00	0.002	<0.0002	0.11
Mean	5.16	116	108	6	19.5	1.37	<0.001	<0.001	0.042	ND	<0.05	<0.0001	<0.001	0.005	0.01	1.56	<0.00004	0.08	<0.001	0.00	0.002	<0.0002	0.11
Median	5.16	116	108	6	19.5	1.37	<0.001	<0.001	0.042	ND	<0.05	<0.0001	<0.001	0.005	0.01	1.56	<0.00004	0.08	<0.001	0.00	0.002	<0.0002	0.11
95th Percentile		116	108	6	19.5	1.37	<0.001	<0.001	0.042	ND	<0.05	<0.0001	<0.001	0.005	0.01	1.56	<0.00004	0.08	<0.001	0.00	0.002	<0.0002	0.11
20th Percentile	5.16																						
80th Percentile	5.24																						
Surface Water WQGV	6.5-8.0	2200	**1500^**	1000++	350+	**5.25^^**	0.024	0.00005	0.7+++	0.1	**1.25**	0.0015	0.005	0.005	1.5+++	0.3+++	0.00006	1.9	0.01+	0.05	0.005	0.005	**0.153**

Appendix D

D1 – D6 Borehole Logs

ELECTRICITY COMMISSION OF N.S.W.
GEOTECHNICAL LOG

WALLERAWANG P.S
GROUND WATER MONITORING

W .GM1/D 1

INCLINATION: 90
AZIMUTH:
ISG CO-ORDINATES: 217828E 1303552N
COLLAR R.L.: 947.8
DATUM: AHD
SHEET 1 OF 1
LOCATION PLAN NO. DE202722C

R.L.	DESCRIPTION OF CORE (ROCK TYPE, COLOUR, GRAIN SIZE, MINERAL COMPOSTITION, TEXTURE, HARDNESS.)	DEPTH	LIFT AND % CORE LOSS	REDUCED LEVEL AND METHOD	STRUCTURES (JOINTS (SPACING, ATTITUDE, SMOOTHNESS, APERTURE, COATING, INFILLING) BEDDING, VEINS, SEAMS, FAULTS, CRUSHED ZONES)	SAMPLE NUMBER AND SPT. WATER PRESSURE TEST (LUGEONS)
	CORE LOSS.			AUGV	0.00 - 7.30 DESCRIPTION OF SPT SAMPLES ONLY	
946.8		1.00				
946.3	SAND. MOTTLED GREY-ORANGE; MEDIUM SAND. WITH PEBBLES TO 5 MM. MINOR CLAY BINDER SLIGHTLY MOIST (1S.F).	1.45				
945.8	NON CORE DRILLING.	2.00				
945.3	CLAYEY SAND. MOTTLED GREY-ORANGE MEDIUM SAND. WITH PEBBLES TO 5 MM. MOIST. (2S.F)..	2.45				2S 6 8 10
944.8	NON CORE DRILLING.	3.00		945		
944.3	SAND. MOTTLED ORANGE-BROWN; WITH PEBBLES TO 10MM. MINOR CLAY BINDER. SLIGHTLY MOIST. (3S.F)..	3.45				3S 6 10 15
943.8	NON CORE DRILLING.	4.00				
943.3	CLAYEY SAND. LIGHT GREY; WITH PEBBLES TO 10MM. MOIST. FINE TO COARSE GRAINED. (4S.F).	4.45				4S 5 7 11
942.8	NON CORE DRILLING.	5.00				
942.3	CLAYEY SAND; WITH PEBBLES TO 10 MM. MOIST. GRADES TO SANDY CLAY FINES OF MEDIUM TO HIGH PLASTICITY (5S.F)..	5.45				5S 2 3 6
941.8	NON CORE DRILLING.	6.00				
941.3	CLAYEY SAND. MOTTLED ORANGE-GREY FINE SAND. WITH PEBBLES TO 5MM. MOIST. (6S.F).	6.45				6S 11 15 15
940.8	NON CORE DRILLING.	7.00				
940.6	CLAYEY SAND. MOTTLED ORANGE-RED; FINE SAND. WITH PEBBLES TO 4MM. MOIST TO WET.	7.15				7S 2
	NON CORE DRILLING. DRILLER REPORTS IRONSTONE AND SHALE.		100	940 RR	7.30 V-BIT REFUSAL	
938.8		9.00				

COMMENCED: 28/10/85
COMPLETED: 29/10/85
CONTRACTOR: MCDERMOTT
DRILLER: J.SHAW
DRILL TYPE: PIO 160
LOGGED BY: G WILSON
CHECKED BY:

END OF HOLE

ELECTRICITY COMMISSION OF N.S.W.
GEOTECHNICAL LOG

WALLERAWANG P.S
GROUND WATER MONITORING

W .GM1/D 2

INCLINATION: 90
AZIMUTH:

ISG CO-ORDINATES: 215588E 1303352N

COLLAR R.L.: 919.9
DATUM: AHD

SHEET 1 OF 2
LOCATION PLAN NO.
DE202722

R.L.	DESCRIPTION OF CORE ROCK TYPE, COLOUR, GRAIN SIZE, MINERAL COMPOSITION, TEXTURE, HARDNESS.	DEPTH
	NON CORE DRILLING.	
914.3		5.60
914.1	CORE LOSS.	5.80
913.4	CARBONACEOUS SILTSTONE, BLACK. IRONSTONE FRAGMENTS AT 5.80-5.85M..	6.48
913.2	COAL, BLACK.	6.68
912.9	CLAYSTONE, MOTTLED BROWN-ORANGE.	7.01
912.4	COALY SILTSTONE, BLACK.	7.52
911.6	COAL, BLACK.	8.28
911.0	CARBONACEOUS SANDSTONE, MOTTLED GREY-BROWN, WITH PEBBLES TO 5MM GRADES TO SILTSTONE.	8.85
909.9	SANDSTONE INTERBEDDED WITH MUDSTONE (50%). MOTTLED GREY-BROWN. BEDDING <6MM. CARBONACEOUS MUDSTONE LAMINAE LESSEN TO TOP.	10.00

DEGREE OF WEATHERING: FR FS SW MW HW CW

GRAPHIC LOG

LIFT AND % CORE LOSS: 6

REDUCED LEVEL AND METHOD: AUGV 915 NMLC 910

DEPTH (METRES): 1 2 3 4 5 6 7 8 9 10

CASING

STRENGTH ESTIMATED L M H VH POINT LOAD MPA: 0.1 0.3 1.0 3.0 10.0

STRUCTURES
JOINTS (SPACING, ATTITUDE, SMOOTHNESS, APERTURE, COATING, INFILLING)
BEDDING, VEINS, SEAMS, FAULTS, CRUSHED ZONES

1.00 - 1.45 SILTY TO SANDY CLAY, MOTTLED GREY ORANGE, MOIST. CW MUDSTONE? (1S,F)

2.00 - 2.45 ORANGE CLAYEY SAND TO CLAY, MOIST (2S,F).

3.00 - 3.45 ORANGE-GREY CLAYEY SAND WITH ROCK FRAGMENTS TO 15MM (3S,F).

4.00 - 4.45 GREY CLAY, CW CLAYSTONE?, SOFT, MOIST (4S,F).

5.00 - 5.25 MIXED SAMPLE, FINE GRAINED SLIGHTLY CLAYEY GRAVEL, WEAKLY BOUND, PLUS PURPLE-ORANGE CW MUDSTONE (5S,F).

5.80 - 7.01 DOMINANT JOINTS AT 0 DEG, MINOR IRONSTAINING

6.31 INTERSECTING IRONCOATED JOINTS AT 15 AND 80 DEG

7.01 - 8.28 CLEAT AT 0.80 AND 90 DEG. PART FRAGMENTED BY DRILLING

8.28 - 9.56 CORE PIECES 10 TO 320MM

9.56 - 10.43 WEATHERED JOINTS AT 0 DEG

FRACTURE SPACING (M): 1.00 0.50 0.10 0.05 0.01

DRILL WATER LOSS

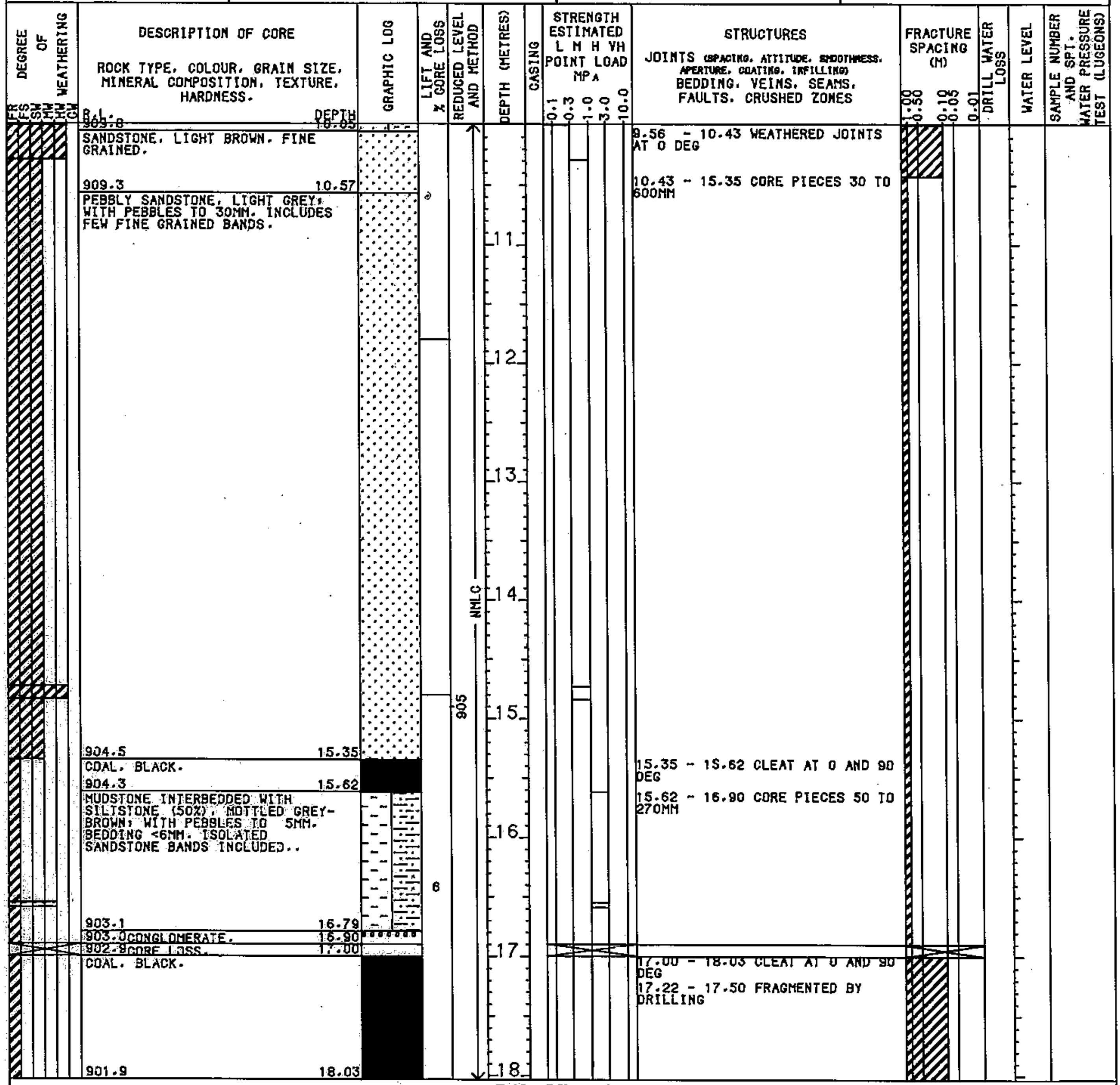
WATER LEVEL

SAMPLE NUMBER AND SPT, WATER PRESSURE TEST (LUGEONS)		
1S	8 15 15	
2S	4 5 6	
3S	4 15 17	
4S	6 8 10	
5S	5 25 R	

COMMENCED: 31/10/85
COMPLETED: 02/11/85
CONTRACTOR: MCDERMOTT
DRILLER: J.SHAW
DRILL TYPE: PIO 160
LOGGED BY: G WILSON
CHECKED BY:

ELECTRICITY COMMISSION OF N.S.W. GEOTECHNICAL LOG	WALLERAWANG P.S GROUND WATER MONITORING	W .GM1/D 2

INCLINATION: 90 AZIMUTH:	ISG CO-ORDINATES: 215588E 1303352N	COLLAR R.L.: 919.9 DATUM: AHD	SHEET 2 OF 2 LOCATION PLAN NO. DE202722



DESCRIPTION OF CORE

ROCK TYPE, COLOUR, GRAIN SIZE, MINERAL COMPOSITION, TEXTURE, HARDNESS.

R.L.	DEPTH	
909.8	10.05	
		SANDSTONE, LIGHT BROWN, FINE GRAINED.
909.3	10.57	
		PEBBLY SANDSTONE, LIGHT GREY; WITH PEBBLES TO 30MM. INCLUDES FEW FINE GRAINED BANDS.
904.5	15.35	
		COAL, BLACK.
904.3	15.62	
		MUDSTONE INTERBEDDED WITH SILTSTONE (50%), MOTTLED GREY-BROWN; WITH PEBBLES TO 5MM. BEDDING <6MM. ISOLATED SANDSTONE BANDS INCLUDED..
903.1	16.79	
903.0	16.90	CONGLOMERATE.
902.9	17.00	CORE LOSS.
		COAL, BLACK.
901.9	18.03	

END OF HOLE

STRUCTURES

JOINTS (SPACING, ATTITUDE, SMOOTHNESS, APERTURE, COATING, INFILLING) BEDDING, VEINS, SEAMS, FAULTS, CRUSHED ZONES

9.56 - 10.43 WEATHERED JOINTS AT 0 DEG

10.43 - 15.35 CORE PIECES 30 TO 600MM

15.35 - 15.62 CLEAT AT 0 AND 90 DEG

15.62 - 16.90 CORE PIECES 50 TO 270MM

17.00 - 18.03 CLEAT AT 0 AND 90 DEG

17.22 - 17.50 FRAGMENTED BY DRILLING

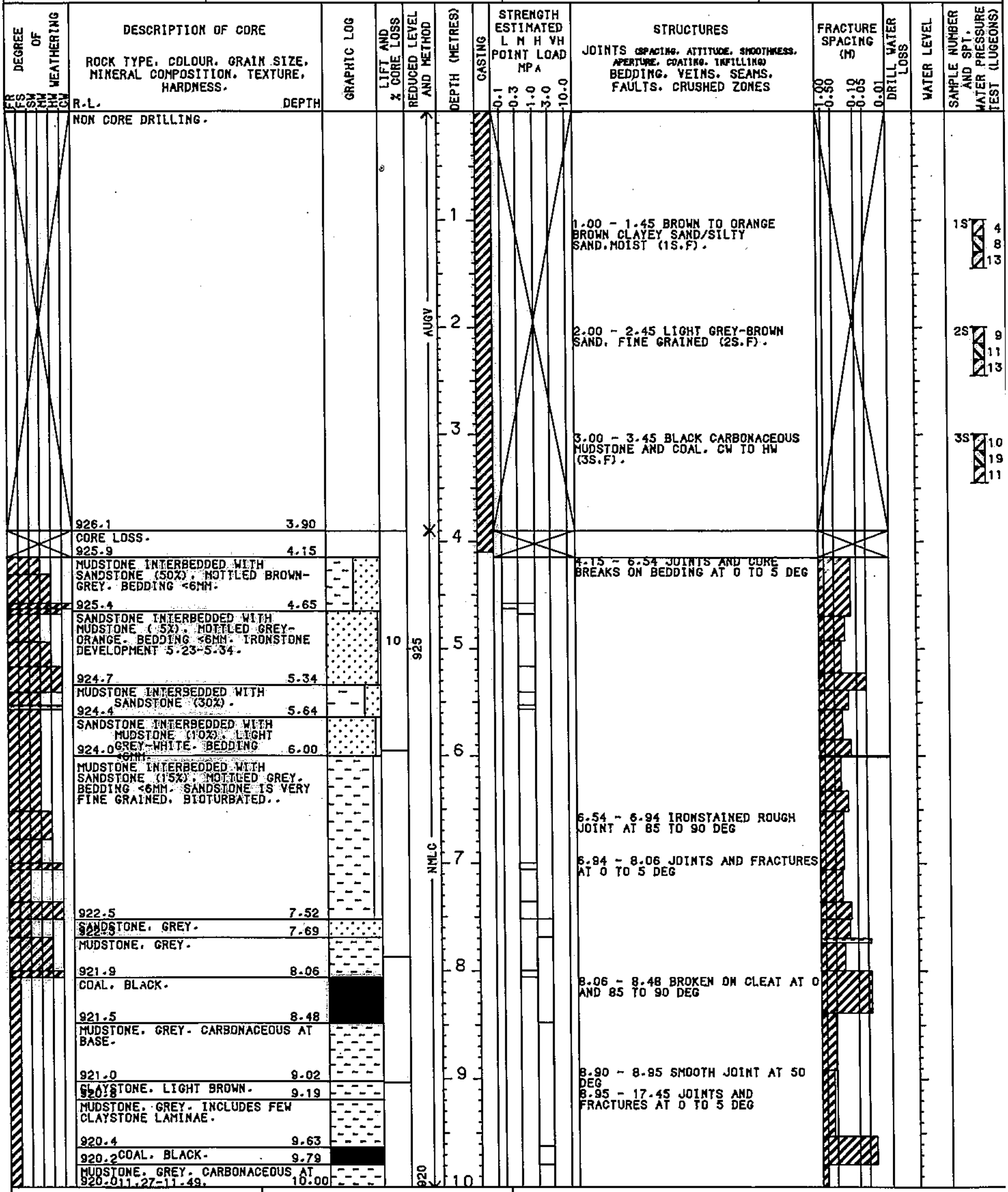
COMMENCED: 31/10/85	CONTRACTOR: MCDERMOTT	DRILL TYPE: PIO 160	
COMPLETED: 02/11/85	DRILLER: J.SHAW	LOGGED BY: G WILSON	CHECKED BY:

ELECTRICITY COMMISSION OF N.S.W.
GEOTECHNICAL LOG

WALLERAWANG P.S
GROUND WATER MONITORING

W .GM1/D 3

INCLINATION: 90
AZIMUTH:
ISG CO-ORDINATES: 216191E 1303706N
COLLAR R.L.: 930.0
DATUM: AHD
SHEET 1 OF 2
LOCATION PLAN NO. DE202722



DESCRIPTION OF CORE
ROCK TYPE. COLOUR. GRAIN SIZE. MINERAL COMPOSITION. TEXTURE. HARDNESS.

R.L.		DEPTH
	NON CORE DRILLING.	
926.1		3.90
925.9	CORE LOSS.	4.15
925.4	MUDSTONE INTERBEDDED WITH SANDSTONE (50%). MOTTLED BROWN-GREY. BEDDING <6MM.	4.65
924.7	SANDSTONE INTERBEDDED WITH MUDSTONE (5%). MOTTLED GREY-ORANGE. BEDDING <6MM. IRONSTONE DEVELOPMENT 5.23-5.34.	5.34
924.4	MUDSTONE INTERBEDDED WITH SANDSTONE (30%).	5.64
924.0	SANDSTONE INTERBEDDED WITH MUDSTONE (10%). LIGHT GREY-WHITE. BEDDING <6MM.	6.00
922.5	MUDSTONE INTERBEDDED WITH SANDSTONE (15%). MOTTLED GREY. BEDDING <6MM. SANDSTONE IS VERY FINE GRAINED. BIOTURBATED..	7.52
922.3	SANDSTONE. GREY.	7.69
921.9	MUDSTONE. GREY.	8.06
921.5	COAL. BLACK.	8.48
921.0	MUDSTONE. GREY. CARBONACEOUS AT BASE.	9.02
920.8	CLAYSTONE. LIGHT BROWN.	9.19
920.4	MUDSTONE. GREY. INCLUDES FEW CLAYSTONE LAMINAE.	9.63
920.2	COAL. BLACK.	9.79
920.0	MUDSTONE. GREY. CARBONACEOUS AT 11.27-11.49.	10.00

STRUCTURES
JOINTS (SPACING. ATTITUDE. SMOOTHNESS. APERTURE. COATING. INFILLING) BEDDING. VEINS. SEAMS. FAULTS. CRUSHED ZONES

1.00 - 1.45 BROWN TO ORANGE BROWN CLAYEY SAND/SILTY SAND.MOIST (1S.F).

2.00 - 2.45 LIGHT GREY-BROWN SAND. FINE GRAINED (2S.F).

3.00 - 3.45 BLACK CARBONACEOUS MUDSTONE AND COAL. CW TO HW (3S.F).

4.15 - 6.54 JOINTS AND CORE BREAKS ON BEDDING AT 0 TO 5 DEG

6.54 - 6.94 IRONSTAINED ROUGH JOINT AT 85 TO 90 DEG

6.94 - 8.06 JOINTS AND FRACTURES AT 0 TO 5 DEG

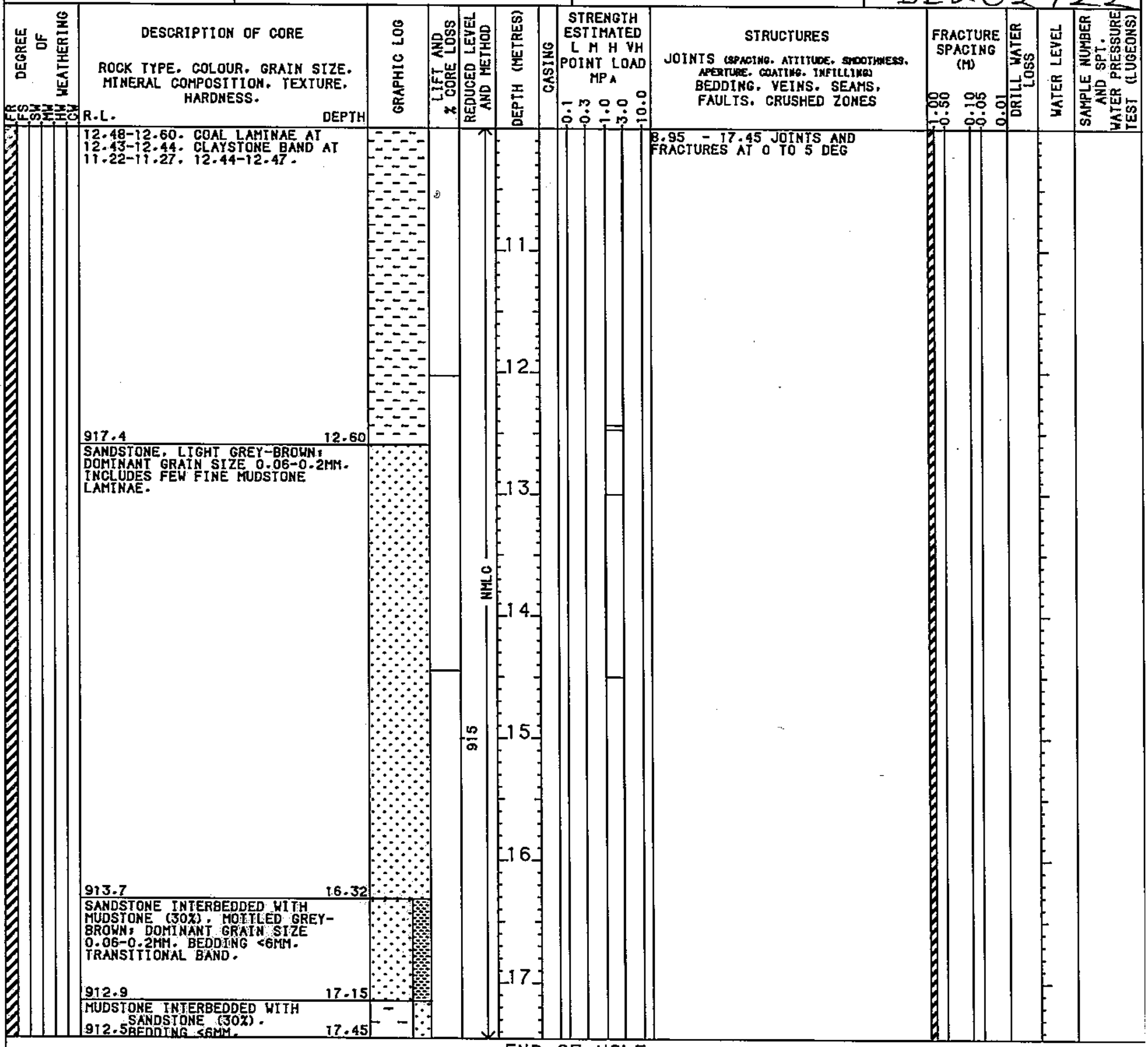
8.06 - 8.48 BROKEN ON CLEAT AT 0 AND 85 TO 90 DEG

8.90 - 8.95 SMOOTH JOINT AT 50 DEG
8.95 - 17.45 JOINTS AND FRACTURES AT 0 TO 5 DEG

COMMENCED: 29/10/85	CONTRACTOR: MCDERMOTT	DRILL TYPE: PIO 160	
COMPLETED: 30/10/85	DRILLER: J.SHAW	LOGGED BY: G WILSON	CHECKED BY:

ELECTRICITY COMMISSION OF N.S.W. GEOTECHNICAL LOG	WALLERAWANG P.S GROUND WATER MONITORING	W .GM1/D 3

INCLINATION: 90 AZIMUTH:	ISG CO-ORDINATES: 216191E 1303706N	COLLAR R.L.: 930.0 DATUM: AHD	SHEET 2 OF 2 LOCATION PLAN NO. DE202722



R.L.	DESCRIPTION OF CORE ROCK TYPE. COLOUR. GRAIN SIZE. MINERAL COMPOSITION. TEXTURE. HARDNESS.	DEPTH
	12.48-12.60. COAL LAMINAE AT 12.43-12.44. CLAYSTONE BAND AT 11.22-11.27. 12.44-12.47.	
917.4		12.60
	SANDSTONE. LIGHT GREY-BROWN; DOMINANT GRAIN SIZE 0.06-0.2MM. INCLUDES FEW FINE MUDSTONE LAMINAE.	
913.7		16.32
	SANDSTONE INTERBEDDED WITH MUDSTONE (30%). MOTTLED GREY-BROWN; DOMINANT GRAIN SIZE 0.06-0.2MM. BEDDING <6MM. TRANSITIONAL BAND.	
912.9		17.15
	MUDSTONE INTERBEDDED WITH SANDSTONE (30%). BEDDING <6MM.	
912.5		17.45

STRUCTURES
JOINTS (SPACING. ATTITUDE. SMOOTHNESS. APERTURE. COATING. INFILLING)
BEDDING. VEINS. SEAMS. FAULTS. CRUSHED ZONES

8.95 - 17.45 JOINTS AND FRACTURES AT 0 TO 5 DEG

END OF HOLE

COMMENCED: 29/10/85	CONTRACTOR: MCDERMOTT	DRILL TYPE: PIO 160	
COMPLETED: 30/10/85	DRILLER: J.SHAW	LOGGED BY: G WILSON	CHECKED BY:

ELECTRICITY COMMISSION OF N.S.W.
GEOTECHNICAL LOG

WALLERAWANG P.S
GROUNDWATER MONITORING

W .GM1/D 4

INCLINATION: 90
AZIMUTH:

ISG CO-ORDINATES: 216087E 1304304N

COLLAR R.L.: 906.7
DATUM: AHD

SHEET 1 OF 1
LOCATION PLAN NO. DE 202722

R.L.	DESCRIPTION OF CORE ROCK TYPE, COLOUR, GRAIN SIZE, MINERAL COMPOSITION, TEXTURE, HARDNESS.	DEPTH	REDUCED LEVEL AND METHOD	STRUCTURES JOINTS (SPACING, ATTITUDE, SMOOTHNESS, APERTURE, COATING, INFILLING) BEDDING, VEINS, SEAMS, FAULTS, CRUSHED ZONES	SAMPLE NUMBER AND SPT. WATER PRESSURE TEST (LUGEONS)
	NON CORE DRILLING.		AUGV		
905.7	TOPSOIL, DARK BROWN, WET, ORGANIC RICH (1S.F)..	1.00			1S 1 1 0
905.2	NON CORE DRILLING.	1.45	905		
904.7	CLAY, BROWN, MOIST TO WET, MINOR ORGANIC CONTENT AND SAND FINE TO COARSE (2S.F)..	2.00			2S 1 2 2
904.2	NON CORE DRILLING.	2.45			
903.7	CLAYEY SAND, LIGHT ORANGE, MOIST TO WET, FINE GRAINED (3S F).	3.00			3S 1 1 2
903.2	NON CORE DRILLING.	3.45			
902.7	SAND, LIGHT GREY, WET, FINE TO COARSE GRAINED, ROCK FRAGMENTS TO 20MM INCLUDED (4S F)..	4.00			4S 2 3 4
902.2	NON CORE DRILLING.	4.45	RR	4.60 V-BIT REFUSAL	
900.7		6.00	900		

COMMENCED: 05/11/85
COMPLETED: 05/11/85
CONTRACTOR: MCDERMOTT
DRILLER: J.SHAW
DRILL TYPE: PIO 160
LOGGED BY: G WILSON
CHECKED BY:

END OF HOLE

ELECTRICITY COMMISSION
OF N.S.W.
GEOTECHNICAL LOG

WALLERAWANG P.S
GROUNDWATER MONITORING

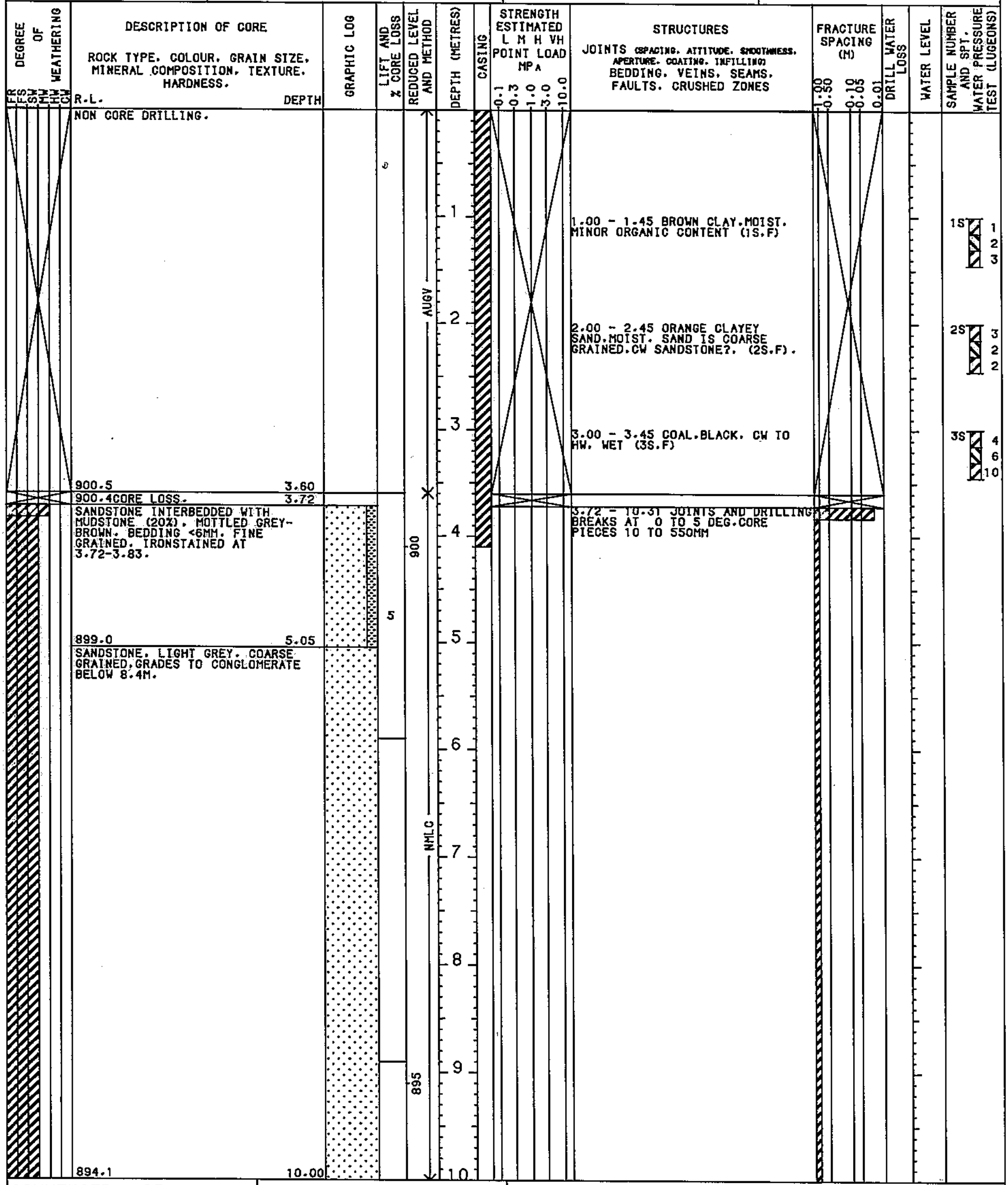
W .GM1/D 5

INCLINATION: 90
AZIMUTH:

ISG
CO-ORDINATES: 215566E
1304170N

COLLAR R.L.: 904.1
DATUM: AHD

SHEET 1 OF 2
LOCATION PLAN NO.
DE 202722



NON CORE DRILLING.

900.5 3.60
900.4 CORE LOSS. 3.72

SANDSTONE INTERBEDDED WITH MUDSTONE (20%). MOTTLED GREY-BROWN. BEDDING <6MM. FINE GRAINED. IRONSTAINED AT 3.72-3.83.

899.0 5.05

SANDSTONE. LIGHT GREY. COARSE GRAINED. GRADES TO CONGLOMERATE BELOW 8.4M.

894.1 10.00

1.00 - 1.45 BROWN CLAY. MOIST. MINOR ORGANIC CONTENT (1S.F)

2.00 - 2.45 ORANGE CLAYEY SAND. MOIST. SAND IS COARSE GRAINED. CW SANDSTONE?. (2S.F).

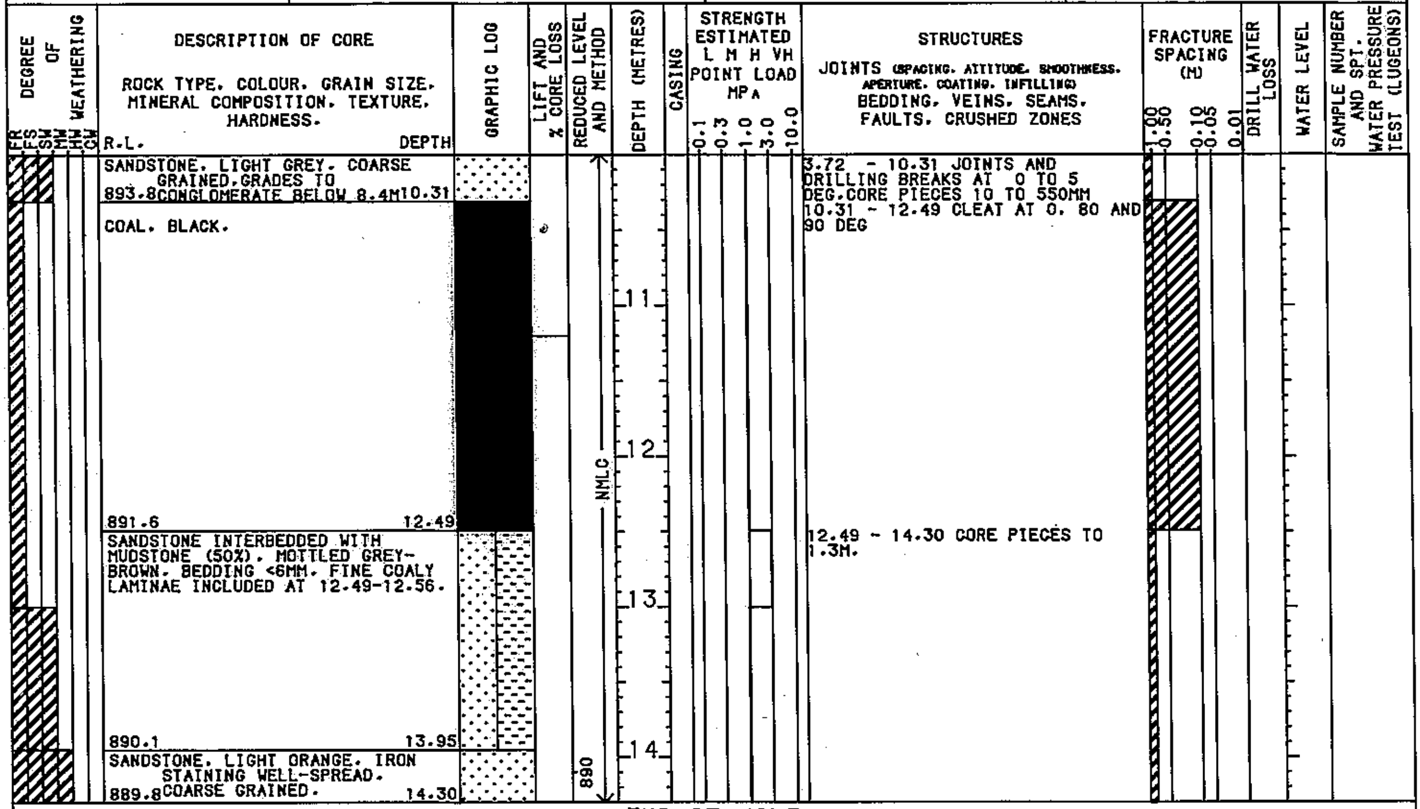
3.00 - 3.45 COAL. BLACK. CW TO HW. WET (3S.F)

3.72 - 10.31 JOINTS AND DRILLING BREAKS AT 0 TO 5 DEG. CORE PIECES 10 TO 550MM

COMMENCED: 05/11/85
COMPLETED: 06/11/85
CONTRACTOR: MCDERMOTT
DRILLER: J.SHAW
DRILL TYPE: PIO 160
LOGGED BY: G WILSON
CHECKED BY:

ELECTRICITY COMMISSION OF N.S.W. GEOTECHNICAL LOG	WALLERAWANG P.S GROUNDWATER MONITORING	W .GM1/D 5

INCLINATION: 90 AZIMUTH:	ISG CO-ORDINATES: 215566E 1304170N	COLLAR R.L.: 904.1 DATUM: AHD	SHEET 2 OF 2 LOCATION PLAN NO. DE202722



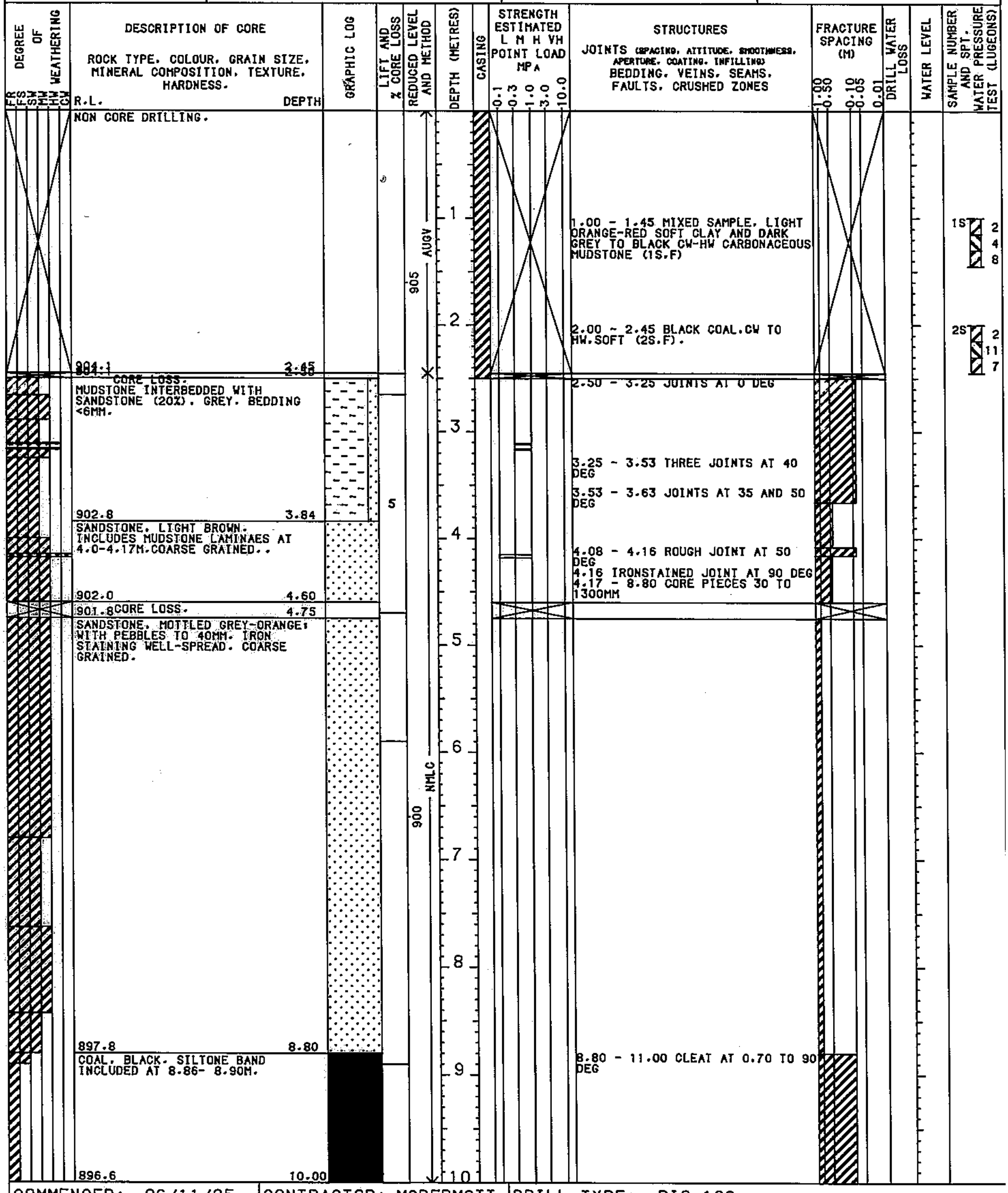
R.L.	DESCRIPTION OF CORE ROCK TYPE, COLOUR, GRAIN SIZE, MINERAL COMPOSITION, TEXTURE, HARDNESS.	DEPTH	STRUCTURES JOINTS (SPACING, ATTITUDE, SMOOTHNESS, APERTURE, COATING, INFILLING) BEDDING, VEINS, SEAMS, FAULTS, CRUSHED ZONES
893.8	SANDSTONE, LIGHT GREY, COARSE GRAINED.GRADES TO CONGLOMERATE BELOW 8.4M	10.31	3.72 - 10.31 JOINTS AND DRILLING BREAKS AT 0 TO 5 DEG.CORE PIECES 10 TO 550MM
891.6	COAL, BLACK.	12.49	10.31 - 12.49 CLEAT AT 0, 80 AND 90 DEG
890.1	SANDSTONE INTERBEDDED WITH MUDSTONE (50%), MOTTLED GREY-BROWN, BEDDING <6MM, FINE COALY LAMINAE INCLUDED AT 12.49-12.56.	13.95	12.49 - 14.30 CORE PIECES TO 1.3M.
889.8	SANDSTONE, LIGHT ORANGE, IRON STAINING WELL-SPREAD. COARSE GRAINED.	14.30	

END OF HOLE

COMMENCED: 05/11/85	CONTRACTOR: MCDERMOTT	DRILL TYPE: PIO 160	
COMPLETED: 06/11/85	DRILLER: J.SHAW	LOGGED BY: G WILSON	CHECKED BY:

ELECTRICITY COMMISSION OF N.S.W. GEOTECHNICAL LOG	WALLERAWANG P.S GROUNDWATER MONITORING	W .GM1/D 6

INCLINATION: 90 AZIMUTH:	ISG CO-ORDINATES: 215332E 1303997N	COLLAR R.L.: 906.6 DATUM: AHD	SHEET 1 OF 2 LOCATION PLAN NO. DE 202722



DESCRIPTION OF CORE
ROCK TYPE. COLOUR. GRAIN SIZE. MINERAL COMPOSITION. TEXTURE. HARDNESS.

R.L.		DEPTH
	NON CORE DRILLING.	
904.1		2.45
904.1	CORE LOSS.	2.50
	MUDSTONE INTERBEDDED WITH SANDSTONE (20%). GREY. BEDDING <6MM.	
902.8		3.84
	SANDSTONE. LIGHT BROWN. INCLUDES MUDSTONE LAMINAES AT 4.0-4.17M.COARSE GRAINED..	
902.0		4.60
901.8	CORE LOSS.	4.75
	SANDSTONE. MOTTLED GREY-ORANGE; WITH PEBBLES TO 40MM. IRON STAINING WELL-SPREAD. COARSE GRAINED.	
897.8		8.80
	COAL. BLACK. SILTONE BAND INCLUDED AT 8.86- 8.90M.	
896.6		10.00

STRUCTURES
JOINTS (SPACING, ATTITUDE, SMOOTHNESS, APERTURE, COATING, INFILLING) BEDDING. VEINS. SEAMS. FAULTS. CRUSHED ZONES

1.00 - 1.45 MIXED SAMPLE. LIGHT ORANGE-RED SOFT CLAY AND DARK GREY TO BLACK CW-HW CARBONACEOUS MUDSTONE (1S.F)

2.00 - 2.45 BLACK COAL.CW TO HW.SOFT (2S.F).

2.50 - 3.25 JOINTS AT 0 DEG

3.25 - 3.53 THREE JOINTS AT 40 DEG

3.53 - 3.63 JOINTS AT 35 AND 50 DEG

4.08 - 4.16 ROUGH JOINT AT 50 DEG

4.16 IRONSTAINED JOINT AT 90 DEG

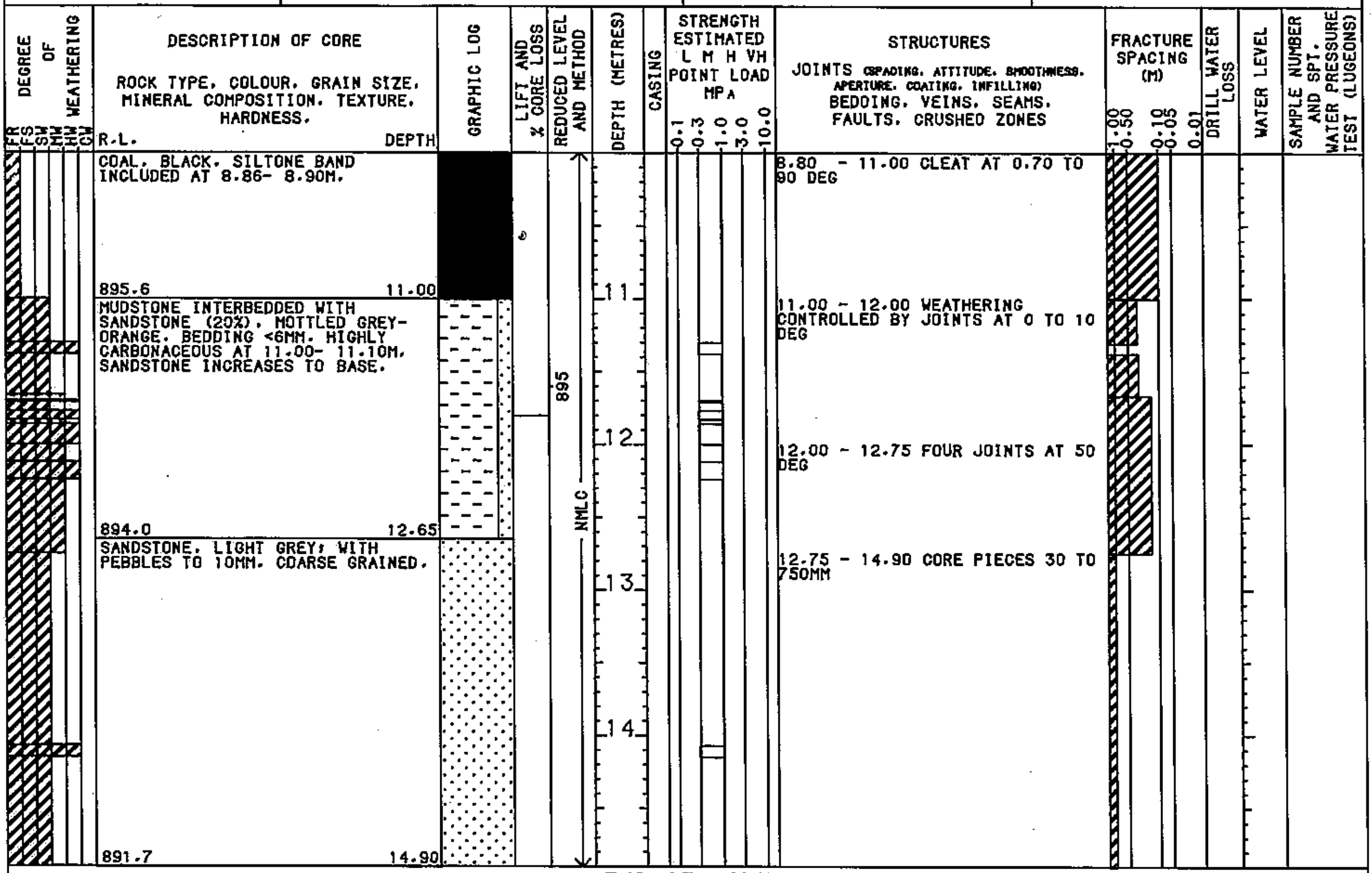
4.17 - 8.80 CORE PIECES 30 TO 1300MM

8.80 - 11.00 CLEAT AT 0.70 TO 90 DEG

COMMENCED: 06/11/85	CONTRACTOR: MCDERMOTT	DRILL TYPE: PIO 160	
COMPLETED: 07/11/85	DRILLER: J.SHAW	LOGGED BY: G WILSON	CHECKED BY:

ELECTRICITY COMMISSION OF N.S.W. GEOTECHNICAL LOG	WALLERAWANG P.S GROUNDWATER MONITORING	W .GM1/D 6

INCLINATION: 90 AZIMUTH:	ISG CO-ORDINATES: 215332E 1303997N	COLLAR R.L.: 906.6 DATUM: AHD	SHEET 2 OF 2 LOCATION PLAN NO. DE 202722



DESCRIPTION OF CORE ROCK TYPE, COLOUR, GRAIN SIZE, MINERAL COMPOSITION, TEXTURE, HARDNESS.	R.L.	DEPTH	STRUCTURES JOINTS (SPACING, ATTITUDE, SMOOTHNESS, APERTURE, COATING, INFILLING) BEDDING, VEINS, SEAMS, FAULTS, CRUSHED ZONES
COAL, BLACK, SILTONE BAND INCLUDED AT 8.86- 8.90M.	895.6	11.00	8.80 - 11.00 CLEAT AT 0.70 TO 90 DEG
MUDSTONE INTERBEDDED WITH SANDSTONE (20%), MOTTLED GREY-ORANGE. BEDDING <6MM. HIGHLY CARBONACEOUS AT 11.00- 11.10M, SANDSTONE INCREASES TO BASE.	894.0	12.65	11.00 - 12.00 WEATHERING CONTROLLED BY JOINTS AT 0 TO 10 DEG 12.00 - 12.75 FOUR JOINTS AT 50 DEG
SANDSTONE, LIGHT GREY; WITH PEBBLES TO 10MM. COARSE GRAINED.	891.7	14.90	12.75 - 14.90 CORE PIECES 30 TO 750MM

END OF HOLE

COMMENCED: 06/11/85	CONTRACTOR: MCDERMOTT	DRILL TYPE: PIO 160	
COMPLETED: 07/11/85	DRILLER: J.SHAW	LOGGED BY: G WILSON	CHECKED BY:

Document prepared by

Aurecon Australasia Pty Ltd
ABN 54 005 139 873
Level 5, 116 Military Road
Neutral Bay NSW 2089
PO Box 538
Neutral Bay NSW 2089
Australia

T +61 2 9465 5599
F +61 2 9465 5598
E sydney@aurecongroup.com
W aurecongroup.com

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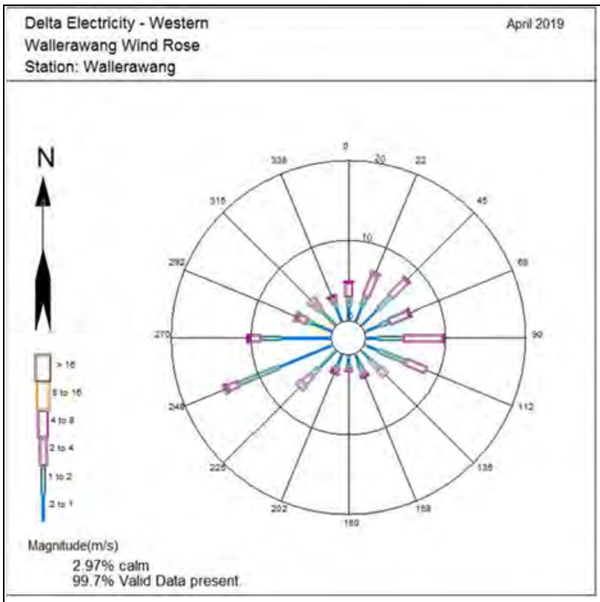
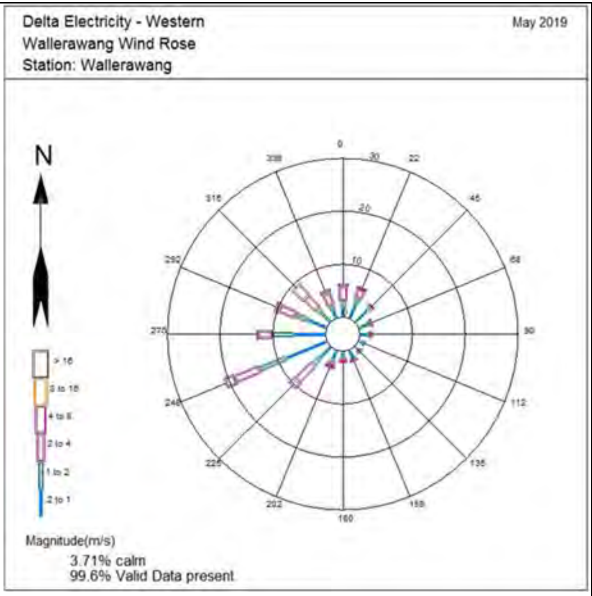
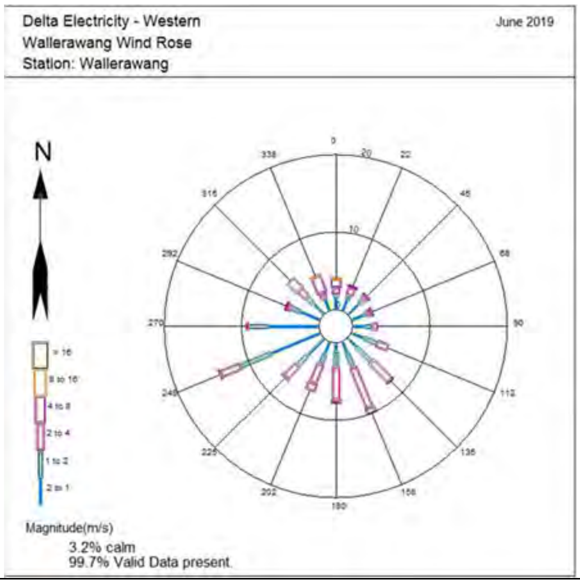
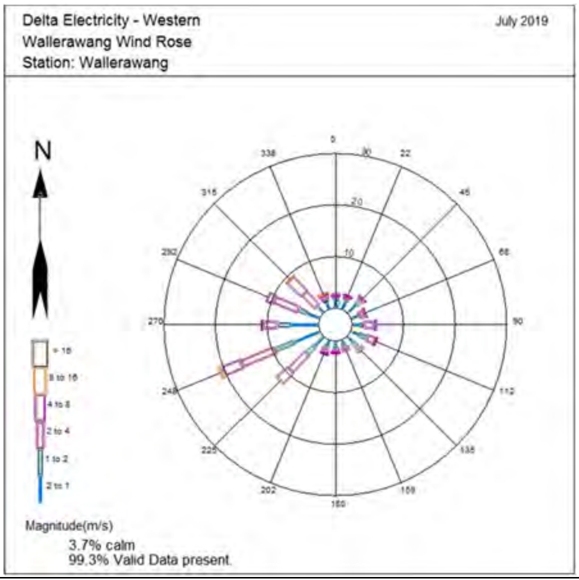
Bringing ideas to life

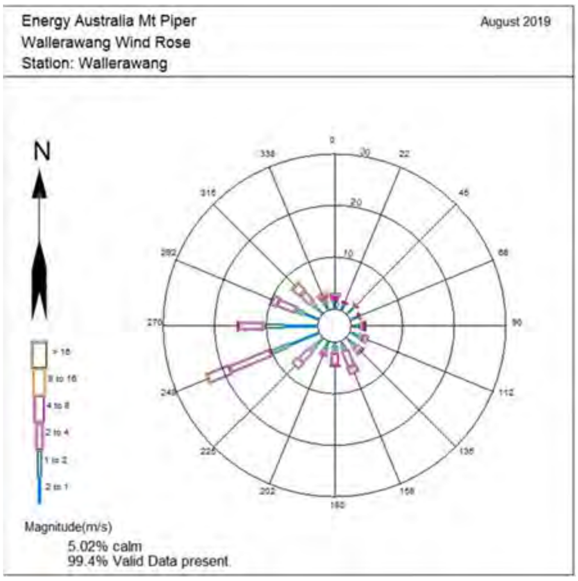
Appendix D
EnergyAustralia NSW Windrose April 2019- March 2020



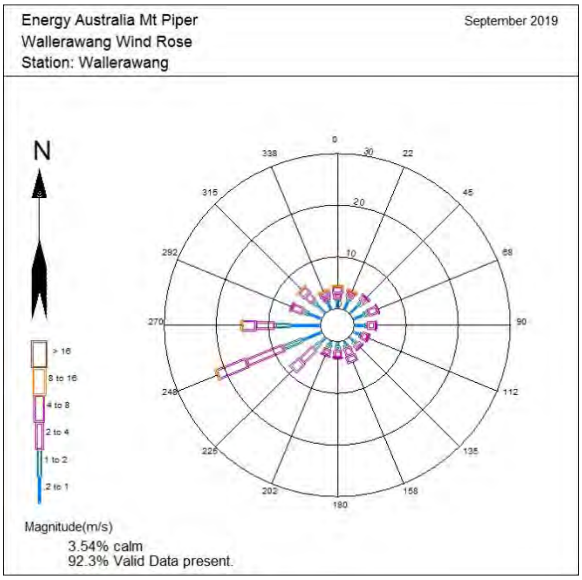




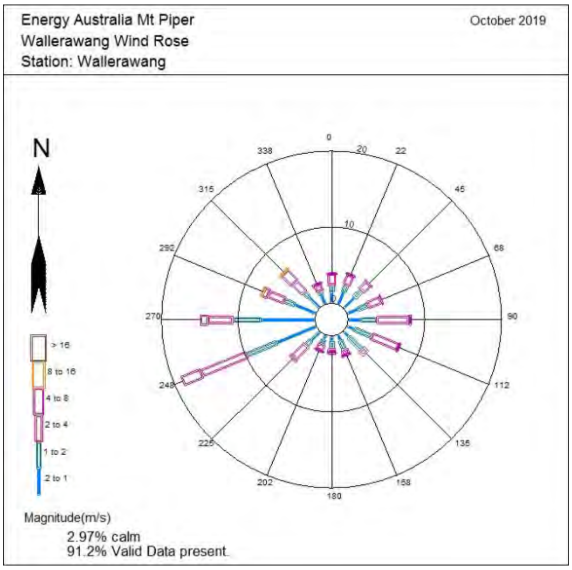



Energy Australia Mt Piper
Wallerawang Wind Rose
Station: Wallerawang
August 2019

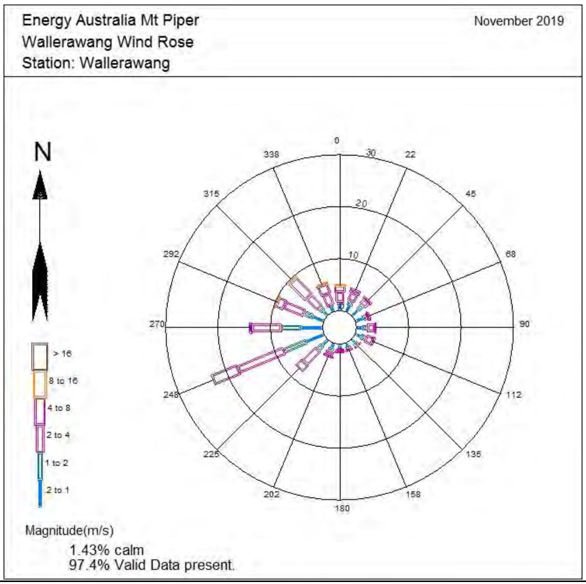
5.02% calm
99.4% Valid Data present.


Energy Australia Mt Piper
Wallerawang Wind Rose
Station: Wallerawang
September 2019

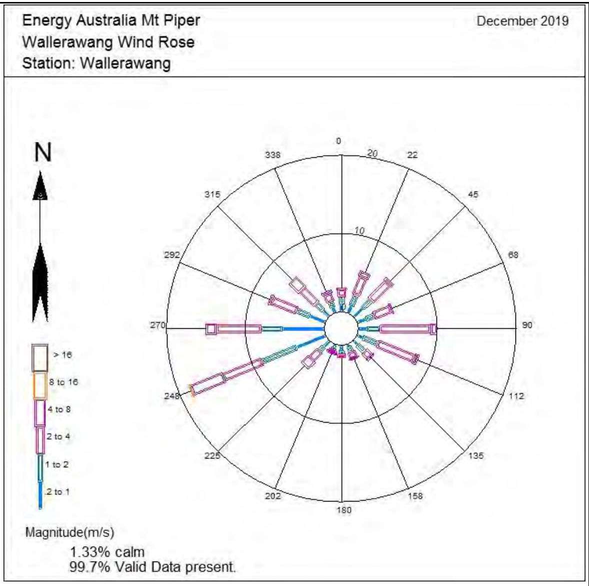
3.54% calm
92.3% Valid Data present.


Energy Australia Mt Piper
Wallerawang Wind Rose
Station: Wallerawang
October 2019

2.97% calm
91.2% Valid Data present.


Energy Australia Mt Piper
Wallerawang Wind Rose
Station: Wallerawang
November 2019

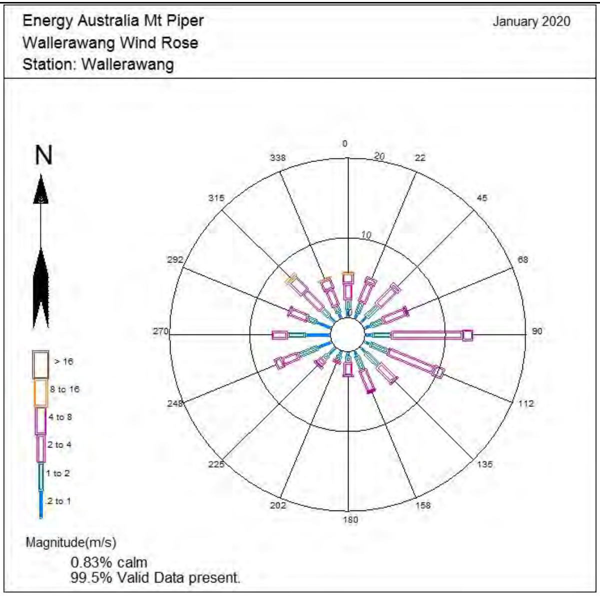
1.43% calm
97.4% Valid Data present.



Energy Australia Mt Piper
Wallerawang Wind Rose
Station: Wallerawang

December 2019

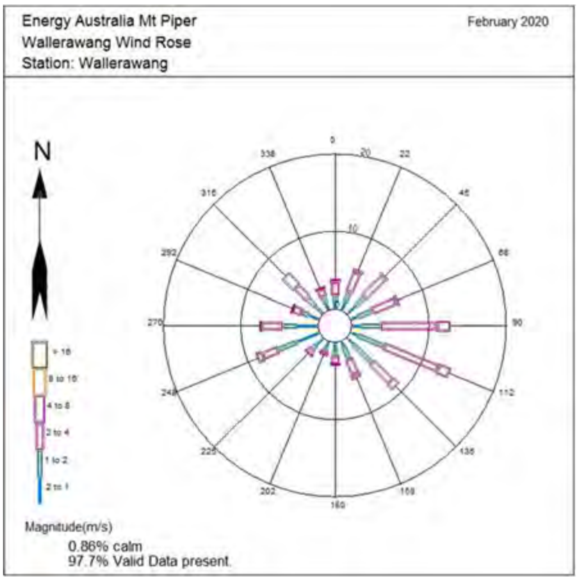
1.33% calm
99.7% Valid Data present.



Energy Australia Mt Piper
Wallerawang Wind Rose
Station: Wallerawang

January 2020

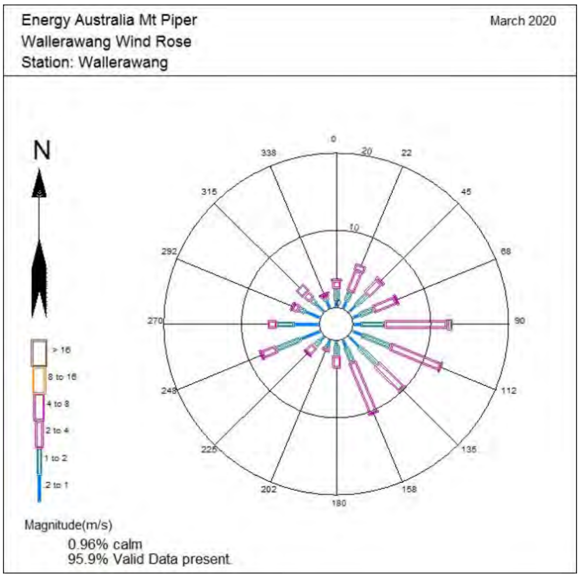
0.83% calm
99.5% Valid Data present.



Energy Australia Mt Piper
Wallerawang Wind Rose
Station: Wallerawang

February 2020

0.86% calm
97.7% Valid Data present.



Energy Australia Mt Piper
Wallerawang Wind Rose
Station: Wallerawang

March 2020

0.96% calm
95.9% Valid Data present.

Appendix E
EnergyAustralia NSW Community Sponsorships and Donations 2019-2020

Recipient	Reason	Month/Year
Ironfest	Community Event	April 2019
Sea Bees	Fishing Event Lake Lyell	April 2019
Mingaan Aboriginal Corporation	Support local event	May 2019
Lithgow City Council	Lithglow Event	May 2019
St Josephs	Mothers Day Fete	May 2019
Lithgow Golf Club	Mt Piper Plate Event	May 2019
Wallerawang/Lidsdale Progress Assn	New Years Eve Fireworks	July 2019
Lithgow Public School	Books in Homes Program	July 2019
Rydal Village Association	Daffodils at Rydal	July 2019
Hartley Historic Association	Back to Hartley 2019	July 2019
Lithgow High School	Presentation Day	August 2019
Lithgow City Council	Halloween	August 2019
Barton Park Giant Tree Arboretum	Projects at the Arboretum – Lake Wallace	August 2019
Lithgow Bears RLFC	Active Kids Sports Program	August 2019
Bathurst Centacare	Cooking Classes for Disadvantaged Families in Community	August 2019
Lithgow District Car Club	Security Fencing Yvonne Martin Memorial Motorsport Park	August 2019
Dry July	Matching Staff Donation	September 2019
Rydal Show Society	Rydal Show	November 2019
St Josephs School Portland	Presentation Day	November 2019
Legacy	Matching staff donation	November 2019
Lithgow & District Community Nursery	Assistance with propagation/provision of plants for local environment	November 2019
Capertee Public School	Presentation Day	November 2019
Lithgow Public School	Presentation Day	November 2019
Portland Central School	Presentation Day	November 2019
St Patricks School	Presentation Day	November 2019
Wallerawang Public School	Presentation Day	November 2019
Zig Zag Public School	Presentation Day	November 2019
LINC Communities & Kids	Carers Pamper Day	November 2019
LINC	Hub Homework Centre	November 2019

Dymocks Childrens Charities	Books for School Library	November 2019
Life Education	Healthy Harold	November 2019
Marathon Health	Taxi Vouchers/Moibilising Mental Health	November 2019
Portland District Sports Club	Updating toilet facilities	November 2019
Wallerawang Central Acclimatisation Society	Gone Fishing Day – Lake Wallace	November 2019
Lithgow Junior Cricket	Purchase equipment	November 2019
Oxfam Australia	Matching Staff donation	November 2019
Jeans for Genes	Matching Staff Donation	November 2019
La Salle Academy Lithgow	Presentation Day	December 2019
Lithgow Show Society	Lithgow Show	December 2019
Cooerwull Public School	Presentation Day	December 2019
Cullen Bullen Public School	Presentation Day	December 2019
Hampton Public School	Presentation Day	December 2019
Meadow Flat Public School	Presentation Day	December 2019
Lithgow Swimming Club	Twilight Swimming Meet	December 2019
The Longest Day	Matching Staff Donation	December 2019
Movember	Matching Staff Donation	December 2019
Starlight Children’s Foundation	Matching Staff Donation	December 2019