Kerosene Vale Ash Repository Stage 2

Annual Review

April 2017 – March 2018

Kerosene Vale Ash Repository Stage 2 Annual Review

Name of Operation	**Kerosene Vale Ash Repository Stage 2**
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 2017**
AEMR end date	**31st March 2018**
I, Ben Eastwood, certify that this report is a true and accurate record of the compliance status of Kerosene Vale Ash Repository Stage 2 for the period 1st April 2017 to 31st March 2018 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	**13 July 2018**

This report may be cited as:

EnergyAustralia NSW (2018) Kerosene Vale Stage 2 Ash Repository Annual Review April 2017 – March 2018. EnergyAustralia NSW, NSW Australia.

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1. Summary of compliance

The Kerosene Vale Ash Repository Stage 2 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 Kerosene Vale Ash Repository Stage 2 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 2017-18 Reporting Period

Were all conditions of the relevant approval(s) complied with?	
Project Approval #07_0005	~~YES~~/**NO**
Environment Protection Licence #766	**YES**/~~NO~~
Water Access Licence #10AL116411	**YES**/~~NO~~

Table 2: Details of Non-Compliance during 2017-18 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
10AL116411	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
- Noise from the Kerosene Vale Ash Repository site was inaudible at sensitive receivers during the reporting period.
- Air quality monitoring results were well below the Operational Environment Management Plan (OEMP) assessment criteria for depositional dust gauges located in Wallerawang and Lidsdale townships.
- There were no surface water discharge events during the reporting period.
- Water monitoring results were compliant with relevant OEMP assessment criteria.
- There were no incidents that caused or threatened material harm to the environment.

2. Introduction

2.1 Background

The Kerosene Vale Ash Repository (KVAR) 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.

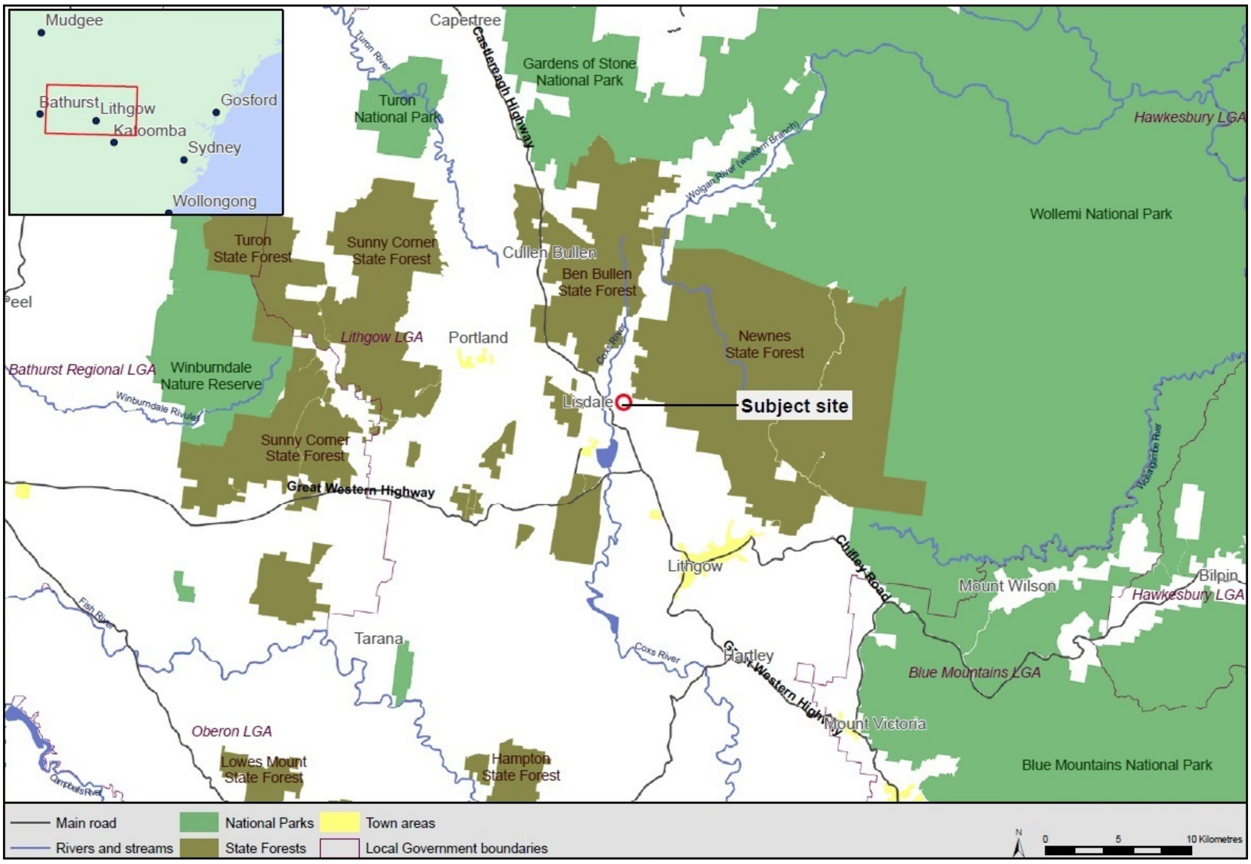

Figure 1: Regional context map

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) (Parsons Brinckerhoff, 2008b), 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 also removed from service and deregistered from the market. As a consequence, EnergyAustralia NSW have engaged Aurecon to produce a strategy for the decommissioning, ceased energy production in April 2014 and is currently being decommissioned and dismantled. As such, the bulk transport and disposal of ash to the Kerosene Vale Ash Repository subsequently ceased following the closure of the Wallerawang Power Station. The Kerosene Vale Ash Repository is currently being managed in a care and maintenance arrangement. Small volumes of ash will be disposed of at Kerosene Vale Ash Repository as and 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.

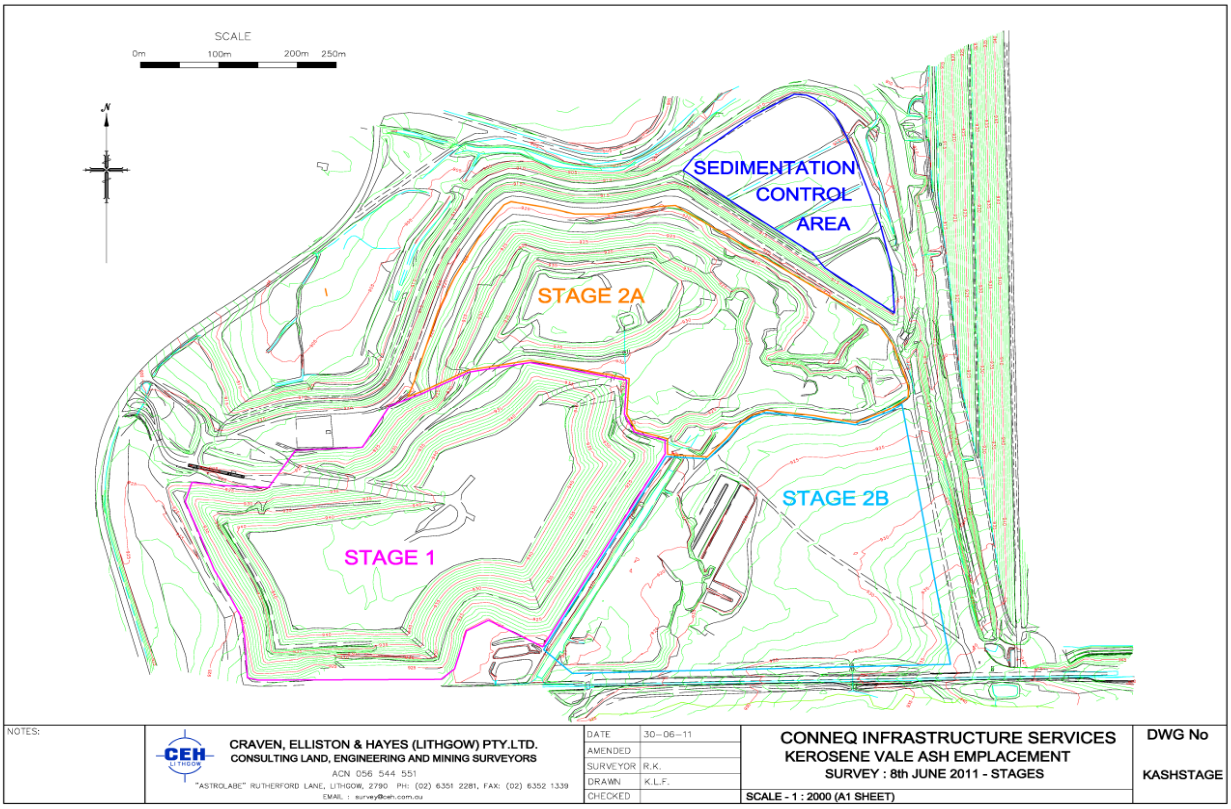

Figure 2: Revised ash placement strategy for KVAR- Stages 1, 2A and 2B

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 (DP&I, 2008). This report covers the operations and environment and community performance of the Kerosene Vale Ash Repository from April 2017 and March 2018 (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 Kerosene Vale Ash Repository Stage 2 are listed in Table 4.

Table 4: Kerosene Vale Ash Repository Contact

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

3. Consents, Leases and Licences

This AEMR has been prepared to address the relevant conditions of the project approval and the Statement of Commitments which have been triggered during the reporting period. The operation of the KVAR 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 July 2005 (Renewed 26 November 2008)	26 November 2013	Granted by Minister for DoP, Section 75J of the EP&A Act.
Environment Protection Licence (EPL) No. 766	20 December 2017	20 December 2022 (Review Date)	EPL held by EnergyAustralia NSW for Wallerawang Power Station
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 June 2031	Granted by DPI Water, under the *Water Management Act 2000*

During the 2017-18 reporting period, EnergyAustralia NSW submitted an application to vary EPL 766 to the NSW EPA to authorise the importation of virgin excavated natural material (VENM) and excavated natural material (ENM) onto the licensed premises for land rehabilitation purposes. This application was approved by the EPA in December 2017.

On the 22nd December 2017, EnergyAustralia NSW submitted an application to DPE for the modification of project approval 07_0005 under section 75W of the Environmental Planning and Assessment Act (EP&A Act). The application sought approval for the importation of clean fill from offsite sources in NSW to be used in the capping and rehabilitation of the Kerosene Vale Ash Repository. The application and supporting Statement of Environmental Effects was placed on public exhibition and a determination is pending. It is anticipated that the application will be determined in the next reporting period.

On the 27th February 2018, EnergyAustralia NSW advised the DPE of its intention to seek a further modification of Project Approval 07_0005, under section 75W of the EP&A Act. The purpose of this additional modification is for undertaking final closure and rehabilitation activities of the Wallerawang Ash Repository. The DPE confirmed on the 28th February 2018 that the proposal can be considered as a Section 75W modification under the former Part 3A process.

A summary of compliance against the applicable statutory authority is provided Section 1.

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 KVAR. 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 (Parsons Brinckerhoff, 2008b).

The scope of the OEMP covers operations involving the movement and placement of ash from Wallerawang Power Station (WWPS) to the KVAR Stage 2 area of the Kerosene Vale Ash Repository. The OEMP has been reviewed by EnergyAustralia NSW during the 2017-18 reporting period to ensure that it reflects the current Care and Maintenance activities. The reviewed OEMP has been prepared in consultation with the EPA, WaterNSW, DPI-Water, DPI-Fisheries and was submitted on the Department of Planning and Environment on the 4th August 2017.

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 NSW Department of Planning (DoP).

4. Operations during reporting period

Due to the non-operational status of Wallerawang Power Station, no ash has been generated for disposal at KVAR during the reporting period. As such, KVAR 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 activities. The contractor provides maintenance services for relevant aspects of ash and dust management at the Wallerawang Ash Repository, which includes overall management of the KVAR.

During the 2017-18 reporting period, work has been performed on the final capping resulting in an additional 0.5 hectares of previously exposed ash being capped (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)	37.7	37.7	37.7
Area of repository capped (ha)	32.9	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 DP&E, formerly DoP, 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 KVAR Stage 2B 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 rehabilitation (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 in isolation at this time without taking into account 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.

EnergyAustralia NSW has engaged Aurecon to prepare a Closure and Rehabilitation strategy for the Wallerawang Ash Repository, i.e. KVAR and Sawyers Swamp Creek Ash Dam (SSCAD). A groundwater model has been prepared to support the closure and rehabilitation strategy. Consultation with government agencies will be scheduled during the next reporting period, i.e. 2018-19, to gain feedback on the performance measures detailed within the strategy document.

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. As detailed in Section 3, the EPL and Project Approval has been modified within the reporting period to enable the import of VENM and 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 20 September 2017, the DP&E stated it was generally satisfied that the 2016-2017 Annual Review adequately addressed the relevant requirements of the Project Approval. Four actions were requested by DP&E, which are detailed in Table 7. A response to these actions was submitted to the DP&E in a letter dated 26 October 2017 and the status of these actions is discussed in the relevant sections of this Annual Review.

Table 7: Actions required from last Annual Review

Item	Action required from 2017 Annual Review	Requested by	Action taken	Where discussed in AEMR
1	***Project boundary*** *– Future Annual Reviews are to include the project approval boundary on the relevant plan(s).*	DP&E	Plans have been updated to include the project approval boundary.	Figure 3 Figure 14 Figure 19 Figure 20
2	***Graphs*** *– Provide graphs for key analytes over the period of monitoring for both groundwater and surface water to show trends.*	DP&E	Graphs of key analytes which show trends have been provided for groundwater and surface water as requested.	Sections 7.1 & 7.2
3	***Closure and Rehabilitation Plan*** *– The Closure and Rehabilitation Plan is to be submitted to the Department by 31 October 2017.*	DP&E	EnergyAustralia NSW have engaged external consultants to develop a closure and rehabilitation plan for the Wallerawang ash repositories. The Closure and Rehabilitation Plan has not been completed. The DPE will be consulted accordingly.	Section 4.4

Item	Action required from 2017 Annual Review	Requested by	Action taken	Where discussed in AEMR
4	***Publicly available documents*** *– In accordance with Condition 5,2 of Schedule 2 of the approval, EnergyAustralia is required to make the documents of Condition 5.1 publicly available on the company website and ensure that these documents are up-to-date. It is noted that the complaints register and a copy of the Environmental Protection Licence are currently not available.*	DP&E	EnergyAustralia NSW maintains a website for KVAR that contains the relevant documentation as required under Condition 5.2 Schedule 2 of Project Approval 07_0005. These documents include: • Project Approval; • Environmental Assessment; • Environmental Management Plans; • Annual Environmental Management Reports; and • Environmental Protection Licence 766 The link on the website to the approval and management plan documentation is: https://www.energyaustralia.com.au/about-us/energy-generation/wallerawang-power-station-closure/kerosene-vale-ash-repository The link on the website to the Environment Protection Licence 766 is: https://www.energyaustralia.com.au/about-us/energy-generation/wallerawang-power-station-closure/wallerawang-epa-reports EnergyAustralia NSW receives very few complaints from the community in relation to its activities. A summary of complaints is provided in the Annual Review Report, which is publicly available on the company website. No complaints have been received to date during the current reporting period for KVAR; as such no complaints register has been published.	Sections 9.3 & 9.4

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 & D.

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 0.5 to 2.4 g/m^2/month deposited dust	Annual average dust levels show a slight decreasing 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.

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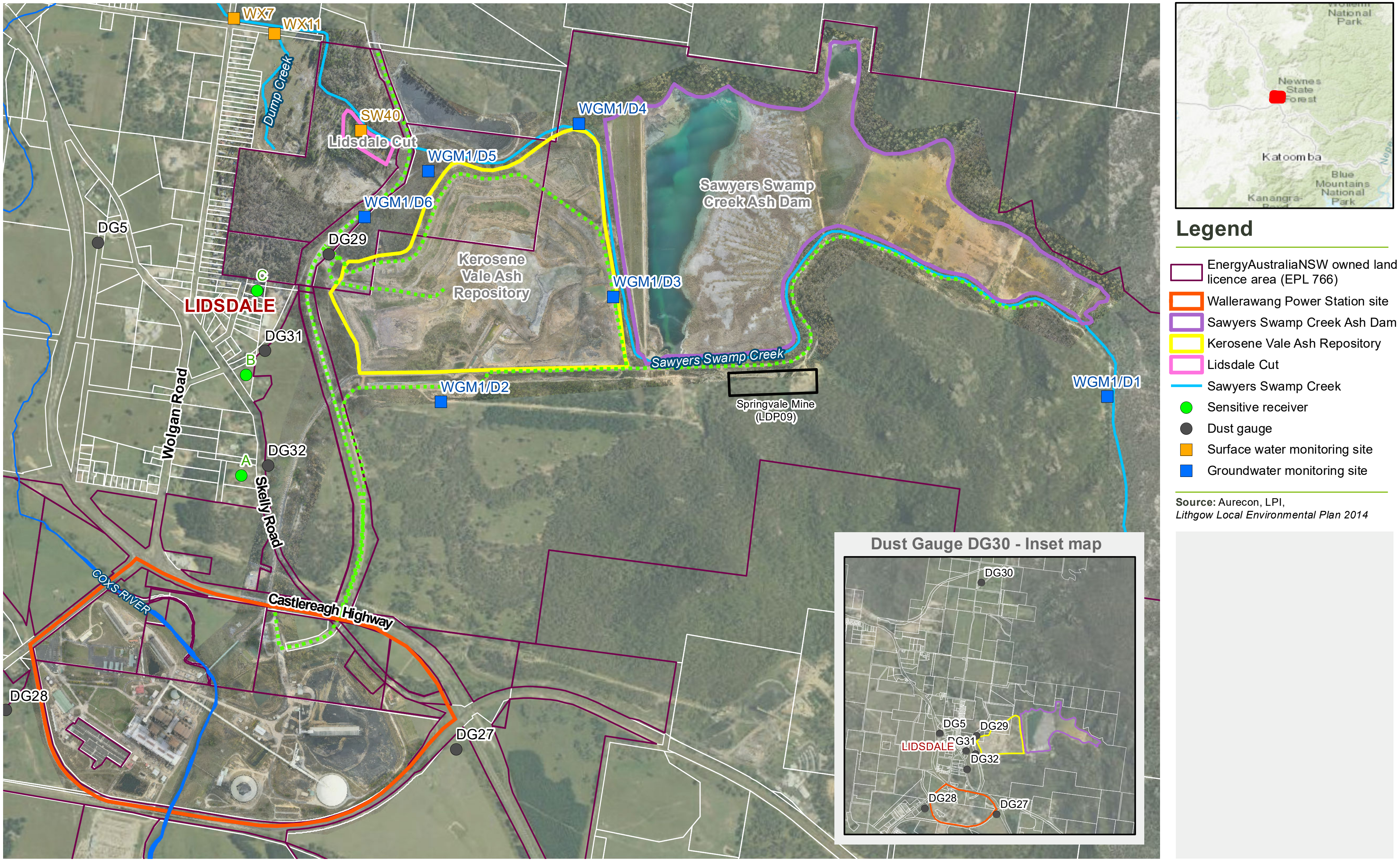

Source: Aurecon, LPI,
Lithgow Local Environmental Plan 2014

Projection: GDA 1994 MGA Zone 56

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Wallerawang Power Station (13 July 2018)

Figure 3: Environmental monitoring locations

6.1 Ash delivery and placement

Due to the non-operational status 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.

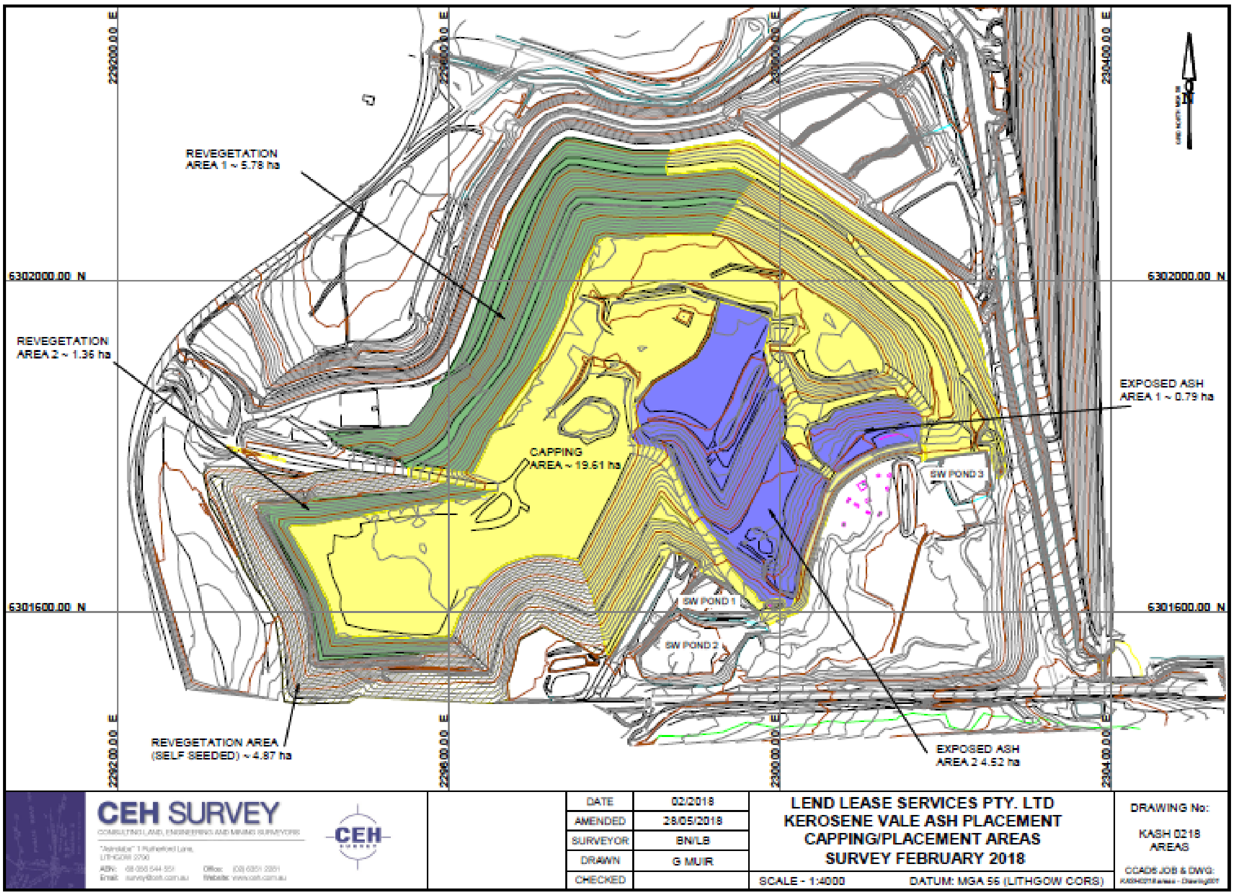


Figure 4: Area of exposed ash remaining at Kerosene Vale Ash Repository Stage 2

Table 9: Ash Footprint areas

Ash Footprint area	Area (ha)
Exposed ash	5.3
Footprint	13.1
Batters	10.0
Laybacks	3.0
Top Level	6.3
Total Ash Footprint	37.7

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.

All management and mitigation measures specified in the approved OEMP were found to be complied with.

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 non-operational status 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 was engaged by EnergyAustralia NSW to carry out ongoing operational noise monitoring for the KVAR Stage 2 located in Wallerawang, NSW (2017). The noise measurements were performed on one occasion throughout the reporting period – in September 2017 (Appendix B). Noise monitoring for KVAR Stage 2B was performed in accordance with the methods described in the approved OEMP.

Noise from the ash placement area was inaudible at the sensitive receivers. This was primarily due to the KVAR being in care and maintenance. There were no truck movements associated with the haulage of ash to the repository area. The minor activities on the ash placement area including light vehicle movements and auxiliary equipment was inaudible and did not contribute to the background noise levels recorded at the sensitive receivers.

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 exceedences 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 Repository Site Management Plan (Lend Lease, 2012) for KVAR Stage 2 operations contains an Implementation Strategy in accordance with the Air Quality Monitoring Program, as required under the CoAs as stipulated by DP&E and as 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 KVAR area (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 KVAR Stage 2. 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 KVAR.

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 between November 2017 and February 2018, but equally high evaporation rates resulted in a net irrigation rate below the maximum application rate for irrigation.

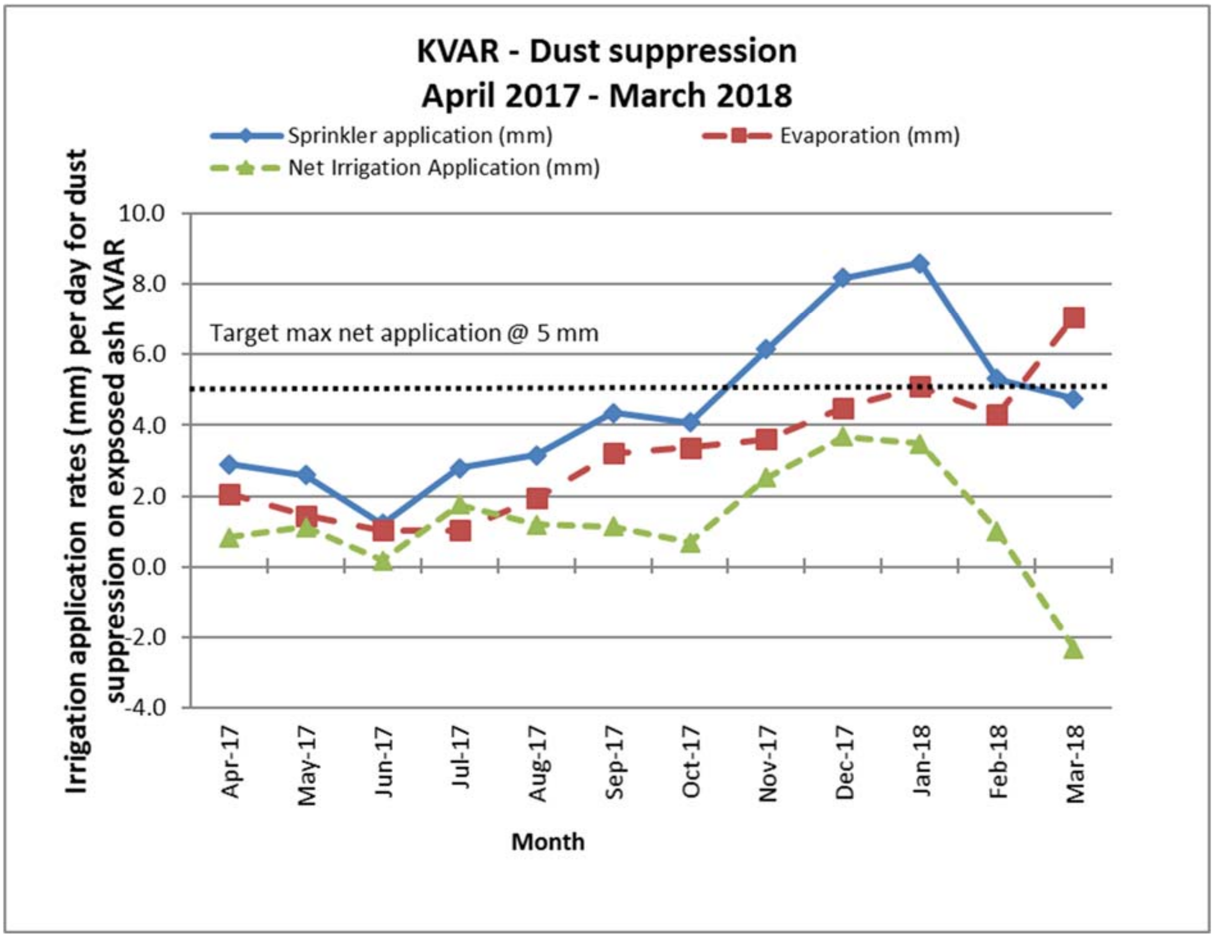


Figure 5: Efficacy of irrigation operations April 2017 – March 2018

6.4.2.2 Dust deposition monitoring

Dust gauge data from the 2017-2018 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.

Combined annual average depositional dust data over the previous three-year period is presented in Figure 6. Additional annual average depositional dust data for each of the seven OEMP dust deposition gauges are presented in Figure 7 to Figure 13.

An examination of the historical data indicates a slight decrease in the depositional dust concentrations at the KVAR during the period April 2016 to March 2017, with concentrations remaining stable during the current reporting period. Operations at Wallerawang and in turn Kerosene Vale Ash Repository, ceased in April 2014, with a reduction in depositional dust concentrations 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 4 g/m^2/month deposited dust).

Historical high depositional dust gauge readings have generally been attributed to wild fires, out of area dust storms and hazard reduction burning occurring in the Central West, Blue Mountains, Hawkesbury and even the Sydney Region. These events are known to affect particulate levels by increasing the levels above the standard requirements across the state.

As such, to account for natural events, the national goal for particulates excludes exceptional events such as these (OEH, 2017). Hazard reduction burns are generally performed in the aforementioned areas in July to September, with the bushfire season commencing in October. Conversely, peaks in the combined averages of the 7 depositional dust gauges generally align within the hazard reduction or bushfire season.

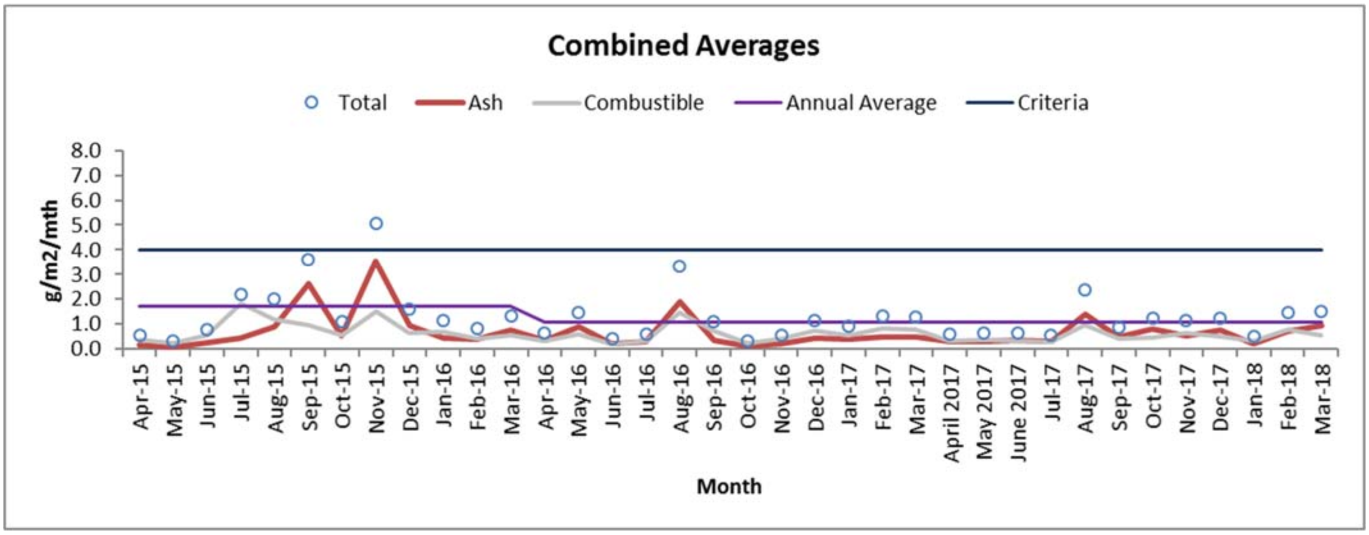


Figure 6: Combined averages for the 7 OEMP depositional dust gauges

The peak in Total depositional dust observed in November 2015 is the result of anomalously high results recorded at Deposition Dust Gauges (DDG) 28 & 32. DDG 28 was found to contain bugs, plant matter, organic matter, fine brown / black dust and coarse brown / black dust. Whilst DDG 32 contained bugs, fine brown dust & coarse brown dust. Both of these gauges are located to the South-West of Kerosene Vale Ash repository, which was the direction in which the wind was predominantly blowing from throughout November 2015. It is therefore unlikely that KVAR would be the cause of the high results observed within DDG 28 & 32.

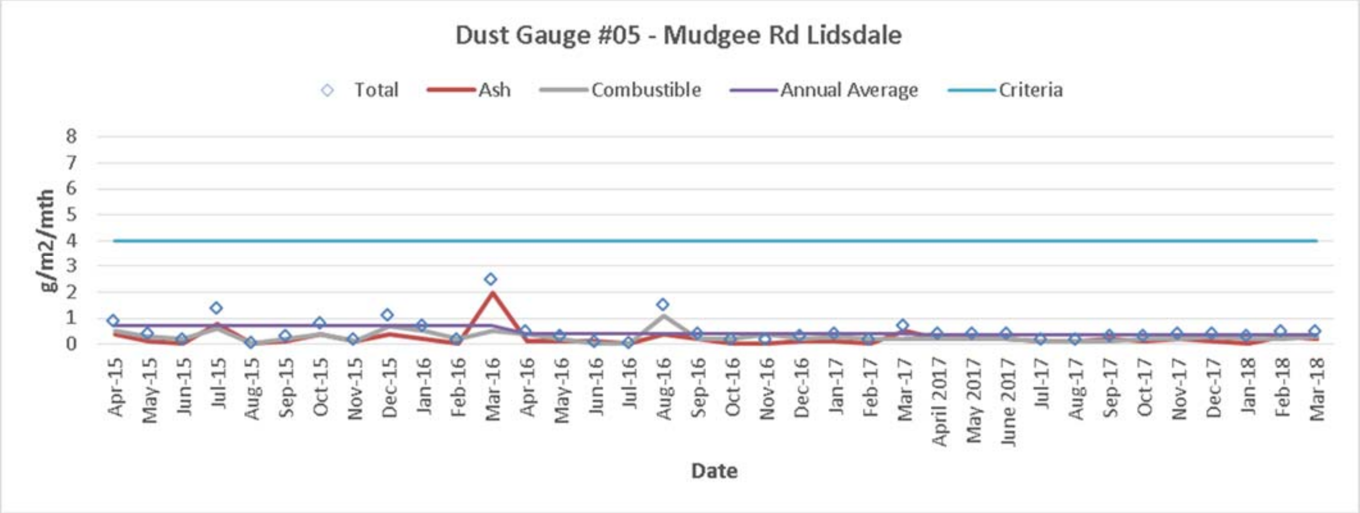


Figure 7: Depositional Dust Summary - Dust Gauge 5

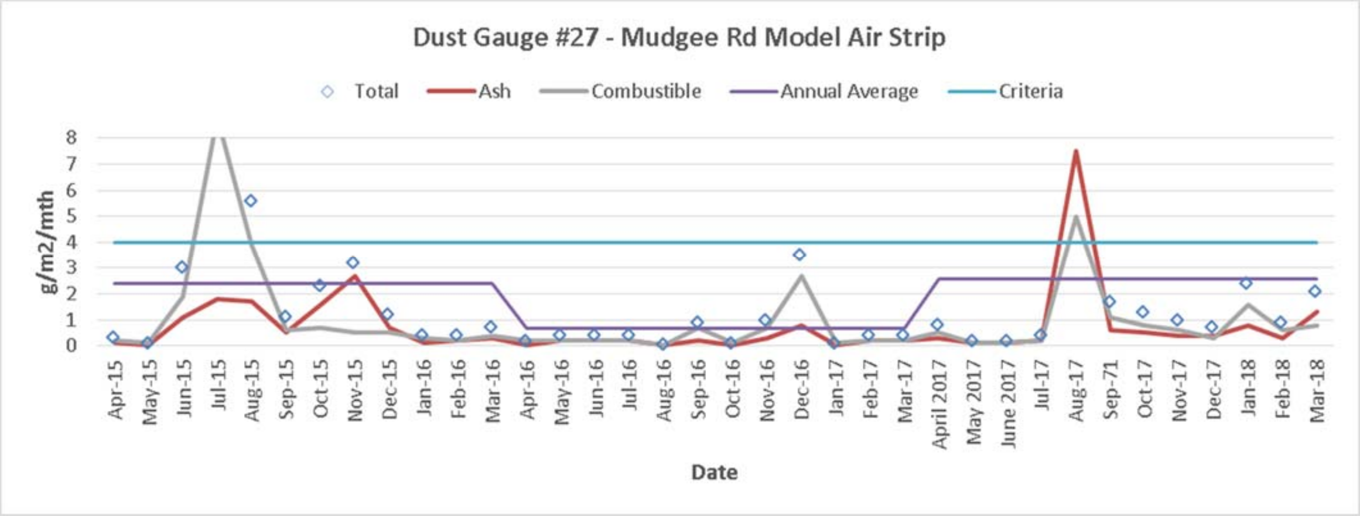


Figure 8: Depositional Dust Summary - Dust Gauge 27

There was an elevated result recorded during the reporting period in August 2017. It is not typical for this gauge to record such elevated levels of inorganic and combustible matter. There was an elevated volume of combustible and non-combustible matter in the sample for August. It is not clear what may have caused this isolated high result. The predominant winds were from the south-west which suggests the KVAR was not the predominant contributor. Increased insect or other biological activity may have influenced this result which is reflective of the higher combustible material being recorded than what normally would be expected.

The Peak observed in Dust Gauge 27 (Figure 8) are likely not related to works at Kerosene Vale Ash Repository as Dust Gauge 27 is located to the South of Kerosene Vale and winds were predominantly blowing from the South-West (i.e. from Dust gauge 27 towards KVAR) during the months when peaks were recorded.

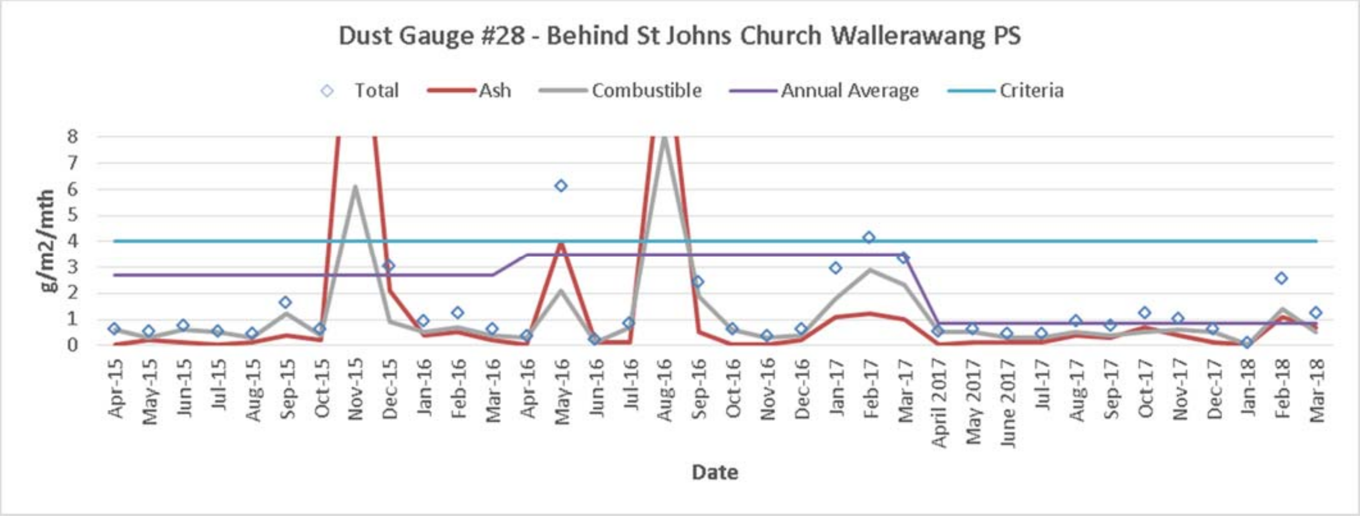


Figure 9: Depositional Dust Summary - Dust Gauge 28

There were no exceedances of the air quality amenity criteria at Dust Gauge 28 during the reporting period. Previous peaks observed in Dust Gauge 28 (Figure 9) are isolated events and unlikely to be solely attributable to activities at Kerosene Vale Ash Repository. Dust Gauge 28 is located to the South-West of Kerosene Vale and winds were predominantly blowing from the South-West (i.e. from Dust gauge 28 towards KVAR) during the months when peaks were recorded. There is no ongoing trend of air quality degradation reflected at Dust Gauge 28.

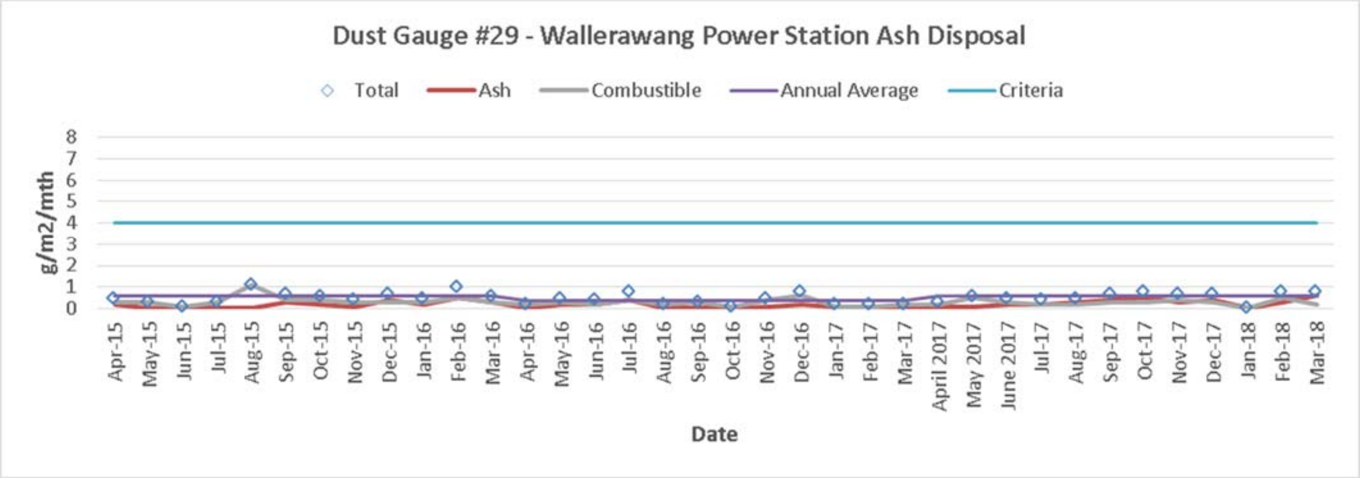


Figure 10: Depositional Dust Summary - Dust Gauge 29

There were no elevated results recorded at Dust Gauge 29 during the reporting period. Results are consistent with previous years and complied with the amenity criteria.

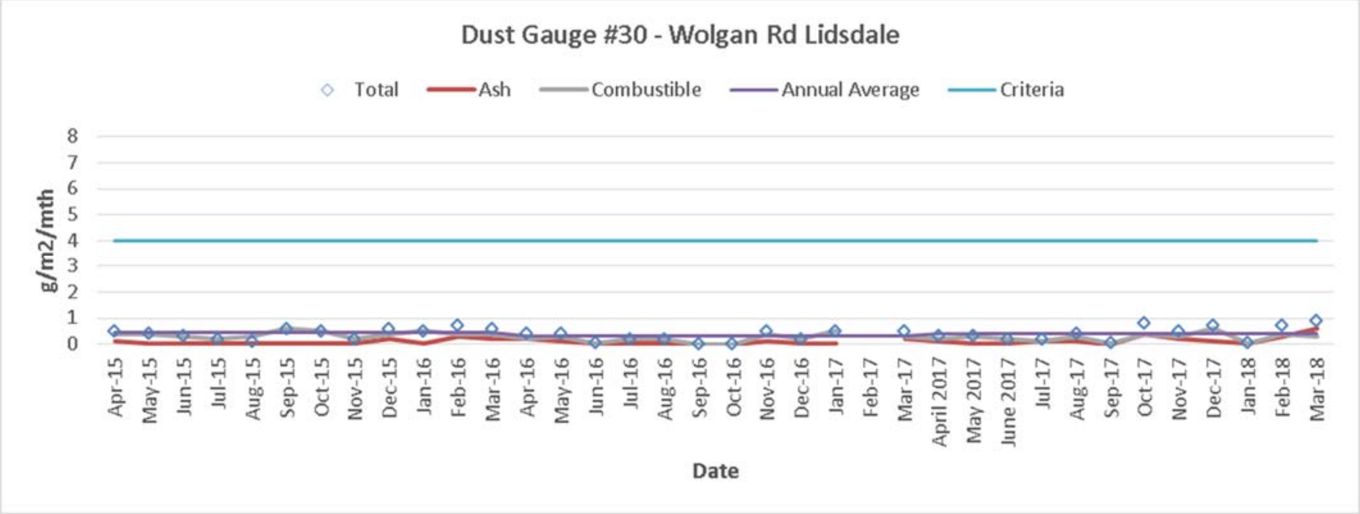


Figure 11: Depositional Dust Summary - Dust Gauge 30

There were no elevated results recorded at Dust Gauge 30 during the reporting period. Results are consistent with previous years and complied with the amenity criteria.

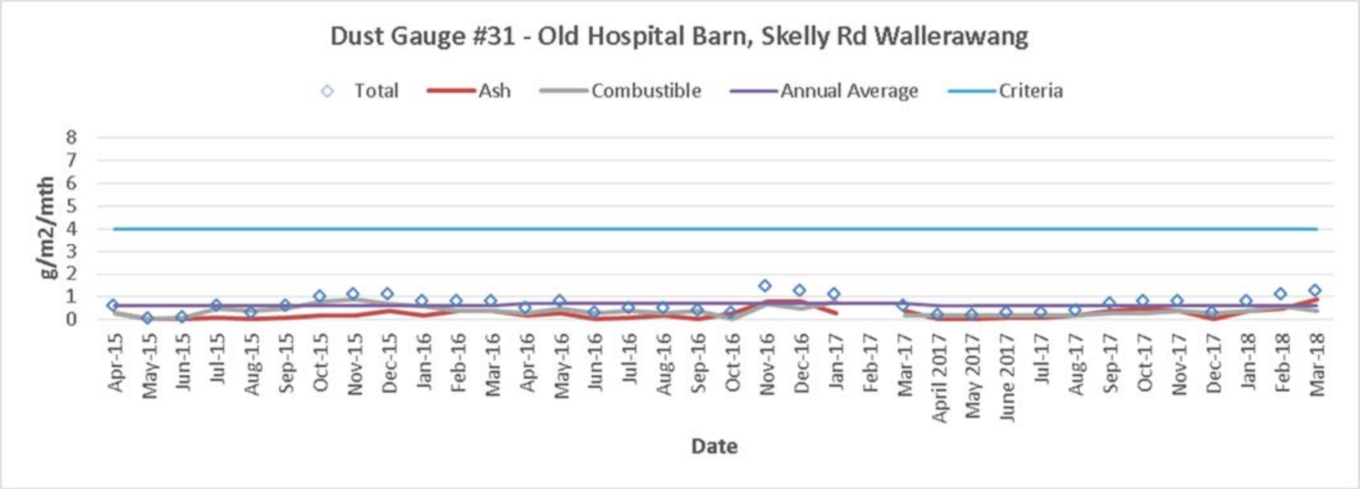


Figure 12: Depositional Dust Summary - Dust Gauge 31

There were no elevated results recorded at Dust Gauge 31 during the reporting period. Results are consistent with previous years and complied with the amenity criteria.

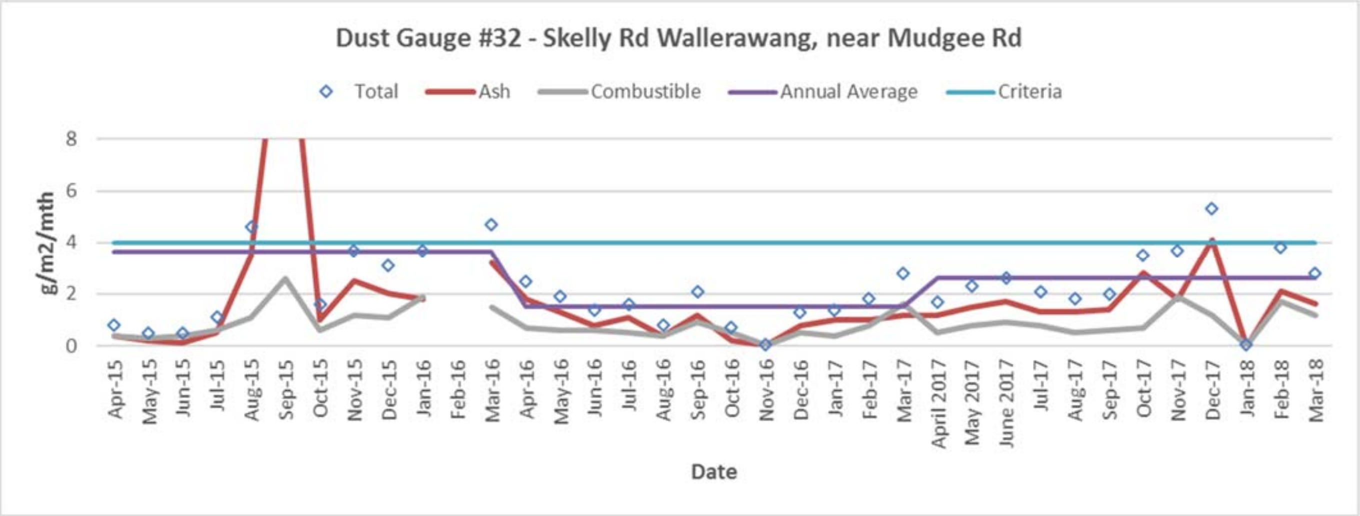


Figure 13: Depositional Dust Summary - Dust Gauge 32

Dust Gauge 32 is located some distance from the KVAR and is regularly influenced by other adjacent landuse activities. Peaks observed in Dust Gauge 32 (Figure 13) are likely not related to works at Kerosene Vale Ash Repository as Dust Gauge 32 is located to the South-West of Kerosene Vale and winds were predominantly blowing from the South-West (i.e. from Dust Gauge 32 towards KVAR) during the months when peaks were recorded.

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 2017-2018 reporting period. These results confirm that the control measures in place at the KVAR are effective in controlling air emissions. indicate that KVAR is managed effectively for dust and as such is in compliance with CoAs 2.33 and 3.8.

6.4.3 Reportable Incidents

There were no reportable incidents relating to air quality during the reporting period.

Peaks observed in Dust Gauges 27 and 32 during the reporting period have been investigated and have not been attributed to activates at the KVAR. There is no ongoing trend of decreasing air quality that is attributable to the KVAR.

6.4.4 Further Improvements

Investigate if methods are available to minimise 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 KVAR Stage 2 were deemed to have met the OEMP targets for waste management for the 2017-18 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.

EnergyAustralia NSW is currently developing a closure and rehabilitation plan for the KVAR. The existing approved OEMP rehabilitation sub-plan describes the use of capping material to cover and rehabilitate the surface of KVAR. As part of the closure and rehabilitation strategy, it has been recognised that additional capping material may be required to achieve the rehabilitation objectives and targets. As such, EnergyAustralia NSW is investigating the use Virgin excavated Natural material (VENM) and Excavated Natural Material (ENM) for use in the rehabilitation and closure of KVAR.

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 Wallerawang Power Station, including Kerosene Vale Ash Repository, is taken from the Coxs 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 2017 – 30 June 2018).

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 (Parsons Brinckerhoff, 2008b) includes a Groundwater Management Plan for KVAR and adjacent KVAD. 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).

The blocked toe drains of KVAD were cleared in February 2010, and further monitoring of groundwater levels within the Ash Dam and KVAR Stage 2 were instigated. This included subsurface investigations.

Subsurface investigations and subsurface drainage works (for seepage collection) and installation of additional water monitoring points (Figure 14) 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 14). Additional sites sampling the local Kerosene Vale Ash Dam and Repository (KVAD/R) seepage and SSCAD, offer further information in regards to the local groundwater quality under SSCAD, KVAD and the KVAR.

Figure 14: Surface and groundwater monitoring sites for SSCAD and KVAR

7.1.2 Environmental Performance

EnergyAustralia NSW engaged independent specialist consultants Aurecon to undertake a detailed Water Quality Assessment for the April 2017 to March 2018 reporting period for the KVAR (Aurecon, 2018). In summary, the groundwater assessment found that there have been no significant effects of the KVAR dry ash placement area on the local groundwater aquifers during the reporting period. The Water Quality Assessment is provided in full in Appendix D.

In order to assess the effects of the KVAR groundwater on the water quality at the receiving groundwater bore D5, trends in indicator parameters for D5 have been provided in Figure 15. A comparison of parameters for bores inside the KVAD/R and its seepage points for the reporting period and since 1988 are provided in Appendix D Table 4-4 and Table 5-2, respectively.

The assessment of groundwater quality found that:

There has been a general decrease in indicator parameters at the KVAR groundwater receiving site (bore D5) throughout the reporting period. However, the majority of parameters still remain above the Local/ANZECC water quality guideline values (Figure 15).

Results are reflective of the complex influences on water quality associated with a number of existing and historic land use activities, such as open cut and underground mining, chitter deposits, pumping and discharge regimes from both SSCAD and KVAD. This is discussed further in in Appendix D Table 4-4 and Table 5-2 and the Kerosene Vale Stage 2 Ash Repository Area Environmental Assessment (Parsons Brinckerhoff, 2008a).

The Kerosene Vale Stage 2 Environmental Assessment (Parsons Brinckerhoff, 2008a) predicted that the increase in the thickness of the ash layer, as ash placement continued within KVAR Stage 2, would increase residence times of water in the ash. This has the potential to increase trace element concentrations in groundwater.

It was predicted that changes to groundwater quality as a result of KVAR Stage 2 would be minimal (Parsons Brinckerhoff, 2008a). This was primarily due to the low recharge of the groundwater system occurring through the historically wet-ash placement (within KVAD and SSCAD) and expected low infiltration through the dry-ash placement in KVAR. It was predicted that the small quantities of water would pass through the KVAR and reach the groundwater table.

Based on this data it appears that it is not conclusive to directly attribute groundwater quality impacts in bore D5 solely to a single source, such as the KVAR.

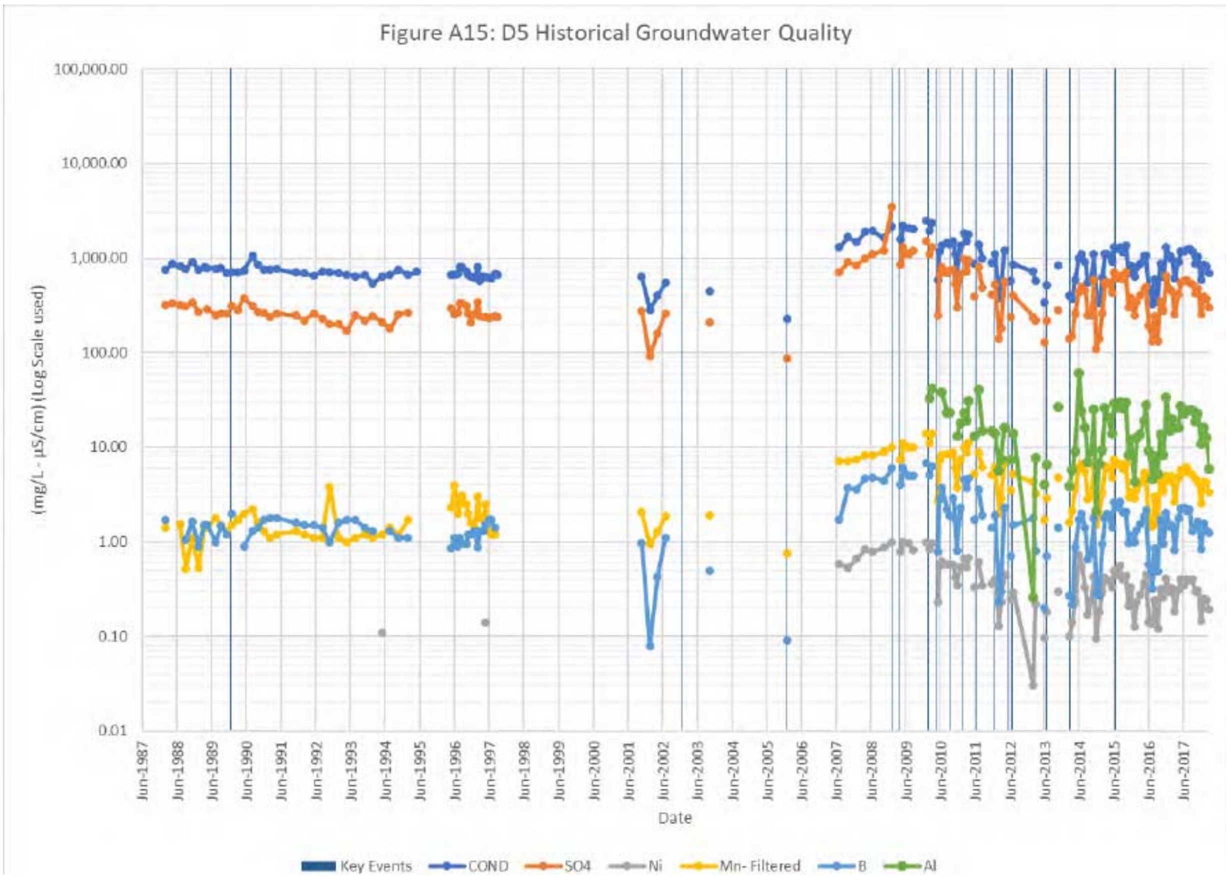


Figure 15: Historical trend of water quality within groundwater bore D5

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 16). 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.

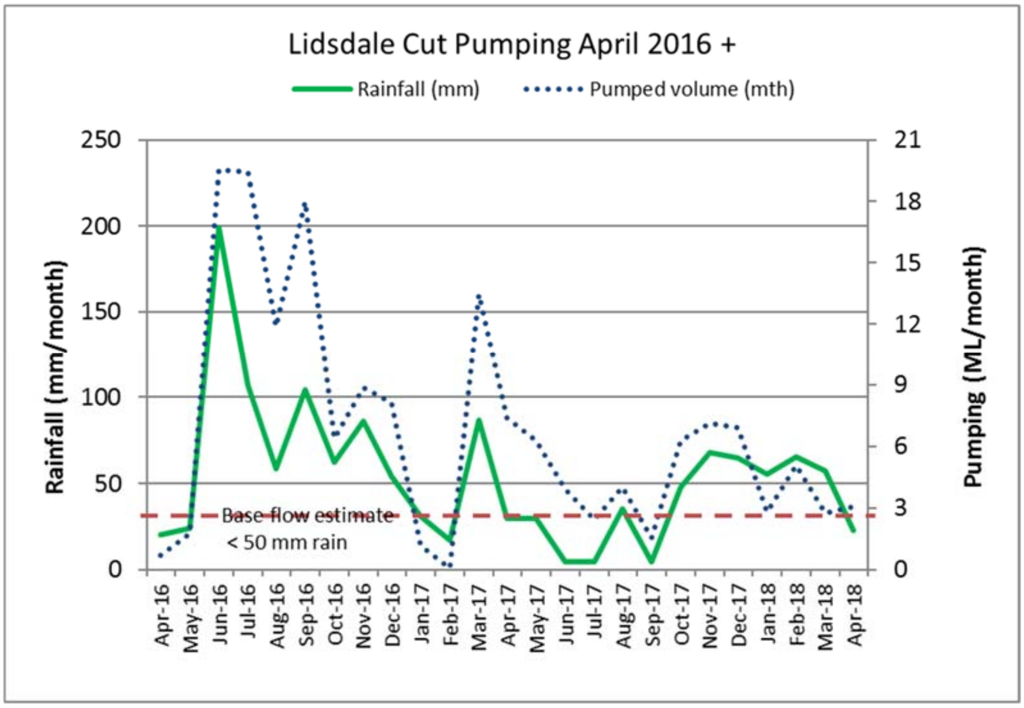


Figure 16: Rainfall compared to the amount pumped from Lidsdale Cut.

There have been increases in trace metal concentrations within the Lidsdale Cut monitoring site, with the majority of the concentrations exceeding the water quality guideline values during the 2017-18 reporting period (Figure 17). However, it should be noted that the water quality guideline values are only applicable to the KVAR receiving water sites of Sawyers Swamp Creek at WX7 and groundwater bore D5.

With the exception of iron and fluoride, 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 D Tables 4-2 and 4-4). 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 at KVAR to be performed as part of the Closure & Rehabilitation of Wallerawang Ash Repositories.

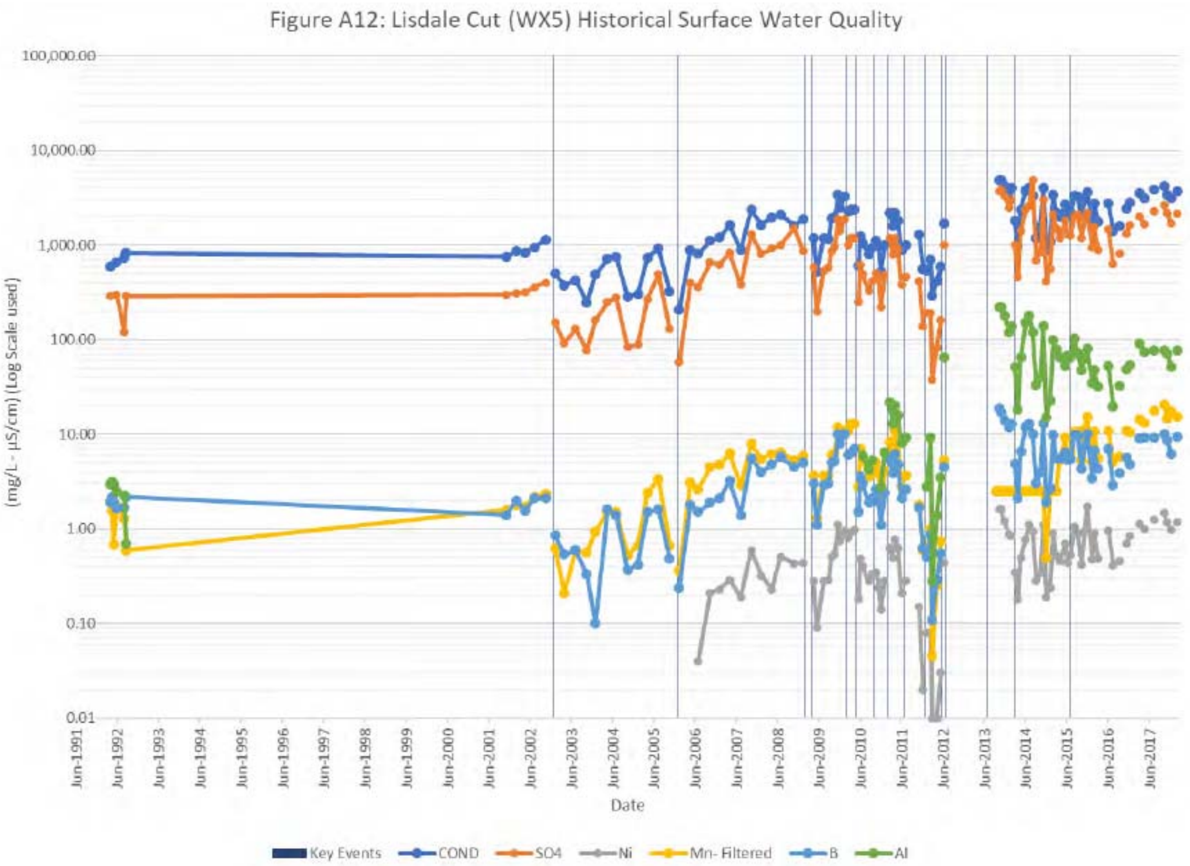


Figure 17: Historical trend for water quality within Lidsdale Cut Pond

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 KVAR Stage 2 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 (Appendix C, shaded cells) 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 2017 to March 2018 reporting period (Aurecon, 2018). 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 D.

In order 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. Figure 18 shows trends in indicator parameters for WX7 since 1991 to 2018. 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 4-2 and Table 5-1, respectively.

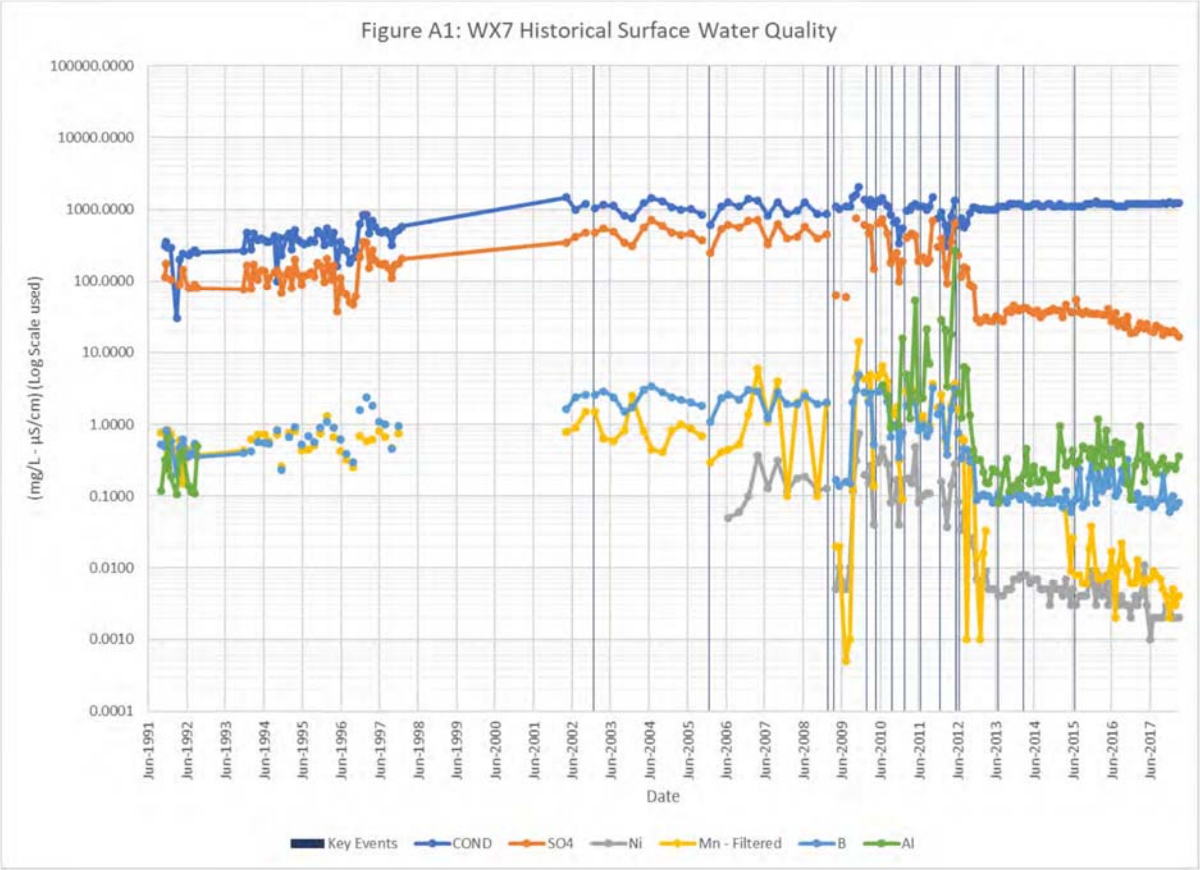


Figure 18: Historical Trend for water quality at Sawyers Swamp Creek at WX7.

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 (Figure 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 D Table 4-2). Arsenic and molybdenum were slightly above the ANSECC guideline and is consistent with the results measured at the upstream monitoring sites on SSC (Appendix D Table 4-2). As these concentrations differ to those of Kerosene Vale Ash Dam or Repository (KVAD/R) Seepage (Appendix D Table 4-2), it is likely that these are associated with other landuse practices in the area and are not directly related to KVAD/R.

The Kerosene Vale Stage 2 Environmental Assessment (Parsons Brinckerhoff, 2008a) indicated that there is the potential for:

- Pollutants within the ash to be mobilised in runoff from exposed ash areas; and
- Sediment to be mobilised in runoff from disturbed areas of the site and from capped areas prior to revegetation.

However, the potential for the water quality within Sawyers Swamp Creek to be impacted by possible discharges from the KVAR site would be low as a result of the water management system at KVAR outlined in the approved Operational Environmental Management Plan (Parsons Brinckerhoff, 2008b).

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. Approximately 20 ML of water per day is discharged by the mining operations into Sawyers Swamp Creek. 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 KVAR Stage 2 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.

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 Hydrological Monitoring

EnergyAustralia NSW has determined that there is no longer any need to realign SSC. As such, hydrological monitoring as required under CoA 3.6 is not required.

7.4 Erosion and Sediment Control

7.4.1 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 KVAR, 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).

Source: Aurecon, LPI, EnergyAustralia, OEH

Figure 19: Existing site drainage system

7.4.2 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 directed to the north reported into the North Holding Pond. 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.

7.4.3 Reportable Incidents

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

7.4.4 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.

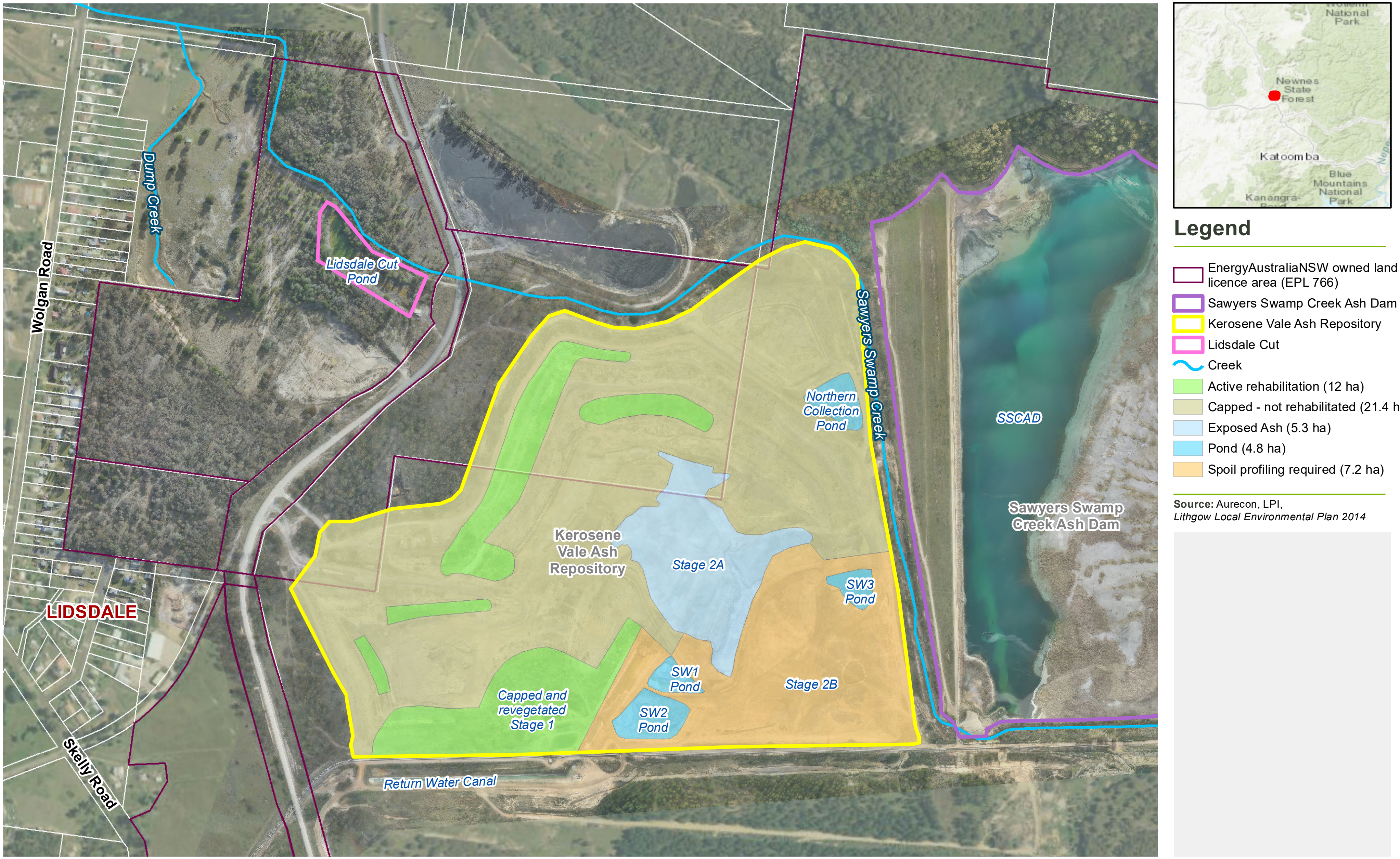
8.1.2 Environmental Performance

During the 2017-18 reporting period, a new rehabilitation status plan (Figure 20) was produced to provide a more accurate representation of the active disturbance and rehabilitation areas at KVAR. 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 2016 – Mar 2017	This Reporting period Apr 2017 – Mar 2018	Next Reporting period Apr 2018 – Mar 2019
Total footprint of KVAR (Stage 1 & 2)	50.7	50.7	50.7
Total active disturbance	44.1	38.7	38.7
Land being prepared for rehabilitation	40.3	33.9	33.9
Land under active rehabilitation	6.6	12.0	12.0
Completed rehabilitation	0.0	0.0	0.0

As detailed within Table 13 and Figure 20, of the total area that has been capped, approximately 12.0 ha have had final planting and soil cover completed and is actively growing, i.e. is considered to be land under active rehabilitation. 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 of topsoil or similar before revegetation can take place. Rehabilitation work is also recommended to include an organic soil layer, such as compost or mulch, on all completed capping. Use of mulch significantly reduces the cost required to build sediment control ponds as using a mulch layer will directly contribute to achieving water of a quality that will be suitable for direct inflow to the catchment.



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

1:8,500

0 100 200 m

Projection: GDA 1994 MGA Zone 56

P:\GIS\Project-3\project\253776_Wallerawang Power Station Demolition SEE\Figure20 Current rehabilitation status.mxdJOB No.\13-07-18Martin.Russell\Rev 0

Wallerawang Power Station (13 July 2018)

Figure 20: Current rehabilitation status at Kerosene Vale Ash Repository

Landscaping and revegetation at the KVAR for the 2017-18 reporting period has been limited to capping an additional 0.5 ha of exposed ash, maintaining the previous planting and weed management for pampas grass colonisation. The previous planting was conducted in August 2014 to conclude the landscape planting expected in conjunction with ash placement, i.e. pro-rata completion of ash to completed capping. Previously reported planting includes areas of Stage 1 western batter, which was performed in 2013. On this site, composted organic waste materials were used to cover the batters to reduce soil loss. Trees and shrub planting has established well as shown in Plates 1 & 2.

Plate 1: Kerosene Vale Ash Repository Stage 1 rehabilitation works [view east] (planted August 2014, photo taken 27th October 2017)

Plate 2: Kerosene Vale Ash Repository Stage 1 rehabilitation works (planted August 2014, photo taken 1st November 2017)

The process of capping over the remaining exposed ash is subject to available soil material. This is being sourced through access to material via the resource recovery general exemption for Virgin Excavated Natural Material (VENM) and Excavated Natural Material (ENM). EnergyAustralia NSW is seeking a modification to the KVAR Project Approval to import large volumes of ENM and VENM from across NSW. The Modification is discussed in more detail in Section 3.

The site has an area that was excavated for ash placement, but not filled as a result of the Wallerawang Power Station being decommissioned, and remains with approximately 7.2 ha of exposed soils and coal settling pond sediments (Plate 3). Work and soil placement needs to be undertaken to re-establish the soil profile across this area.

Plate 3: 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 (2017/18 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 require remedial soil cover or a dress soil cover, prior to planting.

[*] 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 in particular pampas grass.

9. Community

9.1 Community Engagement

During the reporting period Community Reference Group meetings were held on 7th June 2017, 23rd August 2017, 7th December 2017 and 14th March 2018. The Community Reference Group comprises representatives from the local community and EnergyAustralia NSW. The Group 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 Reference Group 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 E.

9.3 Community complaints

During the 2017-18 reporting period, no complaints were recorded in relation to activities at Kerosene Vale Ash Repository.

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 Reference Group 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 KVAR 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 2017-18 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 were no reportable incidents, official cautions, warning letters, penalty notices or prosecution proceedings by any regulatory body during the reporting period.

There were no environmental incidents recorded during the 2017-18 reporting period.

12. Activities to be completed in the next reporting period

KVAR will continue under care and maintenance arrangements while the final closure and rehabilitation plan is developed. 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 the KVAR;
- 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 KVAR. 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 DP&E. 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 2017-2018 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	Review the scope of independent noise monitoring in light of KVAR being in care and maintenance.	By March 2020
Air Quality	Investigate if methods are available to minimise vandalism to depositional dust gauges.	By March 2019
Water Quality	Further hydrogeological investigations at KVAR to be performed as part of the Closure & Rehabilitation of Wallerawang Ash Repositories.	By December 2018
	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.	2018/19 reporting period.
Landscape & Revegetation	Progress development of the closure and rehabilitation management strategy for KVAR.	To be performed as part of DDR rehabilitation works.
	Control the spread of invasive weed species in particular pampas grass.	Annual

13. References

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EPA. (1999). *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes .* Environment Protection Authority, NSW.

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Hyder Consulting. (2001). *Wallerawang Ash Management Proposed Dry Ash Handling Facility.* Hyder Consulting (Australia) Pty Ltd.

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OEH. (2017). *Towards Cleaner Air: NSW Air Quality Statement 2016.* Retrieved from State of NSW & Office of Environment and Heritage: www.environment.nsw.gov.au/resources/air/nsw-annual-air-quality-statement-2016-170013.pdf

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Parsons Brinckerhoff. (2009). *Stage 2 Kerosene Vale Ash Repository Operational Noise Review.* Parsons Brinckerhoff Australia Pty Ltd, NSW.

14. Glossary of Terms

AEMR	Annual Environmental Management Report
CEMP	Construction Environmental Management Plan
CoA	Condition of Approval (also known as MCoA – Minister's CoA)
DDR	Decommissioning, Deconstruction & Rehabilitation
DE	Delta Electricity
DECC	Department of Environment & Climate Change
DoP	Department of Planning
DP&E	Department of Planning and Environment (formerly DP&I / DoP)
DP&I	Department of Planning and Infrastructure
EPL	Environment Protection Licence
KVAD	Kerosene Vale Ash Dam
KVAD/R	Kerosene Vale Ash Dam and Repository
KVAR	Kerosene Vale Ash Repository
mAHD	Metres Australian Height Datum
NEMMCO	National Electricity Market Management Company
OEH	Office of Environment & Heritage (formerly DECC)
OEMP	Operation Environmental Management Plan
ONVMP	Operational Noise and Vibration Management Plan
RL	Relative Level
SSC	Sawyers Swamp Creek
SSCAD	Sawyers Swamp Creek Ash Dam

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 20 September 2017, the DP&E made four comments in regards to the 2016-17 AEMR. The response to these actions are provided within Table 7, Section 5 of this report. No further requests from the Secretary of the DP&E were received in the 2017-18 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 September 2017 indicate KVAR Stage 2 operations are compliant with operational noise criteria (Aurecon, 2017)

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 EnergyAustralia NSW has implemented six-monthly noise monitoring assessments. 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

EnergyAustralia NSW has implemented six-monthly noise monitoring assessments. 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.
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 2017-18 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 (Parsons Brinckerhoff, 2008b) and provided to Delta to determine the minimum monitoring requirements for groundwater 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 (Parsons Brinckerhoff, 2008b) 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 (Parsons Brinckerhoff, 2008b) 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 (PB, 2009) 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 (Parsons Brinckerhoff, 2008b) 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 (April, 2009), which is currently under review by EnergyAustralia NSW and will be submitted to the DP&E for approval upon completion. 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.
- Kerosene Vale – Stage 2 Ash Repository Area – Submissions Report prepared by Parsons Brinckerhoff and dated 30 May 2008.
- Project Approval (Conditions of Approval) File S07/00001, dated 26 November 2008.
- Construction Environment Management Plan (Conneq, 2011)
- Operation Environment Management Plan (Parsons Brinckerhoff, 2008b)
- 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.

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 DP&E 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 DP&E 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 has been 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 submitted on the Department of Planning and Environment on the 4th August 2017.

Compliance Assessment Finding - Compliant

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 No environmental incidents requiring notification of the Secretary occurred within the April 2017- March 2018 reporting period
Compliance Assessment Finding - Not applicable

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 – October 2017

Project: Kerosene Vale Ash repository Stage 2

Ongoing operational noise measurements (Sept 2017)

Prepared for:
EnergyAustralia NSW

Project: 247023

4 October 2017

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Document control record

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Document control

Report Title		Ongoing operational noise measurements (Sept 2017)				
Document ID		247023-KV-REP-11-REV2	**Project Number**		247023	
File Path		\\Aurecon.info\Shares\AUSYD\Projects\BG\247023\3.Project Delivery\12.Deliverables\Acoustics\170911_Sept 2017 Survey\Report\KVAR Compliance Noise Sept 2017 rev2.docx				
Client		EnergyAustralia NSW	**Client Contact**		Alicia de Vos	
Rev	**Date**	**Revision Details/Status**	**Prepared by**	**Author**	**Verifier**	**Approver**
1	3 October 2017	Initial Draft	AL	AL	BD	HT
2	4 October 2017	Final issue	AL	AL	BD	HT
Current Revision		**2**				

Approval

Author Signature		Approver Signature	HTilley
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Title	Acoustic Consultant	Title	Environmental Consultant

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Appendices

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Tables

1 Introduction

Aurecon was engaged by EnergyAustralia NSW to carry out ongoing operational noise monitoring for the Kerosene Vale Stage 2 Ash Repository (KVAR) located in Wallerawang, NSW in accordance with Project Approval Application No. 07_0005. The noise measurements were carried out on Sunday 10 September 2017 and Monday 11 September 2017, during the early 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. No noise emissions from the location of the KVAR was evident during the current site visit.

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

Note * - distance relates to the property boundary or a point 30 m 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 thus their noise impact is 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, for the purpose of prediction of noise emissions from ash trucks alone, EnergyAustralia NSW provides the number of truck movements for the periods of measurement.

Figure 1 | Site details

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 Conditions 2.8 are 7:00 am to 10:00 pm Monday to Sunday.

3 Noise measurements

3.1 Measurement methodology

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

- Ambient noise measurements and
- Sound exposure level measurements.

The measurements were carried out on Sunday 10 September 2017 and Monday 11 September 2017, during the early morning and evening periods, when the noise impacts are likely to be the most significant.

Ambient noise measurements

The ambient compliance noise measurements were conducted using a Larson Davis 831 Type 1 sound level meter which was set to ‘A’ frequency weighting, ‘F’ time weighting, and was 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 Table 2). A Larson Davis CAL200 was utilised to calibrate the sound level meters before and after each series of measurements. No significant calibration drift was noted.

The weather during the ambient noise logging ranged from overcast to sunny conditions, and wind speeds were less than 3 m/s at ground level. Measurements were generally taken in accordance with the Australian Standard *AS 1055 1997: Acoustics – Description and measurement of environmental noise*.

Sound exposure level (SEL) measurements

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

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

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 Measurement locations

The measurement locations were chosen to represent the three most affected sensitive receivers as outlined in the ONVMP and shown in Table 1. These three receivers were identified based on the information in the Stage 2 Kerosene Vale Ash Repository operational noise review.

Due to the high background noise levels at each of the three monitoring locations it was difficult to assess individual truck noise events. A fourth noise monitoring location identified as Location D and shown in Appendix C, was selected closer to the haulage route to measure individual truck pass-by events. Table 2 and Figure 2 outline the noise measurement locations.

Table 2: Representative noise measurement locations

Measurement location	Measurement distance to haulage road (meters)	Representative sensitive receiver
A	300	60 Skelly Road
B	270	10 Skelly Road
C	145	21 Neubeck Street
D	80	-

Figure 2 | Noise measurement locations

3.3 Conditions during measurements

3.3.1 Operating conditions

EnergyAustralia NSW stated that no trucks were operating during any of the measurement periods.

3.3.2 Meteorological conditions

The meteorological conditions applicable to the noise survey period are based on meteorological data provided at 15 minute intervals from the Mt Piper weather station. This data is shown in Appendix D.

No rain periods or adverse winds were experienced during the attended noise monitoring events.

3.4 Results

3.4.1 Ambient noise measurements

The results from the 15 minute ambient noise measurements at each of the measurement locations are shown in Table 3.

Table 3: Noise measurement results (15 minute)

Location	Date of measurement	Time	Measured sound pressure level dB(A)					Number of truck Pass-bys and direction of travel[1]		
			L_{Aeq}#	L_{Amax}*	L_{Amin}**	L_{A10}^^	L_{A90}^	North	South	Total
60 Skelly Road (A)	Sunday 10/09/2017	8:58	**43**	71	31	42	34	0	0	0
		18:36	**43**	59	37	45	39	0	0	0
	Monday 11/09/2017	10:43	**43**	67	34	41	36	1	0	0
		18:33	37	51	32	39	34	0	0	0
10 Skelly Road (B)	Sunday 10/09/2017	8:41	36	60	26	37	29	0	0	0
		18:50	**43**	61	36	46	38	0	0	0
	Monday 11/09/2017	10:27	**49**	74	33	45	36	0	0	0
		18:17	39	56	35	42	36	0	0	0
21 Neubeck Street (C)	Sunday 10/09/2017	8:19	**41**	58	29	45	32	0	0	0
		19:07	**44**	63	33	46	36	0	0	0
	Monday 11/09/2017	10:10	**43**	64	33	46	37	0	0	0
		17:59	**43**	68	34	44	36	0	0	0

Note : [1] - Truck counts include ash trucks and light commercial vehicles.

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

\# *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.*

The measured $L_{Aeq\ (15\ min)}$ exceeded the assessment criteria of $L_{Aeq\ (15\ min)}$ of 40 dB(A) during all but three of the attended noise monitoring events. As there were no truck movements (except one light commercial vehicle) associated with the operation of the KVAR during the attended noise monitoring event, it can be assumed that the KVAR operations did not contribute to the high background noise levels at any of the measurement locations and that the high noise levels are associated with local noise events such as traffic from surrounding roads and birds/insects.

3.4.2 SEL measurements

The individual truck pass-by noise event (SEL) measurements at Location D (approximately 80 meters from the haulage road) were conducted on 7 November 2011, 21 April 2013 and 31 March 2014. The results are summarised in Table 4. The number of actual truck pass-bys counted during the daytime survey are also summarised in Table 4. These data were used to predict the noise impact from the truck movement on the sensitive receivers.

Based on the visual site inspection, the grade (slope) of the haulage road rises from south to north. The 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 summarised in Table 4.

Table 4: 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 Noise assessment

General observation regarding the ambient noise environment, as well as the truck movements and ash repository operations, during the attended noise measurements are described as follows.

- Operational noise from the KVAR site and the truck engine noise was inaudible at the sensitive receiver locations during the attended noise measurements and no ash trucks were visible on the haul road, but one light commercial vehicle was sighted on the haul road.
- The noise levels at all locations were affected by background noise sources such as bird/insects, domestic animals and domestic noise. Background noise at all sites was dominated by the intermittent traffic noise from nearby Castlereagh Highway and Wolgan Road.

General observations for the three monitoring locations are described below.

4.1 Location A (60 Skelly Road)

The background noise contributions at Location A were predominantly from the traffic noise from Castlereagh Highway and distant traffic. Faint and intermittent traffic noise from Wolgan Road was also audible.

The haulage road was clearly visible from this location, however no coal or ash trucks were visible on the haulage road during the attended noise monitoring period (except for one light commercial vehicle during the Monday morning period). Noise from birds and insects also contributed to the ambient noise at this location.

As shown in Table 3, the background noise varied over the two days with L_{A90} ranging from 34 dB(A) to 39 dB(A). The background noise (L_{A90}) during the attended noise measurements was predominantly due to road traffic on the Castlereagh Highway, Wolgan Road and other nearby roads.

4.2 Location B (10 Skelly Road)

Contributions to the background noise at Location B were predominantly from birds/insects/animals and traffic on Wolgan Road and Skelly Road.

Traffic noise from Wolgan Road and Skelly Road was clearly audible at this location and also contributed to the ambient noise levels.

The haulage road was clearly visible from this measuring location, however no coal or ash truck were visible on haulage road during the attended noise monitoring period movement.

Background noise levels varied over the two days with L_{A90} ranging from 29 dB(A) to 38 dB(A).

4.3 Location C (21 Neubeck Street)

Contributions to the background noise at Location C were predominantly from birds/insects/animals and distant traffic on Wolgan Road and other roads.

Dogs at the nearest residential property affected the ambient noise levels (due to intermittent barking) measured at this location. Traffic noise from Wolgan Road was clearly audible and also contributed to the ambient noise levels.

The haulage road was not clearly visible from this location because of an earth mound and heavy vegetation blocking the line of sight; however no truck engine noise was audible during the attended noise monitoring period.

Background noise varied over the two days with L_{A90} ranging from 32 dB(A) to 37 dB(A).

4.4 Location D

The noise data collected at Location D (Figure 2 and Appendix C) measured the SEL of individual truck pass-by events on 7 November 2011, 22 April 2013 and 31 April 2014 (See Table 4).

This location is closest to the haulage road and as such, each truck pass-by was the dominant noise source (clearly audible above other ambient noise sources) during these monitoring events.

5 Analysis and recommendations

5.1 Data analysis

As can be observed from the summary of noise measurements presented above, the existing ambient noise levels $L_{Aeq\ (15\ min)}$ exceed the assessment criteria of $L_{Aeq\ (15\ min)}$ of 40 dB(A) on all but three of the monitoring events. This section deals with noise prediction based on the number of truck movements (worst case scenario) for any worst case 15 minute period.

To assess the impact of the ash truck noise emissions, the influence of individual truck pass-by noise events have to be taken into account. $L_{Aeq\ (15\ min)}$ noise level was predicted based on the SEL measurement results (shown in Table 4) 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 the distance of the noise source from the receiver. The assessment included the calculated barrier effect (- 2dB(A)) at Location C. This is due to the earth mound located on the northern side of the site which blocks the line of sight between 21 Neubeck Street and the haulage road, therefore attenuating the noise from the haulage road. Generally, trucks operate at a constant rate, with approximately 15-20 minute circuits for each truck. Table 5 provides a summary of truck pass-bys based on information collected during a previous site visit.

Table 5: 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** is the worst-case truck movement (most frequent) used to predict the noise contribution from the truck movements (shown in Table 6)
Maximum number of truck pass-bys as per information collected during the site visit.

As shown in Table 5, the maximum number of truck pass-bys was during the morning period on both 30/03/2014 and 31/03/2014. The lowest truck pass-bys was during the evening period on 30/03/2014. The noise emissions from the KVAR are considered to be below the assessment criteria as they were predominantly inaudible during the noise survey and could not be distinguished.

Table 6 provides the noise predictions from haulage trucks alone at the nearest sensitive receivers based on SEL measurements. The prediction is calculated from the movement of ash trucks based on the worst case scenario (i.e. 2.3 truck pass-bys during any 15 minute period).

Table 6: Noise predictions from truck movements based on SEL measurements

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

Note * - Includes the calculated barrier attenuation (-2dBA) provided by the earth mound blocking direct line of sight between the residence and haulage road.

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

There were no truck movements during this current noise monitoring event, therefore the operational noise emissions from the Stage 2 KVAR is considered to be compliant with Condition 2.15 of the Project Approval.

6 Conclusion

Aurecon conducted operational noise monitoring for the Stage 2 KVAR located in Wallerawang, NSW. The noise measurements were carried out at the three most affected sensitive receiver locations on Sunday 10 September 2017 and Monday 11 September 2017, in the early morning and evening in accordance with the KVAR Stage 2 ONVMP.

The applicable noise assessment criteria of $L_{Aeq\ (15\ minute)}$ of 40 dB(A) from all ash haulage and ash placement associated operational noise emissions at the nearest sensitive receivers is outlined in the Project Approval, Application No. 07_0005.

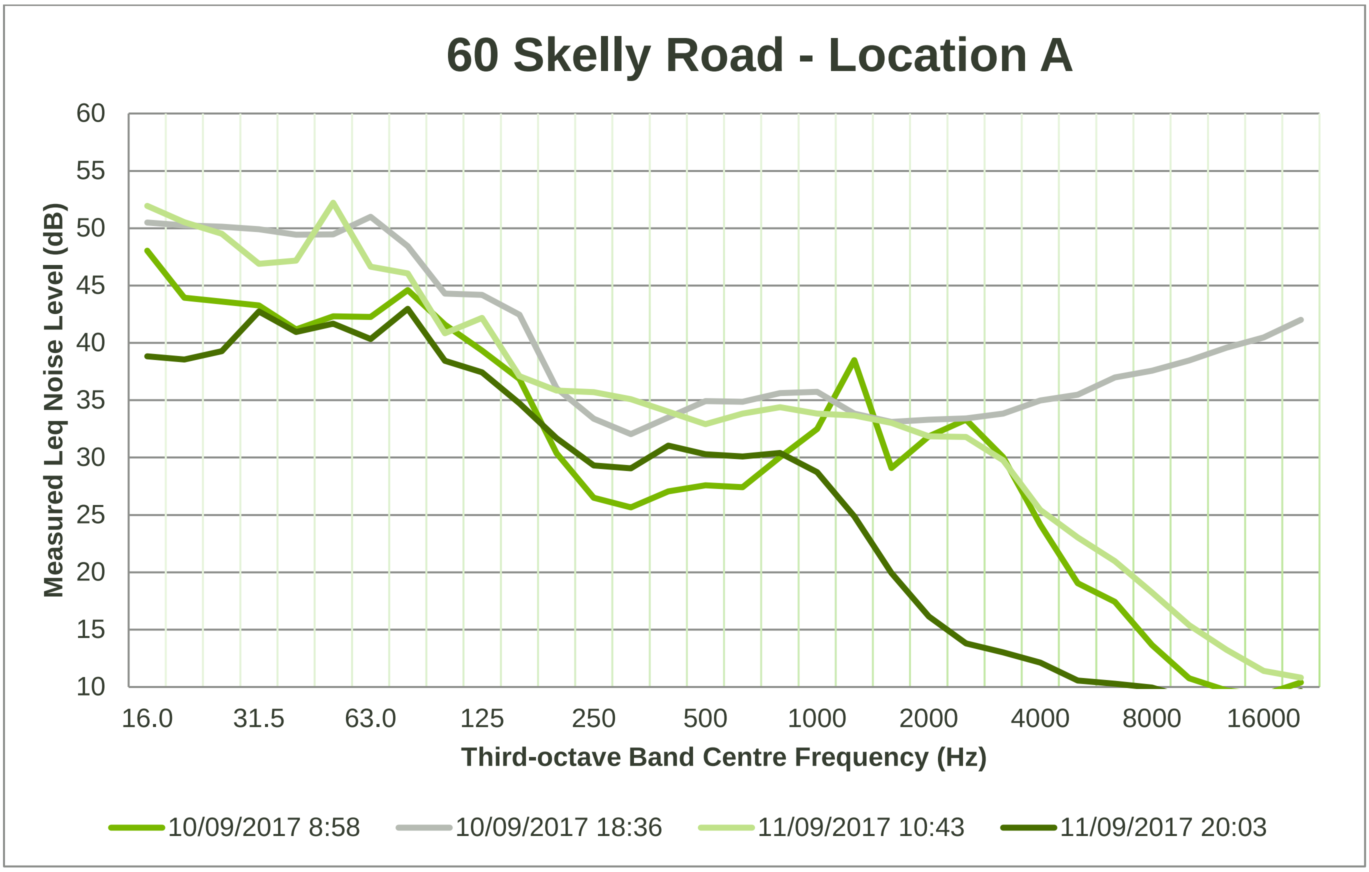
The primary contributor to the background and ambient noise levels at all measurement locations was the traffic noise on the nearby roads.

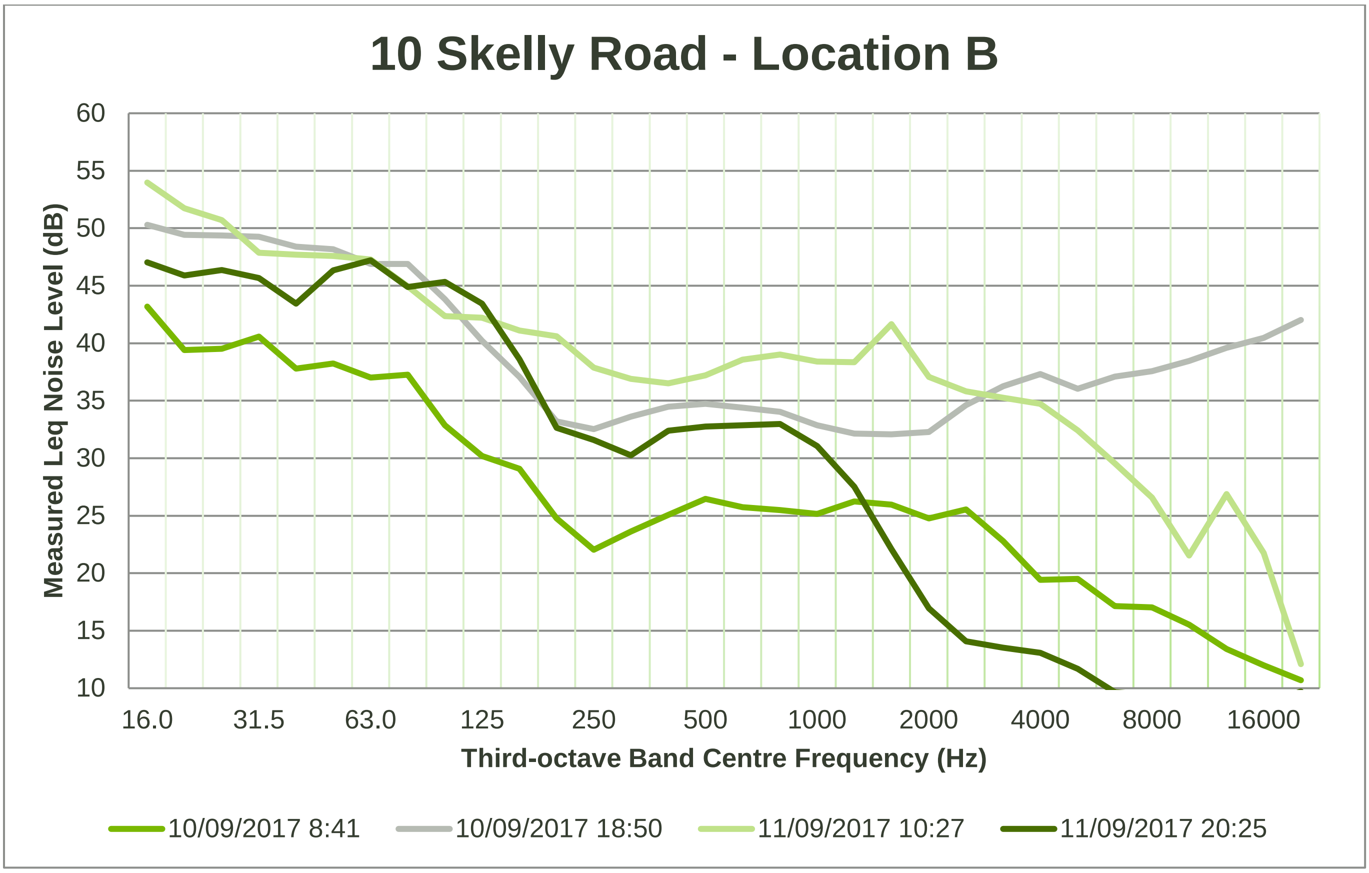
Based on the noise predictions resulting noise from the operation of trucks/ light commercial vehicles from the Stage 2 KVAR are considered compliant with the Conditions of Approval.

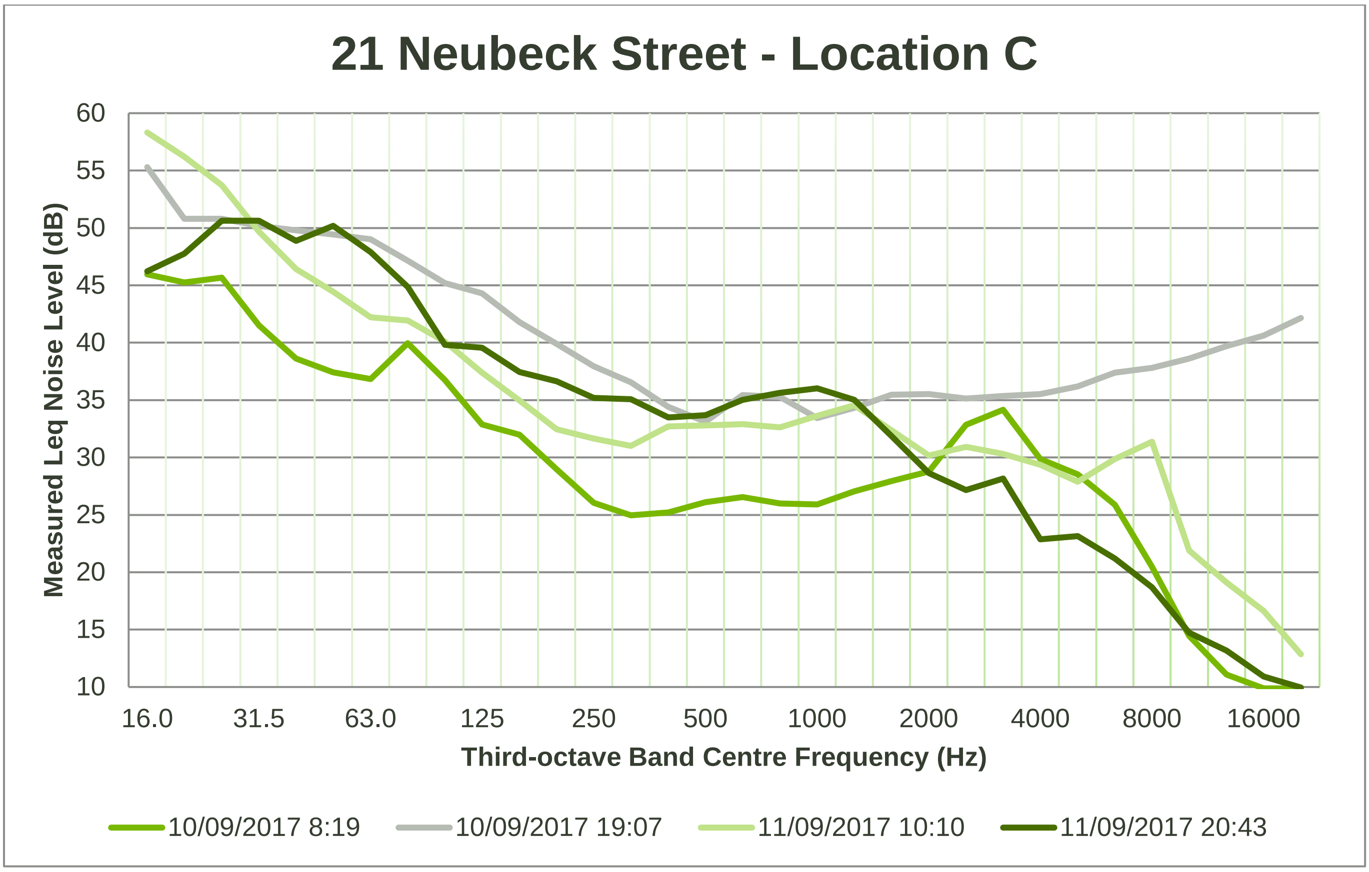
7 References

- 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.
- Office of Environment & Heritage (OEH) *Interim Construction Noise Guideline (ICNG).*
- Office of Environment & Heritage (OEH) *Industrial Noise Policy (INP)*.
- Australian Standard *AS 1055 1997: Acoustics – Description and measurement of environmental noise*.

Appendix A
Measured noise spectra




10 Skelly Road - Location B
Measured Leq Noise Level (dB)
60
55
50
45
40
35
30
25
20
15
10
16.0
31.5
63.0
125
250
500
1000
2000
4000
8000
16000
Third-octave Band Centre Frequency (Hz)
10/09/2017 8:41
10/09/2017 18:50
11/09/2017 10:27
11/09/2017 20:25


21 Neubeck Street - Location C
Measured Leq Noise Level (dB)
60
55
50
45
40
35
30
25
20
15
10
16.0
31.5
63.0
125
250
500
1000
2000
4000
8000
16000
Third-octave Band Centre Frequency (Hz)
10/09/2017 8:19
10/09/2017 19:07
11/09/2017 10:10
11/09/2017 20:43

Appendix B
Glossary of terms

Term	Definition
Sound Pressure Level	Sound or noise is the sensation produced at the ear by very small fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range (from 20 microPascals to 60 Pascals). A scale that compresses this range to a more manageable size and that is best matched to subjective response is the logarithmic scale, rather than a linear scale.
Sound Pressure Level (Lp)	Is defined as: $L_P = 10\log_{10}\left(\frac{p^2}{p_{ref}^2}\right)dB$ In the above equation, *p* is the sound pressure fluctuation (above or below atmospheric pressure), and p_{ref} is 20 microPascals (2 x 10^{-5} Pa), the approximate threshold of hearing. To avoid a scale which is too compressed, a factor of 10 is included, giving rise to the decibel, or dB for short.
A-Weighted Decibel (dB(A)) & Loudness	In some circumstances, the sound pressure level is expressed as C-Weighted decibels, instead of the more common A-Weighted. The C-Weighting filter is designed to replicate the response of the human ear above 85 dB, and places a greater weighting on low frequency noise.
L_{Aeq}	The time averaged C-weighted sound pressure level for a time interval, as defined in AS1055.1. It is generally described as the equivalent continuous C-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_{Ceq}	The time averaged C-weighted sound pressure level for a time interval, as defined in AS1055.1. It is generally described as the equivalent continuous C-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_{An}	The sound level, which, for a specified time interval, in relation to an investigation of a noise, means the A-weighted sound pressure level that is equalled or exceeded for n% of the interval. Commonly used percentages are 1, 10, 90 & 99%.

Term	**Definition**
L_{Cpk}	The peak C-weighted sound pressure level for a time interval.
$L_{Cmax,T}$	The average maximum C-weighted sound pressure level, which, for the specified time interval, means the C-weighted sound pressure level during the interval obtained by using the fast time weighting and arithmetically averaging the maximum sound levels of the noise during the interval. Under certain conditions the 10th percentile noise level, $L_{C10,T}$, can represent the average maximum C-weighted sound pressure level.
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.
Octave	Frequency bands allow a representation of the spectrum associated with a particular noise. They are an octave wide, meaning that the highest frequency in the band is just twice the lowest frequency, with all intermediate frequencies included and all other frequencies excluded. Each octave band is described by its centre frequency.
Maximum Exposure Time (Hours)	The maximum possible time a person can be safely exposed to a specific noise level (L_{Aeq}).
Sound Exposure Level (SEL)	Sound exposure level abbreviated as SEL and L_{AE}, is the total noise energy produced from a single noise event. The Sound Exposure Level is a metric used to describe the amount of noise from an event such as an individual aircraft flyover. It is computed from measured dB(A) sound levels. The Sound Exposure Level is the integration of all the acoustic energy contained within the event.

Appendix C
Site photograph

Figure 3 | Location D

Appendix D
Weather data

Table 7: Meteorological conditions during noise survey

Date	Time	Rainfall (mm)	Wind Speed 10m above ground (m/s)	Wind Direction (deg.)	Temp (°C)	Relative humidity (%)
10/09/2017	0:00	0.0	2.6	230	12	94
10/09/2017	0:15	0.0	2.9	233	14	86
10/09/2017	0:30	0.0	1.4	225	13	86
10/09/2017	0:45	0.0	1.2	236	13	88
10/09/2017	1:00	0.0	1.5	241	12	90
10/09/2017	1:15	0.0	1.7	216	12	92
10/09/2017	1:30	0.0	2.4	211	12	93
10/09/2017	1:45	0.0	2.4	224	13	92
10/09/2017	2:00	0.0	2.1	214	13	90
10/09/2017	2:15	0.0	0.9	168	13	90
10/09/2017	2:30	0.0	0.8	171	12	92
10/09/2017	2:45	0.0	0.7	255	11	93
10/09/2017	3:00	0.0	1.1	63	11	95
10/09/2017	3:15	0.0	0.6	212	10	96
10/09/2017	3:30	0.0	0.7	167	9	97
10/09/2017	3:45	0.0	0.5	320	9	97
10/09/2017	4:00	0.0	1.3	253	9	98
10/09/2017	4:15	0.0	1.0	243	9	98
10/09/2017	4:30	0.0	0.6	224	9	98
10/09/2017	4:45	0.0	0.9	257	9	99
10/09/2017	5:00	0.0	0.9	244	9	99
10/09/2017	5:15	0.0	1.0	237	9	99
10/09/2017	5:30	0.0	0.7	270	8	99
10/09/2017	5:45	0.0	1.0	212	8	99
10/09/2017	6:00	0.0	1.0	244	8	99

Date	Time	Rainfall (mm)	Wind Speed 10m above ground (m/s)	Wind Direction (deg.)	Temp (°C)	Relative humidity (%)
10/09/2017	6:15	0.0	1.7	257	8	99
10/09/2017	6:30	0.0	1.2	212	8	100
10/09/2017	6:45	0.0	1.6	220	9	100
10/09/2017	7:00	0.0	0.5	288	9	100
10/09/2017	7:15	0.0	0.9	307	11	100
10/09/2017	7:30	0.0	1.5	41	12	100
10/09/2017	7:45	0.0	1.1	56	15	90
10/09/2017	8:00	0.0	2.0	185	17	79
10/09/2017	8:15	0.0	1.5	160	19	69
10/09/2017	8:30	0.0	2.1	143	19	64
10/09/2017	8:45	0.0	2.0	167	20	61
10/09/2017	9:00	0.0	1.9	141	20	56
10/09/2017	9:15	0.0	2.0	159	21	55
10/09/2017	9:30	0.0	2.4	149	22	52
10/09/2017	9:45	0.0	1.6	140	23	45
10/09/2017	10:00	0.0	1.7	83	21	49
10/09/2017	10:15	0.0	1.9	79	23	45
10/09/2017	10:30	0.0	1.7	103	23	40
10/09/2017	10:45	0.0	1.7	135	23	38
10/09/2017	11:00	0.0	1.2	168	24	38
10/09/2017	11:15	0.0	2.7	227	25	36
10/09/2017	11:30	0.0	1.8	189	24	38
10/09/2017	11:45	0.0	2.5	248	25	34
10/09/2017	12:00	0.0	3.3	267	24	41
10/09/2017	12:15	0.0	2.7	219	24	39
10/09/2017	12:30	0.0	4.6	264	24	41
10/09/2017	12:45	0.0	3.9	157	25	40
10/09/2017	13:00	0.0	2.7	201	25	39
10/09/2017	13:15	0.0	2.9	243	25	38
10/09/2017	13:30	0.0	2.1	207	25	36
10/09/2017	13:45	0.0	2.5	204	26	37
10/09/2017	14:00	0.0	2.2	288	25	38
10/09/2017	14:15	0.0	1.5	88	25	36
10/09/2017	14:30	0.0	2.3	40	25	36
10/09/2017	14:45	0.0	2.0	267	26	34
10/09/2017	15:00	0.0	2.4	45	26	34

Date	Time	Rainfall (mm)	Wind Speed 10m above ground (m/s)	Wind Direction (deg.)	Temp (°C)	Relative humidity (%)
10/09/2017	15:15	0.0	2.0	150	26	33
10/09/2017	15:30	0.0	2.4	182	26	32
10/09/2017	15:45	0.0	1.7	243	27	30
10/09/2017	16:00	0.0	2.5	148	26	30
10/09/2017	16:15	0.0	0.9	238	27	30
10/09/2017	16:30	0.0	1.9	328	26	30
10/09/2017	16:45	0.0	1.0	258	27	30
10/09/2017	17:00	0.0	2.2	219	26	24
10/09/2017	17:15	0.0	2.6	237	25	27
10/09/2017	17:30	0.0	1.5	255	21	39
10/09/2017	17:45	0.0	1.4	263	19	43
10/09/2017	18:00	0.0	1.2	247	18	46
10/09/2017	18:15	0.0	1.8	229	17	49
10/09/2017	18:30	0.0	1.8	228	16	51
10/09/2017	18:45	0.0	2.0	222	15	57
10/09/2017	19:00	0.0	1.8	238	16	58
10/09/2017	19:15	0.0	1.8	215	15	66
10/09/2017	19:30	0.0	0.5	214	15	66
10/09/2017	19:45	0.0	1.2	241	14	70
10/09/2017	20:00	0.0	1.6	245	14	72
10/09/2017	20:15	0.0	1.6	229	14	72
10/09/2017	20:30	0.0	1.6	242	14	75
10/09/2017	20:45	0.0	1.8	242	13	78
10/09/2017	21:00	0.0	1.6	232	14	79
10/09/2017	21:15	0.0	1.5	232	13	83
10/09/2017	21:30	0.0	1.7	248	13	82
10/09/2017	21:45	0.0	1.4	221	13	82
10/09/2017	22:00	0.0	1.5	232	12	87
10/09/2017	22:15	0.0	1.6	235	12	86
10/09/2017	22:30	0.0	1.2	225	13	87
10/09/2017	22:45	0.0	1.0	249	11	89
10/09/2017	23:00	0.0	0.4	198	11	90
10/09/2017	23:15	0.0	0.9	264	10	92
10/09/2017	23:30	0.0	1.3	218	10	93
10/09/2017	23:45	0.0	1.5	210	10	95
11/09/2017	0:00	0.0	1.3	243	10	95

Date	Time	Rainfall (mm)	Wind Speed 10m above ground (m/s)	Wind Direction (deg.)	Temp (°C)	Relative humidity (%)
11/09/2017	0:15	0.0	0.8	231	10	95
11/09/2017	0:30	0.0	1.3	219	10	95
11/09/2017	0:45	0.0	1.5	237	9	96
11/09/2017	1:00	0.0	0.9	211	10	96
11/09/2017	1:15	0.0	1.3	245	9	97
11/09/2017	1:30	0.0	0.5	208	9	97
11/09/2017	1:45	0.0	0.6	255	9	97
11/09/2017	2:00	0.0	1.3	230	9	97
11/09/2017	2:15	0.0	1.7	225	8	97
11/09/2017	2:30	0.0	1.3	221	8	98
11/09/2017	2:45	0.0	1.0	227	9	99
11/09/2017	3:00	0.0	0.7	228	8	99
11/09/2017	3:15	0.0	0.4	222	8	99
11/09/2017	3:30	0.0	0.7	254	8	99
11/09/2017	3:45	0.0	1.0	211	8	99
11/09/2017	4:00	0.0	1.1	239	8	99
11/09/2017	4:15	0.0	1.1	227	8	99
11/09/2017	4:30	0.0	1.2	226	8	99
11/09/2017	4:45	0.0	1.2	239	8	99
11/09/2017	5:00	0.0	1.0	207	8	99
11/09/2017	5:15	0.0	0.8	247	8	99
11/09/2017	5:30	0.0	1.0	224	7	99
11/09/2017	5:45	0.0	0.4	36	8	99
11/09/2017	6:00	0.0	0.7	196	7	99
11/09/2017	6:15	0.0	1.1	246	8	100
11/09/2017	6:30	0.0	0.9	232	8	100
11/09/2017	6:45	0.0	0.7	210	9	100
11/09/2017	7:00	0.0	0.3	206	9	100
11/09/2017	7:15	0.0	0.5	45	11	100
11/09/2017	7:30	0.0	0.5	139	14	100
11/09/2017	7:45	0.0	0.5	45	17	86
11/09/2017	8:00	0.0	0.6	110	18	75
11/09/2017	8:15	0.0	1.1	50	20	63
11/09/2017	8:30	0.0	1.5	261	22	51
11/09/2017	8:45	0.0	3.0	230	23	43
11/09/2017	9:00	0.0	3.3	207	24	40

Date	Time	Rainfall (mm)	Wind Speed 10m above ground (m/s)	Wind Direction (deg.)	Temp (°C)	Relative humidity (%)
11/09/2017	9:15	0.0	4.3	221	24	37
11/09/2017	9:30	0.0	4.1	217	24	36
11/09/2017	9:45	0.0	4.4	225	25	34
11/09/2017	10:00	0.0	4.2	218	25	33
11/09/2017	10:15	0.0	3.7	214	25	32
11/09/2017	10:30	0.0	4.0	219	26	30
11/09/2017	10:45	0.0	4.1	217	27	29
11/09/2017	11:00	0.0	3.3	256	26	30
11/09/2017	11:15	0.0	5.0	229	26	29
11/09/2017	11:30	0.0	4.5	221	27	28
11/09/2017	11:45	0.0	3.3	242	27	27
11/09/2017	12:00	0.0	3.7	304	27	27
11/09/2017	12:15	0.0	4.1	240	27	27
11/09/2017	12:30	0.0	3.1	270	27	29
11/09/2017	12:45	0.0	3.7	284	27	28
11/09/2017	13:00	0.0	4.8	255	27	30
11/09/2017	13:15	0.0	3.2	261	27	30
11/09/2017	13:30	0.0	4.2	260	27	28
11/09/2017	13:45	0.0	4.7	285	27	25
11/09/2017	14:00	0.0	4.1	254	28	22
11/09/2017	14:15	0.0	2.9	291	28	20
11/09/2017	14:30	0.0	3.3	265	28	20
11/09/2017	14:45	0.0	3.0	255	28	20
11/09/2017	15:00	0.0	3.5	255	28	20
11/09/2017	15:15	0.0	4.4	227	28	22
11/09/2017	15:30	0.0	4.0	217	28	22
11/09/2017	15:45	0.0	4.2	232	28	20
11/09/2017	16:00	0.0	5.0	213	28	23
11/09/2017	16:15	0.0	4.3	233	28	21
11/09/2017	16:30	0.0	3.5	216	27	22
11/09/2017	16:45	0.0	4.0	222	26	22
11/09/2017	17:00	0.0	2.6	227	26	22
11/09/2017	17:15	0.0	2.5	234	25	26
11/09/2017	17:30	0.0	2.5	243	23	34
11/09/2017	17:45	0.0	2.5	241	23	34
11/09/2017	18:00	0.0	1.4	202	23	35

Date	Time	Rainfall (mm)	Wind Speed 10m above ground (m/s)	Wind Direction (deg.)	Temp (°C)	Relative humidity (%)
11/09/2017	18:15	0.0	0.8	125	21	40
11/09/2017	18:30	0.0	0.6	168	19	45
11/09/2017	18:45	0.0	1.0	201	18	50
11/09/2017	19:00	0.0	1.3	245	17	54
11/09/2017	19:15	0.0	1.4	237	17	55
11/09/2017	19:30	0.0	0.6	224	16	59
11/09/2017	19:45	0.0	2.0	231	15	64
11/09/2017	20:00	0.0	1.6	231	15	65
11/09/2017	20:15	0.0	0.9	233	15	65
11/09/2017	20:30	0.0	1.4	250	15	68
11/09/2017	20:45	0.0	1.6	232	14	71
11/09/2017	21:00	0.0	1.9	236	14	75
11/09/2017	21:15	0.0	1.7	241	15	76
11/09/2017	21:30	0.0	1.5	250	15	76
11/09/2017	21:45	0.0	1.6	234	15	77
11/09/2017	22:00	0.0	1.7	214	14	80
11/09/2017	22:15	0.0	0.5	235	14	83
11/09/2017	22:30	0.0	1.5	229	13	83
11/09/2017	22:45	0.0	1.8	216	14	85
11/09/2017	23:00	0.0	1.7	225	14	82
11/09/2017	23:15	0.0	1.7	242	15	82
11/09/2017	23:30	0.0	1.6	231	15	81
11/09/2017	23:45	0.0	1.2	239	14	83

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United Arab Emirates, Vietnam.

Appendix C
Current water sampling points

Current water sampling points surface water monitoring KVAR 2010 - 2018

Site #	Nalco site ID	Reported origin	Aspect	Sample ID	Note	Easting	Northing
2	Lend Lease	Clean Water Runoff & Holding Pond	North Pond	CW Pond Runoff 2	Monthly	230112	6302059
3	88	Surface Water Runoff Collection	Internal ash surface runoff	SW Pond 1	Monthly		
4	87	West KVAD Wall subsurface	Groundwater through-flow	WX 50 Outflow	Monthly	229661	6302244
5	Lend Lease	Clean Water Collection near compound	Clean Water Runoff Pond 1	Clean Water Runoff-1	Monthly	229396	6301834
6	Lend Lease	KVAR North Holding Pond	Groundwater seepage, and stormwater runoff	North Holding Pond	Monthly	230225	6302106
7	38	Sawyers Swamp Creek Ash Dam	Dam water	Return Water Canal	Monthly	229765	6301461
8	79	Sawyers Swamp Creek Ash Dam	SSCAD seepage into SSC	Seepage @ V notch	Monthly	230260	6302287
9	41	Sawyers Swamp Creek Lower	Catchment Quality Comparison	SSC @ WX7	Monthly	228957	6302712
10	Lend Lease	Inflow of Sawyers Swamp Ck 0 m	Catchment Quality Comparison	SSC Upstream @ 0 m	Indicative	230386	6301545
11	Lend Lease	Sawyers Swamp Creek @ 300 m	Catchment Quality Comparison	SSC @ 300m	Monthly	230284	6301969
12	Lend Lease	Sawyers Swamp Creek @ 600 m	Catchment Quality Comparison	SSC @ 600m	Monthly	230253	6302120
13	84	Sawyers Swamp Creek @ 800 m	Catchment Quality Comparison	SSC @ 800m	Monthly	229954	6302256
14	83	Sawyers Swamp Creek @ 1250 m (near D5)	Catchment Quality Comparison	SSC @ 1200 m	Monthly	229650	6302253
16	39	Dump Creek	Catchment Quality Comparison	DC	Monthly	229112	6302668
17	80	West KVAD Wall surface right	KVAD Toe Drain seepage	Right	Monthly	229662	6302177
18	81	West KVAD Wall s surface left	KVAD Toe Drain seepage	Left	Monthly	229688	6302194
40	40	Lidsdale Cut	Catchment Quality Comparison	LC @ WX5	Monthly	229490	6302227

Groundwater level monitoring for KVAR 2010 - 2018

Site #	Nalco site ID	Reported origin	Aspect	Sample ID	Note	Easting^2	Northing^2
8	75	Groundwater Bore GW10	KVAD West Wall	GW10^2	Toe Drains	229754	6302228
9	76	Groundwater Bore GW11	KVAD West Wall	GW11^2	Toe Drains	229612	6301994
11	78	Groundwater Bore AP17	KVAD North Wall	AP17^2	Toe Drains	229915	6302193
19	Lend Lease	South West KVAR subsurface	Groundwater through-flow	Sump 1	Monthly	229441	6301496
20	Lend Lease	East KVAD Wall subsurface	Groundwater through-flow1	Sump 2	Monthly	230218	6302032
21	32	Groundwater Bore WGM1/D1	Regional	D12	Upstream	231988.5	6301410
22	33	Groundwater Bore WGM1/D2	Regional	D22	South East	229680	6301387.7
23	34	Groundwater Bore WGM1/D3	Regional	D32	East below SCAD	230276.1	6301753.2
24	35	Groundwater Bore WGM1/D4	Regional	D42	NE corner SSC	230160.7	6302349.8
27	85	Groundwater Bore GW6	KVAD	GW62	North West at SSC	229754	6302228
31	86	North KVAD Wall subsurface	Groundwater through-flow	North Wall	Monthly	229908	6302216
32	Lend Lease	Groundwater Well APA02	KVAR Stage 2A – Level	APA02	Stage 1A KVAR	229890	6301839.4
33	Lend Lease	Groundwater Well APA09A	KVAR Stage 2A - Level	APA09A	KVAR Stage 2A above clay cap north	229849	6302125.4
34	Lend Lease	Groundwater Well APA09B	KVAR Stage 2A - Level	APA09B	KVAR Stage 2A KVAD north	229849.5	6302125.7
35	Lend Lease	Groundwater Well APA10	KVAR Stage 2A - Level	APA10	KVAR Stage 2A KVAD west	229694.1	6302054.4
36	36	Groundwater Bore WGM1/D5	Regional	D52	Downstream	229642.5	6302205.9
36	Lend Lease	Groundwater Well APA11	KVAR Stage 2A - Level	APAD11	KVAR Stage 2A KVAD subsurface drain	229930	6301886
37	37	Groundwater Bore WGM1/D6	Regional	D62	Up dip coal seam	229412	6302027.8

Site #	Nalco site ID	Reported origin	Aspect	Sample ID	Note	Easting[2]	Northing[2]
37	Lend Lease	Groundwater Well APA12	KVAR Stage 2A - Level	APAD12	KVAR Stage 2A KVAD subsurface drain	229916	6301846
38	Lend Lease	Groundwater Well APA13	KVAR Stage 2A - Level	APAD13	KVAR Stage 2A KVAD subsurface drain	229985	6301931
39	Lend Lease	Groundwater Well APA14	KVAR Stage 2A	APAD14	KVAR Stage 2A KVAD subsurface drain	230024	6301949
41	Lend Lease	Groundwater Well APA16A	KVAR Stage 2A	APAD16	KVAR Stage 2A KVAD subsurface drain	230174	6301968
42	Lend Lease	Groundwater Well APA17	KVAR Stage 2A	APAD17	KVAR Stage 2A KVAD subsurface drain	230169	6301969
43	Lend Lease	Groundwater VWP[1] APA08	KVAR Stage 2A	APA08	KVAR Stage 2A above clay cap	229731.2	6301943.1
44	Lend Lease	Groundwater VWP[1] APA07	KVAR Stage 2A	APA07	KVAR Stage 2A above clay cap	229891.3	6302057.1
45	Lend Lease	Groundwater VWP[1] APA06	KVAR Stage 2A	APA06	KVAR Stage 2A above clay cap	230019.4	6302054.3
46	Lend Lease	Groundwater VWP[1] APA04	KVAR Stage 2A	APA04	KVAR Stage 2A above clay cap	229955.8	6301987.5
47	Lend Lease	Groundwater BH Cent KV_MB	Regional	KV_MB1D	Upslope adjacent to SSCAD	230604.2	6301288.2
48	Lend Lease	Groundwater BH Cent KV_MB	Regional	KV_MB1S	Upslope adjacent to SSCAD	230600	6301290
49	Lend Lease	Groundwater BH Cent KV_MB	Regional	KV_MB6D	KVAR Stage 2B	229982.9	6301782.6
50	Lend Lease	Groundwater BH Cent KV_MB	Regional	KV_MB6S	KVAR Stage 2B	229986.9	6301784.6
51*	Lend Lease	Groundwater BH Cent KV_MB	Regional	KV_MB8A	Offsite comparison un-disturbed	229166.4	6301607.4
52	Lend Lease	Centre APA Stage 1 and KVAR Stage 2	KVAR Stage 2A	Sump 3	KVAR Stage 2B		
53	Lend Lease level only	Groundwater Well 01	Groundwater through-flow	2012-PVC01	KVAR Stage 1	229468.21	6301620.1

Site #	Nalco site ID	Reported origin	Aspect	Sample ID	Note	Easting[2]	Northing[2]
54	Lend Lease level only	Groundwater Well 02	Groundwater through-flow	2012- PVC-02	KVAR Stage 1	229612.67	6301629.2
55	Lend Lease level only	Groundwater Well 03	Groundwater through-flow	2012- PVC-03	KVAR Stage 1	229564.84	6301717.9
56	Lend Lease level only	Groundwater VWP[1] 04	Groundwater through-flow	2012-VWP-04	KVAR Stage 1	229708.16	6301675.2
57	Lend Lease level only	Groundwater VWP[1] 05	Groundwater through-flow	2012-VWP-05	KVAR Stage 1	229815.42	6301684.6
58	Lend Lease level only	Groundwater VWP[1] 06	Groundwater through-flow	2012-VWP-06	KVAR Stage 1	229768.96	6301784.4
59	Lend Lease level only	Groundwater VWP[1] 07	Groundwater through-flow	2012-VWP-07	KVAR Stage 1	229683.52	6301792.7
60	Lend Lease level only	Groundwater Well 08	Groundwater through-flow	2012- PVC-08	KVAR Stage 1	229811.22	6301829.9
61	Lend Lease level only	Groundwater VWP[1] 09	Groundwater through-flow	2012-VWP-09	KVAR Stage 1	229851.8	6301752.8
62	Lend Lease	Groundwater Well APA15	KVAR Stage 2A	APAD15	KVAR Stage 2A KVAD subsurface drain	230159	6301948

[1] VWP – Vibrating Wire Piezometer – Pressure Transducer located in fly ash

[2] Water Quality Monitoring Results Available Groundwater KVAR Site - 2010 to 2011

* Previously Centennial Coal bores- now sampled by EnergyAustralia NSW

Water level measured only

Appendix D
KVAR Stage 2 Water Quality Assessment – June 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

Energy Australia NSW

Reference: 502838

Revision: 3

2018-06-22

Document control record

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Document control

Report title		Water Quality Assessment from April 2017 to March 2018 in Relation to the Decommissioned Wallerawang Power Station				
Document code			**Project number**		502838	
File path		\\Aurecon.info\Shares\AUSYD\Projects\EAD\EAD FY16\6. Teams\Environment\3. Projects\502838 - Wallerawang Groundwater Annual Reports\9 Reporting\Report\20180601_ 502838_180531_KVAR_WQ_Assessment_Draft_V1.0_R1.docx				
Client		Energy Australia NSW				
Client contact			**Client reference**			
Rev	**Date**	**Revision details/status**	**Author**	**Reviewer**	**Verifier** (if required)	**Approver**
0	2018-05-31	Draft	D. Harris	C. Molloy		C. Molloy
1	2018-06-08	Draft	D. Harris	C. Molloy		C. Molloy
2	2018-06-15	Draft Final	D. Harris	C. Molloy		C. Molloy
3	2018-06-22	Final	D. Harris	C. Molloy		C. Molloy
Current revision		**3**				

Approval

Author signature		Approver signature	
Name	David Harris	Name	Colm Molloy
Title	Senior Consultant	Title	Principal

Executive summary

This annual assessment report contributes to the Annual Environment Management Report (AEMR) for the 2017 / 2018 reporting period for the decommissioned and partly capped Kerosene Vale Ash Repository (KVAR) to address the requirements of the NSW Department of Planning and Environment's 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 quality, pursuant to Conditions 3.4 and 3.5 of Project Approval 07_0005.

Groundwater and surface water quality signals within / downgradient of the KVAR and surface water (WX7) / groundwater (D5) receiving sites are highly complex spatially and temporally.

Influences on water quality are associated with a number of existing and past land uses including the 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 Springvale Mine at LDP009.

Review of both recent (2017-2018) and historical (1991-2018) data for surface water monitoring associated with the KVAR has identified that the KVAR is currently not having a measurable impact on surface water quality in SSC at the designated surface water receiving site (WX7). Results indicate that the current water quality in SSC at WX7 is dominated by discharge from Springvale Mine at LDP009, which discharges 18ML/d to SSC.

The 95th percentile concentrations of arsenic, iron and molybdenum within Springvale Mine Discharge currently exceed the adopted water quality guideline values (WQGVs), and as a result 95th percentile concentrations of arsenic and molybdenum currently exceed the adopted WQGVs at WX7.

The 95th percentile concentrations of water quality parameters within groundwater bore D5 currently exceeds WQGVs for Al, B, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb and Zn. Results are reflective of water quality contributions from current and historic land use practices. It is possible that the KVAR is contributing to elevated parameters in groundwater for Bore D5. Further assessment is required to determine any potential contribution from KVAR.

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.

Further hydrogeological investigation is recommended to assess the KVARs contribution to water quality changes in Bore D5.

EnergyAustralia NSW has engaged independent consultants to undertake surface and groundwater assessments to facilitate closure and rehabilitation of the KVAR. These assessments include: groundwater modelling, installation of additional groundwater monitoring bores, water quality study, geotechnical assessments, final landform design, and rehabilitation plans. These works are expected to be completed in late 2018.

Contents

Appendices

Figures

Tables

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 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 2017 – March 2018 reporting period and considers previous years monitoring results for interpretation of trends.

1.2 Site Regulation

The annual assessments of surface water and groundwater quality are undertaken in accordance with the NSW Department of Planning and Environment's Development Consent conditions for the Kerosene Vale Ash Repository outlined in the KVAR Operations Environmental Management Plan, and because the Wallerawang Power Station Environment Protection Licence (EPL) 766 of 20th December 2017 has been retained by EnergyAustralia NSW.

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

In accordance with previous reports, the contract and fee proposal, and to meet requirements in response to the NSW Department of Planning and Environment's 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 Guidelines Values (WQGVs)
- Assessment of recent (2017-2018) 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 (2017-2018) 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

1.5 Previous Reports

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

- 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 Brinkerhoff (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 2017 to March 2018 from upstream, downstream and background reference locations summarized in Table 4-1, Section 4.1.1
- Groundwater quality and level data from April 2017 to March 2018 from upstream, downstream and background reference locations summarised in Table 4-3, Section 4.2.1

1.7 Data Quality

The data contained within this report has been provided to Aurecon by EnergyAustralia NSW. The data was checked for outliers using the ANZECC (2000) (Chapter 6) protocols for data analysis and interpretation.

Care should be exercised in labelling extreme observations as 'outliers', however "*on the balance of probabilities, an observation beyond three standard deviations from the mean is likely to be aberrant*" (ANZECC, 2000). As such observations beyond three standard deviations that present no rational explanation, such as a shift in environmental conditions, were excluded from the statistical interpretation of recorded data with all exclusions and reasoning for exclusion logged for critical review.

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). With the exception of 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, sulphate, 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 and 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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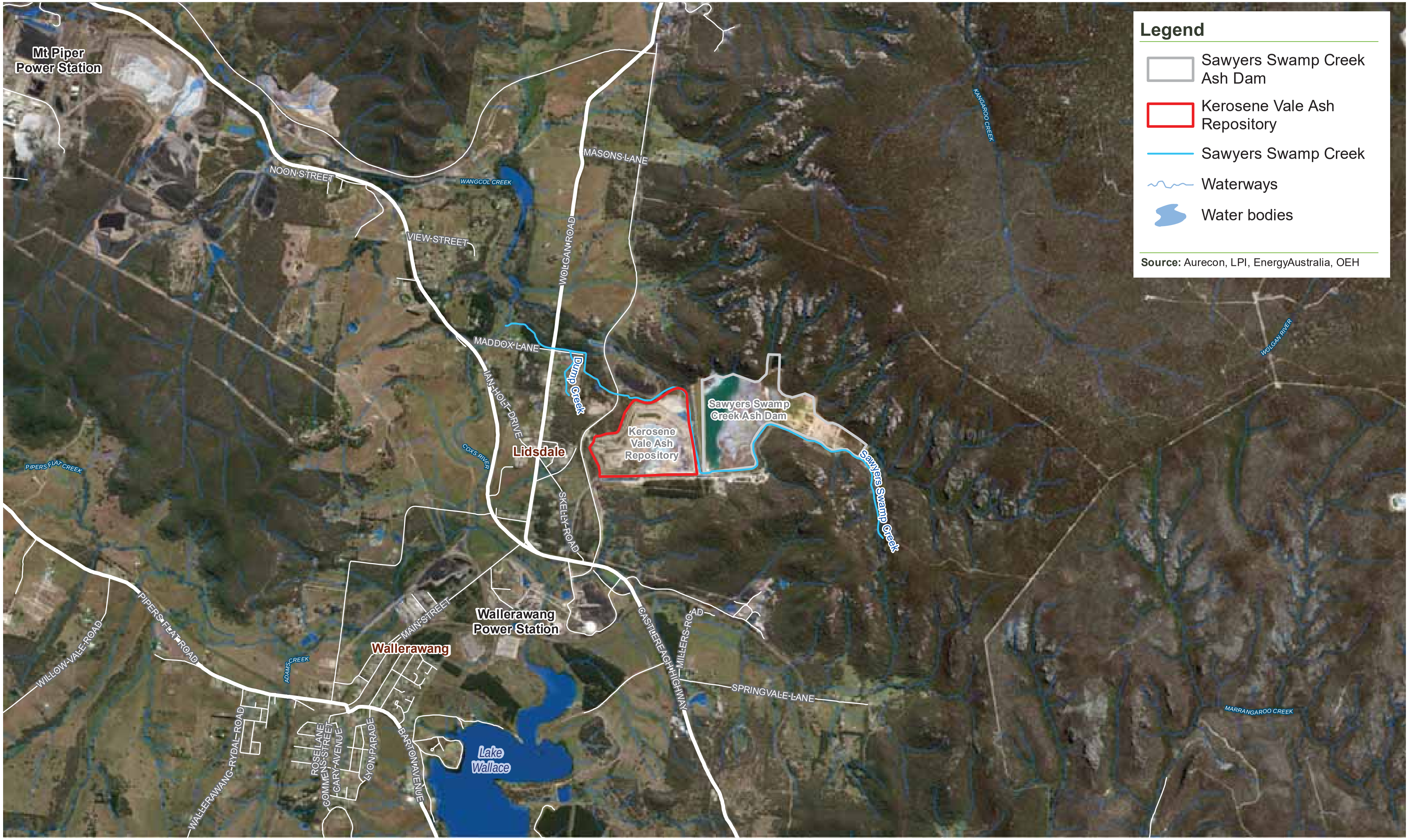

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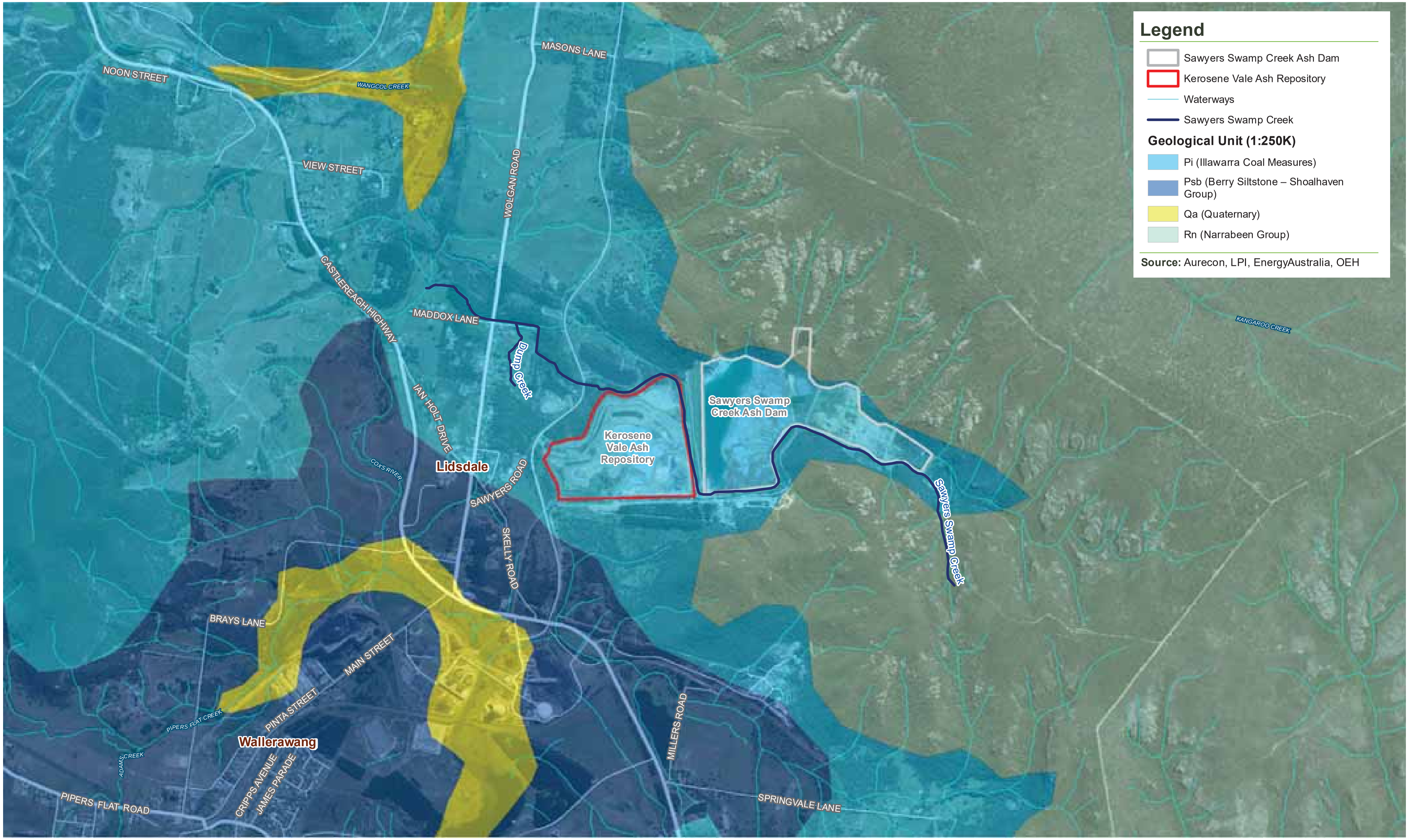
Projection: GDA 1994 MGA Zone 56

EnergyAustralia **Wallerawang Power Station**

Figure 2-1: Site Location

P:\GIS\Project-2\project\EnergyAustralia Western Power Stations\208562 - Wallerawang PS\Maps\208562 - Figure 2-1 Site Location .mxd\JOB No.\30-05-18\Ross.Ma\Rev 3

P:\GIS\Project-2\project\EnergyAustralia Western Power Stations\208562 - Wallerawang PS\Maps\208562 - 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.

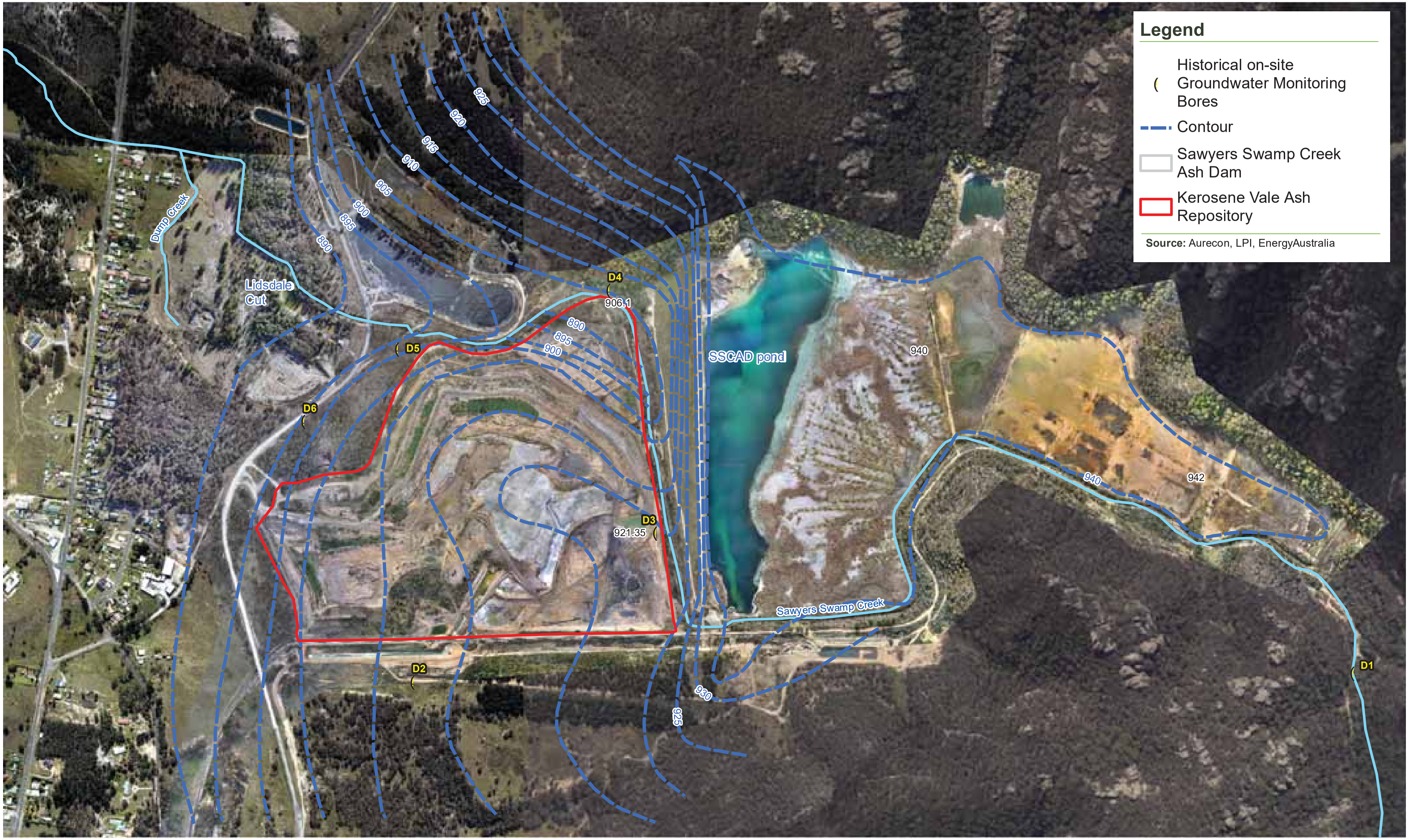
Ash emplacement in the eastern portion of the catchment forms a wedge shape above the original (palaeo) surface of the basin valley. The ash wedge ranges in depth from 0m in the vicinity of the Freshwater Diversion Dam, to approximately 22m at the eastern most portion of the SSCAD pond (adjacent to pond 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 Cox’s 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 940mAHD. 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 Cox’s 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) has been 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.



Source: Aurecon, LPI, EnergyAustralia

P:\GIS\Project-2\project\EnergyAustralia Western Power Stations\208562 - Wallerawang PS\Maps\208562 - Figure 2-3 5m Catchment Groundwater SSC.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 2-3: 5m Catchment Groundwater SSC Catchment

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, a number of 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.

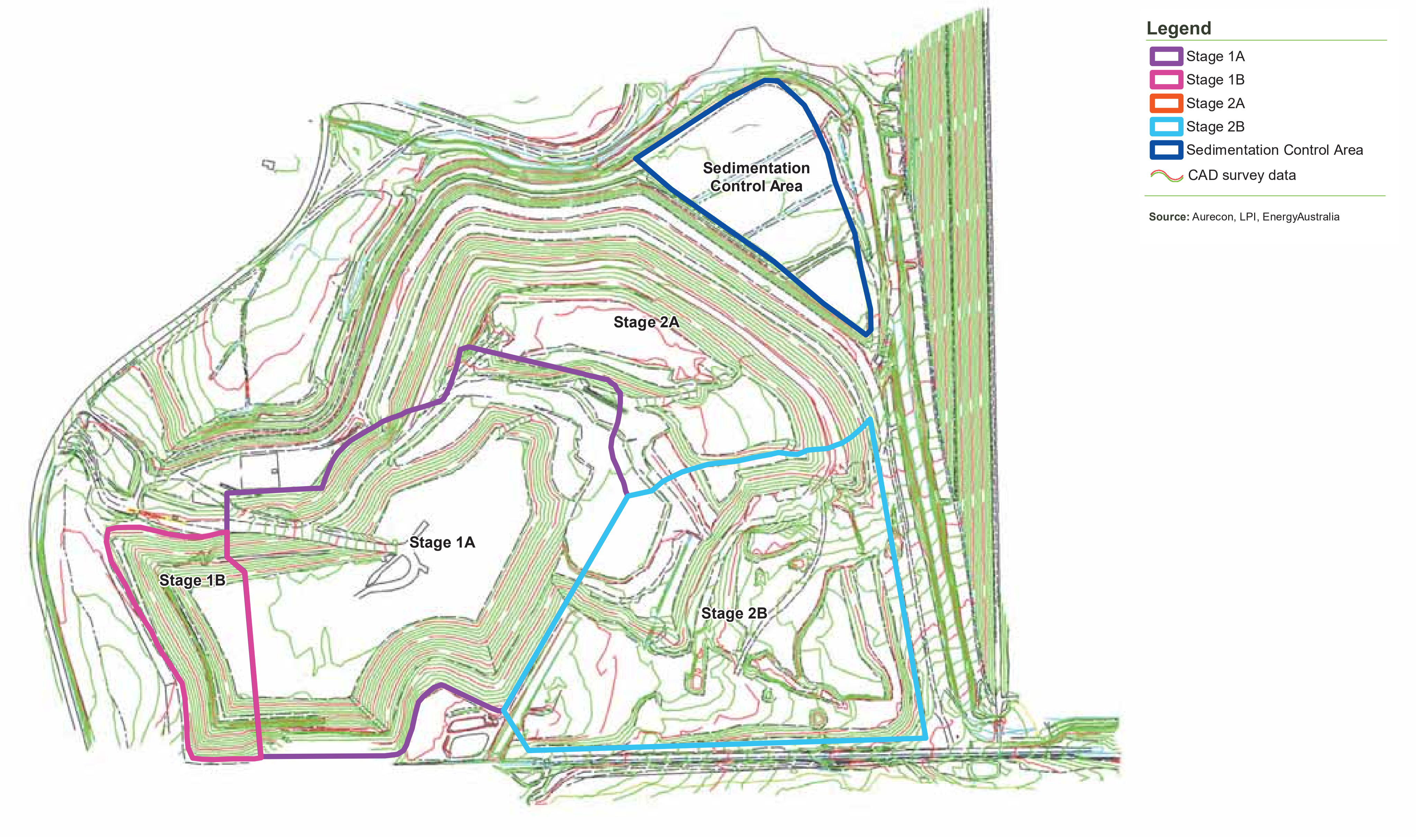
Table 2-2 Kerosene Vale Ash Repository – Record of Key Activities and Events

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	Pumping from LC to SSC Stops
July 2012	Pumping 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

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.



Source: Aurecon, LPI, EnergyAustralia

Projection: GDA 1994 MGA Zone 56

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

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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 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 is currently 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 is currently around 18ML/d.

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 a 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 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 Canal is discharged to the SSCAD via a pump-back system.

Source: Aurecon, LPI, EnergyAustralia, OEH

P:\GIS\Project-2\project\EnergyAustralia Western Power Stations\208562 - Wallerawang PS\Maps\208562 - Figure 2-5 Site Layout and Design.mxd\JOB No.\30-05-18\Ross.Ma\Rev 3

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Projection: GDA 1994 MGA Zone 56

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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 water 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 (1995) 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). The GILs are adopted in the NEPM 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, 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, but not to Lidsdale Cut (WX5) since July 2012.These monitoring points are 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: 2017 - 2018

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

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

Routine long-term water quality data has been collected for SSC at receiving water (WX7), and upgradient location (WX1) 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

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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 2017-2018 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 2017-2018 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)	8.2	1200	ND	26	6.44	0.445	0.028	0.0005	0.0284	0.0005	0.128	0.00005	ND	0.004	1.3	*0.495*	0.00002	0.0239	0.045	0.003	0.00072	0.0004	0.0154
Sawyers Swamp Creek – Surface Water Receiving Site																							
WX7 (41)	8.9	1230	736	24.3	6.09	0.364	0.0248	0.0005	0.0289	ND	0.145	0.000145	0.0005	0.00445	1.31	0.0245	0.00002	0.00845	0.0464	0.0066	0.001	0.000345	0.0167
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
Downstream V-Notch (93)	8.6	1254	719.5	23.56	6.16	0.706	0.0249	0.0005	0.03575	ND	0.124	0.00005	0.0005	0.000725	1.3565	0.29785	0.00002	0.06635	0.045	0.0039	0.00145	0.000345	0.0154
Downstream KVAR (83)	8.6	1259	748	30.115	6.02	0.459	0.0253	0.0005	0.02845	ND	0.147	0.00005	0.0005	0.001175	1.343	0.02395	0.00002	0.0297	0.0459	0.004	0.00145	0.000345	0.0129
Spillway (225)	8.2	1254	698	22.72	5.89	0.469	0.027	0.0005	0.0309	ND	0.1145	0.00005	0.0005	0.01005	1.2845	0.0687	0.00002	0.01825	0.05035	0.004	0.001	0.000345	0.02575
SSCAD																							
SSCAD (38)	4.9	1750	1155	881	21	14.6	0.008	0.0005	0.035	ND	3.68	0.00684	0.0005	0.01345	5.121	0.211	0.00002	3.21	0.0156	0.205	0.002	0.005645	0.626
SSCAD V-Notch (79)	7.6	2369	1360	1241	59.2	2.22	0.001	0.0005	0.0496	ND	1.75	0.00204	0.001175	0.01045	1.016	0.119	0.00002	8.22	0.002	0.133	0.00117	0.000635	0.217
KVAR / KVAD																							
West KVAD seepage left (81)	3.0	2558	1890	1254	27.1	16.55	0.0027	0.0005	0.0191	ND	4.1	0.0003	0.00285	0.0114	6.62	8.40	0.000037	8.2	0.00092	0.281	0.00485	0.00267	0.295
West KVAD seepage right (80)	2.9	4803	3745	2954	36.7	50.18	0.002	0.0005	0.003	ND	15.2	0.00234	0.0005	0.000725	23.04	66.2	0.00002	23.3	0.00117	2.67	0.00117	0.00182	3.74
North Wall Collection (86)	2.9	5240	3895	3121	26.0	41.3	0.0089	0.0005	0.00435	ND	13.8	0.000345	0.003	0.00145	56.2	109	0.000033	19.9	0.00245	1.46	0.0005	0.00480	3.5
Subsurface Throughflow (87)	3.3	5064	4845	3302	29.9	83.7	0.064	0.0005	0.00445	ND	13.4	0.0009	0.00245	0.00245	90.2	201	0.00002	17.2	0.00117	1.6	0.001	0.0598	4.68
Lidsdale Cut																							
Lidsdale Cut WX5 (40)	3.1	4077	3020	2547	34.3	77.5	0.009	0.05	0.017	ND	9.85	0.0169	0.008	0.0167	22.5	14.2	0.00002	19.825	0.0005	1.43	0.01075	0.075	2.66
Dump Creek																							
Dump Ck WX11 (39)	3.7	1932	1025	958.6	34.3	7.03	0.0019	0.0005	0.06745	ND	3.62	0.00154	0.00145	0.0178	2.15	17.7	0.00002	7.68	0.002	1.18	0.01	0.001245	3.03
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
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

WX7 – Receiving Site

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 the 95th percentile concentrations of key parameters of surface water samples at WX7 in SSC from the 2017-2018 monitoring period are generally below the adopted WQGVs with the exception of the following:

- pH - Exceeds upper limit
- Arsenic – Marginally exceeds ANZECC (2000) WQGV
- Molybdenum – Marginally exceeds Irrigation WQGV

Exceedances of these parameters at WX7 are attributed to discharge from Springvale Mine at LDP009 into SSC. Aurecon understands that Springvale Mine Discharges approximately 18ML/d into SSC at LDP009, and that the discharge is sampled at Site 158. Due to the ephemeral nature of SSC, discharge from Springvale Mine dominates surface water in SSC and as a result water quality at WX7 (Site 41) is reflective of the Springvale Discharge sampled at Site 158.

As the observed concentrations of water quality parameters in SSC at WX7 are reflective of discharge from Springvale Mine, it can be inferred that the KVAR is not currently affecting water quality in SSC at the receiving site.

Sawyers Swamp Creek Additional Sites

The results presented in Table 4-2 indicate that 95th percentile concentrations of key parameters in the SSC additional sites, including sites 93, 83 and 225, from the 2017-2018 monitoring period are generally below the adopted WQGVs with the exception of the following:

- pH - Exceeds upper limit
- Arsenic – Marginally exceed ANZECC (2000) WQGVs
- Molybdenum – Marginally exceed Irrigation WQGVs
- Copper (Site 225 only) – Exceeds ANZECC (2000) WQGV

Site 92 (WX1) was dry throughout the 2017-2018 monitoring period and as such no water quality data is available for assessment. Concentrations of water quality parameters at Sites 93, 83 and 225 are similar to water quality at WX7 (Site 41). As these sites are located downgradient of the Springvale Mine Licence Discharge Point (LDP009), and show close similarity with the chemistry of Springvale Mine water discharge, it is clear that water quality at these sites is dominated by the Springvale Mine water discharge and is generally unaffected by the KVAR.

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

SSCAD

The results presented in Table 4-2 indicate that 95th percentile concentrations of a number of key parameters from the 2017-2018 monitoring period SSCAD monitoring points (Sites 38 & 79) exceeded the adopted WQGVs, including:

- pH (Site 38 only) – Below lower limit
- Conductivity (Site 79 only) – Exceeds ANZECC (2000) WQGV
- Aluminium (Site 38 only) – Exceeds locally derived WQGV
- Sulfate (Site 79 only) - Exceeds Livestock ADWGV
- Boron – Exceeds locally derived WQGV
- Cadmium – Exceeds ANZECC (2000) WQGV

- Copper – Exceeds ANZECC (2000) WQGV
- Fluoride (Site 38 only) – Exceeds Drinking Water ADWGV
- Manganese – Exceeds ANZECC (2000) WQGV
- Molybdenum (Site 38 only) – Exceeds Irrigation WQGV
- Nickel – Exceeds ANZECC (2000) WQGV
- Zinc - Exceeds locally derived WQGV

The elevated concentrations of water quality parameters at these sites is 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.

Both sites 79 and 38 are hydraulically isolated from SSC and receiving water site WX7, and water quality at these locations does not directly affect the water quality in SSC. Monitoring results from these sites are consistent with the monitoring results from previous years.

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 2017-2018 monitoring period generally exceeded the adopted WQGVs with the exceptions of Cl, As (excluding Site 87), Ba, Cd (excluding Site 80), Cr, Cu (excluding Site 81), Hg, Mo, Pb, and Se (excluding Site 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 hydraulically isolate the KVAR / KVAD from SSC. Water collected in the KVAD toe drains is transmitted to Lidsdale Cut, from where it is currently pumped to the a dirty water pond (adjacent to the Return Water Canal) and back to the SSCAD.

The KVAR / KVAD surface water monitoring sites (80, 81, 86, 87) are hydraulically isolated from SSC by the KVAD / KVAR toe drains which divert water from the KVAD / KVAR to Lidsdale Cut Pond.

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

Lidsdale Cut Pond (WX5)

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 2017-2018 monitoring period generally exceeded the adopted WQGVs, with the exceptions of Cl, As, Ba, Hg and Mo. With the exception of 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 however that Lidsdale Cut Pond is pumped back to the Dirty Water Pond adjacent to the Return Water Canal, before being pumped back to SSCAD. Therefore, the water in Lidsdale Cut Pond does not directly affect water quality in SSC or at receiving Site WX7.

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

Dump Creek (WX11)

The results presented in Table 4-2 indicate that the 95th percentile concentrations of a number of key parameters in surface water monitoring locations for Dump Creek over the 2017-2018 monitoring period exceeded the adopted WQGVs, including:

- pH – Below lower limit
- Aluminium – Exceeds locally derived WQGV
- Boron – Exceeds locally derived WQGV
- Cadmium – Exceeds ANZECC (2000) WQGV
- Copper – Exceeds ANZECC (2000) WQGV
- Fluoride – Exceeds Drinking Water ADWGV
- 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 below 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	1988-2018	229636	6302189
		KVAR / KVAD			
37	Groundwater Bore WGM1/D6	Regional Coal Seam – Downgradient KVAR / KVAD	1988-2018	229415	6302029
77	Groundwater Bore AP09	KVAD North Wall	2010-2018	229837	6302182
78	Groundwater Bore AP17	KVAD North Wall	2010-2018	229916	6302192
94	KVAD Seepage	KVAD Seepage	2010-2018	229462	6302267
85	Groundwater Bore GW6	Seepage – Downgradient KVAR / KVAD	2010-2018	229753	6302222
75	Groundwater Bore GW10	KVAD West Wall	2010-2018	229612	6302000
76	Groundwater Bore GW11	KVAD West Wall	2010-2018	229648	6302092
		Downgradient of SSCAD / Upgradient – Cross Gradient of KVAR / KVAD			

33	Groundwater Bore WGM1/D2	Regional - South East	1988-2018	229681	6301387
34	Groundwater Bore WGM1/D3	Regional - East below SSCAD, Upgradient KVAR / KVAD	1988-2018	230278	6301752
35	Groundwater Bore WGM1/D4	Regional – NE of SSC	1988-2018	230159	6302353
Upgradient of SSCAD					
32	Groundwater Bore WGM1/D1	Regional - Upstream – Upper Catchment	1988-2018	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 (2018). No records are available for GW6 for the 2017-2018 monitoring period.

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 2017-2018 monitoring period.

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 2018 and are generally complete, but with missing data between February 1998 - November 2001 and October 2004 – July 2007. Data is available for the 2017-2018 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 2018, including the 2017-2018 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 2017-2018 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 2017-2018 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)	4.49	1229	943.15	580.75	31.175	25.905	0.0078	0.0005	0.10835	ND	2.26	0.00984	0.0148	0.0429	0.75815	4.17	0.0000845	5.93	0.0067	0.401	0.0844	0.00404	1.63
KVAR / KVAD																							
WGM1/D6 (37)	4.59	2258	2048	1262	57.33	6.7825	0.002	0.0005	0.0187	ND	1.41	0.00113	0.00345	0.0173	0.465	266	0.00002	11	0.0005	0.587	0.0170	0.00059	1.44
AP09 (77)	6	3023	2554	1768	25.84	0.66	0.0005	0.0005	0.01745	ND	3.19	0.0001	0.002525	0.0005	4.72	139	0.00002	10.5	0.179	1.53	0.0005	0.00079	1.36
AP17 (78)	4.01	5373	5922	3712	37.85	110.45	0.005	0.0005	0.017	ND	14.4	0.0019	0.004	0.005	91.2	259	0.00002	16.1	0.00635	1.77	0.002	0.183	5.52
KVAD Seepage (94)	8.25	1254	799	22.7	5.89	0.469	0.0100	0.0005	0.0309	ND	0.1145	0.00005	0.0005	0.01005	1.28	0.0687	0.00002	0.0182	0.0503	0.004	0.001	0.000345	0.0257
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)	5.49	939.5	667	377	62.2	0.6925	0.00245	0.0005	0.1134	ND	0.647	0.00253	0.0005	0.00245	0.47085	12.07	0.000029	1.887	0.00117	0.571	0.0028	0.00048	0.570
WGM1/D4 (35)	6.19	1574.5	1203	766	28.5	0.049	0.002	0.0005	0.017	ND	1.88	0.00005	0.0005	0.000725	0.05	59.5	0.00002	14.33	0.000725	0.0313	0.0005	0.0001	0.0374
WGM1/D2 (33)	4.23	640	401	193	36.5	0.4135	0.0005	0.0005	0.03345	ND	0.281	0.000145	0.0005	0.0005	0.1477	1.44	0.000047	0.6568	0.001	0.079	0.00245	0.0001	0.111
Upgradient of SSCAD																							
WGM1/D1 (32)	5.54	142.2	280	19.9	76.0	10.81	0.00155	0.0005	0.1161	ND	0.025	0.00005	0.00865	0.03255	0.0255	3.29	0.0000455	0.1083	0.0005	0.00775	0.0246	0.00062	0.1752
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
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

As outlined in Section 3.3, the groundwater WQGVs apply to bore D5 only, which is designated as the groundwater receiving site. The results presented in Table 4-4 indicate that concentrations of key parameters in groundwater water samples collected from Groundwater Bore D5 (from the 2017-2018 monitoring period) show a number of variable exceedances of the adopted WQGVs, including:

- pH (below ANZECC lower limit)
- Aluminium (exceeds Local WQGV)
- Boron (exceeds Local WQGV)
- Cadmium (exceeds ANZECC WQGV)
- Chromium (exceeds ANZECC WQGV)
- Copper (exceeds ANZECC WQGV)
- Iron (exceeds Local WQGV)
- Mercury (exceeds ANZECC WQGV)
- Manganese (exceeds ANZECC WQGV)
- Nickel (exceeds Local WQGV)
- Lead (exceeds Local WQGV)
- Zinc (exceeds local WQGV)

The chemical signature (pattern and concentration of elevated key parameters) of D5 are comparable with the chemical signatures of Bore D6 and AP09 and similar to AP17, due to elevated concentrations and exceedances of Al, B, Cd, Fe, Mn, Ni, and Zn and low pH at all locations. Concentrations in D5 are notably lower for F, Fe, SO4, conductivity and TDS than for D6, AP09 and AP17.

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 (2017-2018 results) indicate that placement of dry ash within the KVAR may potentially be affecting water quality in bore D5. However, it is noted that discharge from Springvale mine has influenced water quality in D5 through local recharge of groundwater upgradient of the KVAR and adjacent to Bore D5 and through local seepage to D5 via SSC.

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 and AP17 also variably exceed the WQGVs outlined above for D5, along with exceeding ANZECC (2000) WQGVs for:

- Conductivity
- Total dissolved solids
- Sulfate
- Fluoride
- Selenium (AP17)

Concentrations at the KVAD seepage (Site 94) monitoring point do not present a chemistry that is consistent with that of D5, D6, AP17 and AP09, despite being located downgradient of the Stage 2 KVAR area. Concentrations of key parameters are generally below the adopted WQGVs with the exception of:

- pH (marginally above ANZECC upper limit)
- Copper (marginally exceeds ANZECC WQGV)
- Molybdenum (marginally exceeds WQGV)

A review of the historic water quality monitoring results for Site 94 (Section 5.2.2) indicates a reduction in concentrations of all water quality parameters at the start of the 2017-2018 monitoring period, and subsequent results that are both reduced and notably inconsistent with previous years. It is likely that this change reflects a change in the sampling location for Site 94, which is located downgradient of the KVAD / KVAR and upgradient of Lidsdale Cut Pond.

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 (2017-2018 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

Groundwater chemistry of sample sites upgradient of the KVAR and downgradient of the SSCAD (Bores D2, D3, & D4) show statistically comparable chemical signatures between sampling points. For all monitoring bores the concentrations of key parameters are generally below the adopted WQGVs with the exception of:

- pH (below ANZECC lower limit)
- TDS at D4 (exceeds ANZECC WQGV)
- Boron at D4 (exceeds Local WQGV)
- Cadmium at D3 (exceeds ANZECC WQGV)
- Iron at D3 and D4 (exceeds Local WQGV)
- Manganese at D4 (exceeds ANZECC WQGV)
- Nickel at D3 (exceeds Local WQGV)
- Zinc at D3 (exceed Local 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 bore D2 reflect current conditions from a long-term trend of declining pH. Long trends for other water quality parameters including the indicator parameters Mn, B, Ni, SO4 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, Fe, Ni 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 parameter must be described in context with recent historical activities and mechanisms that currently affect water quality.

Notably from Sections 5.2.3, & 6, it is determined that a commencement of discharge from Springvale Mine at LDP009 has resulted in a rise in groundwater levels in the south-east corner of the KVAR, proximal to bore D3. The rise in groundwater levels is theorised to have resulted in migration of groundwater into the dry ash KVAR, resulting in recent (post June 2013) changes to water quality which currently affect the water quality in bore D3, along with compound effects on water quality in the KVAR / KVAD sampling bores and downgradient sites D6 and D5.

Current groundwater quality at bore D4 (Site 34) is complexly influenced by both discharge from Springvale Mine, 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. Overall groundwater in bore D4 is generally reflective of the water quality Springvale Mine with lesser influences from KVAR / KVAD. 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.

Boreholes Upgradient SSCAD

Groundwater samples collected from Borehole D1 – Located in the middle-upper portions of the SSC catchment, upgradient of the SSCAD have concentrations of key parameters exceeding the following WQGVs:

- pH (below ANZECC lower limit)
- Aluminium (exceeds Local WQGV)
- Chromium (exceeds ANZECC WQGV)
- Copper (exceeds ANZECC WQGV)
- Iron (exceeds Local WQGV)
- Lead (exceeds Local WQGV)

The chemical signature of groundwater samples from Bore D1 are distinctly different from those within and downgradient of the KVAR area, most notably with respect to the low concentrations of aluminium, sulfate, manganese and zinc observed in D1. Groundwater quality in D1 reflective of catchment conditions that are unaffected by the SSCAD, KVAR and KVAD.

5 Surface Water and Groundwater Trends

5.1 Surface Water Trends 1992 – 2018

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 (2012-2018) / 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 of discharge from Springvale Mine to SSC at LDP009 (July 2013) 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	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)	2011-2018	8.68	1200	610.5	45.8	10.06	0.45	0.0315	0.0005	0.0321	0.0005	0.126	0.0001	0.0016	0.004	1.3	0.517	0.00002	0.0202	0.0481	0.005	0.001	0.000955	0.024
Sawyers Swamp Creek (Receiving Site)																								
SSC WX7 (41)	1991-2003	7.78	847	603	345	48.4	0.565	0.001	0.001	0.0443	ND	2.39	0.001	0.001	0.009	1.34	0.742	0.0002	0.920	ND	ND	0.0029	0.0029	0.179
	2003-2012	8.6	1494	1152	710	32.1	85.8	0.025	0.001	0.0787	0.005	3.21	0.0054	0.005	0.0102	2.12	0.224	0.0001	5.04	0.02	0.446	0.0138	0.003	0.830
	2012-2018	8.8	1225	757	104	11.5	1.29	0.0305	0.001	0.0376	ND	0.395	0.0002	0.002	0.004	1.4	0.0847	0.00005	0.536	0.0518	0.0293	0.0027	0.001	0.0871
Sawyers Swamp Creek (Additional Sites)																								
Upstream SSCAD WX1 (92)	1992	6.2	3000	ND	ND	8	0.120	ND	ND	ND	ND	0.042	ND	ND	ND	ND	0.435	ND	0.068	ND	ND	ND	ND	0.040
	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	6.81	162.8	152.4	31.5	12	3.55	0.0011	0.001	ND	ND	0.06	0.0002	0.0031	0.009	0.1	2.98	0.000062	0.523	0.01	0.01	0.005	0.002	0.05
Downstream v-notch (93)	2012-2018	8.72	1240	772	67.6	13	0.741	0.03	0.001	0.0384	ND	0.199	0.0002	0.002	0.00595	1.38	0.158	0.00005	0.5	0.05	0.006	0.002	0.001	0.032
Downstream KVAR (83)	2010-2012	8.58	1030	ND	346	33	1.7	0.0038	0.001	0.0854	0.0018	1.23	0.0002	0.0026	0.0028	1.08	0.618	0.00005	1.5	0.02	0.01	0.0018	0.002	0.04
	2012-2018	8.73	1250	790.5	41.0	6.316	0.52	0.03	0.0005	0.0321	ND	0.273	0.0001	0.002	0.002	1.5	0.116	0.00005	0.5	0.051	0.0091	0.00105	0.001	0.0301
Spillway (225)	2013-2018	8.6	1250	760	40.1	6.36	0.530	0.03	0.0005	0.033	ND	0.15	0.0001	0.002	0.003	1.32	0.0365	0.00005	0.5	0.0521	0.006	0.00105	0.001	0.0301
SSCAD																								
SSCAD (38)	1996-2003	6.45	1946	1514	980	58	ND	0.0357	0.001	0.148	0.00895	7.87	0.0141	0.0154	0.0174	11.2	0.345	0.0002	1.57	0.186	0.147	0.005	0.316	0.535
	2003-2012	7.2	2456	1941	1391	42.1	7.37	0.05	0.01	0.1	0.0077	7.9	0.01075	0.01	0.03015	10.15	ND	0.0001	1.82	0.09	0.1375	0.01	0.171	0.4715
	2012-2018	7.8	1700	1300	860	21.2	13.6	0.006	0.001	0.073	ND	3.52	0.0068	0.002	0.02105	4.59	0.2935	0.00005	3.16	0.04	0.196	0.002	0.007	0.5801
SSCAD V-Notch (79)	2010-2012	7.97	2015	1580	970	52.8	1.58	0.0014	0.001	0.0612	0.001	2.88	0.00088	0.002	0.00484	1.5	0.03	0.00005	0.376	0.01	0.018	0.0018	0.002	0.118
	2012-2018	8.6	2456	1917	1330	56.3	9.99	0.016	0.0005	0.0596	ND	2.382	0.00777	0.00305	0.014	2.43	2.30	0.00005	8.74	0.0381	0.272	0.0051	0.00170	0.415
KVAR / KVAD																								
West KVAD seepage left (81)	2010-2012	3.1	2949	2300	1500	30.8	71.1	0.0028	0.001	0.016	0.0166	8.895	0.00174	0.00821	0.0465	3.88	68.7	0.00005	16.8	0.01	1.2	0.00942	0.00285	1.585
	2015-2017	3.14	2794	2066	1392	27.1	39.7	0.0064	0.0005	0.0208	ND	5.92	0.00076	0.0068	0.0256	15.2	70.6	0.0001	8.54	0.0005	0.3878	0.0066	0.0048	0.8356
West KVAD seepage right (80)	2010-2012	3.2	3265	2580	1700	39.8	22.8	0.001	0.001	0.018	0.0168	8.9	0.00128	0.001	0.0068	7.1	13.8	0.00005	19	0.01	1.6	0.011	0.002	2.08
	2015-2018	3.2	4782	4202	2942	36.7	50.5	0.002	0.0005	0.006	ND	15.3	0.0024	0.0005	0.002	21.1	63.4	0.00002	24.8	0.002	2.76	0.002	0.003	3.74
Nth Wall collection (86)	2010-2012	4.78	1094	740	447	21.9	3	0.0067	0.001	0.045	0.00195	2.29	0.0002	0.00147	0.00495	0.4	10	0.00005	3.69	0.01	0.06	0.005	0.002	0.13
	2013-2018	3.1	5131	4429	2886	41.6	160	0.025	0.0005	0.0201	ND	13.3	0.0415	0.0089	0.0338	45.1	112.3	0.00005	18.3	0.00305	1.401	0.002	0.00343	2.906
Surface water runoff (87)	2010-2012	4.99	2395	1895	1580	25	126.2	0.001	0.001	0.0709	0.002	3.18	0.00195	0.00875	0.0128	1.97	22.6	0.00005	8.94	0.01	0.198	0.001	0.0039	0.476
	2015-2018	3.45	5052	5070	3292	29.5	82.1	0.039	0.0005	0.0102	ND	12.7	0.0009	0.002	0.00375	87.8	189.5	0.00002	17.02	0.002	1.59	0.001	0.0492	4.47
Lidsdale Cut																								
Lidsdale Cut WX5 (40)	1991-2003	5.98	1061	657	383.6	60.4	3.12	0.001	0.001	0.0398	ND	2.17	0.001	0.0082	0.005	2.11	0.85	0.0002	2.255	ND	ND	0.0038	0.001	0.354
	2003-2012	7.33	2385	1920	1410	35.5	20.5	0.05	0.01	0.07	0.02565	7.1	0.005	0.01	0.01	13.5	14.1	0.0001	11.1	0.038	0.942	0.01	0.006	1.22
	2012-2018	3.9	4196	4290	3660	33.8	180	0.0298	0.0005	0.0788	ND	13.9	0.0438	0.0223	0.0472	35.3	20.9	0.00005	17.1	0.001	1.58	0.0328	0.0854	3.16
Dump Creek																								
Dump Creek WX11 (39)	1991-2003	8	1025	900.6	458.8	59.35	0.341	0.001	0.001	0.0468	ND	1.97	0.001	0.0082	0.002	1.16	5.26	0.0002	1.89	ND	ND	0.001	0.0028	0.278
	2003-2012	5.9	1695	1195	749	25	1.6	0.05	0.01	0.032	0.005	2.9	0.0022	0.01	0.01	1.1	6.39	0.0001	7.26	0.01	0.452	0.01	0.006	1.1
	2012-2018	3.7	2062	1500	1073	34.44	5.7	0.001	0.001	0.0395	ND	3.73	0.0009	0.002	0.0135	11.45	12.36	0.00005	8.1	0.01	0.686	0.009	0.002	1.8
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

Orange: Outliers Removed

Additional notes: See Table 4-2

5.1.1 WX7 – Surface Water Receiving Site

1991-2003

Sawyers Swamp Creek (WX7)

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, SO4, and conductivity for the period between 1991 and 2018 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 SO4, 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, SO4, B, 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)

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 pumping 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 SO4, 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, SO4, and conductivity for the period between 1991 and 2018 for WX7. The chart shows that concentrations of SO4 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, SO4, 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.

2012-2018

Sawyers Swamp Creek (WX7)

Surface water samples collected for WX7 during this period represent surface water quality of SSC receiving site at the cessation of pumping 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 pumping 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.

Figure A1 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 1991 and 2018 for WX7. The chart shows that concentrations of all water quality parameters dropped significantly immediately following the June 2012 event when pumping from Lidsdale Cut to SSC ceased. It is noted that the declining trends for Al, B, Ni and SO4 are acutely interrupted, and/ or reversed (i.e. Aluminium) in July 2013, at which point discharge from Springvale Mine commences and subsequently dominates water quality characteristics at WX7.

With cessation of pumping 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 a number of parameters, including indicator parameters Mn, B, SO4, and Ni are lower than the pre-dry ash emplacement (1991-2003) values. As such, in accordance with recent 2017-2018 monitoring results, it can be determined that the KVAR is not currently affecting water quality in SSC at WX7 at a quantifiable level.

5.1.2 Sawyers Swamp Creek Additional Sites

1992

Upstream SSCAD - WX1 (Site 92)

Surface water samples collected for WX1 during this period represent 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 95th percentile concentrations in surface waters of WX1 were generally below the adopted WQGVs during the 1992 monitoring period, with the exception of Fe, which was recorded at roughly twice the adopted WQGV (0.76mg/L) and conductivity (3000µs/cm).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, SO4, 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.

2012-2018

Upstream SSCAD WX1 (Site 92)

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 2012-2018 monitoring period, with the exception of Cu, Fe and Hg, which marginally exceeded WQGVs.

Figure A2 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 1992 and 2018 for WX1. The chart shows 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.

Downstream KVAR (Site 83)

The results presented in Table 5-1 indicate that the 95th percentile concentrations of water quality parameters in surface waters at the Downstream KVAR monitoring point generally decreased during the 2012-2018 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 8.58.

Figure A4 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 2012 and 2018 for Downstream KVAR. The chart shows relatively stable to decreasing trend for all parameters, 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 2012-2018 monitoring period are attributed to discharge from Springvale Mine at LDP009, which since 2013 has 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). The results indicate that the KVAR does not have a measurable effect on water quality in SSC at Site 83.

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 8.72.

Figure A3 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 2012 and 2018 for Downstream V-Notch. The chart shows 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 2012-2018 monitoring period are attributed to discharge from Springvale Mine at LDP009, which since 2013 has 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). The results indicate that the KVAR does not have a measurable effect on water quality in SSC at Site 93.

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.

Figure A5 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 2013 and 2018 for Spillway 225 (2012 data not available). The chart shows generally stable to declining concentrations for key water quality parameters with the exception of aluminium and conductivity which present slight increasing trends. Increasing conductivity is largely driving 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 2012-2018 monitoring period are primarily attributed to discharge from Springvale Mine at LDP009, which since 2013 has dominated the water quality in SSC. As such the concentrations of water quality parameters at Site 225 are reflective of the water quality sample at the discharge point (Site 158). The results indicate that the KVAR does not have a measurable effect on water quality in SSC at Site 225.

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.

Figure A6 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 1996 and 2018 for SSCAD 38. The results show generally increasing concentrations up to 2003 for SO4, Mn, B, and Ni and conductivity (SO4 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 a number of 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 SO4, 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.

Figure A6 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 2003 and 2012 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.

Figure A7 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 2010 and 2012 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.

2012-2018

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 2012-2018 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.

Figure A6 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 2013 and 2018 for SSCAD 38. Data is not available for the period between February 2012 and April 2013 and are represented in the graph by straight lines which connect data prior to and following this gap.

The results show a decrease in SO4 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) pumping 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. It should also be noted the concentrations of SO4 and overall conductivity have returned to a rising trend in recent years 2016-2018 in-line with rising trends of other water quality parameters.

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 2012-2018 monitoring period in comparison to the 2003-2012 monitoring period for SO4, 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.

Figure A7 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 2012 and 2018 for SSCAD V-Notch (Site 79). Data is not available for the period between February 2012 and April 2013 and are represented in the graph by straight lines which connect data prior to and following this gap. 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.

Figure A8 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between February 2010 and March 2018 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.

Figure A9 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between February 2010 and March 2018 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 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.

Figure A10 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between March 2010 and March 2018 for Site 86. For the period between March 2010 and February 2012, the chart shows a variable series of rising (Al, Mn), falling (SO4, B, Cond), and stable (Ni) trends up to November 2010 at which point there is a significant drop in concentrations of all parameters. Following this event, concentrations recover and SO4, 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 October 2010 is indicative of increasing influence of the KVAR on water quality at Site 86.

Surface Water Runoff (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 generally exceeded the adopted WQGVs with the exceptions of Cl, As Ba, Be, Hg, Mo, Pb and Se. pH was below the lower limit of the WQGVs and moderately acidic with pH 4.99.

Figure A11 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between April 2010 and March 2018 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 SO4 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. SO4 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 October 2010 is indicative of increasing influence of the KVAR on water quality at Site 87.

2012-2018

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. 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, Ag, Ba, Be, Cd, Mo and Se.. pH increased slightly but remained highly acidic at pH 3.14.

Figure A8 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between April 2010 and March 2018 for Site 81. For the period between April 2015 and March 2018, 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 2018 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 March 2018) generally increased in comparison to 2010-2012 concentrations, with the exceptions of 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.

Figure A9 Appendix A10 presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between February 2010 and March 2018 for Site 80. For the period between April 2015 and March 2018, 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 2018 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 March 2018) 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 3.1. The shift in water quality between the 2010-2012 and 2014-2018 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 2014-2018 monitoring period, the majority of water quality parameters exceeded the WQGVs, with the exceptions of Cl, Ba, Hg, Mo, Pb and Se.

Figure A10 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between February 2010 and March 2018 for Site 86. For the period between April 2014 and March 2018, 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 2018 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 March 2018) generally increased significantly, with the exceptions of Al, Ba, Cd, Cr, Cu, Hg, Mo and Pb. pH decreased significantly to highly acidic conditions at pH 3.45. As a result of the increased concentrations in water quality parameters, As and Se joined other water quality parameters exceeding the WQGVs; whilst Cd, Cr and Cu concentrations decreased to below the WQGVs.

Figure A11 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between April 2010 and March 2018 for Site 87. For the period between April 2015 and March 2018, the chart shows shallow rising - stable 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 (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 87 between 2013 and 2018 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)

1991-2003

Lidsdale Cut (WX5)

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 1991-2003 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 1991-2003, with the exception of B, Cr, F, Fe, Mn and Zn. pH was below the lower limit of the WQGVs and mildly acid at pH 5.98.

Figure A12 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between April 1992 and March 2018.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)

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, Ag, Ba, Be, and Hg which remained below the WQGVs. pH became more neutral at pH 7.33.

Figure A12 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between April 1992 and March 2018. 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, volatility decreases but gives way to a rising trend in concentration of water quality indicator parameters. The shift to increasing trends and decreasing volatility 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) 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 Bore D6 solely to a single source such as the KVAR.

2012-2018

Lidsdale Cut (WX5)

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 March 2018, 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 3.9.

Figure A12 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between April 1992 and March 2018. For the period between October 2012 and March 2018, values of all indicator parameters increased significantly and entered into relatively stable (e.g. SO4, 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 (2012-2018) appear to suggest that the KVAR placement may have influenced water quality in Lidsdale Cut Pond (WX5) 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 2012-2018 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 discharge 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.

Figure A13 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between October 1991 and March 2018 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.

Figure A13 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between October 1991 and March 2018 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 Bore D6 solely to a single source such as the KVAR without further investigation.

2012-2018

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 2018 generally increased relative to 2003-2012 values, with the exceptions of As, Cd, Cr, Pb and Se. pH decreased to highly acidic conditions at pH 3.7. As a result of the changes in water quality, SO4, Al, and F rose above their respective WQGVs, whilst As, Cd, Cr, and Se dropped below their respective WQGVs.

Figure A13 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between October 1991 and March 2018 at WX11. For the period between June 2012 and March 2018, concentrations of indicator parameters fluctuated with significant volatility within overall stable to rising 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. An increasing trend is observed for all indicator parameters between 2017 and 2018.

Overall, the results for the 2012-2018 monitoring period appear to suggest that the KVAR placement may have influenced water quality in Dump Creek (WX11) 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. 3.7 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. 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 D6 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 (Site 158) sampling point for the period between 2011 and 2018 were generally below the adopted WQGVs, with the exception of As, Fe and Mo, which marginally exceeded the WQGVS.

Figure A14 Appendix A presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 2011 and March 2018 for Springvale 158. The chart shows that concentrations have remained relatively stable over time, though with noticeable reduction in concentrations of sulfate.

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

5.2 Groundwater Trends 1988 - 2018

To assess 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 (2010-2018). 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 2017-2018 Groundwater Monitoring Results (mg/L) – 95th Percentiles

Sample Location	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*
Groundwater Receiving Site																								
Groundwater Bore WGM1/D5 (36)	1988-2003	4.73	864.8	576.8	336.6	26	ND	0.01055	0.001	0.622	0.006	1.76	0.0419	0.0499	0.0708	0.7665	15.96	0.00064	3.045	ND	0.137	0.0685	0.00175	0.6943
	2003-2010	4.09	2341.6	1995	1490	27.65	41.2	0.04765	0.00955	0.0379	0.02935	6.285	0.01075	0.005	0.0439	1.3	25.9	0.0001095	13.85	0.0105	1	0.026	0.0058	2.085
	2010-2018	4.61	1385.6	1122	715.5	36	30.8	0.01165	0.001	0.0842	ND	3.181	0.06965	0.01355	0.0616	1.255	5.44	0.000142	8.16	0.01	0.58705	0.1155	0.005	3.2935
KVAR / KVAD																								
Groundwater Bore WGM1/D6 (37)	1988-2003	5.6	1220	770	400	80	ND	0.00575	0.001	0.78	0.001	1	0.00585	0.0256	0.036	0.35	130	0.0008	5.015	ND	0.20065	0.017	0.0715	0.3235
	2003-2010	4.6	1423	784	440	70.5	5.96	0.05	0.01	0.04	0.016	0.89	0.0022	0.0155	0.01	0.7	85.7	0.0001	4.65	0.066	0.5475	0.015	0.006	1.95
	2010-2018	4.508	2016	1760	1147	57.605	6.792	0.006	0.001	0.02755	ND	1.302	0.00432	0.004	0.016	0.7	200	0.00005	9.66	0.01	0.6355	0.022	0.002	1.8
Groundwater Bore AP09 (77)	2010-2018	6.5	3005	2546	1650	41.89	0.555	0.0888	0.001	0.031	ND	3.1	0.000448	0.001	0.004	2.124	121	0.00005	12.6	0.198	1.33	0.003	0.002	1.11
Groundwater Bore AP17 (78)	2010-2018	5.595	5302	5531	3506	22	103	0.124	0.001	0.026	ND	14.05	0.0018	0.003	0.0638	109.3	238	8.3E-05	16.6	0.1	1.9375	0.0056	0.135	5.84
KVAD Seepage (94)	2015-2017	3.83	4793	4762	3449	44.8	214.4	0.0449	0.0005	0.0314	ND	13.93	0.0571	0.0257	0.0533	33.5	43.8	0.0000242	25.1	0.00285	2.30	0.007	0.0432	3.49
Groundwater Bore GW6 (85)	2010-2016	7.44	4474	3286	1690	608	14.4	0.0072	0.001	0.301	ND	0.224	0.000344	0.0106	0.0254	1.64	14	0.000114	26.3	0.01	0.3674	0.114	0.002	0.344
Groundwater Bore GW10 (75)	2010-2013	6.62	1745	1345	866	168	50.2	0.0397	0.001	0.3545	ND	1.59	0.01025	0.0114	0.0547	7.79	6.38	0.0000725	9.78	0.235	2.08	0.1665	0.0095	2.97
Groundwater Bore GW11 (76)	2010-2016	7.4	1040	744	436	27.08	20	0.015	0.001	0.202	ND	1.514	0.000367	0.01	0.02535	0.44	4.814	0.000094	4.42	0.0415	0.03	0.0619	0.00245	0.238
Downgradient SSCAD - Upgradient KVAR																								
Groundwater Bore WGM1/D3 (34)	1988-2003	6.5	740	487	124	86	ND	0.0306	0.001	0.254	0	0.2	0.001	0.0232	0.0165	0.46	11	0.00078	0.731	ND	0.0905	0.0169	0.0024	0.14
	2003-2010	6.6	807.9	526	130	110	0.7175	0.05	0.01	0.129	0.001	0.049	0.002	0.01	0.01	0.1	4.885	0.0001	1.095	0.01	0.1955	0.01	0.006	0.11
	2010-2018	6.254	924	597.8	302.8	155.4	0.649	0.006	0.001	0.12	ND	0.388	0.00036	0.003	0.0116	0.1614	10.84	0.00005	1.448	0.01	0.3098	0.004	0.002	0.3068
Groundwater Bore WGM1/D4 (35)	1988-2003	6.8	730	520	222	56.2	ND	0.00775	0.001	0.514	0.0009	0.5	0.00365	0.0162	0.0513	0.37	93.5	0.00262	7.24	0	0.0233	0.014	0.0461	0.098
	2003-2010	6.3	1582.9	1300	954	35	0.085	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
	2010-2018	6.2	1694.6	1396.5	880	47.36	0.08	0.003	0.001	0.0288	ND	1.95	0.0002	0.002	0.0046	0.1	61.6	0.00005	19	0.01	0.05	0.001	0.002	0.09
Groundwater Bore WGM1/D2 (33)	1988-2003	5.51	320	277	67.1	61.1	ND	0.0017	0.001	0.1437	ND	0.14	0.001	0.04485	0.038	0.3185	2.26	0.00081	0.534	ND	0.0317	0.031	0.001	0.13
	2003-2010	4.99	461	309	158	43.9	ND	0.05	0.01	0.0708	0.001	0.129	0.002	0.01	0.01	0.19	5.29	0.00013	0.624	0.01	0.06	0.01	0.006	0.13
	2010-2018	5.055	640	384	177	38.7	0.4015	0.001	0.001	0.045	ND	0.221	0.0002	0.0022	0.007	0.1	3.585	0.00008	0.805	0.01	0.086	0.003	0.002	0.126
Upgradient of SSCAD and KVAR / KVAD																								
Groundwater Bore WGM1/D1 (32)	1988-2003	6.16	322	247	13.7	82.6	ND	0.005	0.0091	0.185	0	0.175	0.003	0.04275	0.05375	0.548	7.705	0.00052	0.7475	ND	ND	0.019	0.0027	0.150
	2003-2010	6.1	141	179	11.7	21	7.42	0.0027	0.001	0.1046	0.0012	0.047	0.00147	0.0061	0.0277	0.1	2.24	0.000088	0.498	0.01	0.01	0.0131	0.002	0.144
	2010-2018	6	149	169	19	28.7	7.06	0.001	0.001	0.0914	ND	0.07	0.0002	0.00485	0.021	0.1	1.5195	0.00005	0.6755	0.01	0.01	0.013	0.002	0.179
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

5.2.1 Groundwater Bore D5 – Receiving Site

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, SO4, Cl, As, Ba, Be, F, Ni and Se were below the adopted WQGVs.

Figure A15 Appendix B presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 1988 and 2018 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 SO4, 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 Figure A15 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 D6 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 SO4, Ca, and Zn and other parameters, at concentrations significantly above pre-KVAR levels.

2010-2018

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key parameters in D5 decrease for SO4, Al, As, B, F, Fe, Mn, Mo, Ni, & Se during the 2010-2018 period. Concentrations of Cl, Ba, Cd, Cr, Cu and Pb increased in 95th percentile concentrations. pH becomes slightly more alkaline, though still acidic (pH 4.61), while overall conductivity decreases.

Time series records for indicator parameters (presented in Figure 15 Appendix B) show that concentrations of Mn, B, SO4, Ni, and overall conductivity decrease initially following completion of Stage 1 dry ash emplacement in the KVAR (February 2009), and again in May 2010 following the installation of SSCAD Seepage Collection. 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 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.

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 D6 solely to a single source such as the KVAR without further, more detailed investigation.

5.2.2 KVAR / KVAD Monitoring Bores

1988-2003

D6

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, SO4, Cl, As, Be, B, F, and Zn did not exceed WQGVs. No data was available for Al or Mo.

Figure A16 Appendix A presents time series records of indicator parameters Al, Mn, B, Ni, SO4, and conductivity for the period between 1988 and 2018 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, AP17, GW10, GW11

Groundwater quality data for GW10, GW11, AP9 and AP17 are only available for the period between 2010 and 2018.

2003-2010

D6

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 SO4, 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, SO4, and conductivity for the period between 2003 and 2010 for D6 (Figure A16 Appendix B), show a sudden drop in concentrations from 2003, potentially associated with capping of the KVAD 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.

2010-2018

D6

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key water quality parameters in groundwater of D6 increased for SO4, Al, B, Cd, Cu, Fe, Mn, Ni, and Pb during the 2010-2018 monitoring period with a corresponding increase in conductivity and decrease in pH (pH 4.5). 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, SO4 and conductivity for the period between 2010 and 2018 for D6 (Figure A16 Appendix B) show volatile fluctuations but relatively stable concentrations up to July 2012 for heavy metals and an increasing trend for SO4 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 2010-2018 monitoring period appear to suggest that the KVAR placement may have potentially influenced water quality in Bore D6 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, AP17, GW6, GW10, GW11, and KVAD Seepage

The bores GW10 and GW11 and 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 due to drying out of the monitoring point.

Concentrations of key water quality parameters in AP09, AP17, GW6 and KVAD Seepage generally exceed the WQGVs for SO4, Al, As, B, Cd, Cr, Cu, F, Fe, Mn, Ni, and Zn, along with variable exceedances of Hg, Mo, Pb and Se. The 95th Percentile Concentrations of key water quality parameters in GW11 are all below the adopted WQGVs.

Figures A17-A22 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 2010-2018 for AP09 and AP17. Records for GW6 present significant data gaps, whilst records for GW11 and KVAD Seepage are only available for years 2015-2018.

Figures A17-A18 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 (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

Groundwater monitoring point D2 is located south (cross-gradient) of the KVAR Stage 1 area, downgradient of the SSCAD and adjacent to the return 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.

Figure A25 Appendix B presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4 and conductivity for the period of 1988-2018 for D2. The results show a gradual rising trend at D2 for conductivity, SO4 and Mn during the 1988-2003 monitoring period, potentially corresponding with effects from Stage 1 dry ash emplacement.

D3

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.

Figure A23 Appendix B presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4 and conductivity for the period of 1988-2018 for D3. The results show that concentrations of key water quality parameters were relatively stable during the 1988-2003 monitoring period at D3.

D4

Groundwater monitoring point D3 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.

Figure A24 Appendix B presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4 and conductivity for the period of 1988-2018 for D4. The results show that concentrations of key water quality parameters SO4, 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

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, SO4, 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, SO4 and conductivity or the period between 1988 and 2018 for D2 (Figure A25 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

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 SO4, 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, SO4 and conductivity for the period between 1988 and 2018 for D3 (Figure A23 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

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 SO4, 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, SO4 and conductivity for the period between 1988 and 2018 for D4 (Figure A23 Appendix B), show a continuation of the rising trend in concentrations of SO4, 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.

2010-2018

D2

The results presented in Table 5-2indicate that the 95th percentile concentrations of key water quality parameters in groundwater at D3 increased marginally for SO4, B, Mn, Ni during the 2010-2018 monitoring period, with a corresponding increase in overall conductivity. Remaining parameters generally decreased or remained stable with a slight rise in overall pH (pH 5.05) and Cr and Se dropped to concentrations below their relevant WQGVs.

Figure A25 Appendix B presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4 and conductivity for the period of 1988-2018 for D2. The results show a noticeable increase in the rate of the rising trend at D2 for conductivity, SO4, 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. A recent increase in concentrations of key water quality parameters is observed between November 2017 and March 2018. The cause of this increase in currently unknown.

D3

The results presented in Table 5-2 indicate that the 95th percentile concentrations of key water quality parameters in groundwater at D3 increased for SO4, Cl, B, Cu, F, Fe, Mn, Ni, and Zn during 2010-2018 monitoring period, with a corresponding increase in overall conductivity. Remaining parameters generally decreased or remained stable with a slight drop in overall pH (pH 6.25). As, Cd, Cr, and Se dropped to concentrations below the WQGVs.

Figure A23 Appendix B presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4 and conductivity for the period of 1988-2018 for D3. The results show a drop in SO4 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 SO4, 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 2010-2018 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

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 2010-2018 monitoring period, with the exception of Cl, and B, which have increased marginally with B increasing to concentrations above its WQGV.

Figure A24 Appendix B presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4 and conductivity for the period of 1988-2018 for D4. The results show stable to decreasing trends for SO4, Mn, and Ni during the 2010-2018 monitoring period.

The timing of erratic signals observed in Al at D4 correspond with the timing of decreasing concentrations of SO4, 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.

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 parameters.

5.2.4 Upgradient of SSCAD and KVAR / KVAD

1988-2003

D1

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, SO4, Mn, B, and Ni are not significant components of the composition of groundwater.

Figure A26 Appendix B presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4 and conductivity for the period of 1988-2018 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

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.

Figure A26 Appendix B presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4 and conductivity for the period of 1988-2018 for D1, with the exception of SO4 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.

2010-2018

D1

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 2010-2018 monitoring period, with the exception of SO4, Cl, B, Mn and Zn which increased marginally alongside overall conductivity. Concentrations of Cd, Hg and Fe subsequently dropped below the adopted WQGVs as a result of the declining trend.

Figure A26 Appendix B presents a time-series chart of the concentrations of indicator parameters Al, Mn, B, Ni, SO4 and conductivity for the period of 1988-2018 for D1. In general, concentrations of indicator parameters show decreasing trends but higher volatility in results during the 2010-2018 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, SO4 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

6.1 Summary

This 2017-2018 water quality monitoring report is required for the NSW Department of Planning and Environment's Development Consent Conditions for the Kerosene Vale Ash Repository and because the Wallerawang Power Station's Environment Protection Licence (EPL 766) as of 1 January 2018 has been retained.

6.1.1 KVAR Impacts on Surface Water Quality

Surface Water Receiving Site

Review of both recent (2017-2018) and historical (1991-2018) data for surface water monitoring associated with the KVAR has identified that the KVAR is currently not having a measurable impact on surface water quality in Sawyers Swamp Creek at the designated surface water receiving site (WX7). Results indicate that the current water quality in SSC at WX7 is dominated by discharge from Springvale Mine at LDP009, which discharges 18ML/d to SSC.

The 95th Percentile concentrations of arsenic, iron and molybdenum within Springvale Mine Discharge currently exceed the adopted water quality guidelines, and as a result 95th percentile concentrations of arsenic and molybdenum currently exceed the adopted water quality guidelines at WX7.

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 Lidsdale Cut and Dump Creek, 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.

The 95th percentile concentrations of water quality parameters within KVAR / KVAD surface water monitoring sites, Dump Creek (WX11) and Lidsdale Cut (WX5) currently exceed water quality parameters for TDS, conductivity, SO_4, AS, Cd, Cr, Se (Dump Creek excluded), Al, B, C, F, Fe, Mn, Ni, Pb and Zn.

Review of long term water quality data for Dump Creek indicates that concentrations of B, Cr, Fe, and Zn exceeded WQGVs during the pre-KVAR period (1988-2003), 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, located upgradient of the KVAR / KVAD.

Between 2010 and 2018 concentrations of water quality parameters continue to rise in apparent correlation with groundwater levels in bore D3. Accordingly the 95th percentile concentrations of TDS, conductivity, SO_4, As, Cd, Cr, Al, B, C, F, Fe, Mn, Ni, Pb and Zn in Dump Creek currently exceed WQGVs, whilst pH is now highly acidic (pH 3.7).

The long-term water quality and recent monitoring results (2017-2018) for Dump Creek indicate a possible impact from the KVAR on groundwater 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 in groundwater in Bore D6 solely 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 quality.

Interpretation of long term water quality data for Lidsdale Cut Pond (WX5) 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 in groundwater in Bore D6 solely to a single source such as the KVAR.

The KVAR does not appear to be affecting water quality for sites 225, 93, or 83 (which are dominated by discharge from Springvale Mine); sites 38 and 79 (which are dominated by water quality from SSCAD) or site 92 which is located in the middle-upper portions of the catchment upgradient of the SSCAD and KVAR.

6.1.2 KVAR Impacts on Groundwater Quality

Groundwater Receiving Site

A review of groundwater quality in Bore D5 in correlation with groundwater levels in Bore D3 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 4.73. 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 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 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 (2017-2018) groundwater at D5 currently exceeds WQGVs for Al, B, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb and Zn.

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 is having a potential 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, 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 a number of indicator parameters are subsequently observed for D6 between 2003 and 2010, concurrent with the start of rising groundwater levels in Bore D3. Between 2010 and 2018 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 a number of 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 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, is currently 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 concentrations of Al, Cr, Cu, Fe, and Pb generally exceed WQGVs.

7 Limitations

This report is for the exclusive use of EnergyAustralia only. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from Aurecon.

This report has been prepared based on the scope of services provided. Aurecon cannot be held responsible to the Client and/or others for any matters outside the agreed scope of services. Other parties should not rely upon this report and should make their own enquiries and obtain independent advice in relation to such matters.

This report has been prepared by Aurecon with reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with the Client. Information reported herein is based on the interpretation of data collected by others (data, surveys, analyses, designs, plans and other information), which has been accepted in good faith as being accurate and valid. Aurecon performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environmental services and consulting profession. No warranties express or implied, are made.

Except where it has been stated in this report, Aurecon has not verified the accuracy or completeness of the data relied upon. Statements, opinions, facts, information, conclusions and/or recommendations made in this report ("conclusions") are based in whole or part on the data obtained, those conclusions are contingent upon the accuracy and completeness of the data. Aurecon cannot be held liable should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Aurecon leading to incorrect conclusions.

The report should not be applied for any purpose other than that originally specified at the time the report was issued.

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Appendix A

Surface Water Quality Trends 1991-2018


Figure A1: WX7 Historical Surface Water Quality

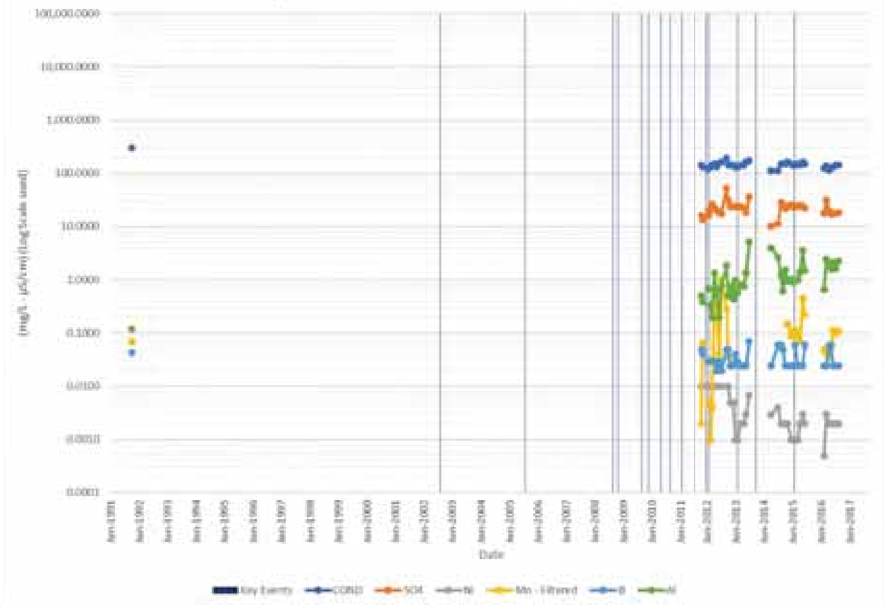


Figure A2: WX1 Historical Surface Water Quality

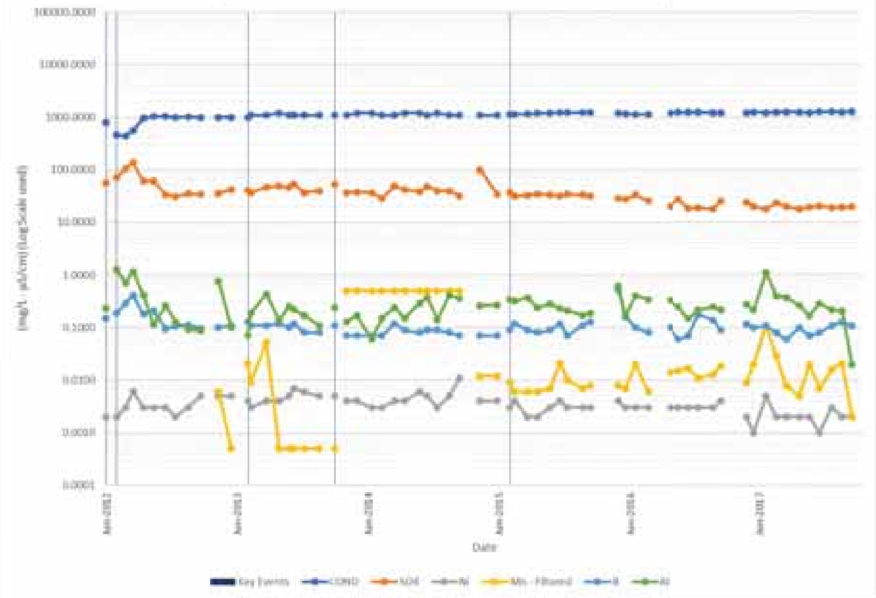


Figure A3: Downstream V-Notch Historical Surface Water Quality

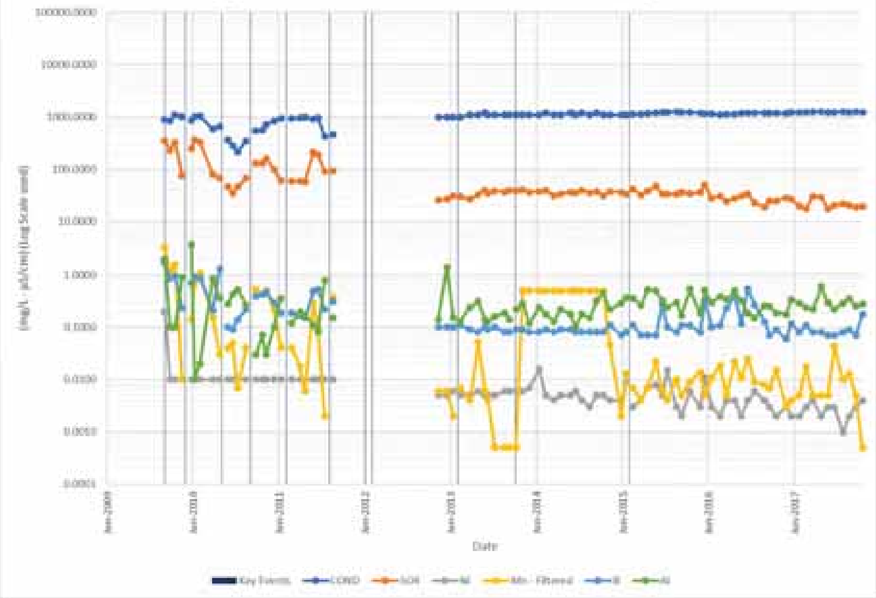


Figure A4: Downstream KVAR Historical Surface Water Quality

Figure A5: Spillway 225 Historical Surface Water Quality

Figure A6: SSCAD 38 Historical Surface Water Quality

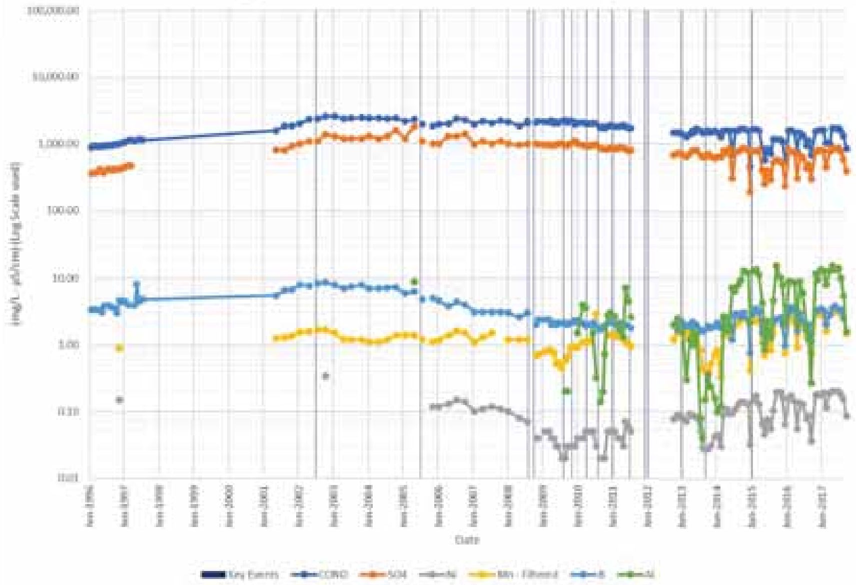


Figure A7: SSCAD V-Notch Historical Surface Water Quality

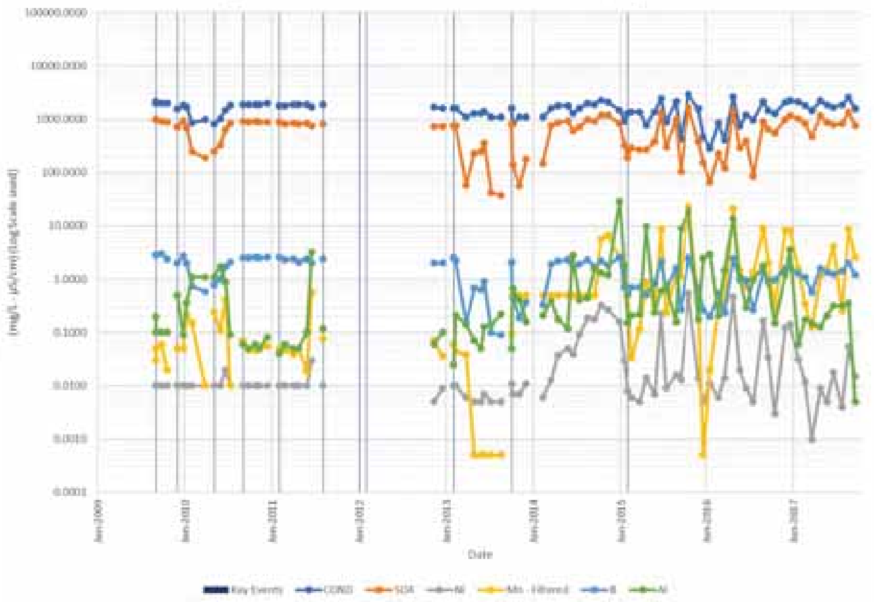


Figure A8: West KVAD Seepage Left Historical Surface Water Quality

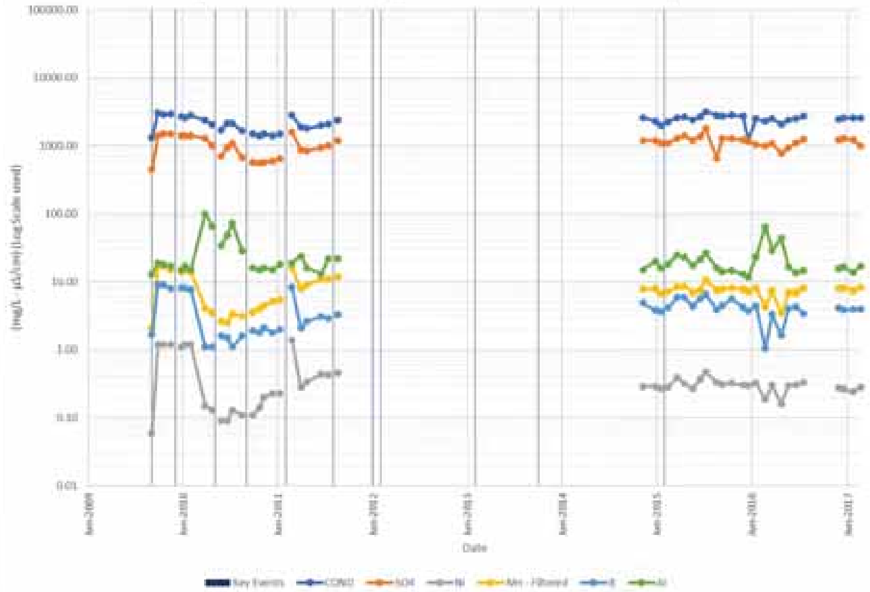


Figure A9: West KVAD Seepage Right Historical Surface Water Quality

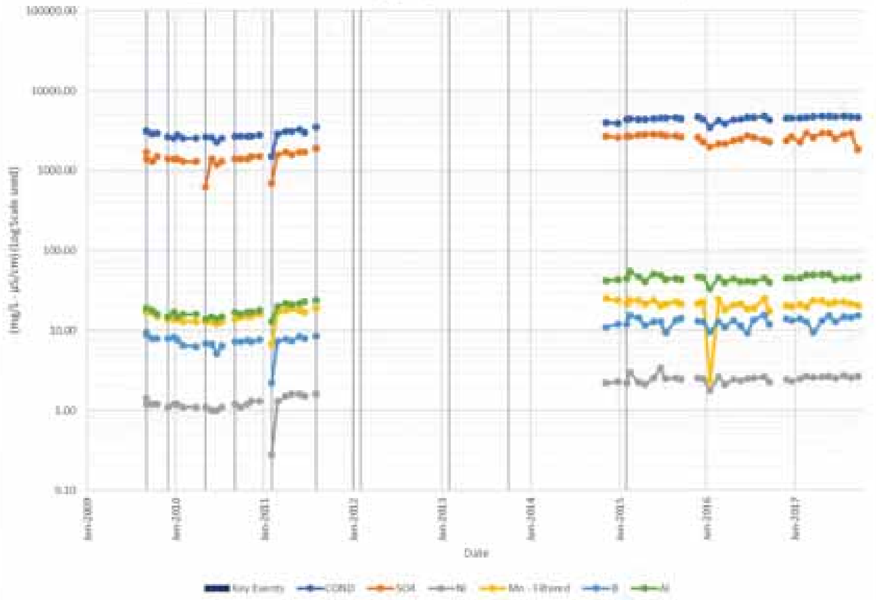


Figure A10: North Wall Collection Historical Surface Water Quality

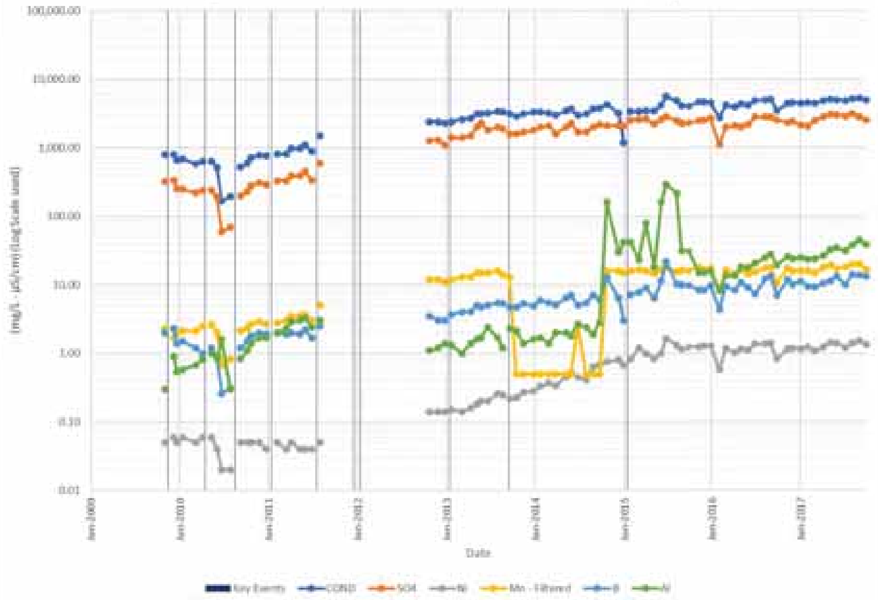


Figure A11: Surface Water Runoff Historical Surface Water Quality

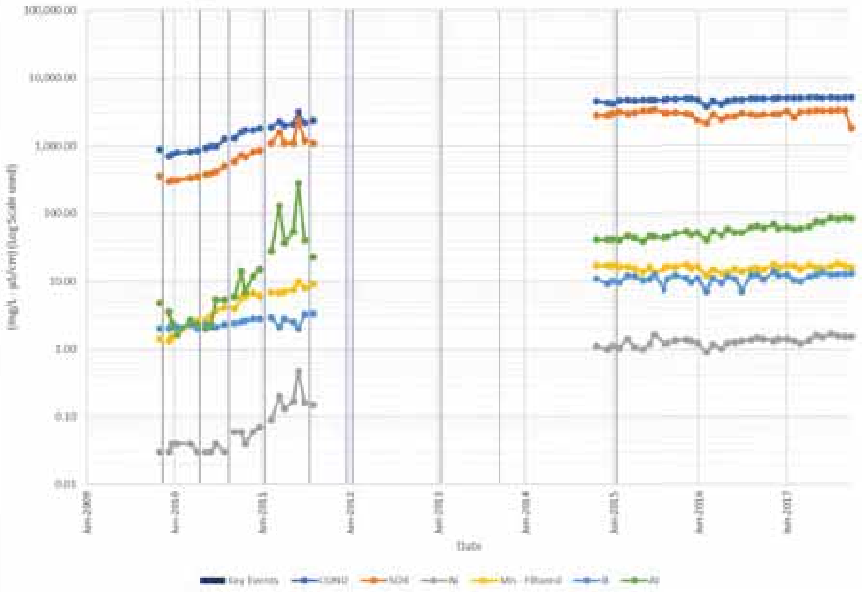


Figure A12: Lisdale Cut (WX5) Historical Surface Water Quality

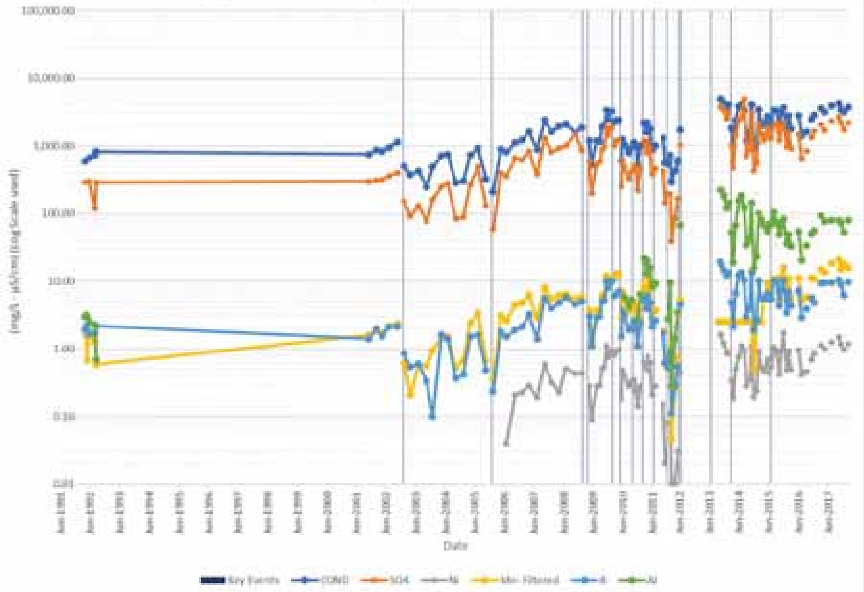


Figure A13: Dump Creek (WX11) Historical Surface Water Quality

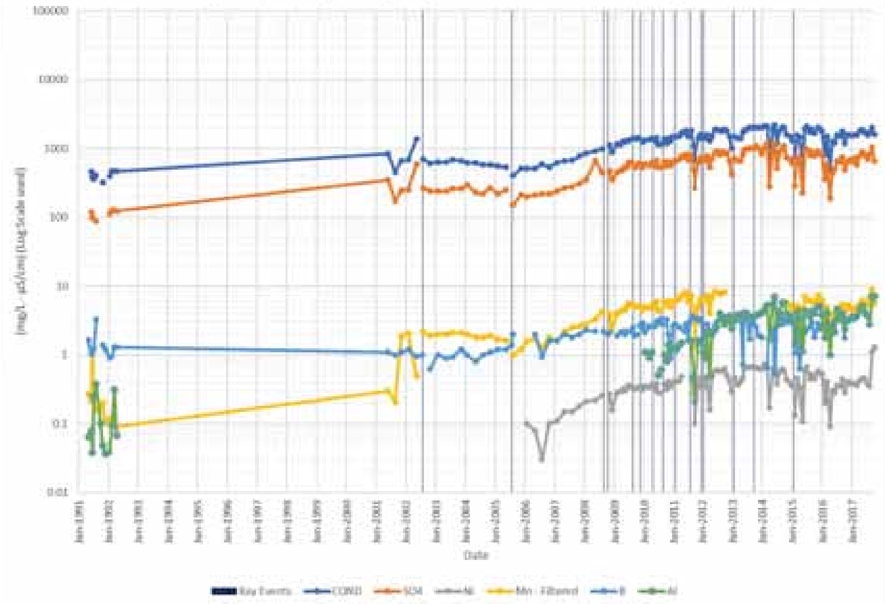
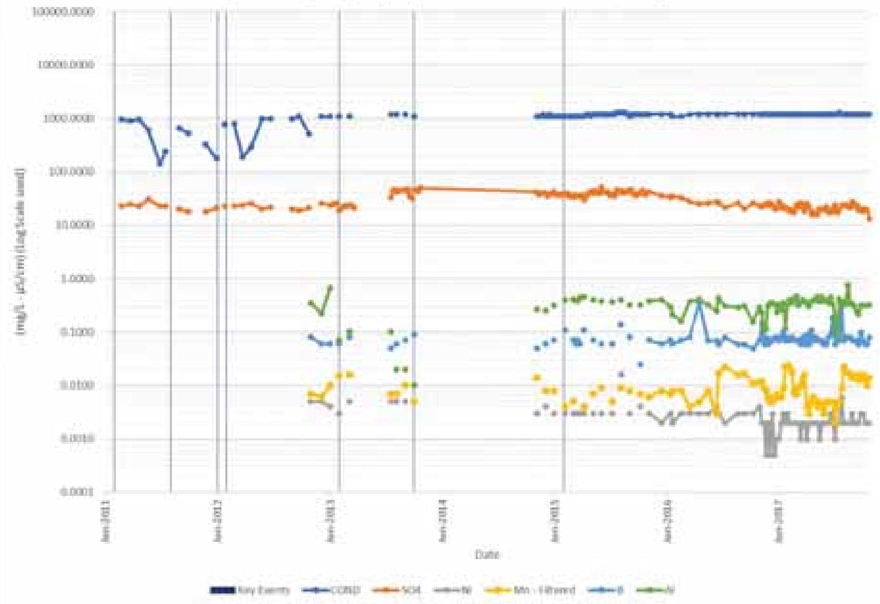


Figure A14: Springvale (158) Historical Surface Water Quality



Appendix B

Groundwater Quality Trends 1988-2018

Figure A15: D5 Historical Groundwater Quality

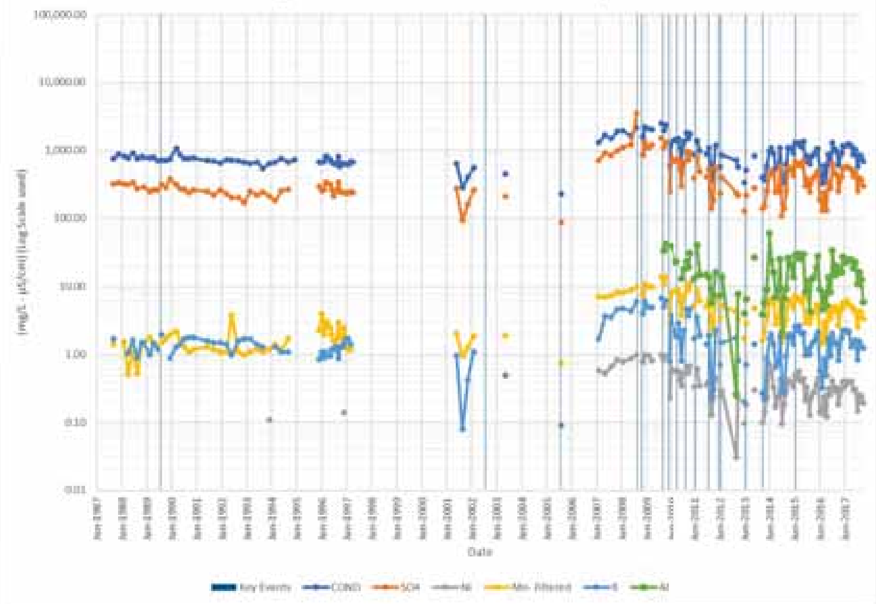


Figure A16: D6 Historical Groundwater Quality

Figure A17: AP09 Historical Groundwater Quality

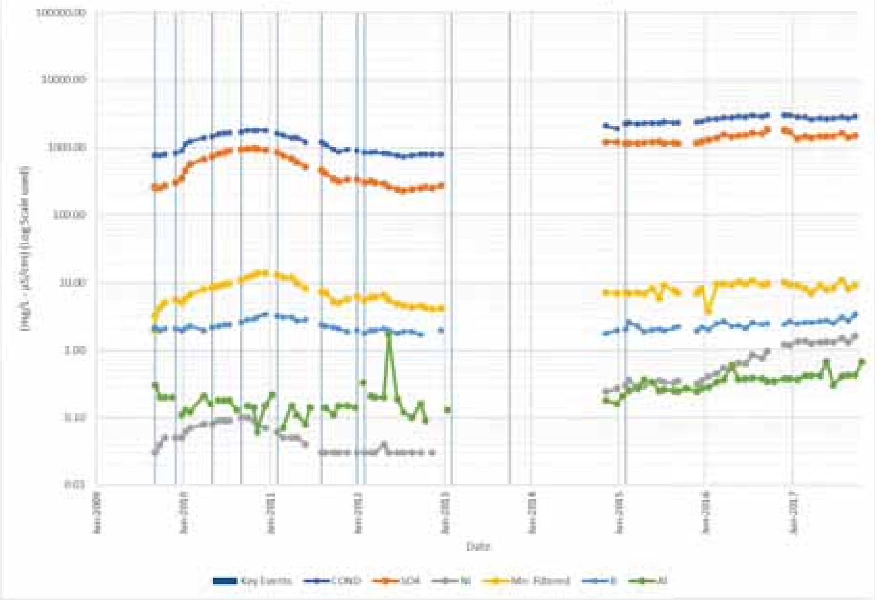
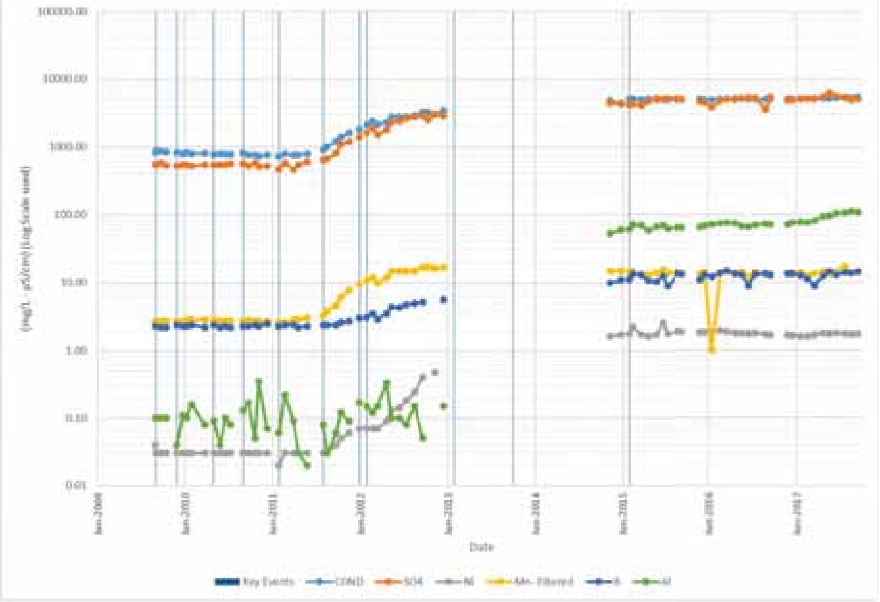


Figure A18: AP17 Historical Groundwater Quality



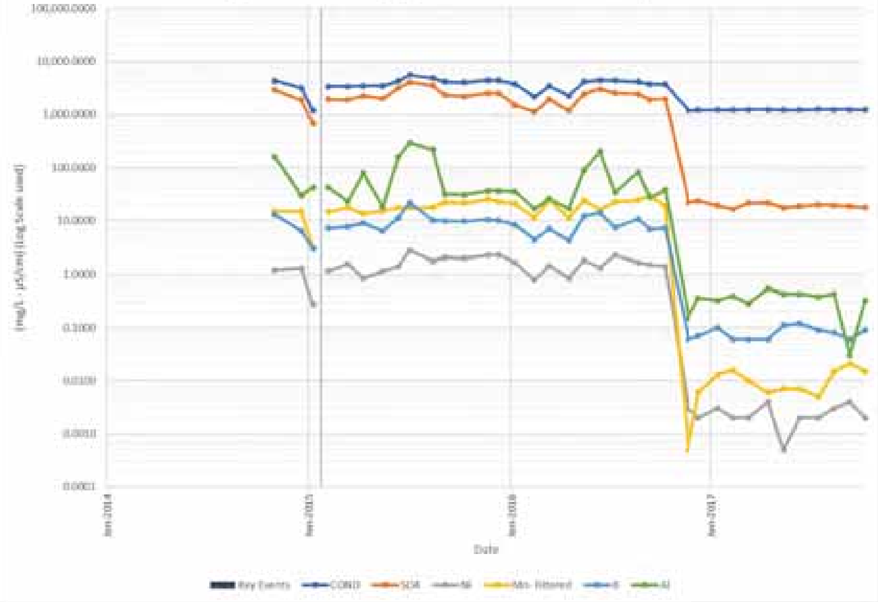


Figure A19: KVAD Seepage Historical Groundwater Quality

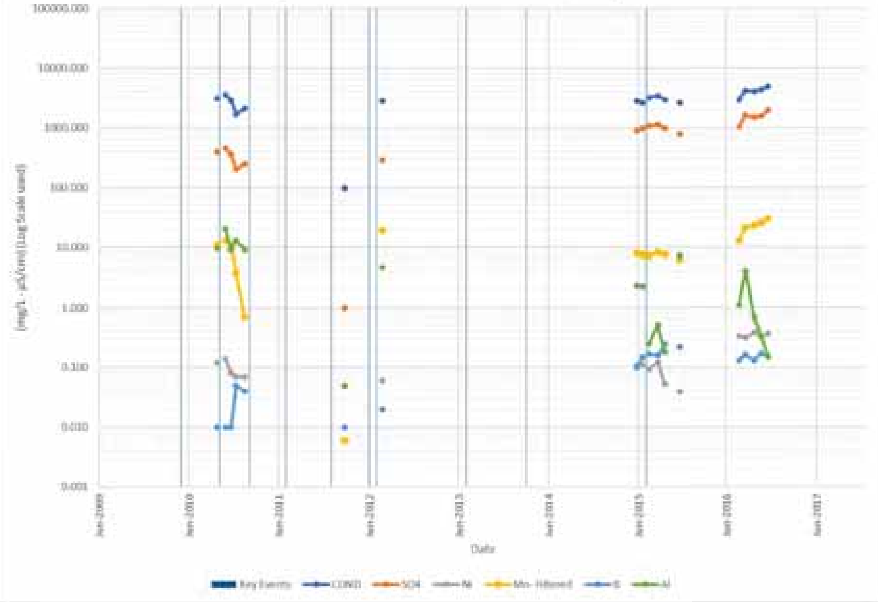


Figure A20: GW6 Historical Groundwater Quality

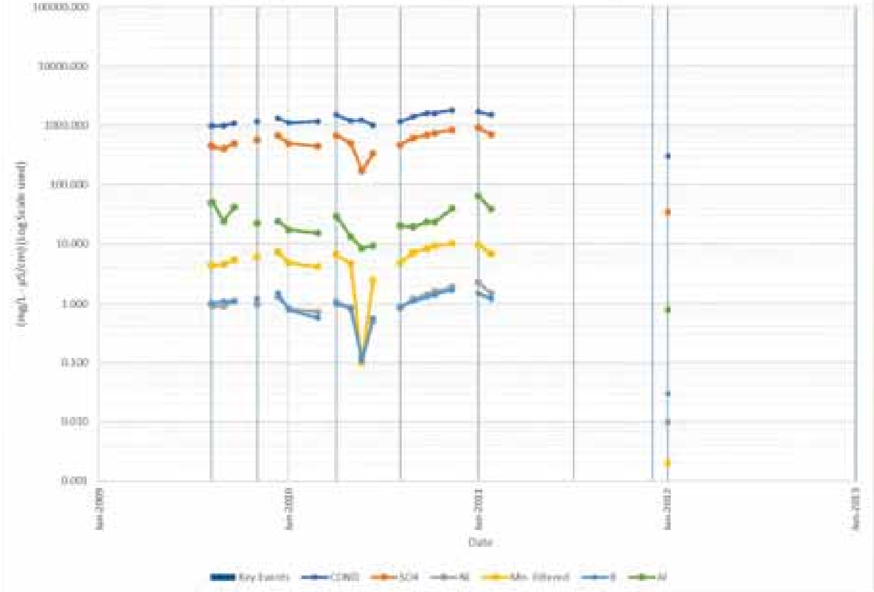


Figure A21: GW10 Historical Groundwater Quality

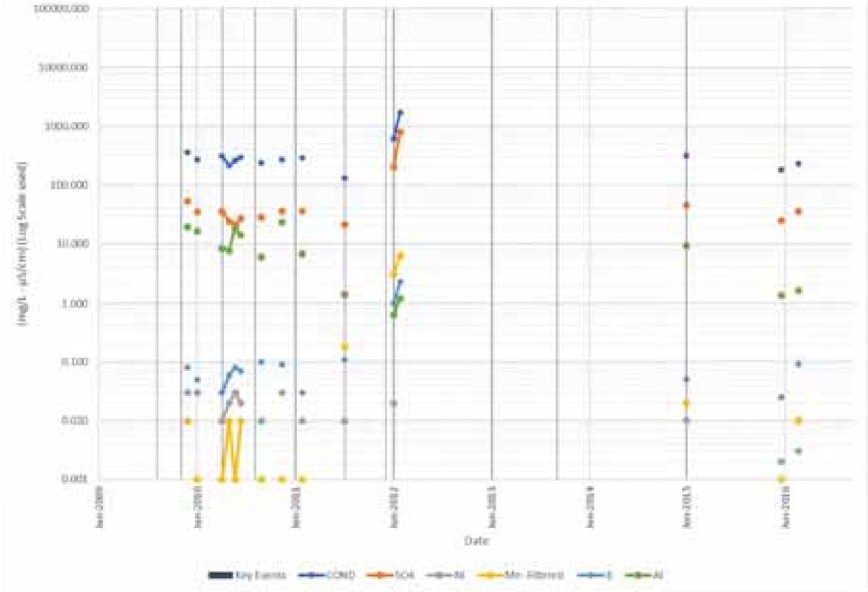


Figure A22: GW11 Historical Groundwater Quality

Figure A23: D3 Historical Groundwater Quality

Figure A24: D4 Historical Groundwater Quality

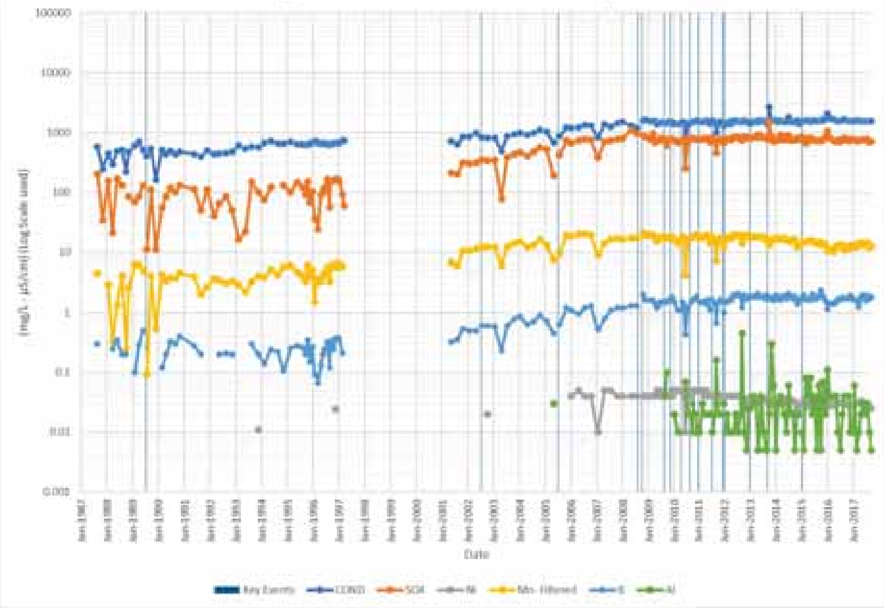


Figure A25: D2 Historical Groundwater Quality

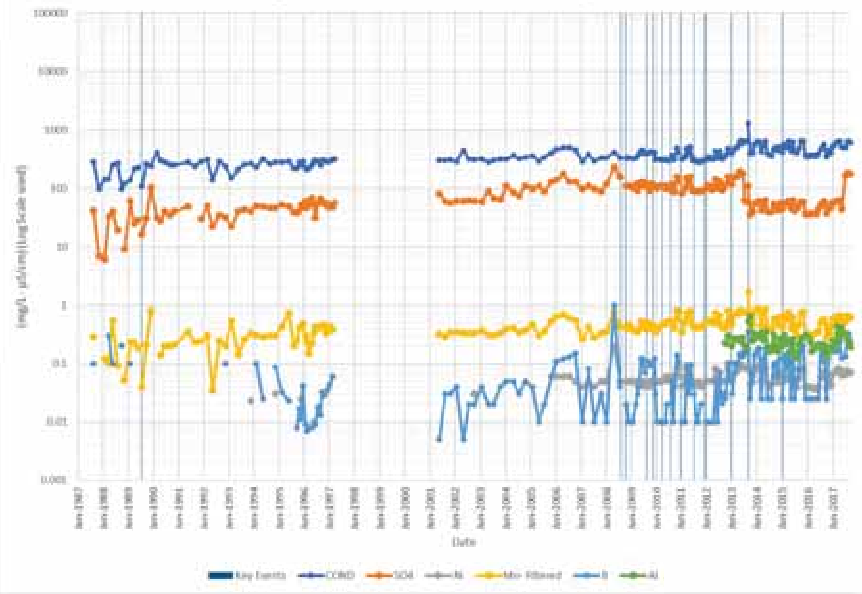
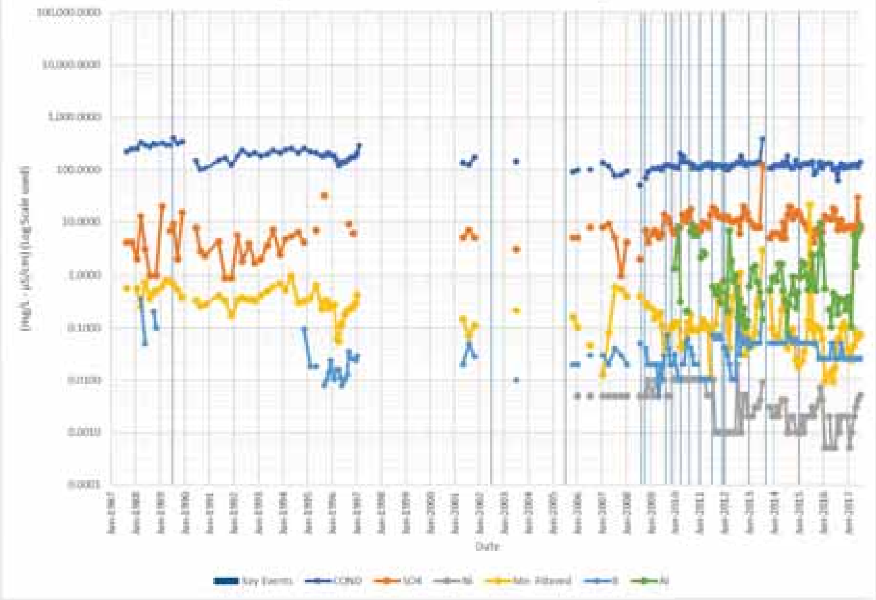


Figure A26: D1 Historical Groundwater Quality



Appendix C

2017 – 2018 Surface Water / Groundwater Monitoring Results and Summary Statistics

SSCAD 38 Post-Dry Ash Placement Data April, 2017 to March 2018 (mg/L)

SAMPLE	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
27-Apr-17	0.0005	11.6	0.5	0.002	3.26	0.035		88.5	0.0062	19.2	1580	0.0005	0.01	3.54	0.1	0.00002	52.1	25	3.16	0.01	172		0.178	0.0005	4.64	0.0057	765	1150	0.58
17-May-17	0.0005	9.41	0.5	0.003	3.32	0.031		86.9	0.0068	20.2	1590	0.0005	0.01	4.95	0.093	0.00002	54.2	23	3.1	0.006	170		0.185	0.0005	4.76	0.0052	814	1110	0.674
21-Jun-17	0.0005	13.6	0.5	0.002	3.49	0.034		92.8	0.0063	20.2	1630	0.0005	0.01	3.8	0.171	0.00002	59	24.6	2.86	0.012	179		0.18	0.001	4.5	0.0051	822	1160	0.546
19-Jul-17	0.0005	13	0.5	0.002	3.29	0.032		85.6	0.0064	19.2	1640	0.0005	0.011	2.94	0.19	0.00002	54.2	23.8	3.08	0.01	172		0.194	0.0005	4.59	0.0056	794	1150	0.535
16-Aug-17	0.0005	7.93	0.5	0.001	2.03	0.022		53.2	0.0037	11.6	1050	0.0005	0.008	1.84	0.126	0.00002	35.9	13.2	1.63	0.008	97.2		0.117	0.0005	4.83	0.0032	448	642	0.357
21-Sep-17	0.0005	12.9	0.5	0.006	2.82	0.032		98.4	0.0069	19	1030	0.0005	0.011	2.98	0.237	0.00002	59.8	24.1	2.96	0.008	174		0.194	0.0005	4.6	0.0055	777	1260	0.575
18-Oct-17	0.0005	15.4	0.5	0.007	3.58	0.035		89.5	0.0068	21.2	1750	0.0005	0.01	5.33	0.136	0.00002	62.9	24.3	3.24	0.02	170		0.206	0.0005	4.51	0.0053	895	1320	0.561
15-Nov-17	0.0005	13.3	0.5	0.003	3.81	0.033		90.8	0.0065	20.8	1710	0.0005	0.013	4.01	0.177	0.00002	44.6	24.5	3.19	0.009	182		0.205	0.002	4.53	0.005	851	1280	0.577
20-Dec-17	0.0005	14	0.5	0.008	3.42	0.028		96.6	0.0063	20.9	1750	0.0005	0.012	3.29	0.085	0.00002	55	26	3.19	0.009	192		0.202	0.002	4.43	0.0055	870	1230	0.588
17-Jan-18	0.0005	9.85	0.5	0.008	3.37	0.031		89	0.0063	17.6	1550	0.0005	0.014	3.61	0.102	0.00002	54.3	24	2.99	0.006	167		0.182	0.0005	4.61	0.0051	769	1180	0.547
14-Feb-18	0.0005	5.48	0.5	0.002	2.64	0.028		75.8	0.0048	14.8	1310	0.0005	0.012	2.27	0.071	0.00002	42.2	18.8	2.48	0.004	134		0.152	0.0005	4.7	0.0053	594	940	0.54
14-Mar-18	0.0005	1.6	1	0.0005	1.58	0.028		57.7	0.0027	11	870	0.0005	0.004	1.24	0.016	0.00002	35	12.7	1.48	0.004	92.1		0.086	0.0005	5.02	0.0027	395	560	0.364

SSCAD 38 Post-Dry Ash Placement Data April, 2017 to March 2018 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
Minimum	0.0005	1.6	0.5	0.0005	1.58	0.022		53.2	0.0027	11	870	0.0005	0.004	1.24	0.016	0.00002	35	12.7	1.48	0.004	92.1		0.086	0.0005	4.43	0.0027	395	560	0.357
Maximum	0.0005	15.4	1	0.008	3.81	0.035		98.4	0.0069	21.2	1750	0.0005	0.014	5.33	0.237	0.00002	62.9	26	3.24	0.02	192		0.206	0.002	5.02	0.0057	895	1320	0.674
Mean	0.0005	10.673	0.542	0.004	3.051	0.031		83.733	0.006	17.975	1455.000	0.001	0.010	3.317	0.125	0.000	50.767	22.000	2.780	0.009	158.442		0.173	0.001	4.643	0.005	732.833	1081.833	0.537
Median	0.0005	12.25	0.5	0.0025	3.305	0.0315		88.75	0.0063	19.2	1585	0.0005	0.0105	3.415	0.114	0.00002	54.2	24.05	3.035	0.0085	171		0.1835	0.0005	4.605	0.00525	785.5	1155	0.554
90th Percentile	0.0005	13.96	0.5	0.0079	3.571	0.0349		96.22	0.0068	20.89	1746	0.0005	0.0129	4.856	0.1887	0.00002	59.72	24.96	3.19	0.0118	181.7		0.2047	0.0019	4.823	0.00559	868.1	1278	0.5872
95th Percentile	0.0005	14.63	0.725	0.008	3.6835	0.035		97.41	0.006845	21.035	1750	0.0005	0.01345	5.121	0.21115	0.00002	61.195	25.45	3.2125	0.0156	186.5		0.20545	0.002	4.9155	0.005645	881.25	1298	0.6267

Dump Ck WX11 39 Decomissioned Ash Placement Data April, 2017 to March 2018 (mg/L)

SAMPLE	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
27-Apr-17	0.0005	3.14	0.5	0.0005	2.82	0.018		68.2	0.0004	19.1	1600	0.0005	0.002	1.52	6.08	0.00002	29.2	68.6	5.4	0.0005	102		0.404	0.004	3.07	0.0004	649	1010	1.08
17-May-17	0.0005	3.32	0.5	0.0005	2.36	0.015		58.4	0.0005	21.9	1570	0.0005	0.003	1.83	6.66	0.00002	30.2	54.7	4.78	0.002	93.6		0.379	0.004	3.12	0.0004	694	1040	1.12
21-Jun-17	0.0005	3.58	0.5	0.0005	2.57	0.017		60	0.0004	21.4	1540	0.0005	0.002	0.726	6.26	0.00002	28.8	54.5	4.55	0.0005	97.1		0.388	0.004	3.03	0.0004	642	978	1.13
19-Jul-17	0.0005	3.41	0.5	0.0005	2.41	0.015		58.4	0.0006	21.5	1590	0.0005	0.005	0.881	5.67	0.00002	28.2	55.4	4.78	0.0005	94.8		0.386	0.005	3.03	0.0005	728	985	1.21
16-Aug-17	0.0005	3.64	0.5	0.0005	2.3	0.014		56.6	0.0004	21	1570	0.0005	0.004	0.495	5.22	0.00002	28.7	53.6	4.54	0.0005	90.6		0.356	0.005	3.07	0.0005	584	798	1.18
21-Sep-17	0.0005	4.54	0.5	0.0005	2.61	0.019		75.4	0.0005	25.1	1810	0.0005	0.005	1.37	7.33	0.00002	33.6	66.8	5.55	0.0005	111		0.42	0.005	3.03	0.0005	802	1150	1.48
18-Oct-17	0.0005	5.1	0.5	0.0005	2.89	0.031		77.1	0.0007	27	1860	0.0005	0.006	2.56	11.7	0.00002	36.4	68.9	6.15	0.0005	114		0.46	0.006	3.17	0.0004	892	1340	1.5
15-Nov-17	0.0005	4.15	0.5	0.0005	3.08	0.034		72.8	0.0006	25.7	1720	0.0005	0.006	1.06	16.2	0.00002	26.9	66.2	5.69	0.0005	113		0.446	0.005	3.25	0.0004	803	1100	1.31
20-Dec-17	0.0005	3.68	0.5	0.001	3.67	0.048		69	0.0005	22.9	1560	0.0005	0.008	0.822	11.5	0.00002	36.4	63.5	5.25	0.0005	106		0.378	0.006	3.33	0.0003	707	956	1.09
17-Jan-18	0.0005	2.78	0.5	0.0005	3.19	0.067		85.6	0.0004	30.7	1700	0.0005	0.006	0.907	11.4	0.00002	45.1	76.9	6.8	0.0005	127		0.351	0.004	3.93	0.0002	835	1100	0.774
14-Feb-18	0.0005	7.09	0.5	0.003	3.59	0.068		115	0.0015	38.8	2020	0.001	0.016	0.943	1.98	0.00002	48	96.4	8.77	0.002	148		1.1	0.01	3.68	0.0013	1040	1210	3.11
14-Mar-18	0.0005	6.99	0.5	0.001	1.75	0.035		69.3	0.0016	25.9	1590	0.002	0.02	1.33	19.6	0.00002	33.5	53.2	5.58	0.0005	90.6		1.28	0.01	3.14	0.0012	657	958	2.97

Dump Ck WX11 39 Decomissioned Ash Placement Data April, 2017 to March 2018 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
Minimum	0.0005	2.78	0.5	0.0005	1.75	0.014		56.6	0.0004	19.1	1540	0.0005	0.002	0.495	1.98	0.00002	26.9	53.2	4.54	0.0005	90.6		0.351	0.004	3.03	0.0002	584	798	0.774
Maximum	0.0005	7.09	0.5	0.003	3.67	0.068		115	0.0016	38.8	2020	0.002	0.02	2.56	19.6	0.00002	48	96.4	8.77	0.002	148		1.28	0.01	3.93	0.0013	1040	1340	3.11
Mean	0.0005	4.285	0.5	0.000792	2.77	0.03175		72.15	0.000675	25.08333	1677.5	0.000667	0.006917	1.203667	9.133333	0.00002	33.75	64.89167	5.653333	0.00075	107.3083		0.529	0.005667	3.2375	0.000542	752.75	1052.083	1.496167
Median	0.0005	3.66	0.5	0.0005	2.715	0.025		69.15	0.0005	24	1595	0.0005	0.0055	1.0015	6.995	0.00002	31.85	64.85	5.475	0.0005	104		0.396	0.005	3.13	0.0004	717.5	1025	1.195
90th Percentile	0.0005	6.801	0.5	0.001	3.55	0.0651		84.75	0.00142	30.33	1855	0.00095	0.0152	1.799	15.75	0.00002	44.23	76.1	6.735	0.00185	125.7		1.036	0.0096	3.645	0.00113	886.3	1204	2.823
95th Percentile	0.0005	7.035	0.5	0.0019	3.626	0.06745		98.83	0.001545	34.345	1932	0.00145	0.0178	2.1585	17.73	0.00002	46.405	85.675	7.6865	0.002	136.45		1.181	0.01	3.7925	0.001245	958.6	1268.5	3.033

Lisdale Cut WX5 40 Post-Dry Ash Placement Data April, 2017 to March, 2018 (mg/L)

SAMPLE	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
27-Apr-17	0.05	74.3	0.5	0.008	9.17	0.02		206	0.016	23	3160	0.007	0.012	13.9	9.13	0.00002	139	93.3	13.1	0.0005	213		1	0.01	3.11	0.06	1650	1770	1.94
May-June 2017	No data																												
20-Jul-17	0.05	77.5	0.5	0.006	9.28	0.008		242	0.0172	31.2	3830	0.008	0.018	20.3	16	0.00002	158	102	17.8	0.0005	252		1.26	0.011	3.06	0.04	2300	3600	2.51
Aug-Sept 2017	No data																												
19-Oct-17	0.05	77.6	0.5	0.009	9.98	0.005		268	0.0142	35.4	4160	0.008	0.013	23.3	8.26	0.00002	163	120	20.5	0.0005	268		1.49	0.008	3.05	0.08	2630	3920	2.72
15-Nov-17	0.05	71.5	0.5	0.008	8.65	0.008		214	0.0152	28.3	3430	0.006	0.012	18.5	8.13	0.00002	114	91.5	14.7	0.0005	224		1.17	0.01	3.13	0.04	2170	2770	2.21
27-Dec-17	0.05	51.6	0.5	0.004	6.26	0.008		190	0.0101	22.4	3160	0.004	0.008	7.36	4.91	0.00002	119	85.9	17.4	0.0005	187		0.969	0.008	3.09	0.02	1710	2340	1.76
17-Jan-18	No data																												
14-Feb-18	0.05	76.6	0.5	0.009	9.46	0.004		235	0.0156	26.7	3730	0.007	0.011	16.9	6.94	0.00002	135	100	15.4	0.0005	244		1.18	0.008	3.09	0.05	2150	3270	2.2
14-Mar-18	No data																												

Lisdale Cut WX5 40 Post-Dry Ash Placement Data April, 2017 to March, 2018 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
Minimum	0.05	51.6	0.5	0.004	6.26	0.004		190	0.0101	22.4	3160	0.004	0.008	7.36	4.91	0.00002	114	85.9	13.1	0.0005	187		0.969	0.008	3.05	0.02	1650	1770	1.76
Maximum	0.05	77.6	0.5	0.009	9.98	0.02		268	0.0172	35.4	4160	0.008	0.018	23.3	16	0.00002	163	120	20.5	0.0005	268		1.49	0.011	3.13	0.08	2630	3920	2.72
Mean	0.05	71.51667	0.5	0.007333	8.8	0.008833		225.8333	0.014717	27.83333	3578.333	0.006667	0.012333	16.71	8.895	0.00002	138	98.78333	16.48333	0.0005	231.3333		1.178167	0.009167	3.088333	0.048333	2101.667	2945	2.223333
Median	0.05	75.45	0.5	0.008	9.225	0.008		224.5	0.0154	27.5	3580	0.007	0.012	17.7	8.195	0.00002	137	96.65	16.4	0.0005	234		1.175	0.009	3.09	0.045	2160	3020	2.205
90th Percentile	0.05	77.55	0.5	0.009	9.72	0.014		255	0.0166	33.3	3995	0.008	0.0155	21.8	12.565	0.00002	160.5	111	19.15	0.0005	260		1.375	0.0105	3.12	0.07	2465	3760	2.615
95th Percentile	0.05	77.575	0.5	0.009	9.85	0.017		261.5	0.0169	34.35	4077.5	0.008	0.01675	22.55	14.2825	0.00002	161.75	115.5	19.825	0.0005	264		1.4325	0.01075	3.125	0.075	2547.5	3840	2.6675

SSC WX7 41 Decommissioned Ash Placement Data April, 2017 to March, 2018 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	NO2+NO3	Na	NFR	Ni	Ortho P	Pb	pH	Se	SiO2	SO4	TDS	TOT P	Zn
27-Apr-17	0.0005	0.16	597	0.023	0.09	0.024		4.76	0.00005	5.38	1200	0.0005	0.005	1.25	0.03	0.00002	10.4	3.54	0.006	0.038		334		0.011		0.001	8.7	0.0001		22	731		0.02
17-May-17	0.0005	0.37	616	0.018	0.08	0.02		3.91	0.00005	5.49	1200	0.0005	0.0005	1.27	0.012	0.00002	11.3	2.6	0.007	0.033		307		0.003		0.0005	8.7	0.0002		24.9	760		0.01
21-Jun-17	0.0005	0.3	653	0.012	0.09	0.02		3.9	0.00005	5.75	1200	0.0005	0.0005	0.973	0.018	0.00002	10.4	2.43	0.007	0.034		298		0.001		0.0005	8.8	0.0003		20.2	738		0.007
19-Jul-17	0.0005	0.25	686	0.012	0.07	0.018		3.79	0.00005	6.11	1200	0.0005	0.0005	0.945	0.02	0.00002	10.6	2.44	0.009	0.035		305		0.002		0.0005	8.8	0.0001		19	636		0.008
16-Aug-17	0.0005	0.21	643	0.01	0.08	0.01		2.95	0.00005	5.11	1200	0.0005	0.0005	0.738	0.017	0.00002	8.41	1.5	0.008	0.028		305		0.002		0.0005	8.9	0.0004		23.9	755		0.011
21-Sep-17	0.0005	0.28	715	0.014	0.09	0.022		4.25	0.00005	6.01	1200	0.0005	0.0005	1.34	0.015	0.00002	11.5	2.82	0.007	0.038		291		0.002		0.0005	8.8	0.0002		21.9	754		0.008
19-Oct-17	0.0005	0.34	658	0.02	0.2	0.03		4.33	0.00005	5.8	1220	0.0005	0.0005	1.29	0.009	0.00002	12.3	3.07	0.005	0.047		283		0.002		0.0005	8.7	0.0001		17.7	744		0.01
16-Nov-17	0.0005	0.23	656	0.021	0.09	0.026		4.57	0.00005	6.08	1200	0.0005	0.0005	1.19	0.015	0.00002	9.52	3.11	0.004	0.044		335		0.003		0.001	8.8	0.0001		20.4	724		0.0025
20-Dec-17	0.0005	0.27	718	0.022	0.06	0.025		3.88	0.0001	5.49	1260	0.0005	0.004	1	0.019	0.00002	12.1	2.7	0.002	0.043		375		0.003		0.0005	8.71	0.0001		19.2	775		0.009

17-Jan-18	0.0005	0.26	714	0.027	0.1	0.028		4.82	0.00005	5.04	1200	0.0005	0.004	1.01	0.014	0.00002	12	3.58	0.005	0.044		334		0.002		0.0005	8.7	0.0001		20.2	728		0.01
14-Feb-18	0.0005	0.24	716	0.023	0.07	0.026		4.62	0.0002	5.12	1230	0.0005	0.0005	0.668	0.014	0.00002	11.1	3.34	0.003	0.046		340		0.002		0.0005	8.69	0.0003		18.6	689		0.006
14-Mar-18	0.0005	0.36	717	0.019	0.08	0.026		4.31	0.00005	5.43	1230	0.0005	0.0005	0.906	0.012	0.00002	11.2	3.01	0.004	0.045		346		0.002		0.0005	8.62	0.0003		16.8	735		0.014

SSC WX7 41 Decommissioned Ash Placement Data April, 2017 to March, 2018 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	NO2+NO3	Na	NFR	Ni	Ortho P	Pb	pH	Se	SiO2	SO4	TDS	TOT P	Zn
Minimum	0.0005	0.16	597	0.01	0.06	0.01		2.95	0.00005	5.04	1200	0.0005	0.0005	0.668	0.009	0.00002	8.41	1.5	0.002	0.028		283		0.001		0.0005	8.62	0.0001		16.8	636		0.0025
Maximum	0.0005	0.37	718	0.027	0.2	0.03		4.82	0.0002	6.11	1260	0.0005	0.005	1.34	0.03	0.00002	12.3	3.58	0.009	0.047		375		0.011		0.001	8.9	0.0004		24.9	775		0.02
Mean	0.0005	0.2725	674.0833	0.018417	0.091667	0.022917		4.174167	6.67E-05	5.5675	1211.667	0.0005	0.001458	1.048333	0.01625	0.00002	10.9025	2.845	0.005583	0.039583		321.0833		0.002917		0.000583	8.743333	0.000192		20.4	730.75		0.009625
Median	0.0005	0.265	672	0.0195	0.085	0.0245		4.28	0.00005	5.49	1200	0.0005	0.0005	1.005	0.015	0.00002	11.15	2.915	0.0055	0.0405		320.5		0.002		0.0005	8.705	0.00015		20.2	736.5		0.0095
90th Percentile	0.0005	0.358	716.9	0.023	0.099	0.0278		4.746	0.000095	6.073	1230	0.0005	0.004	1.288	0.0199	0.00002	12.09	3.52	0.0079	0.0459		345.4		0.003		0.00095	8.8	0.0003		23.71	759.5		0.0137
95th Percentile	0.0005	0.3645	717.45	0.0248	0.145	0.0289		4.787	0.000145	6.0935	1243.5	0.0005	0.00445	1.3125	0.0245	0.00002	12.19	3.558	0.00845	0.04645		359.05		0.0066		0.001	8.845	0.000345		24.35	766.75		0.0167

Upstream SSCAD 92 (WX1) Post-Dry Ash Placement Data April, 2017 to March, 2018 (mg/l)

SAMPLE	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
Apr 2017-Ma															No data														

Spillway 225 Data from April, 2017 to March, 2018 enters SSC at spillway (mg/L)

SAMPLE	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
27-Apr-17	0.0005	0.15	602	0.027	0.06	0.023		4.13	0.00005	5.4	1190	0.0005	0.002	1.18	0.03	0.00002	9.18	3	0.0005	0.037	296		0.003	8.4	0.0005	8.15	0.31	0.0001	22	677	0.8	6	0.014
17-May-17	0.0005	0.36	615	0.015	0.07	0.018		3.66	0.00005	5.31	1220	0.0005	0.0005	1.25	0.01	0.00002	10.9	2.45	0.006	0.032	298		0.002	8.4	0.0005	8.23	0.46	0.0003	23.6	682	1	2.4	0.007
21-Jun-17	0.0005	0.32	643	0.014	0.1	0.019		3.85	0.00005	5.64	1230	0.0005	0.0005	1.16	0.014	0.00002	10.4	2.37	0.013	0.036	303		0.003	8.4	0.0005	8.16	0.29	0.0002	19.1	790	0.8	2.3	0.008
19-Jul-17	0.0005	0.39	681	0.015	0.06	0.018		3.62	0.00005	5.88	1220	0.0005	0.0005	1.18	0.006	0.00002	11	2.31	0.016	0.035	312		0.002	9.2	0.0005	8.25	0.13	0.0001	16.6	643	0.6	2	0.009
16-Aug-17	0.0005	0.28	640	0.01	0.06	0.007		2.68	0.00005	4.81	1240	0.0005	0.0005	1.03	0.01	0.00002	7.94	1.23	0.01	0.028	294		0.002	9.2	0.001	8.2	0.27	0.0004	21.5	686	0.5	1.3	0.01
21-Sep-17	0.0005	0.53	714	0.021	0.06	0.032		4.48	0.00005	5.88	1250	0.0005	0.006	1.19	0.004	0.00002	11.9	3.05	0.006	0.052	297		0.004	7.2	0.0005	8.12	0.33	0.0003	21.8	648	0.8	2.9	0.017
18-Oct-17	0.0005	0.42	634	0.02	0.11	0.027		4.09	0.00005	5.81	1230	0.0005	0.015	1.29	0.008	0.00002	12.1	2.94	0.007	0.041	280		0.0005	8.5	0.001	8.23	0.42	0.0001	17.4	746	0.8	2	0.019
15-Nov-17	0.0005	0.42	654	0.023	0.12	0.027		4.12	0.00005	5.91	1220	0.0005	0.0005	1.13	0.008	0.00002	8.1	2.91	0.007	0.044	299		0.002	7.9	0.001	8.15	0.41	0.0001	18.7	738	0.8	1.6	0.013
20-Dec-17	0.0005	0.38	707	0.02	0.09	0.024		3.75	0.00005	5.77	1260	0.0005	0.0005	1.15	0.007	0.00002	9.74	2.48	0.005	0.042	338		0.002	5.5	0.001	8.27	0.51	0.0002	19.9	704	0.9	1.8	0.01
17-Jan-18	0.0005	0.42	705	0.027	0.08	0.03		4.81	0.00005	4.77	1250	0.0005	0.0005	1.16	0.004	0.00002	12	3.58	0.015	0.044	332		0.003	8.6	0.0005	8.2	0.18	0.0001	19.5	812	0.7	2.8	0.006
14-Feb-18	0.0005	0.03	716	0.019	0.06	0.026		4.56	0.00005	4.86	1240	0.0005	0.0005	1.09	0.116	0.00002	11.1	3.09	0.021	0.049	343		0.004	8.1	0.0005	8.24	0.13	0.0003	18.8	720	0.6	2.1	0.034
14-Mar-18	0.0005	0.32	724	0.013	0.09	0.022		4.43	0.00005	5.56	1230	0.0005	0.0005	1.28	0.003	0.00002	11.8	3.1	0.015	0.032	366		0.002	7.9	0.0005	8.18	0.1	0.0003	17.6	692	0.7	3.2	0.0025

Spillway 225 Data from April, 2017 to March, 2018 enters SSC at spillway (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
Minimum	0.0005	0.03	602	0.01	0.06	0.007		2.68	0.00005	4.77	1190	0.0005	0.0005	1.03	0.003	0.00002	7.94	1.23	0.0005	0.028	280		0.0005	5.5	0.0005	8.12	0.1	0.0001	16.6	643	0.5	1.3	0.0025
Maximum	0.0005	0.53	724	0.027	0.12	0.032		4.81	0.00005	5.91	1260	0.0005	0.015	1.29	0.116	0.00002	12.1	3.58	0.021	0.052	366		0.004	9.2	0.001	8.27	0.51	0.0004	23.6	812	1	6	0.034
Mean	0.0005	0.335	669.5833	0.018667	0.08	0.02275		4.015	0.00005	5.466667	1231.667	0.0005	0.002292	1.174167	0.018333	0.00002	10.51333	2.709167	0.010125	0.039333	313.1667		0.002458	8.108333	0.000667	8.198333	0.295	0.000208	19.70833	711.5	0.75	2.533333	0.012458
Median	0.0005	0.37	667.5	0.0195	0.075	0.0235		4.105	0.00005	5.6	1230	0.0005	0.0005	1.17	0.008	0.00002	10.95	2.925	0.0085	0.039	301		0.002	8.4	0.0005	8.2	0.3	0.0002	19.3	698	0.8	2.2	0.01
90th Percentile	0.0005	0.42	715.8	0.0266	0.109	0.0297		4.552	0.00005	5.88	1250	0.0005	0.0056	1.277	0.0284	0.00002	11.99	3.099	0.0159	0.0485	342.5		0.0039	9.14	0.001	8.249	0.456	0.0003	21.98	785.6	0.89	3.17	0.0188
95th Percentile	0.0005	0.4695	719.6	0.027	0.1145	0.0309		4.6725	0.00005	5.8935	1254.5	0.0005	0.01005	1.2845	0.0687	0.00002	12.045	3.316	0.01825	0.05035	353.35		0.004	9.2	0.001	8.259	0.4825	0.000345	22.72	799.9	0.945	4.46	0.02575

SSCAD v-notch 79 Data from April, 2017 to March 2018 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
27-Apr-17	0.0005	0.15	67	0.001	0.95	0.032		94	0.00005	44.7	1270	0.0005	0.0005	0.624	0.022	0.00002	12	49.6	0.294	0.002	129		0.003	9.9	0.0005	7.48	0.005	0.0001	553	820	0.6	7	0.0025
17-May-17	0.0005	1.19	24	0.0005	1.55	0.054		152	0.002	51.8	2080	0.002	0.002	0.799	0.014	0.00002	24.9	76.9	7.95	0.001	191		0.126	10.9	0.0005	6.25	0.07	0.0005	1000	1580	0.5	5.5	0.196
21-Jun-17	0.0005	3.49	10	0.001	1.58	0.046		180	0.0021	56.3	2230	0.0005	0.01	0.858	0.184	0.00002	25.1	90.3	8.08	0.0005	207		0.142	10.8	0.002	5.81	0.1	0.0008	1160	1790	0.3	7.4	0.243
19-Jul-17	0.0005	0.06	64	0.0005	1.24	0.037		138	0.0001	62.5	2110	0.0005	0.0005	0.348	0.023	0.00002	18.1	87.1	1.5	0.0005	201		0.032	11.3	0.0005	6.93	0.005	0.0001	1020	1690	0.05	1.9	0.018
16-Aug-17	0.0005	0.18	48	0.0005	1.05	0.028		104	0.00005	56.5	1810	0.0005	0.0005	0.39	0.017	0.00002	15	69.4	0.345	0.0005	167		0.012	12.4	0.0005	7.37	0.005	0.0002	814	1080	0.1	4.3	0.008
21-Sep-17	0.0005	0.15	289	0.0005	0.57	0.046		76	0.00005	35.4	1430	0.0005	0.0005	0.788	0.026	0.00002	15.8	38	0.127	0.002	182		0.001	8.3	0.0005	7.34	0.01	0.0001	464	938	0.3	3.4	0.0025
18-Oct-17	0.0005	0.13	52	0.0005	1.55	0.032		145	0.00005	47.8	2220	0.0005	0.0005	1.07	0.025	0.00002	23.7	89.8	1.12	0.0005	200		0.009	8.9	0.0005	7.21	0.005	0.0003	1150	1830	0.3	2.4	0.0025
15-Nov-17	0.0005	0.21	106	0.0005	1.32	0.036		136	0.00005	54	1830	0.0005	0.0005	0.973	0.054	0.00002	12.6	67.7	1.48	0.001	175		0.005	6.9	0.0005	7.28	0.005	0.0002	855	1320	0.6	4.4	0.007
20-Dec-17	0.0005	0.32	75	0.0005	1.21	0.036		129	0.00005	30.7	1640	0.0005	0.011	0.569	0.033	0.00002	19.1	60.5	4.02	0.0005	147		0.018	4.6	0.0005	7.17	0.005	0.0001	767	1060	0.5	7.9	0.011
17-Jan-18	0.0005	0.32	178	0.0005	1.37	0.032		132	0.00005	38	1860	0.0005	0.0005	0.895	0.013	0.00002	19.9	68.8	0.257	0.002	207		0.004	9	0.0005	7.89	0.005	0.0002	813	1400	0.4	6.9	0.0025
14-Feb-18	0.0005	0.36	48	0.0005	1.96	0.038		208	0.0001	38.3	2540	0.0005	0.0005	0.941	0.066	0.00002	30.4	102	8.4	0.0005	248		0.054	7.8	0.0005	7.01	0.01	0.0003	1340	1910	1.2	9.8	0.022
14-Mar-18	0.0005	0.005	58	0.0005	1.19	0.026		120	0.00005	33.8	1580	0.0005	0.0005	0.816	0.044	0.00002	21.1	62.3	2.53	0.002	150		0.015	7.3	0.0005	7.11	0.005	0.0004	745	1050	0.8	9.1	0.0025

SSCAD v-notch 79 Data from April, 2017 to March 2018 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
Minimum	0.0005	0.005	10	0.0005	0.57	0.026		76	0.00005	30.7	1270	0.0005	0.0005	0.348	0.013	0.00002	12	38	0.127	0.0005	129		0.001	4.6	0.0005	5.81	0.005	0.0001	464	820	0.05	1.9	0.0025
Maximum	0.0005	3.49	289	0.001	1.96	0.054		208	0.0021	62.5	2540	0.002	0.011	1.07	0.184	0.00002	30.4	102	8.4	0.002	248		0.142	12.4	0.002	7.89	0.1	0.0008	1340	1910	1.2	9.8	0.243
Mean	0.0005	0.547083	84.91667	0.000583	1.295	0.036917		134.5	0.000392	45.81667	1883.333	0.000625	0.002292	0.755917	0.043417	0.00002	19.80833	71.86667	3.008583	0.001083	183.6667		0.035083	9.008333	0.000625	7.070833	0.019167	0.000275	890.0833	1372.333	0.470833	5.833333	0.043125
Median	0.0005	0.195	61	0.0005	1.28	0.036		134	0.00005	46.25	1845	0.0005	0.0005	0.8075	0.0255	0.00002	19.5	69.1	1.49	0.00075	186.5		0.0135	8.95	0.0005	7.19	0.005	0.0002	834.5	1360	0.45	6.2	0.0075
90th Percentile	0.0005	1.107	170.8	0.00095	1.577	0.046		177.2	0.00181	56.48	2229	0.0005	0.0092	0.9698	0.0648	0.00002	25.08	90.25	8.067	0.002	207		0.1188	11.26	0.0005	7.469	0.064	0.00049	1159	1826	0.78	8.98	0.1786
95th Percentile	0.0005	2.225	227.95	0.001	1.751	0.0496		192.6	0.002045	59.2	2369.5	0.001175	0.01045	1.01665	0.1191	0.00002	27.485	95.565	8.224	0.002	225.45		0.1332	11.795	0.001175	7.6645	0.0835	0.000635	1241	1866	0.98	9.415	0.21715

Downstream v-notch 93 Data from April, 2017 to March 2018 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
27-Apr-17	0.0005	0.18	598	0.022	0.11	0.022		4.33	0.00005	5.39	1190	0.0005	0.0005	1.14	0.044	0.00002	9.62	3.28	0.014	0.038	313		0.002	8.1	0.0005	8.62	0.41	0.0001	21.7	642	0.7	5.5	0.0025
17-May-17	0.0005	0.28	601	0.014	0.12	0.018		3.68	0.00005	5.47	1210	0.0005	0.0005	1.25	0.036	0.00002	10.7	2.52	0.009	0.032	296		0.002	8.3	0.0005	8.63	0.5	0.0003	24	718	1	3.5	0.0025
21-Jun-17	0.0005	0.22	646	0.011	0.1	0.018		4	0.00005	5.73	1230	0.0005	0.0005	1.18	0.035	0.00002	10.6	2.54	0.02	0.036	308		0.001	8.3	0.0005	8.62	0.34	0.0003	19.7	719	0.7	2.4	0.006
19-Jul-17	0.0005	1.08	673	0.024	0.11	0.044		4.84	0.00005	5.99	1200	0.0005	0.001	1.18	0.503	0.00002	10.7	3.01	0.112	0.03	299		0.005	7.3	0.001	8.18	0.21	0.0002	17.5	724	0.6	36.9	0.022
16-Aug-17	0.0005	0.4	634	0.011	0.08	0.013		3.11	0.00005	5.6	1230	0.0005	0.0005	1.02	0.13	0.00002	8.49	1.73	0.029	0.027	300		0.002	8.2	0.001	8.55	0.33	0.0004	23.2	626	0.5	4.6	0.01
21-Sep-17	0.0005	0.38	719	0.015	0.06	0.024		4.08	0.00005	5.67	1240	0.0005	0.0005	1.16	0.032	0.00002	11.3	2.82	0.008	0.042	287		0.002	7	0.0005	8.58	0.44	0.0002	19.6	798	0.8	4.6	0.006
18-Oct-17	0.0005	0.27	652	0.016	0.1	0.027		4.08	0.00005	5.89	1230	0.0005	0.0005	1.28	0.011	0.00002	11.8	2.93	0.005	0.039	269		0.002	8.2	0.0005	8.62	0.47	0.0002	17.7	730	0.9	2.1	0.005
15-Nov-17	0.0005	0.17	653	0.019	0.07	0.026		4.3	0.00005	5.98	1210	0.0005	0.0005	1.13	0.044	0.00002	8.46	3.11	0.02	0.043	312		0.002	7.3	0.002	8.58	0.51	0.0001	19.2	720	0.7	1.2	0.0025
20-Dec-17	0.0005	0.29	704	0.021	0.08	0.026		3.78	0.00005	5.92	1260	0.0005	0.0005	1.17	0.021	0.00002	9.89	2.54	0.007	0.042	341		0.001	5.2	0.0005	8.65	0.59	0.0002	20	722	0.9	2.2	0.01
17-Jan-18	0.0005	0.22	704	0.026	0.11	0.029		4.79	0.00005	4.81	1250	0.0005	0.0005	1.08	0.015	0.00002	12.4	3.64	0.016	0.045	337		0.003	7.4	0.0005	8.63	0.27	0.0001	18.6	780	0.7	1.6	0.0025
14-Feb-18	0.0005	0.21	717	0.022	0.13	0.025		4.68	0.00005	4.96	1240	0.0005	0.0005	1.08	0.019	0.00002	10.5	3.15	0.021	0.045	336		0.002	7.6	0.0005	8.59	0.26	0.0003	19	632	0.7	1.3	0.006

14-Mar-18	0.0005	0.02	687	0.015	0.11	0.022		4.42	0.00005	6.38	1250	0.0005	0.0005	1.45	0.01	0.00002	12.2	3.13	0.002	0.032	371		0.002	7.1	0.0005	8.59	0.2	0.0003	19.4	696	0.7	4.6	0.0025

Downstream v-notch 93 Data from April, 2017 to March 2018 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
Minimum	0.0005	0.02	598	0.011	0.06	0.013		3.11	0.00005	4.81	1190	0.0005	0.0005	1.02	0.01	0.00002	8.46	1.73	0.002	0.027	269		0.001	5.2	0.0005	8.18	0.2	0.0001	17.5	626	0.5	1.2	0.0025
Maximum	0.0005	1.08	719	0.026	0.13	0.044		4.84	0.00005	6.38	1260	0.0005	0.001	1.45	0.503	0.00002	12.4	3.64	0.112	0.045	371		0.005	8.3	0.002	8.65	0.59	0.0004	24	798	1	36.9	0.022
Mean	0.0005	0.31	665.6667	0.018	0.098333	0.0245		4.174167	0.00005	5.649167	1228.333	0.0005	0.000542	1.176667	0.075	0.00002	10.555	2.866667	0.021917	0.037583	314.0833		0.002167	7.5	0.000708	8.57	0.3775	0.000225	19.96667	708.9167	0.741667	5.875	0.006458
Median	0.0005	0.245	663	0.0175	0.105	0.0245		4.19	0.00005	5.7	1230	0.0005	0.0005	1.165	0.0335	0.00002	10.65	2.97	0.015	0.0385	310		0.002	7.5	0.0005	8.605	0.375	0.0002	19.5	719.5	0.7	2.95	0.0055
90th Percentile	0.0005	0.398	715.7	0.0238	0.119	0.0288		4.779	0.00005	5.989	1250	0.0005	0.0005	1.277	0.1214	0.00002	12.16	3.267	0.0282	0.0448	340.6		0.0029	8.29	0.001	8.63	0.509	0.0003	23.05	775	0.9	5.41	0.01
95th Percentile	0.0005	0.706	717.9	0.0249	0.1245	0.03575		4.8125	0.00005	6.1655	1254.5	0.0005	0.000725	1.3565	0.29785	0.00002	12.29	3.442	0.06635	0.045	354.5		0.0039	8.3	0.00145	8.639	0.546	0.000345	23.56	788.1	0.945	19.63	0.0154

Nth Wall collection 86 Data from April, 2017 to March 2018 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
27-Apr-17	0.0005	25.8	0.5	0.004	11.8	0.002		356	0.0003	21.3	4470	0.001	0.0005	29.2	47.6	0.00005	192	109	17.5	0.0005	338		1.16	5.7	0.0005	2.93	0.005	0.0034	2340	3850	4.7	0.8	2.26
17-May-17	0.0005	23.8	0.5	0.004	10.1	0.0005		364	0.0001	23.8	4600	0.002	0.0005	35.9	54.3	0.00002	184	104	15.6	0.003	330		1.17	8.5	0.0005	2.85	0.01	0.0025	2450	3760	5.4	0.6	2.32
21-Jun-17	0.0005	24.6	0.5	0.003	11.1	0.003		348	0.00005	20.6	4450	0.002	0.0005	33.6	43.1	0.00002	171	102	15.9	0.0005	309		1.16	11.9	0.0005	2.76	0.02	0.0025	2130	3020	5.1	0.3	2.3
19-Jul-17	0.0005	23.4	0.5	0.002	9.35	0.0005		345	0.0002	20	4530	0.002	0.0005	32.7	45	0.00002	176	99.3	15.9	0.0005	312		1.22	13	0.0005	2.75	0.01	0.0032	2050	3960	4.8	0.3	2.34
16-Aug-17	0.0005	24	0.5	0.002	9.24	0.0005		318	0.0001	19	4490	0.001	0.0005	30.4	53.7	0.00002	153	94.5	14.9	0.002	290		1.08	12.8	0.0005	2.74	0.01	0.003	2490	3900	3.9	0.9	2.17
21-Sep-17	0.0005	26.3	0.5	0.004	10.5	0.002		391	0.0001	24.1	4840	0.001	0.0005	44.2	65.8	0.00002	178	108	17.8	0.0005	328		1.22	11.9	0.0005	2.83	0.05	0.0027	2820	3650	4.2	12.1	2.5
18-Oct-17	0.0005	32.6	0.5	0.007	11.3	0.006		379	0.0002	24.7	5070	0.002	0.001	46.2	68.4	0.00002	194	113	19.2	0.0005	338		1.43	15	0.0005	2.88	0.05	0.0034	3090	4780	4.4	2.7	2.88
15-Nov-17	0.0005	34.5	0.5	0.004	13.2	0.0005		389	0.0001	25.4	4980	0.002	0.001	42.1	78.9	0.00002	211	112	17	0.0005	368		1.4	9.6	0.0005	2.87	0.05	0.0029	3010	3280	3.9	1.9	2.9
20-Dec-17	0.0005	31.2	0.5	0.008	10	0.0005		398	0.00005	24.1	4880	0.002	0.0005	45.1	148	0.00002	226	112	18.2	0.0005	379		1.21	3.8	0.0005	2.99	0.025	0.0026	2880	4340	5.1	3.5	2.2
17-Jan-18	0.0005	37.9	0.5	0.01	14	0.0005		438	0.0002	24.2	5150	0.002	0.002	59.8	73.4	0.00002	210	123	19.9	0.0005	392		1.39	3.9	0.0005	2.97	0.025	0.0032	3160	3890	6.5	1.6	2.91
14-Feb-18	0.0005	44.4	0.5	0.006	13.7	0.001		445	0.0004	20.6	5350	0.003	0.001	35.5	41.8	0.00002	239	124	20.1	0.0005	411		1.5	4.7	0.0005	2.93	0.02	0.0053	2840	5000	6.7	2.2	3.83
14-Mar-18	0.0005	38.9	0.5	0.005	13.1	0.0005		424	0.0003	26.9	4920	0.003	0.0005	53.4	30.3	0.00002	228	114	16.8	0.0005	391		1.34	5.8	0.0005	2.96	0.02	0.0044	2540	4100	6.2	0.8	3.23

Nth Wall collection 86 Data from April, 2017 to March 2018 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
Minimum	0.0005	23.4	0.5	0.002	9.24	0.0005		318	0.00005	19	4450	0.001	0.0005	29.2	30.3	0.00002	153	94.5	14.9	0.0005	290		1.08	3.8	0.0005	2.74	0.005	0.0025	2050	3020	3.9	0.3	2.17
Maximum	0.0005	44.4	0.5	0.01	14	0.006		445	0.0004	26.9	5350	0.003	0.002	59.8	148	0.00005	239	124	20.1	0.003	411		1.5	15	0.0005	2.99	0.05	0.0053	3160	5000	6.7	12.1	3.83
Mean	0.0005	30.61667	0.5	0.004917	11.44917	0.001458		382.9167	0.000175	22.89167	4810.833	0.001917	0.00075	40.675	62.525	2.25E-05	196.8333	109.5667	17.4	0.000833	348.8333		1.273333	8.883333	0.0005	2.871667	0.024583	0.003258	2650	3960.833	5.075	2.308333	2.653333
Median	0.0005	28.75	0.5	0.004	11.2	0.0005		384	0.00015	23.95	4860	0.002	0.0005	39	54	0.00002	193	110.5	17.25	0.0005	338		1.22	9.05	0.0005	2.875	0.02	0.0031	2680	3895	4.95	1.25	2.42
90th Percentile	0.0005	38.8	0.5	0.0079	13.65	0.0029		436.6	0.0003	25.33	5142	0.0029	0.001	52.68	78.35	0.00002	227.8	122.1	19.83	0.00185	391.9		1.427	12.98	0.0005	2.969	0.05	0.0043	3082	4736	6.47	3.42	3.198
95th Percentile	0.0005	41.375	0.5	0.0089	13.835	0.00435		441.15	0.000345	26.075	5240	0.003	0.00145	56.28	109.995	3.35E-05	232.95	123.45	19.99	0.00245	400.55		1.4615	13.9	0.0005	2.979	0.05	0.004805	3121.5	4879	6.59	7.37	3.5

West KVAD Seepage Right 80 Data from April, 2017 to March 2018 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
27-Apr-17	0.0005	43.7	0.5	0.0005	12.9	0.001		268	0.0016	32.5	4550	0.0005	0.0005	15.6	29.4	0.00002	193	147	20.6	0.0005	311		2.37	9	0.0005	2.87	0.05	0.0015	2300	3110	4.2	21.2	3.31
17-May-17	0.0005	45.2	0.5	0.0005	13.8	0.0005		276	0.002	35.1	4550	0.0005	0.0005	7.18	42.3	0.00002	189	138	20.4	0.0005	304		2.44	8.1	0.0005	2.92	0.025	0.0014	2360	3760	5.1	1.2	3.5
21-Jun-17	0.0005	44.6	0.5	0.0005	13.2	0.002		293	0.0019	32.5	4560	0.0005	0.0005	19	38.5	0.00002	192	146	19.8	0.0005	307		2.28	4.5	0.0005	2.85	0.02	0.0013	2620	3710	5.7	1.9	3.37
19-Jul-17	0.0005	44.5	0.5	0.0005	13.8	0.002		275	0.0021	32.8	4520	0.0005	0.0005	16.2	43.8	0.00002	195	136	21.1	0.0005	303		2.48	5.5	0.0005	2.88	0.02	0.0014	2270	4070	5.2	8.3	3.53
16-Aug-17	0.0005	49.4	0.5	0.0005	12.6	0.002		266	0.0022	36.6	4600	0.0005	0.0005	13.6	36.8	0.00002	178	133	19.6	0.002	287		2.65	5.2	0.0005	2.86	0.005	0.0013	2950	4080	4.6	1.4	3.42
21-Sep-17	0.0005	49.1	0.5	0.002	9.41	0.003		294	0.0021	33.9	4700	0.0005	0.001	17.1	36.6	0.00002	185	139	23.5	0.0005	291		2.54	9.2	0.0005	2.88	0.02	0.0013	2570	4020	5.7	20.2	3.58
18-Oct-17	0.0005	50.4	0.5	0.002	13.1	0.002		293	0.0024	36.1	4820	0.0005	0.0005	24.2	31.3	0.00002	203	147	23.3	0.0005	309		2.62	11.3	0.0005	2.87	0.005	0.0016	2940	4410	6	6.3	3.72
15-Nov-17	0.0005	50	0.5	0.0005	15.2	0.003		302	0.0023	37	4790	0.0005	0.0005	22.1	28.6	0.00002	221	147	21.5	0.0005	336		2.67	10	0.002	2.86	0.005	0.0014	2920	3730	5.6	15.5	3.77
20-Dec-17	0.0005	43.6	0.5	0.002	12.6	0.002		291	0.0018	35.2	4680	0.0005	0.0005	10.9	93.7	0.00002	206	142	22.5	0.0005	325		2.51	4.5	0.0005	2.94	0.005	0.0012	2500	3360	5.4	1	3.5
17-Jan-18	0.0005	45.2	0.5	0.002	14.7	0.0005		290	0.0021	32.2	4780	0.0005	0.0005	13.1	43.4	0.00002	193	148	22.6	0.0005	326		2.68	2.8	0.0005	2.89	0.02	0.0013	2850	3160	5.6	0.5	3.43
14-Feb-18	0.0005	43.8	0.5	0.0005	14.5	0.0005		304	0.0023	34	4720	0.0005	0.0005	13.8	42.8	0.00002	215	145	21.6	0.0005	334		2.55	4	0.0005	2.93	0.01	0.0021	2960	3950	5.1	0.3	3.55
14-Mar-18	0.0005	46.3	0.5	0.001	15.3	0.0005		324	0.0022	27	4630	0.0005	0.0005	12.2	21.4	0.00002	234	153	20.3	0.0005	371		2.66	4.7	0.0005	2.91	0.005	0.0016	1840	3660	5	0.3	3.63

West KVAD Seepage Right 80 Data from April, 2017 to March 2018 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
Minimum	0.0005	43.6	0.5	0.0005	9.41	0.0005		266	0.0016	27	4520	0.0005	0.0005	7.18	21.4	0.00002	178	133	19.6	0.0005	287		2.28	2.8	0.0005	2.85	0.005	0.0012	1840	3110	4.2	0.3	3.31
Maximum	0.0005	50.4	0.5	0.002	15.3	0.003		324	0.0024	37	4820	0.0005	0.001	24.2	93.7	0.00002	234	153	23.5	0.002	371		2.68	11.3	0.002	2.94	0.05	0.0021	2960	4410	6	21.2	3.77
Mean	0.0005	46.31667	0.5	0.001042	13.42583	0.001583		289.6667	0.002083	33.74167	4658.333	0.0005	0.000542	15.415	40.71667	0.00002	200.3333	143.4167	21.4	0.000625	317		2.5375	6.566667	0.000625	2.888333	0.015833	0.00145	2590	3751.667	5.266667	6.508333	3.525833
Median	0.0005	45.2	0.5	0.0005	13.5	0.002		292	0.0021	33.95	4655	0.0005	0.0005	14.7	37.65	0.00002	194	145.5	21.3	0.0005	310		2.545	5.35	0.0005	2.88	0.015	0.0014	2595	3745	5.3	1.65	3.515
90th Percentile	0.0005	49.94	0.5	0.002	15.15	0.0029		303.8	0.0023	36.55	4789	0.0005	0.0005	21.79	43.76	0.00002	220.4	147.9	23.23	0.0005	335.8		2.669	9.92	0.0005	2.929	0.0245	0.0016	2949	4079	5.7	19.73	3.711
95th Percentile	0.0005	50.18	0.5	0.002	15.245	0.003		313	0.002345	36.78	4803.5	0.0005	0.000725	23.045	66.255	0.00002	226.85	150.25	23.39	0.001175	351.75		2.6745	10.585	0.001175	2.9345	0.03625	0.001825	2954.5	4228.5	5.835	20.65	3.7425

West KVAD Seepage left 81 Data from April, 2017 to March 2018 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
27-Apr-17	0.0005	15.2	0.5	0.0005	4.17	0.01		149	0.00005	25	2450	0.001	0.007	4.51	7.57	0.00004	97.4	67.8	8.02	0.0005	167		0.276	9.9	0.002	3.03	0.02	0.0027	1220	2070	1.4	2.6	0.298
17-May-17	0.0005	16.3	0.5	0.003	3.89	0.02		143	0.0003	27.5	2550	0.002	0.008	6.88	8.54	0.00002	91	61.5	8.03	0.001	160		0.267	11	0.005	2.96	0.01	0.0024	1260	1710	2.2	70.2	0.278
21-Jun-17	0.0005	13.4	0.5	0.0005	3.98	0.009		155	0.0001	24	2560	0.001	0.007	4.82	7.65	0.00002	91.8	63.5	7.31	0.0005	167		0.243	11.8	0.002	2.9	0.03	0.0021	1220	1760	1.9	13.2	0.246
19-Jul-17	0.0005	16.6	0.5	0.001	3.99	0.014		148	0.0003	24.8	2550	0.003	0.012	5.19	3.85	0.00002	85.6	62.1	8.23	0.0005	166		0.282	11.1	0.004	2.98	0.005	0.0025	987	2020	1.9	37.3	0.276
Aug 2017- Mar																	No data																

West KVAD Seepage left 81 Data from April, 2017 to March 2018 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
Minimum	0.0005	13.4	0.5	0.0005	3.89	0.009		143	0.00005	24	2450	0.001	0.007	4.51	3.85	0.00002	85.6	61.5	7.31	0.0005	160		0.243	9.9	0.002	2.9	0.005	0.0021	987	1710	1.4	2.6	0.246
Maximum	0.0005	16.6	0.5	0.003	4.17	0.02		155	0.0003	27.5	2560	0.003	0.012	6.88	8.54	0.00004	97.4	67.8	8.23	0.001	167		0.282	11.8	0.005	3.03	0.03	0.0027	1260	2070	2.2	70.2	0.298
Mean	0.0005	15.375	0.5	0.00125	4.0075	0.01325		148.75	0.000188	25.325	2527.5	0.00175	0.0085	5.35	6.9025	0.000025	91.45	63.725	7.8975	0.000625	165		0.267	10.95	0.00325	2.9675	0.01625	0.002425	1171.75	1890	1.85	30.825	0.2745
Median	0.0005	15.75	0.5	0.00075	3.985	0.012		148.5	0.0002	24.9	2550	0.0015	0.0075	5.005	7.61	0.00002	91.4	62.8	8.025	0.0005	166.5		0.2715	11.05	0.003	2.97	0.015	0.00245	1220	1890	1.9	25.25	0.277
90th Percentile	0.0005	16.51	0.5	0.0024	4.116	0.0182		153.2	0.0003	26.75	2557	0.0027	0.0108	6.373	8.273	0.000034	95.72	66.51	8.17	0.00085	167		0.2802	11.59	0.0047	3.015	0.027	0.00264	1248	2055	2.11	60.33	0.292
95th Percentile	0.0005	16.555	0.5	0.0027	4.143	0.0191		154.1	0.0003	27.125	2558.5	0.00285	0.0114	6.6265	8.4065	0.000037	96.56	67.155	8.2	0.000925	167		0.2811	11.695	0.00485	3.0225	0.0285	0.00267	1254	2062.5	2.155	65.265	0.295

Surface water runoff 87 Data from April, 2017 to March, 2018 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
27-Apr-17	0.0005	67.9	0.5	0.005	13.6	0.001		423	0.0007	23.8	4860	0.001	0.002	69	180	0.00002	278	111	17	0.0005	370		1.32	3.2	0.0005	3.24	0.05	0.009	2850	4760	5	0.7	3.83

17-May-17	0.0005	59.2	0.5	0.006	11.8	0.0005		405	0.0008	36.1	4960	0.001	0.001	80.2	178	0.00002	249	101	15.4	0.0005	344		1.38	3.4	0.0005	3.2	0.05	0.0083	2880	3400	5.6	1.8	3.97
21-Jun-17	0.0005	61.3	0.5	0.005	12.1	0.0005		405	0.0008	23.7	4980	0.002	0.002	77.8	189	0.00002	245	103	16.2	0.0005	341		1.4	3.8	0.0005	3.1	0.005	0.0103	3200	4010	6.2	0.9	4.01
19-Jul-17	0.0005	57.4	0.5	0.005	10.1	0.002		400	0.0006	22.1	4980	0.001	0.002	74.8	185	0.00002	251	99.5	16.3	0.0005	339		1.32	2.8	0.0005	3.15	0.05	0.0143	2610	4900	5.7	0.8	3.84
16-Aug-17	0.0005	58.8	0.5	0.009	9.69	0.002		366	0.0004	20.6	4920	0.0005	0.0005	71	166	0.00002	216	91.9	14.6	0.002	306		1.21	2.2	0.0005	3.19	0.05	0.019	3100	4890	5	2.3	3.39
21-Sep-17	0.0005	62.2	0.5	0.017	11.3	0.005		417	0.0006	25	5040	0.0005	0.002	89.6	169	0.00002	248	98.2	16.8	0.0005	329		1.34	1.6	0.0005	3.22	0.05	0.021	3200	4640	5.9	7	3.97
18-Oct-17	0.0005	73.6	0.5	0.032	12.1	0.004		387	0.0006	23.2	5030	0.0005	0.002	87.2	151	0.00002	266	96.7	15.4	0.0005	320		1.58	1.1	0.0005	3.29	0.05	0.0304	3250	5250	6	1.1	4.5
15-Nov-17	0.0005	71.9	0.5	0.016	13.3	0.004		392	0.0007	24	5000	0.0005	0.002	83.7	165	0.00002	292	96.2	15.1	0.0005	344		1.48	3	0.001	3.26	0.05	0.0351	3240	5010	5.4	0.3	4.31
20-Dec-17	0.0005	83.7	0.5	0.06	12.2	0.003		401	0.0009	23.4	5050	0.001	0.002	78.2	216	0.00002	303	98.7	15.8	0.0005	358		1.66	1.7	0.0005	3.27	0.025	0.0391	3240	4940	5.3	0.1	4.9
17-Jan-18	0.0005	80.1	0.5	0.069	12.3	0.002		413	0.0009	20.1	5020	0.001	0.002	91.1	124	0.00002	269	101	17.5	0.0005	342		1.56	2.9	0.0005	3.32	0.025	0.0476	3330	3640	6.4	0.2	4.27
14-Feb-18	0.0005	83.8	0.5	0.022	12.4	0.003		407	0.0009	20.8	5060	0.002	0.002	65.1	104	0.00002	279	96.6	16.2	0.0005	339		1.51	4	0.0005	3.25	0.005	0.067	3280	5210	5.5	0.1	4.47
14-Mar-18	0.0005	81.6	0.5	0.023	12.6	0.001		439	0.0009	13.8	5070	0.003	0.003	48.7	99.1	0.00002	314	105	15.4	0.0005	382		1.5	2.8	0.001	3.23	0.005	0.054	1820	4800	5.7	0.1	4.29

Surface water runoff 87 Data from April, 2017 to March, 2018 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
Minimum	0.0005	57.4	0.5	0.005	9.69	0.0005		366	0.0004	13.8	4860	0.0005	0.0005	48.7	99.1	0.00002	216	91.9	14.6	0.0005	306		1.21	1.1	0.0005	3.1	0.005	0.0083	1820	3400	5	0.1	3.39
Maximum	0.0005	83.8	0.5	0.069	13.6	0.005		439	0.0009	36.1	5070	0.003	0.003	91.1	216	0.00002	314	111	17.5	0.002	382		1.66	4	0.001	3.32	0.05	0.067	3330	5250	6.4	7	4.9
Mean	0.0005	70.125	0.5	0.022417	11.9575	0.002333		404.5833	0.000733	23.05	4997.5	0.001167	0.001875	76.36667	160.5083	0.00002	267.5	99.9	15.975	0.000625	342.8333		1.438333	2.708333	0.000583	3.226667	0.034583	0.029592	3000	4620.833	5.641667	1.283333	4.145833
Median	0.0005	69.9	0.5	0.0165	12.15	0.002		405	0.00075	23.3	5010	0.001	0.002	78	167.5	0.00002	267.5	99.1	16	0.0005	341.5		1.44	2.85	0.0005	3.235	0.05	0.0257	3200	4845	5.65	0.75	4.14
90th Percentile	0.0005	83.49	0.5	0.0572	13.23	0.004		422.4	0.0009	24.9	5059	0.002	0.002	89.36	188.6	0.00002	301.9	104.8	16.98	0.0005	368.8		1.578	3.76	0.00095	3.288	0.05	0.05336	3277	5190	6.18	2.25	4.497
95th Percentile	0.0005	83.745	0.5	0.06405	13.435	0.00445		430.2	0.0009	29.995	5064.5	0.00245	0.00245	90.275	201.15	0.00002	307.95	107.7	17.225	0.001175	375.4		1.616	3.89	0.001	3.3035	0.05	0.05985	3302.5	5228	6.29	4.415	4.68

Downstream KVAR 83 Data from April, 2017 to March, 2018 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
27-Apr-17	0.0005	0.18	605	0.02	0.06	0.023		4.34	0.00005	5.3	1180	0.0005	0.0005	0.938	0.03	0.00002	9.59	3.28	0.003	0.037	318		0.003	8.6	0.0005	8.63	0.43	0.0001	28.8	703	0.7	5.4	0.008
17-May-17	0.0005	0.34	624	0.016	0.12	0.017		3.74	0.00005	5.58	1220	0.0005	0.002	0.876	0.012	0.00002	11	2.57	0.004	0.034	306		0.002	9.7	0.0005	8.67	0.34	0.0003	27.1	706	0.6	5.9	0.007
21-Jun-17	0.0005	0.29	631	0.012	0.08	0.02		3.94	0.00005	5.68	1230	0.0005	0.0005	1.11	0.016	0.00002	10.4	2.5	0.005	0.038	308		0.002	9.3	0.0005	8.63	0.36	0.0003	20.1	775	0.8	4	0.0025
19-Jul-17	0.0005	0.24	685	0.011	0.11	0.02		3.47	0.00005	5.88	1220	0.0005	0.0005	1.14	0.011	0.00002	10.4	2.26	0.018	0.036	304		0.003	9.9	0.0005	8.63	0.2	0.0001	17.4	666	0.6	2.8	0.0025
16-Aug-17	0.0005	0.22	654	0.009	0.08	0.011		2.85	0.00005	4.91	1250	0.0005	0.0005	1.03	0.019	0.00002	8.4	1.39	0.005	0.031	304		0.004	9.8	0.001	8.63	0.34	0.0004	30.5	800	0.4	1.5	0.012
21-Sep-17	0.0005	0.58	721	0.019	0.08	0.029		4.33	0.00005	5.97	1250	0.0005	0.0005	0.965	0.014	0.00002	12.2	2.93	0.005	0.044	300		0.002	7	0.0005	8.62	0.42	0.0002	29.8	824	0.9	8.7	0.014
18-Oct-17	0.0005	0.3	648	0.017	0.07	0.026		4.17	0.00005	5.81	1230	0.0005	0.0005	1.42	0.008	0.00002	12.3	3.01	0.005	0.042	289		0.003	9	0.0005	8.67	0.48	0.0002	17.5	730	0.8	2	0.008
15-Nov-17	0.0005	0.22	659	0.02	0.07	0.026		4.23	0.00005	6.1	1220	0.0005	0.0005	1.28	0.011	0.00002	8.74	3.02	0.044	0.044	320		0.003	7.6	0.002	8.64	0.5	0.0001	20.5	752	0.7	0.8	0.012
20-Dec-17	0.0005	0.29	721	0.02	0.08	0.025		3.7	0.00005	5.87	1270	0.0005	0.0005	1.03	0.013	0.00002	9.91	2.48	0.01	0.045	340		0.001	5.1	0.0005	8.68	0.59	0.0001	21.6	770	0.9	2	0.007
17-Jan-18	0.0005	0.36	722	0.027	0.09	0.028		4.63	0.00005	4.62	1240	0.0005	0.0005	0.902	0.012	0.00002	11.9	3.38	0.013	0.043	336		0.002	8.6	0.0005	8.66	0.28	0.0001	20.6	780	0.7	3.3	0.007
14-Feb-18	0.0005	0.25	716	0.024	0.07	0.026		4.54	0.00005	5	1250	0.0005	0.0005	1.13	0.011	0.00002	11.5	3.16	0.005	0.047	346		0.003	8.1	0.0005	8.64	0.27	0.0003	19.3	744	0.7	1.8	0.008
14-Mar-18	0.0005	0.28	709	0.018	0.18	0.024		4.41	0.00005	5.6	1230	0.0005	0.0005	1.25	0.011	0.00002	12.1	3.16	0.0005	0.044	367		0.004	8.3	0.0005	8.59	0.21	0.0003	19.6	621	0.7	3.1	0.012

Downstream KVAR 83 Data from April, 2017 to March, 2018 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
Minimum	0.0005	0.18	605	0.009	0.06	0.011		2.85	0.00005	4.62	1180	0.0005	0.0005	0.876	0.008	0.00002	8.4	1.39	0.0005	0.031	289		0.001	5.1	0.0005	8.59	0.2	0.0001	17.4	621	0.4	0.8	0.0025
Maximum	0.0005	0.58	722	0.027	0.18	0.029		4.63	0.00005	6.1	1270	0.0005	0.002	1.42	0.03	0.00002	12.3	3.38	0.044	0.047	367		0.004	9.9	0.002	8.68	0.59	0.0004	30.5	824	0.9	8.7	0.014
Mean	0.0005	0.295833	674.5833	0.01775	0.090833	0.022917		4.029167	0.00005	5.526667	1232.5	0.0005	0.000625	1.08925	0.014	0.00002	10.70333	2.761667	0.009792	0.040417	319.8333		0.002667	8.416667	0.000667	8.640833	0.368333	0.000208	22.73333	739.25	0.708333	3.441667	0.008333
Median	0.0005	0.285	672	0.0185	0.08	0.0245		4.2	0.00005	5.64	1230	0.0005	0.0005	1.07	0.012	0.00002	10.7	2.97	0.005	0.0425	313		0.003	8.6	0.0005	8.635	0.35	0.0002	20.55	748	0.7	2.95	0.008
90th Percentile	0.0005	0.358	721	0.0236	0.119	0.0278		4.527	0.00005	5.961	1250	0.0005	0.0005	1.277	0.0187	0.00002	12.19	3.268	0.0175	0.0449	345.4		0.0039	9.79	0.00095	8.67	0.498	0.0003	29.7	798	0.89	5.85	0.012
95th Percentile	0.0005	0.459	721.45	0.02535	0.147	0.02845		4.5805	0.00005	6.0285	1259	0.0005	0.001175	1.343	0.02395	0.00002	12.245	3.325	0.0297	0.0459	355.45		0.004	9.845	0.00145	8.6745	0.5405	0.000345	30.115	810.8	0.9	7.16	0.0129

Springvale Mine Water Data from April, 2017 to March, 2018 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn- Filt	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
03-Apr-17	0.0005	0.3	674	0.024	0.07	0.026	0.0005	4.25	0.00005	5.02	1200		0.0005	1.3	0.222	0.00002	13.2	3.26	0.012	0.042	286		0.004		0.0005	7.9	0.2	0.0002	23		0.8	4.3	0.007
10-Apr-17	0.0005	0.23	664	0.016	0.15	0.023	0.0005	4.26	0.00005	5.26	1200		0.003	1.3	0.329	0.00002	9.97	2.94	0.012	0.036	319		0.002		0.0005	8	0.27	0.0001	22		0.8	2.1	0.0025
18-Apr-17	0.0005	0.11	585	0.023	0.06	0.022	0.0005	4.18	0.00005	4.68	1200		0.0005	1.3	0.398	0.00002	11.7	2.95	0.009	0.035	333		0.002		0.0005	7.8	0.26	0.0001	24		0.8	3.8	0.0025
24-Apr-17	0.0005	0.12	548	0.025	0.08	0.024	0.0005	4.01	0.00005	4.06	1200		0.003	1.3	0.302	0.00002	11	2.84	0.008	0.038	323		0.0005		0.0005	7.8	0.29	0.0001	25		0.7	4.1	0.005
01-May-17	0.0005	0.31	560	0.011	0.06	0.017	0.0005	3.88	0.00005	6.6	1200		0.002	1.3	0.188	0.00002	9.6	2.84	0.006	0.035	339		0.002		0.0005	8	0.3	0.0003	24		0.7	2.1	0.007
08-May-17	0.0005	0.36	615	0.016	0.07	0.019	0.0005	3.91	0.00005	4.78	1200		0.0005	1.3	0.145	0.00002	11.4	2.61	0.005	0.036	293		0.0005		0.0005	8.1	0.38	0.0002	26		0.7	2.4	0.006
15-May-17	0.0005	0.36	641	0.016	0.07	0.017	0.0005	3.61	0.00005	4.83	1200		0.0005	1.3	0.125	0.00002	10.9	2.46	0.005	0.033	291		0.003		0.0005	8	0.4	0.0001	24		0.7	2	0.0025
22-May-17	0.0005	0.34	615	0.012	0.08	0.018	0.0005	3.76	0.00005	5.41	1200		0.0005	1.3	0.324	0.00002	12	2.7	0.006	0.033	336		0.0005		0.0005	8.1	0.47	0.0001	20		0.9	2.1	0.009
29-May-17	0.0005	0.24	620	0.012	0.08	0.02	0.0005	4.05	0.00005	5.9	1200		0.0005	1.2	0.225	0.00002	11.7	2.58	0.007	0.033	314		0.001		0.0005	8.1	0.45	0.0001	20		0.8	1.7	0.005
05-Jun-17	0.0005	0.33	625	0.012	0.07	0.018	0.0005	3.8	0.00005	6.09	1200		0.002	1.2	0.296	0.00002	10.7	2.46	0.006	0.033	319		0.001		0.0005	8.2	0.45	0.0003	27		1	1.6	0.0025
13-Jun-17	0.0005	0.27	616	0.01	0.08	0.018	0.0005	3.6	0.00005	5.7	1200		0.0005	1.2	0.204	0.00002	9.86	2.43	0.006	0.034	308		0.002		0.0005	8.3	0.43	0.0001	24		0.7	1.2	0.0025
19-Jun-17	0.0005	0.36	625	0.012	0.1	0.019	0.0005	4.03	0.00005	5.63	1200		0.003	1.2	0.292	0.00002	11.3	2.41	0.009	0.036	358		0.003		0.0005	8	0.32	0.0002	20		0.7	1.6	0.007
26-Jun-17	0.0005	0.12	638	0.018	0.07	0.019	0.0005	3.27	0.00005	5.27	1200		0.0005	1.3	1.04	0.00002	9.34	2.05	0.023	0.035	285		0.002		0.0005	7.9	0.16	0.0002	22		0.7	4	0.019
03-Jul-17	0.0005	0.34	644	0.013	0.08	0.021	0.0005	3.5	0.00005	5.7	1200		0.002	1.2	0.298	0.00002	10.2	2.37	0.024	0.037	323		0.003		0.0005	8	0.18	0.0001	20		0.7	1.6	0.008
10-Jul-17	0.0005	0.41	623	0.012	0.07	0.02	0.0005	3.13	0.00005	5.84	1200		0.0005	1.2	0.382	0.00002	9.65	2.11	0.023	0.031	308		0.002		0.0005	8	0.1	0.0001	18		0.6	1.7	0.01
17-Jul-17	0.0005	0.36	589	0.012	0.08	0.02	0.0005	3.66	0.00005	5.65	1200		0.001	1.2	0.207	0.00002	11.5	2.29	0.018	0.035	321		0.002		0.0005	7.9	0.14	0.0001	19		0.7	1.5	0.007
24-Jul-17	0.0005	0.42	644	0.016	0.07	0.018	0.0005	3.32	0.00005	4.82	1200		0.0005	1.2	0.129	0.00002	9.63	2.15	0.008	0.034	325		0.002		0.0005	8.3	0.19	0.0001	17		0.7	1.1	0.006
31-Jul-17	0.0005	0.46	578	0.018	0.07	0.017	0.0005	3.63	0.00005	5.61	1200		0.003	1.2	0.17	0.00002	9.83	2.08	0.007	0.032	226		0.002		0.0005	8.1	0.3	0.0003	24		0.7	2.2	0.009
07-Aug-17	0.0005	0.32	645	0.014	0.07	0.017	0.0005	3.2	0.00005	5.38	1200		0.0005	1.2	0.089	0.00002	11.2	2.23	0.009	0.037	388		0.002		0.0005	8.1	0.24	0.0003	21		0.6	2.6	0.01
14-Aug-17	0.0005	0.37	634	0.009	0.06	0.007	0.0005	2.72	0.00005	5.07	1200		0.004	1.2	0.107	0.00002	8.15	1.26	0.01	0.026	302		0.001		0.0005	8	0.26	0.0004	26		0.5	2	0.014
21-Aug-17	0.0005	0.41	720	0.013	0.08	0.017	0.0005	3.45	0.00005	4.73	1200		0.0005	1.3	0.172	0.00002	11.6	2.22	0.013	0.035	267		0.002		0.0005	8	0.24	0.0003	22		0.7	2.6	0.01
28-Aug-17	0.0005	0.39	723	0.014	0.06	0.017	0.0005	3.57	0.00005	5.8	1200		0.003	1.3	0.278	0.00002	9.54	2.38	0.016	0.034	316		0.002		0.0005	8.1	0.21	0.0001	18		0.6	1.9	0.011
04-Sep-17	0.0005	0.35	651	0.012	0.09	0.017	0.0005	3.54	0.00005	5.4	1200		0.0005	1.3	0.196	0.00002	9.3	2.3	0.004	0.039	314		0.001		0.0005	8.2	0.45	0.0003	25		0.8	1.6	0.01
11-Sep-17	0.0005	0.31	682	0.01	0.06	0.016	0.0005	3.52	0.00005	6.03	1200		0.002	1.3	0.266	0.00002	9.31	2.39	0.003	0.033	328		0.002		0.0005	8.1	0.52	0.0004	22		0.9	2	0.008
18-Sep-17	0.0005	0.39	665	0.018	0.11	0.026	0.0005	3.79	0.00005	5.14	1200		0.0005	1.3	0.212	0.00002	12.1	2.75	0.005	0.043	286		0.002		0.0005	8.1	0.3	0.0002	16		0.8	1.7	0.015
25-Sep-17	0.0005	0.39	722	0.018	0.07	0.026	0.0005	5.12	0.0002	6.23	1200		0.003	1.3	0.154	0.00002	11.9	2.74	0.006	0.042	289		0.002		0.0005	8.2	0.29	0.0001	17		0.9	1.9	0.01
03-Oct-17	0.0005	0.43	714	0.023	0.08	0.026	0.0005	3.77	0.00005	1.04	1200		0.0005	1.3	0.168	0.00002	13.4	2.78	0.005	0.043	281		0.002		0.0005	8.2	0.39	0.0001	16		0.9	1.7	0.011
09-Oct-17	0.0005	0.44	679	0.023	0.07	0.028	0.0005	3.94	0.00005	5.66	1200		0.0005	1.3	0.244	0.00002	11.3	2.87	0.004	0.044	275		0.002		0.0005	8.2	0.38	0.0001	16		0.9	1.7	0.016
16-Oct-17	0.0005	0.38	712	0.02	0.07	0.027	0.0005	3.94	0.00005	6.28	1200		0.003	1.3	0.226	0.00002	12.2	2.96	0.005	0.042	268		0.001		0.0005	8.2	0.39	0.0001	20		1	1.6	0.01
23-Oct-17	0.0005	0.45	719	0.021	0.07	0.029	0.0005	4.2	0.00005	5.9	1200		0.0005	1.3	0.285	0.00002	11.3	3.03	0.004	0.043	287		0.002		0.0005	8.1	0.4	0.0001	19		0.8	1.7	0.013
30-Oct-17	0.0005	0.4	711	0.021	0.06	0.028	0.0005	4.11	0.00005	5.62	1200		0.002	1.3	0.222	0.00002	12.7	3.07	0.003	0.044	303		0.002		0.0005	8.1	0.36	0.0002	20		0.7	1.5	0.011
06-Nov-17	0.0005	0.4	719	0.02	0.06	0.027	0.0005	3.92	0.00005	6.35	1200		0.0005	1.3	0.174	0.00002	10.7	2.98	0.005	0.043	276		0.002		0.0005	8.1	0.42	0.0001	22		0.8	1.6	0.01
13-Nov-17	0.0005	0.36	660	0.021	0.08	0.027	0.0005	4.39	0.00005	6.57	1200		0.002	1.3	0.226	0.00002	9.97	3.14	0.005	0.043	303		0.002		0.0005	8.1	0.43	0.0002	17		0.8	1.7	0.012
20-Nov-17	0.0005	0.44	629	0.022	0.09	0.029	0.0005	4.12	0.00005	5.42	1200		0.0005	1.3	0.26	0.00002	11	3.02	0.005	0.043	317		0.003		0.001	8	0.43	0.0001	17		0.8	1.8	0.011
27-Nov-17	0.0005	0.34	703	0.021	0.19	0.025	0.0005	4.52	0.00005	5.5	1200		0.002	1.3	0.26	0.00002	9.88	3.12	0.005	0.04	338		0.002		0.002	8.1	0.43	0.0001	20		0.9	1.9	0.011
04-Dec-17	0.0005	0.21	696	0.028	0.06	0.027	0.0005	4.51	0.00005	10.1	1200		0.002	1.3	0.335	0.00002	12.1	3.34	0.002	0.041	312		0.001		0.001	8.1	0.45	0.0001	24		0.8	2.8	0.013
11-Dec-17	0.0005	0.09	656	0.028	0.08	0.027	0.0005	4.02	0.00005	5	1200		0.0005	1.3	0.406	0.00002	11	3.06	0.004	0.046	326		0.002		0.0005	8	0.47	0.0002	17		0.9	2.9	0.013
18-Dec-17	0.0005	0.42	670	0.017	0.07	0.019	0.0005	3.28	0.00005	5.4	1300		0.003	1.2	0.237	0.00002	9.58	2.3	0.005	0.034	438		0.002		0.0005	8.2	0.6	0.0002	19		0.9	2.1	0.015

27-Dec-17	0.0005	0.36	710	0.017	0.31	0.027	0.0005	4.58	0.00005	4.92	1200		0.0005	1.3	0.212	0.00002	11.3	3.35	0.009	0.04	275		0.006		0.0005	8	0.36	0.0003	23		0.7	1.9	0.024
02-Jan-18	0.0005	0.38	647	0.02	0.07	0.027	0.0005	4.56	0.00005	4.82	1200		0.0005	1.2	0.234	0.00002	11.5	3.2	0.023	0.04	284		0.002		0.0005	8	0.18	0.0001	24		0.8	1.8	0.008
08-Jan-18	0.0005	0.34	676	0.02	0.08	0.028	0.0005	4.29	0.00005	5.42	1200		0.0005	1.3	0.187	0.00002	11	3.14	0.018	0.04	330		0.002		0.0005	8.2	0.16	0.0001	24		0.8	2.4	0.011
15-Jan-18	0.0005	0.75	691	0.038	0.08	0.03	0.0005	4.56	0.00005	4.7	1200		0.004	1.2	0.484	0.00002	11.9	3.33	0.018	0.042	356		0.002		0.0005	7.9	0.15	0.0001	22		0.7	5	0.012
22-Jan-18	0.0005	0.35	682	0.025	0.08	0.028	0.0005	4.47	0.00005	4.93	1200		0.0005	1.3	0.181	0.00002	13.4	3.32	0.016	0.043	326		0.002		0.0005	7.9	0.1	0.0002	21		0.7	1.9	0.006
29-Jan-18	0.0005	0.35	709	0.036	0.07	0.027	0.0005	4.58	0.00005	6.23	1200		0.004	1.3	0.51	0.00002	12.2	3	0.014	0.044	326		0.003		0.0005	7.9	0.16	0.0004	27		0.7	7.3	0.014
05-Feb-18	0.0005	0.31	683	0.022	0.07	0.025	0.0005	4.26	0.00005	4.96	1200		0.0005	1.3	0.102	0.00002	11.7	3.05	0.015	0.045	334		0.002		0.0005	7.9	0.18	0.0004	23		0.8	4.6	0.006
12-Feb-18	0.0005	0.25	708	0.021	0.07	0.026	0.0005	4.37	0.00005	5.37	1200		0.004	1.3	0.083	0.00002	11.1	2.92	0.016	0.045	342		0.002		0.0005	8	0.18	0.0003	24		0.7	2.5	0.006
19-Feb-18	0.0005	0.22	712	0.019	0.06	0.026	0.0005	4.36	0.00005	5.39	1200		0.003	1.3	0.11	0.00002	11.3	3.18	0.013	0.043	343		0.002		0.0005	8	0.11	0.0003	19		0.7	2.5	0.0025
26-Feb-18	0.0005	0.32	675	0.017	0.1	0.028	0.0005	4.52	0.00005	4.92	1200		0.003	1.3	0.192	0.00002	11.6	3.17	0.014	0.045	314		0.003		0.0005	8.1	0.11	0.0003	20		0.6	10	0.007
05-Mar-18	0.0005	0.32	673	0.02	0.07	0.028	0.0005	4.71	0.00005	5.48	1200		0.003	1.3	0.187	0.00002	11.5	3.27	0.016	0.046	348		0.003		0.0005	7.8	0.09	0.0002	18		0.7	2.1	0.01
12-Mar-18	0.001		699	0.016	0.06	0.023	0.0005	4.37	0.00005	5.2	1200		0.002	1.3	0.185	0.00002	11.5	3.01	0.013	0.042	343		0.002		0.0005	7.9	0.11	0.0001	20		0.7	2.6	0.0025
19-Mar-18	0.0005	0.32	688	0.024	0.06	0.019	0.0005	3.6	0.00005	5.77	1200		0.0005	1.4	0.684	0.00002	9.09	2.33	0.01	0.039	361		0.002		0.0005	7.9	0.1	0.0003	19		1.6	8.6	0.012
26-Mar-18	0.0005	0.33	743	0.017	0.08	0.02	0.0005	3.34	0.00005	4.92	1200		0.002	1.3	0.12	0.00002	9.5	2.26	0.014	0.038	369		0.002		0.0005	8.1	0.04	0.0001	13		0.6	2.3	0.005

Springvale Mine Water Data from April, 2017 to March, 2018 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	NFR	Ni	DO	Pb	pH	NO3	Se	SO4	TDS	TN	rbidity (N	Zn
Minimum	0.0005	0.09	548	0.009	0.06	0.007	0.0005	2.72	0.00005	1.04	1200		0.0005	1.2	0.083	0.00002	8.15	1.26	0.002	0.026	226		0.0005		0.0005	7.8	0.04	0.0001	13		0.5	1.1	0.0025
Maximum	0.001	0.75	743	0.038	0.31	0.03	0.0005	5.12	0.0002	10.1	1300		0.004	1.4	1.04	0.00002	13.4	3.35	0.024	0.046	438		0.006		0.002	8.3	0.6	0.0004	27		1.6	10	0.024
Mean	0.00051	0.339804	663.6538	0.018519	0.081731	0.022692	0.0005	3.9625	5.29E-05	5.432692	1201.923		0.001596	1.275	0.255077	0.00002	10.96731	2.730769	0.010019	0.03875	316.7692		0.002048		0.000548	8.044231	0.288077	0.000187	20.96154		0.773077	2.613462	0.009183
Median	0.0005	0.35	671.5	0.018	0.07	0.0235	0.0005	3.975	0.00005	5.405	1200		0.00075	1.3	0.222	0.00002	11.25	2.84	0.0085	0.0395	318		0.002		0.0005	8.05	0.29	0.00015	20.5		0.7	2	0.01
90th Percentile	0.0005	0.43	718.5	0.0249	0.099	0.028	0.0005	4.556	0.00005	6.23	1200		0.003	1.3	0.3964	0.00002	12.19	3.254	0.018	0.044	355.2		0.003		0.0005	8.2	0.45	0.0003	24.9		0.9	4.28	0.014
95th Percentile	0.0005	0.445	720.9	0.028	0.128	0.02845	0.0005	4.58	0.00005	6.449	1200		0.004	1.3	0.4957	0.00002	12.925	3.3245	0.023	0.045	364.6		0.003		0.000725	8.2	0.47	0.0004	26		0.945	6.035	0.01545

WGM1D1 32 groundwater bore April, 2017 to March, 2018

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered \	Zn
28-Apr-17	0.0005	0.32	17	0.0005	0.025	0.034		2.77	0.00005	12.4	108	0.0005	0.009	0.03	4.06	0.00002	2.86	2.46	0.12	0.0005	10.5	0.002	0.0005	5.68	0.0001	7.37	47	3.8	3.8	0.08
18-May-17	0.0005	0.21	13	0.0005	0.025	0.035		1.73	0.00005	20.7	120	0.0005	0.003	0.02	0.422	0.00002	2.94	2.38	0.094	0.0005	16.2	0.002	0.0005	5.38	0.0001	7.61	78	3.7	3.7	0.056
22-Jun-17	0.0005	0.37	7	0.0005	0.025	0.028		1.03	0.00005	21.6	112	0.0005	0.002	0.017	0.188	0.00002	2.34	1.78	0.037	0.0005	17.1	0.002	0.001	5.18	0.0001	8.2	92	3.8	3.9	0.046
21-Jul-17	0.0005	0.32	8	0.0005	0.025	0.029		0.833	0.00005	22.4	114	0.0005	0.001	0.013	0.162	0.00002	2.18	1.57	0.029	0.0005	14.3	0.0005	0.0005	5.14	0.0001	7.73	88	4.1	4.1	0.041
17-Aug-17	0.0005	0.1	6	0.0005	0.025	0.027		0.859	0.00005	24.4	123	0.0005	0.002	0.005	0.109	0.00002	2.12	1.55	0.024	0.0005	19	0.001	0.0005	5.13	0.0001	8.35	62	4.3	4.3	0.044
21-Sep-17	0.0005	5.69	7	0.0005	0.025	0.056		0.955	0.00005	22.5	118	0.004	0.007	0.012	0.198	0.00002	3.01	1.81	0.045	0.0005	18.5	0.002	0.006	5	0.0002	7.66	224	4.7	4.6	0.062
19-Oct-17	0.0005	1.47	8	0.0005	0.025	0.051		1.05	0.00005	25.1	125	0.0005	0.006	0.005	0.388	0.00002	2.14	1.9	0.08	0.0005	17.8	0.003	0.004	5.19	0.0003	6.96	128	4.9	4.9	0.057
16-Nov-17	0.0005	5.84	10	0.0005	0.025	0.077		1.47	0.00005	115	116	0.004	0.017	0.005	0.885	0.00004	2.61	2.07	0.061	0.0005	12.8	0.004	0.023	5.17	0.0004	29.5	142	5	5	0.177
21-Dec-17	0.0005	8.5	11	0.001	0.025	0.093		1.6	0.00005	27.1	140	0.007	0.021	0.005	1.8	0.00002	3.36	2.32	0.073	0.0005	16.9	0.005	0.013	5.29	0.0003	7.38	172	5.1	5.1	0.116
18-Jan-18	0.0005	12.7	11	0.002	0.025	0.135		2.03	0.00005	28.4	144	0.01	0.042	0.012	2.37	0.00005	5.75	3.24	0.083	0.0005	20	0.01	0.026	5.33	0.0008	6.2	327	5.2	5.2	0.173
01-Feb-18	No data																													
14-Mar-18																												5.4		

WGM1D1 32 groundwater bore April, 2017 to March, 2018

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered \	Zn
Minimum	0.0005	0.1	6	0.0005	0.025	0.027		0.833	0.00005	12.4	108	0.0005	0.001	0.005	0.109	0.00002	2.12	1.55	0.024	0.0005	10.5	0.0005	0.0005	5	0.0001	6.2	47	3.7	3.7	0.041
Maximum	0.0005	12.7	17	0.002	0.025	0.135		2.77	0.00005	115	144	0.01	0.042	0.03	4.06	0.00005	5.75	3.24	0.12	0.0005	20	0.01	0.026	5.68	0.0008	29.5	327	5.4	5.2	0.177
Mean	0.0005	3.552	9.8	0.0007	0.025	0.0565		1.4327	0.00005	31.96	122	0.0028	0.011	0.0124	1.0582	0.000025	2.931	2.108	0.0646	0.0005	16.31	0.00315	0.0075	5.249	0.00025	9.696	136	4.545455	4.46	0.0852
Median	0.0005	0.92	9	0.0005	0.025	0.043		1.26	0.00005	23.45	119	0.0005	0.0065	0.012	0.405	0.00002	2.735	1.985	0.067	0.0005	17	0.002	0.0025	5.185	0.00015	7.635	110	4.7	4.45	0.0595
90th Percentile	0.0005	8.92	13.4	0.0011	0.025	0.0972		2.104	0.00005	37.06	140.4	0.0073	0.0231	0.021	2.539	0.000041	3.599	2.538	0.0966	0.0005	19.1	0.0055	0.0233	5.41	0.00044	10.465	234.3	5.2	5.11	0.1734
95th Percentile	0.0005	10.81	15.2	0.00155	0.025	0.1161		2.437	0.00005	76.03	142.2	0.00865	0.03255	0.0255	3.2995	4.55E-05	4.6745	2.889	0.1083	0.0005	19.55	0.00775	0.02465	5.545	0.00062	19.9825	280.65	5.3	5.155	0.1752

WGM1D1 32 groundwater bore April, 2017 to March, 2018

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered \	Zn
28-Apr-17	0.0005	0.13	0.5	0.0005	0.025	0.025		1.02	0.00005	3.81	345	0.0005	0.0005	0.005	0.01	0.00008	2.96	13.1	0.283	0.0005	37.9	0.037	0.0005	4.36	0.0001	21.2	164	7.5	9.8	0.038
18-May-17	0.0005	0.18	0.5	0.0005	0.12	0.03		1.52	0.00005	26.5	443	0.0005	0.0005	0.063	0.178	0.00002	3.88	15.3	0.436	0.001	49.1	0.052	0.0005	4.12	0.0001	147	246	8.3	10.7	0.058
22-Jun-17	0.0005	0.17	0.5	0.0005	0.19	0.027		1.38	0.00005	21.4	390	0.0005	0.0005	0.064	0.02	0.00002	3.65	13.8	0.334	0.0005	46.7	0.041	0.0005	4.13	0.0001	131	259	8	10.3	0.053
21-Jul-17	0.0005	0.24	0.5	0.0005	0.16	0.034		2.27	0.00005	30.4	526	0.0005	0.0005	0.026	1.29	0.00002	4.12	17.9	0.572	0.001	56.3	0.066	0.001	3.76	0.0001	171	317	8.6	10.7	0.098
17-Aug-17	0.0005	0.21	0.5	0.0005	0.16	0.03		2.12	0.00005	29.4	572	0.0005	0.0005	0.025	1.63	0.00002	3.87	16.8	0.521	0.0005	57.9	0.071	0.002	3.63	0.0001	166	308	8.7	10.6	0.081
21-Sep-17	0.0005	0.43	0.5	0.0005	0.16	0.031		2.7	0.00005	34	620	0.0005	0.0005	0.025	0.822	0.00002	3.62	17.8	0.636	0.0005	60.9	0.079	0.002	3.51	0.0001	177	377	9.3	10.7	0.103
19-Oct-17	0.0005	0.28	0.5	0.0005	0.23	0.029		2.98	0.00005	37	640	0.0005	0.0005	0.25	0.597	0.00002	4.17	17.4	0.67	0.0005	61.8	0.079	0.002	3.56	0.0001	206	359	10.2	11.1	0.122
16-Nov-17	0.0005	0.4	0.5	0.0005	0.12	0.033		2.18	0.0001	30	515	0.0005	0.0005	0.039	0.961	0.00002	2.72	16.5	0.526	0.0005	44.8	0.064	0.003	3.87	0.0001	171	347	8.4	10.7	0.089
21-Dec-17	0.0005	0.32	0.5	0.0005	0.13	0.033		1.78	0.00005	30	504	0.0005	0.0005	0.024	0.703	0.00002	3.39	16.9	0.51	0.0005	52	0.065	0.002	3.92	0.0001	166	342	8.4	10.7	0.089
18-Jan-18	0.0005	0.26	0.5	0.0005	0.25	0.03		2.59	0.0002	33.8	620	0.0005	0.0005	0.029	0.357	0.00002	3.56	19.5	0.646	0.0005	63.8	0.074	0.002	3.58	0.0001	183	415	9.5	11.1	0.091
15-Feb-18	0.0005	0.21	0.5	0.0005	0.32	0.027		2.59	0.00005	34.9	640	0.0005	0.0005	0.005	0.909	0.00002	3.17	17.9	0.634	0.0005	60.6	0.069	0.002	3.52	0.0001	182	390	9.5	11	0.089
15-Mar-18	0.0005	0.19	0.5	0.0005	0.24	0.026		2.58	0.00005	36.1	603	0.0005	0.0005	0.017	0.987	0.00002	3.71	18.1	0.598	0.0005	64.1	0.069	0.002	3.58	0.0001	173	348	9.1	10.9	0.093

WGM1D1 32 groundwater bore April, 2017 to March, 2018

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered \	Zn
Minimum	0.0005	0.13	0.5	0.0005	0.025	0.025		1.02	0.00005	3.81	345	0.0005	0.0005	0.005	0.01	0.00002	2.72	13.1	0.283	0.0005	37.9	0.037	0.0005	3.51	0.0001	21.2	164	7.5	9.8	0.038
Maximum	0.0005	0.43	0.5	0.0005	0.32	0.034		2.98	0.0002	37	640	0.0005	0.0005	0.25	1.63	0.00008	4.17	19.5	0.67	0.001	64.1	0.079	0.003	4.36	0.0001	206	415	10.2	11.1	0.122
Mean	0.0005	0.251667	0.5	0.0005	0.175417	0.029583		2.1425	6.67E-05	28.9425	534.8333	0.0005	0.0005	0.047667	0.705333	0.000025	3.568333	16.75	0.5305	0.000583	54.65833	0.063833	0.001625	3.795	0.0001	157.85	322.6667	8.791667	10.69167	0.083667
Median	0.0005	0.225	0.5	0.0005	0.16	0.03		2.225	0.00005	30.2	549	0.0005	0.0005	0.0255	0.7625	0.00002	3.635	17.15	0.549	0.0005	57.1	0.0675	0.002	3.695	0.0001	171	344.5	8.65	10.7	0.089
90th Percentile	0.0005	0.392	0.5	0.0005	0.249	0.033		2.689	0.000095	35.98	638	0.0005	0.0005	0.0639	1.2597	0.00002	4.096	18.08	0.645	0.00095	63.6	0.0785	0.002	4.129	0.0001	182.9	388.7	9.5	11.09	0.1025
95th Percentile	0.0005	0.4135	0.5	0.0005	0.2815	0.03345		2.826	0.000145	36.505	640	0.0005	0.0005	0.1477	1.443	0.000047	4.1425	18.73	0.6568	0.001	63.935	0.079	0.00245	4.2335	0.0001	193.35	401.25	9.815	11.1	0.11155

WGM1D3 34 groundwater bore April, 2017 to March, 2018

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered \	Zn
28-Apr-17	0.0005	0.32	24	0.0005	0.09	0.078		19	0.00005	54.8	620	0.0005	0.001	0.089	3.09	0.00002	6.4	23.2	0.596	0.0005	63.8	0.117	0.0005	5.19	0.0001	177	296	8.6	8.6	0.091
18-May-17	0.0005	0.23	29	0.0005	0.17	0.083		19.7	0.00005	60.1	640	0.0005	0.0005	0.091	4.57	0.00002	8.18	21.6	0.609	0.0005	62.5	0.105	0.0005	5.21	0.0001	198	426	8.9	8.9	0.072
22-Jun-17	0.0005	0.18	26	0.0005	0.15	0.09		22.9	0.00005	56.4	670	0.0005	0.0005	0.068	4.76	0.00002	8.28	24.6	0.639	0.0005	70.3	0.133	0.0005	5.13	0.0001	208	445	8.7	8.8	0.101
21-Jul-17	0.0005	0.58	50	0.003	0.12	0.097		22.4	0.00005	59.5	680	0.0005	0.003	0.106	10.6	0.00002	8.73	23	0.651	0.002	62.8	0.096	0.005	5.55	0.0003	200	399	8.9	9	0.084
17-Aug-17	0.0005	0.11	29	0.0005	0.2	0.107		24.8	0.00005	55.6	770	0.0005	0.0005	0.078	8.44	0.00002	9.23	27.4	0.729	0.0005	65.6	0.144	0.0005	5.26	0.0001	245	499	8.9	8.9	0.102
21-Sep-17	0.0005	0.25	30	0.0005	0.24	0.108		28.4	0.00005	60.7	800	0.0005	0.0005	0.081	8.51	0.00002	8.72	29.7	0.864	0.0005	66	0.135	0.0005	5.34	0.0001	260	517	9.2	9.2	0.109
19-Oct-17	0.0005	0.13	34	0.002	0.34	0.12		31.3	0.00005	64.2	890	0.0005	0.0005	0.132	12.9	0.00002	9.52	32.8	1.11	0.0005	71	0.129	0.0005	5.45	0.0001	308	604	9.5	9.5	0.113
16-Nov-17	0.0005	0.26	30	0.0005	0.42	0.097		28.1	0.0001	52.7	840	0.0005	0.0005	0.171	11	0.00002	7.07	32	1.1	0.0005	55.3	0.216	0.0005	5.33	0.0001	320	562	8.9	8.9	0.221
21-Dec-17	0.0005	0.5	25	0.001	0.5	0.074		23.7	0.0014	33	780	0.0005	0.002	0.147	6.08	0.00002	10.8	33.2	1.48	0.0005	60.9	0.414	0.001	5.19	0.0001	313	603	8.3	8.4	0.493
18-Jan-18	0.0005	0.57	24	0.0005	0.56	0.081		27.5	0.0024	29.1	850	0.0005	0.002	0.388	6.59	0.00002	12.8	41.6	1.79	0.0005	66.2	0.518	0.0005	5.18	0.0001	348	651	8.3	8.3	0.541
15-Feb-18	0.0005	0.54	33	0.001	0.62	0.085		36.9	0.0021	30.8	1000	0.0005	0.0005	0.402	11.4	0.00004	13.2	50.1	1.92	0.0005	77.2	0.526	0.0005	5.25	0.0003	414	688	8.2	8.3	0.514
15-Mar-18	0.0005	0.83	4	0.0005	0.68	0.028		21.4	0.0027	13.6	700	0.0005	0.0005	0.555	0.088	0.00002	17	37.6	1.86	0.0005	54.6	0.626	0.0005	4.62	0.0007	295	468	7.9	7.8	0.606

WGM1D3 34 groundwater bore April, 2017 to March, 2018

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered \	Zn
Minimum	0.0005	0.11	4	0.0005	0.09	0.028		19	0.00005	13.6	620	0.0005	0.0005	0.068		0.00002	6.4	21.6		0.0005	54.6	0.096	0.0005	4.62	0.0001	177	296	7.9	7.8	0.072
Maximum	0.0005	0.83	50	0.003	0.68	0.12		36.9	0.0027	64.2	1000	0.0005	0.003	0.555		0.00004	17	50.1		0.002	77.2	0.626	0.005	5.55	0.0007	414	688	9.5	9.5	0.606
Mean	0.0005	0.375	28.16667	0.000917	0.340833	0.087333		25.50833	0.000754	47.54167	770	0.0005	0.001	0.192333		2.17E-05	9.994167	31.4		0.000625	64.68333	0.26325	0.000917	5.225	0.000183	273.8333	513.1667	8.691667	8.716667	0.253917
Median	0.0005	0.29	29	0.0005	0.29	0.0875		24.25	0.00005	55.2	775	0.0005	0.0005	0.119		0.00002	8.98	30.85		0.0005	64.7	0.1395	0.0005	5.23	0.0001	277.5	508	8.8	8.85	0.111
90th Percentile	0.0005	0.579	33.9	0.0019	0.614	0.1079		31.01	0.00237	60.64	886	0.0005	0.002	0.4006		0.00002	13.16	41.2		0.0005	70.93	0.5252	0.00095	5.439	0.0003	345.2	646.3	9.17	9.18	0.5383
95th Percentile	0.0005	0.6925	41.2	0.00245	0.647	0.1134		33.82	0.002535	62.275	939.5	0.0005	0.00245	0.47085	12.075	0.000029	14.91	45.425	1.887	0.001175	73.79	0.571	0.0028	5.495	0.00048	377.7	667.65	9.335	9.335	0.57025

WGM1D4 35 groundwater bore April, 2017 to March, 2018

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered	Zn
28-Apr-17	0.0005	0.04	80	0.002	1.71	0.016		98.9	0.00005	28.4	1560	0.0005	0.0005	0.035	44	0.00002	9.41	69.4	11.4	0.0005	135	0.028	0.0005	6.13	0.0001	713	1060	1	1.7	0.034
18-May-17	0.0005	0.01	97	0.002	1.85	0.017		87.5	0.00005	28.8	1560	0.0005	0.0005	0.011	60.4	0.00002	11.3	58.2	13	0.0005	126	0.029	0.0005	6.14	0.0001	762	1110	1	1.7	0.036
22-Jun-17	0.0005	0.01	63	0.002	1.74	0.017		94.2	0.00005	28	1560	0.0005	0.0005	0.03	58.8	0.00002	10.9	60.5	12	0.0005	129	0.029	0.0005	6.11	0.0001	755	1180	1	1.7	0.035
21-Jul-17	0.0005	0.06	66	0.001	1.63	0.017		85.1	0.00005	26.8	1550	0.0005	0.0005	0.023	53.9	0.00002	10.8	57.2	13.1	0.0005	122	0.028	0.0005	6.16	0.0001	768	1150	1	1.8	0.037
17-Aug-17	0.0005	0.005	72	0.002	1.59	0.016		81.2	0.00005	26.2	1570	0.0005	0.0005	0.05	54.8	0.00002	10.7	54.4	12.2	0.001	119	0.03	0.0005	6.13	0.0001	721	1030	1.1	1.3	0.035
21-Sep-17	0.0005	0.01	57	0.0005	1.23	0.016		90	0.00005	23.9	1580	0.0005	0.0005	0.05	29.9	0.00002	10.2	57	13.9	0.0005	123	0.03	0.0005	6.09	0.0001	724	1160	1	1.6	0.031
19-Oct-17	0.0005	0.02	72	0.001	1.77	0.017		83	0.00005	24.8	1560	0.0005	0.0005	0.017	37.3	0.00002	10.4	55.6	14.2	0.0005	120	0.033	0.0005	6.16	0.0001	752	1160	1.1	1.6	0.037
16-Nov-17	0.0005	0.03	76	0.0005	1.91	0.016		84.5	0.00005	25.5	1560	0.0005	0.0005	0.05	32	0.00002	7.39	58.1	12.9	0.0005	126	0.03	0.0005	6.17	0.0001	755	1220	1	1.8	0.031
21-Dec-17	0.0005	0.02	55	0.002	1.58	0.016		88	0.00005	26.8	1560	0.0005	0.0005	0.017	57.6	0.00002	9.58	59.4	13.4	0.0005	130	0.029	0.0005	6.23	0.0001	738	1130	1	1.4	0.038
18-Jan-18	0.0005	0.03	85	0.002	1.86	0.016		88.6	0.00005	24.5	1550	0.0005	0.0005	0.036	52.6	0.00002	10.4	62.3	14.5	0.0005	133	0.03	0.0005	6.14	0.0001	765	1190	1.1	1.3	0.033
15-Feb-18	0.0005	0.01	84	0.002	1.69	0.015		87.3	0.00005	24.3	1540	0.0005	0.001	0.026	38.9	0.00002	9.15	58	11.7	0.0005	130	0.027	0.0005	6.17	0.0001	683	968	1.1	1.3	0.033
15-Mar-18	0.0005	0.005	74	0.0005	1.77	0.012		91.5	0.00005	27.7	1530	0.0005	0.0005	0.005	25.4	0.00002	11.7	61.9	12.3	0.0005	146	0.025	0.0005	6.15	0.0001	699	1040	1.1	1.2	0.016

WGM1D4 35 groundwater bore April, 2017 to March, 2018

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered	Zn
Minimum	0.0005	0.005	55	0.0005	1.23	0.012		81.2	0.00005	23.9	1530	0.0005	0.0005	0.005	25.4	0.00002	7.39	54.4	11.4	0.0005	119	0.025	0.0005	6.09	0.0001	683	968	1	1.2	0.016
Maximum	0.0005	0.06	97	0.002	1.91	0.017		98.9	0.00005	28.8	1580	0.0005	0.001	0.05	60.4	0.00002	11.7	69.4	14.5	0.001	146	0.033	0.0005	6.23	0.0001	768	1220	1.1	1.8	0.038
Mean	0.0005	0.020833	73.41667	0.001458	1.694167	0.015917		88.31667	0.00005	26.30833	1556.667	0.0005	0.000542	0.029167	45.46667	0.00002	10.16083	59.33333	12.88333	0.000542	128.25	0.029	0.0005	6.148333	0.0001	736.25	1116.5	1.041667	1.533333	0.033
Median	0.0005	0.015	73	0.002	1.725	0.016		87.75	0.00005	26.5	1560	0.0005	0.0005	0.028	48.3	0.00002	10.4	58.15	12.95	0.0005	127.5	0.029	0.0005	6.145	0.0001	745	1140	1	1.6	0.0345
90th Percentile	0.0005	0.039	84.9	0.002	1.859	0.017		93.93	0.00005	28.36	1569	0.0005	0.0005	0.05	58.68	0.00002	11.26	62.26	14.17	0.0005	134.8	0.03	0.0005	6.17	0.0001	764.7	1189	1.1	1.79	0.037
95th Percentile	0.0005	0.049	90.4	0.002	1.8825	0.017		96.315	0.00005	28.58	1574.5	0.0005	0.000725	0.05	59.52	0.00002	11.48	65.495	14.335	0.000725	139.95	0.03135	0.0005	6.197	0.0001	766.35	1203.5	1.1	1.8	0.03745

WGM1D5 36 groundwater bore April, 2017 to March, 2018

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered	Zn
28-Apr-17	0.0005	16.2	0.5	0.001	1.77	0.054		40.9	0.0028	19.5	920	0.003	0.01	0.334	2.67	0.00005	17.9	41.5	4.75	0.002	53.8	0.31	0.019	4.2	0.0014	407	632	8.2	8.5	0.553
18-May-17	0.0005	27.5	0.5	0.003	2.26	0.077		44.1	0.0052	24	1180	0.008	0.042	0.473	0.854	0.00009	24.9	45.4	5.79	0.004	72.4	0.404	0.038	3.83	0.0041	555	866	8.2	8.5	1.13
22-Jun-17	0.0005	22.5	0.5	0.001	2.27	0.042		47.3	0.0037	26.3	1170	0.004	0.017	0.582	0.599	0.00002	28.6	49.7	5.46	0.002	78.3	0.347	0.024	3.98	0.0017	574	903	8.3	8.6	0.685
21-Jul-17	0.0005	24.4	0.5	0.002	2.1	0.04		43.7	0.0048	26.8	1220	0.004	0.019	0.683	0.353	0.00002	26.4	49	6.11	0.002	75.1	0.399	0.023	3.79	0.0021	589	958	8.3	8.6	1.07
17-Aug-17	0.0005	24.4	0.5	0.002	2.19	0.044		42.1	0.0033	24	1240	0.006	0.019	0.363	0.467	0.00002	29.4	45.4	5.39	0.002	72.2	0.396	0.022	3.73	0.0024	550	931	8.4	8.6	1.02
21-Sep-17	0.0005	24.6	0.5	0.006	1.29	0.08		44.1	0.0121	33.1	1170	0.013	0.038	0.486	0.598	0.00002	29.5	43.6	5.05	0.002	80.3	0.399	0.048	3.98	0.004	526	906	8.5	8.7	2.15
19-Oct-17	0.0005	18.7	0.5	0.003	1.41	0.044		32	0.008	22.2	880	0.005	0.036	0.85	1.11	0.00006	21.2	34	4.71	0.001	49.2	0.296	0.022	4.01	0.0039	423	640	8.7	8.7	1.21
16-Nov-17	0.0005	22.4	0.5	0.01	1.64	0.143		36.7	0.0064	29.6	1030	0.017	0.044	0.523	5.8	0.00008	21.1	36.7	4.29	0.01	57.7	0.304	0.129	4.21	0.0039	477	734	8.6	8.7	1.12
21-Dec-17	0.0005	10.8	0.5	0.005	0.84	0.064		21	0.0032	12.2	585	0.007	0.025	0.237	1.74	0.00005	17.5	20.3	2.56	0.003	31.4	0.147	0.03	4.12	0.0022	253	477	8.4	8.7	0.478
18-Jan-18	0.0005	16.2	0.5	0.002	1.57	0.053		33.2	0.0031	19.5	860	0.004	0.019	0.316	2.13	0.00002	21.3	35.6	4.35	0.002	48.7	0.252	0.019	4.04	0.0017	396	636	8.5	8.7	0.571
15-Feb-18	0.0005	12.6	0.5	0.002	1.34	0.035		31.8	0.0009	20.8	820	0.003	0.035	0.305	2.84	0.00002	18.4	32.6	4.19	0.0005	43	0.24	0.011	4.35	0.0017	370	714	8.5	8.7	0.426
15-Mar-18	0.0005	5.87	0.5	0.0005	1.25	0.02		28.9	0.00005	15.2	700	0.0005	0.0005	0.29	2.54	0.00002	23.9	28.8	3.33	0.0005	43.3	0.191	0.0005	4.67	0.0019	301	520	8.5	8.6	0.184

WGM1D5 36 groundwater bore April, 2017 to March, 2018

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered	Zn
Minimum	0.0005	5.87	0.5	0.0005	0.84	0.02		21	0.00005	12.2	585	0.0005	0.0005	0.237	0.353	0.00002	17.5	20.3	2.56	0.0005	31.4	0.147	0.0005	3.73	0.0014	253	477	8.2	8.5	0.184
Maximum	0.0005	27.5	0.5	0.01	2.27	0.143		47.3	0.0121	33.1	1240	0.017	0.044	0.85	5.8	0.00009	29.5	49.7	6.11	0.01	80.3	0.404	0.129	4.67	0.0041	589	958	8.7	8.7	2.15
Mean	0.0005	18.8475	0.5	0.003125	1.660833	0.058		37.15	0.004463	22.76667	981.25	0.006208	0.025375	0.4535	1.808417	3.92E-05	23.34167	38.55	4.665	0.002583	58.78333	0.307083	0.032125	4.075833	0.002583	451.75	743.0833	8.425	8.633333	0.883083
Median	0.0005	20.55	0.5	0.002	1.605	0.0485		38.8	0.0035	23.1	975	0.0045	0.022	0.418	1.425	0.00002	22.6	39.1	4.73	0.002	55.75	0.307	0.0225	4.025	0.00215	450	724	8.45	8.65	0.8525
90th Percentile	0.0005	24.58	0.5	0.0059	2.253	0.0797		44.1	0.00784	29.32	1216	0.0125	0.0416	0.6729	2.823	0.000078	29.32	48.64	5.757	0.0039	77.98	0.399	0.047	4.336	0.00399	572.1	928.5	8.59	8.7	1.202
95th Percentile	0.0005	25.905	0.5	0.0078	2.2645	0.10835		45.54	0.009845	31.175	1229	0.0148	0.0429	0.75815	4.172	8.45E-05	29.445	49.315	5.934	0.0067	79.2	0.40125	0.08445	4.494	0.004045	580.75	943.15	8.645	8.7	1.633

WGM1D6 36 groundwater bore April, 2017 to March, 2018

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered	Zn
28-Apr-17	0.0005	3.74	0.5	0.002	1.26	0.014		48.7	0.00005	48.8	1920	0.002	0.0005	0.258	178	0.00002	7.82	88.2	8.41	0.0005	117	0.416	0.004	4.39	0.0002	1050	1680	11	11.1	0.803
18-May-17	0.0005	4.91	0.5	0.002	1.13	0.014		41.4	0.0009	48.7	1870	0.002	0.011	0.476	170	0.00002	10.1	85.5	7.36	0.0005	127	0.498	0.011	4.09	0.0004	1020	1450	11.2	11.2	1.3
22-Jun-17	0.0005	5.84	0.5	0.0005	1.22	0.016		44.5	0.0013	45	1880	0.003	0.016	0.42	153	0.00002	9.85	89.1	7.07	0.0005	126	0.471	0.013	3.92	0.0004	1000	1630	11.2	11.2	1.33
21-Jul-17	0.0005	2.39	0.5	0.0005	1.2	0.022		50.2	0.0001	44.7	1880	0.003	0.003	0.207	210	0.00002	10.4	75.4	9.2	0.0005	107	0.344	0.003	4.62	0.0003	1050	1690	11.3	11.3	0.488
17-Aug-17	0.0005	3.09	0.5	0.0005	1.24	0.014		47.8	0.0004	45.4	1900	0.004	0.003	0.224	188	0.00002	10.7	75.9	7.92	0.0005	107	0.382	0.004	4.31	0.0003	1010	1540	11.3	11.3	0.762
21-Sep-17	0.0005	3.4	0.5	0.0005	1.04	0.015		54.3	0.0004	44.4	1910	0.003	0.009	0.171	200	0.00002	10	78.3	8.56	0.0005	108	0.364	0.006	4.18	0.0002	1010	1680	11.3	11.3	0.791
19-Oct-17	0.0005	2.4	0.5	0.001	1.37	0.016		52.6	0.0002	46.3	1930	0.003	0.004	0.213	201	0.00002	10.2	72	9.76	0.0005	104	0.349	0.003	4.58	0.0003	1120	1760	11.4	11.4	0.625
16-Nov-17	0.0005	6.81	0.5	0.0005	1.4	0.016		54.5	0.001	56.7	2240	0.003	0.011	0.446	210	0.00002	7.9	104	9.1	0.0005	152	0.591	0.022	3.99	0.0005	1290	1900	11.3	11.3	1.51
21-Dec-17	0.0005	5.5	0.5	0.0005	1.28	0.012		56	0.0005	53.4	2180	0.002	0.007	0.456	298	0.00002	9.64	104	9.91	0.0005	148	0.473	0.008	4.02	0.0003	1070	2230	11.3	11.3	1.21
18-Jan-18	0.0005	4.77	0.5	0.001	1.44	0.014		55.4	0.0008	46.2	2000	0.002	0.012	0.265	240	0.00002	9.54	91.9	12.1	0.0005	124	0.459	0.008	4.06	0.0003	1150	1790	11.4	11.4	1.06
15-Feb-18	0.0005	3.15	0.5	0.0005	1.32	0.012		53.8	0.0004	44.4	1960	0.002	0.003	0.157	199	0.00002	9.26	85.3	9.54	0.0005	116	0.376	0.004	4.42	0.0004	1070	1540	11.4	11.4	0.861
15-Mar-18	0.0005	6.76	0.5	0.0005	1.24	0.013		64	0.0009	58.1	2280	0.002	0.019	0.377	177	0.00002	11.8	118	10.1	0.0005	183	0.585	0.01	3.89	0.0007	1240	1760	11.4	11.4	1.4

WGM1D6 36 groundwater bore April, 2017 to March, 2018

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered	Zn
Minimum	0.0005	2.39	0.5	0.0005	1.04	0.012		41.4	0.00005	44.4	1870	0.002	0.0005	0.157	153	0.00002	7.82	72	7.07	0.0005	104	0.344	0.003	3.89	0.0002	1000	1450	11	11.1	0.488
Maximum	0.0005	6.81	0.5	0.002	1.44	0.022		64	0.0013	58.1	2280	0.004	0.019	0.476	298	0.00002	11.8	118	12.1	0.0005	183	0.591	0.022	4.62	0.0007	1290	2230	11.4	11.4	1.51
Mean	0.0005	4.396667	0.5	0.000833	1.261667	0.014833		51.93333	0.000579	48.50833	1995.833	0.002583	0.008208	0.305833	202	0.00002	9.7675	88.96667	9.085833	0.0005	126.5833	0.442333	0.008	4.205833	0.000358	1090	1720.833	11.29167	11.3	1.011667
Median	0.0005	4.255	0.5	0.0005	1.25	0.014		53.2	0.00045	46.25	1925	0.0025	0.008	0.2615	199.5	0.00002	9.925	86.85	9.15	0.0005	120.5	0.4375	0.007	4.135	0.0003	1060	1685	11.3	11.3	0.9605
90th Percentile	0.0005	6.668	0.5	0.0019	1.397	0.016		55.94	0.00099	56.37	2234	0.003	0.0156	0.455	237	0.00002	10.67	104	10.081	0.0005	151.6	0.5763	0.0128	4.564	0.00049	1231	1889	11.4	11.4	1.393
95th Percentile	0.0005	6.7825	0.5	0.002	1.418	0.0187		59.6	0.001135	57.33	2258	0.00345	0.01735	0.465	266.1	0.00002	11.195	110.3	11	0.0005	165.95	0.5877	0.01705	4.598	0.00059	1262.5	2048.5	11.4	11.4	1.4495

AP09 77 groundwater bore April, 2017 to March, 2018

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered	Zn
27-Apr-17	0.0005	0.37	44	0.056	2.75	0.015		201	0.00005	23.7	3000	0.0005	0.0005	0.656	120	0.00002	181	79.8	10.3	0.106	204	1.03	0.0005	5.92	0.0005	1590	2260	3.1	3.3	0.464
17-May-17	0.0005	0.37	55	0.055	2.4	0.013		194	0.00005	25.9	3040	0.0005	0.0005	0.575	136	0.00002	173	70.2	9.98	0.116	191	1.2	0.0005	5.94	0.0005	1840	2560	3.1	3.3	0.56
21-Jun-17	0.0005	0.36	43	0.06	2.63	0.016		206	0.00005	23.5	3010	0.0005	0.0005	0.668	122	0.00002	173	70.2	9.15	0.117	191	1.17	0.0005	5.89	0.0005	1710	2530	3.1	3.3	0.683
21-Jul-17	0.0005	0.41	28	0.061	2.44	0.018		175	0.00005	23.2	2860	0.0005	0.0005	0.736	110	0.00002	169	62.9	9.06	0.131	179	1.34	0.0005	5.97	0.0006	1350	2550	3.1	3.3	0.856
16-Aug-17	0.0005	0.41	43	0.06	2.55	0.017		162	0.0001	21.8	2830	0.0005	0.0005	2.52	104	0.00002	154	57.6	8.01	0.135	170	1.37	0.0005	5.92	0.0006	1480	2310	3.1	3.4	0.977
21-Sep-17	0.0005	0.41	9	0.071	2.57	0.016		159	0.00005	24	2630	0.005	0.0005	1.13	87.6	0.00002	155	54.2	7	0.141	166	1.26	0.0005	5.96	0.0004	1390	1520	3.2	3.4	0.926
18-Oct-17	0.0005	0.66	21	0.065	2.63	0.016		160	0.0001	24.2	2740	0.0005	0.0005	0.901	106	0.00002	164	58.6	8.9	0.146	169	1.29	0.0005	5.94	0.0006	1490	2260	3.2	3.5	1.13
16-Nov-17	0.0005	0.3	55	0.041	2.73	0.016		153	0.00005	25.1	2670	0.0005	0.0005	0.686	101	0.00002	172	58.1	7.83	0.146	175	1.32	0.0005	6	0.0005	1490	2120	3.2	3.5	1.02
20-Dec-17	0.0005	0.4	41	0.057	2.49	0.015		163	0.00005	24.5	2700	0.0005	0.0005	4.32	143	0.00002	184	62.1	8.26	0.154	187	1.3	0.0005	6	0.0003	1470	2260	3.2	3.6	1.05
17-Jan-18	0.0005	0.42	60	0.056	3.05	0.015		176	0.0001	21	2830	0.0005	0.0005	5.22	121	0.00002	166	67.9	10.8	0.176	188	1.48	0.0005	5.94	0.0004	1650	2410	3.4	3.7	1.18
14-Feb-18	0.0005	0.42	67	0.057	2.72	0.016		163	0.00005	24	2690	0.0005	0.0005	1.39	90.6	0.00002	172	60.4	8.1	0.151	179	1.29	0.0005	5.99	0.0009	1420	2230	3.3	3.5	1.15
14-Mar-18	0.0005	0.66	48	0.056	3.38	0.015		193	0.0001	25.8	2920	0.0005	0.0005	3.96	92	0.00002	199	71	8.98	0.184	212	1.61	0.0005	5.93	0.0007	1510	2160	3.3	3.5	1.59

AP09 77 groundwater bore April, 2017 to March, 2018

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered	Zn
Minimum	0.0005	0.3	0.013	0.0005	2.4	0.013		153	0.00005	21	2630	0.0005	0.0005	0.575	87.6	0.00002	154	54.2	7	0.106	166	1.03	0.0005	5.89	0.0003	1350	1520	3.1	3.3	0.464
Maximum	0.0005	0.66	0.018	0.0005	3.38	0.018		206	0.0001	25.9	3040	0.005	0.0005	5.22	143	0.00002	199	79.8	10.8	0.184	212	1.61	0.0005	6	0.0009	1840	2560	3.4	3.7	1.59
Mean	0.0005	0.4325	0.015667	0.0005	2.695	0.015667		175.4167	6.67E-05	23.89167	2826.667	0.000875	0.0005	1.896833	111.1	0.00002	171.8333	64.41667	8.864167	0.141917	184.25	1.305	0.0005	5.95	0.000542	1532.5	2264.167	3.191667	3.441667	0.9655
Median	0.0005	0.41	0.016	0.0005	2.63	0.016		169	0.00005	24	2830	0.0005	0.0005	1.0155	108	0.00002	172	62.5	8.94	0.1435	183	1.295	0.0005	5.94	0.0005	1490	2260	3.2	3.45	0.9985
90th Percentile	0.0005	0.636	0.0169	0.0005	3.02	0.0169		200.3	0.0001	25.73	3009	0.0005	0.0005	4.284	134.6	0.00002	183.7	70.92	10.268	0.1738	202.7	1.469	0.0005	5.999	0.00069	1704	2548	3.3	3.59	1.177
95th Percentile	0.0005	0.66	0.01745	0.0005	3.1985	0.01745		203.25	0.0001	25.845	3023.5	0.002525	0.0005	4.725	139.15	0.00002	190.75	74.96	10.525	0.1796	207.6	1.5385	0.0005	6	0.00079	1768.5	2554.5	3.345	3.645	1.3645

AP17 78 groundwater bore April, 2017 to March, 2018

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered	Zn
28-Apr-17	0.0005	80.3	0.5	0.05	14.1	0.016		423	0.0019	19	5090	0.0005	0.003	85.5	230	0.00002	356	104	15.2	0.008	410	1.64	0.001	4.11	0.118	3150	5600	2.4	2.5	5.18
18-May-17	0.0005	72.1	0.5	0.066	13.5	0.009		388	0.0016	57.1	5120	0.0005	0.004	89	209	0.00002	321	89.5	13.5	0.005	360	1.66	0.002	3.64	0.0983	3130	4890	2.5	2.5	5.11
22-Jun-17	0.0005	77.1	0.5	0.041	13.4	0.005		404	0.0015	17.9	5070	0.001	0.003	82.4	166	0.00002	319	95.4	13.6	0.003	369	1.65	0.001	3.29	0.0918	3210	4860	2.5	2.5	5.04
21-Jul-17	0.0005	77.8	0.5	0.036	12.5	0.002		393	0.0018	16.9	5070	0.002	0.005	80	157	0.00002	314	89.9	14.1	0.002	364	1.62	0.001	3.35	0.106	2940	5200	2.5	2.5	4.91
17-Aug-17	0.0005	76.3	0.5	0.046	11.1	0.011		364	0.0015	15.2	5190	0.002	0.005	56.1	144	0.00002	277	85.2	12.4	0.005	337	1.6	0.001	3.27	0.121	3340	5180	2.5	2.5	4.02
22-Sep-17	0.0005	81.5	0.5	0.135	8.97	0.008		408	0.0018	20	5250	0.002	0.004	92.6	129	0.00002	307	91.6	13.5	0.0005	348	1.68	0.0005	3.18	0.115	3230	5050	2.5	2.5	5.02
19-Oct-17	0.0005	94.8	0.5	0.139	12.4	0.008		392	0.0017	18.7	5210	0.002	0.002	90.2	184	0.00002	356	92.7	14.7	0.0005	355	1.78	0.0005	3.65	0.136	3530	5570	2.6	2.6	5.34
16-Nov-17	0.0005	95.8	0.5	0.065	14.4	0.007		386	0.0018	19.9	5240	0.002	0.004	88.2	201	0.00002	353	88.3	13.2	0.003	363	1.75	0.002	3.64	0.127	3600	6230	2.6	2.6	5.36
21-Dec-17	0.0005	105	0.5	0.203	12.9	0.017		402	0.0015	18.6	5330	0.002	0.004	61.4	295	0.00002	362	89	14.5	0.0005	378	1.77	0.0005	3.78	0.131	3510	5670	2.6	2.6	5.59
18-Jan-18	0.0005	106	0.5	0.231	13.9	0.017		410	0.0019	16.8	5330	0.004	0.004	73.7	228	0.00002	326	90.4	17.3	0.003	368	1.76	0.0005	3.93	0.144	3850	5460	2.6	2.6	5.17
15-Feb-18	0.0005	111	0.5	0.077	13.7	0.015		407	0.0018	16.9	5360	0.004	0.005	38.6	181	0.00002	360	87.6	13.9	0.004	373	1.72	0.002	3.92	0.183	3440	4890	2.6	2.6	5.47
15-Mar-18	0.0005	110	0.5	0.084	14.5	0.014		412	0.0019	22.1	5390	0.003	0.004	84.5	161	0.00002	390	87.9	14	0.005	394	1.74	0.002	3.79	0.184	3380	5070	2.6	2.5	5.36

AP17 77 groundwater bore April, 2017 to March, 2018

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered	Zn
Minimum	0.0005	72.1	0.002	0.002	8.97	0.002		364	0.0015	15.2	5070	0.0005	0.002	38.6	129	0.00002	277	85.2	12.4	0.0005	337	1.6	0.0005	3.18	0.0918	2940	4860	2.4	2.5	4.02
Maximum	0.0005	111	0.017	0.005	14.5	0.017		423	0.0019	57.1	5390	0.004	0.005	92.6	295	0.00002	390	104	17.3	0.008	410	1.78	0.002	4.11	0.184	3850	6230	2.6	2.6	5.59
Mean	0.0005	90.64167	0.01075	0.003917	12.9475	0.01075		399.0833	0.001725	21.59167	5220.833	0.002083	0.003917	76.85	190.4167	0.00002	336.75	90.95833	14.15833	0.003292	368.25	1.6975	0.001167	3.629167	0.129592	3359.167	5305.833	2.541667	2.541667	5.130833
Median	0.0005	88.15	0.01	0.004	13.45	0.01		403	0.0018	18.65	5225	0.002	0.004	83.45	182.5	0.00002	339.5	89.7	13.95	0.003	366	1.7	0.001	3.645	0.124	3360	5190	2.55	2.5	5.175
90th Percentile	0.0005	109.6	0.0169	0.005	14.37	0.0169		411.8	0.0019	21.89	5357	0.0039	0.005	90.08	229.8	0.00002	361.8	95.13	15.15	0.005	392.4	1.769	0.002	3.929	0.1791	3593	5663	2.6	2.6	5.459
95th Percentile	0.0005	110.45	0.017	0.005	14.445	0.017		416.95	0.0019	37.85	5373.5	0.004	0.005	91.28	259.25	0.00002	374.6	99.27	16.145	0.00635	401.2	1.7745	0.002	4.011	0.18345	3712.5	5922	2.6	2.6	5.524

GW6 85 groundwater bore April, 2017 to March, 2018

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered	Zn
28-Apr-17																												2.7	2.8	
17-May-17																												2.8		
22-Jun-17																												2.6	2.8	
20-Jul-17																												2.8		
16-Aug-17																												2.9		
Sept-Oct 201	Dry - No data																													
15-Nov-17																												2.9		
20-Dec-17																												2.9		
Jan-Mar 201	Dry - No data																													

GW6 85 groundwater bore April, 2017 to March, 2018

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Initial WL	covered	Zn
Minimum																												2.6	2.8	
Maximum																												2.9	2.8	
Mean																												2.8	2.8	
Median																												2.8	2.8	
90th Percentile																												2.9	2.8	
95th Percentile																												2.9	2.8	

KVAD Seepage 94 data summary April, 2017 to March, 2018

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Zn
27-Apr-17	0.0005	0.15	602	0.027	0.06	0.023		4.13	0.00005	5.4	1190	0.0005	0.002	1.18	0.03	0.00002	9.18	3	0.0005	0.037	296	0.003	0.0005	8.15	0.0001	22	677	0.014
17-May-17	0.0005	0.36	615	0.015	0.07	0.018		3.66	0.00005	5.31	1220	0.0005	0.0005	1.25	0.01	0.00002	10.9	2.45	0.006	0.032	298	0.002	0.0005	8.23	0.0003	23.6	682	0.007
21-Jun-17	0.0005	0.32	643	0.014	0.1	0.019		3.85	0.00005	5.64	1230	0.0005	0.0005	1.16	0.014	0.00002	10.4	2.37	0.013	0.036	303	0.003	0.0005	8.16	0.0002	19.1	790	0.008
19-Jul-17	0.0005	0.39	681	0.015	0.06	0.018		3.62	0.00005	5.88	1220	0.0005	0.0005	1.18	0.006	0.00002	11	2.31	0.016	0.035	312	0.002	0.0005	8.25	0.0001	16.6	643	0.009
16-Aug-17	0.0005	0.28	640	0.01	0.06	0.007		2.68	0.00005	4.81	1240	0.0005	0.0005	1.03	0.01	0.00002	7.94	1.23	0.01	0.028	294	0.002	0.001	8.2	0.0004	21.5	686	0.01
20-Sep-17	0.0005	0.53	714	0.021	0.06	0.032		4.48	0.00005	5.88	1250	0.0005	0.006	1.19	0.004	0.00002	11.9	3.05	0.006	0.052	297	0.004	0.0005	8.12	0.0003	21.8	648	0.017
18-Oct-17	0.0005	0.42	634	0.02	0.11	0.027		4.09	0.00005	5.81	1230	0.0005	0.015	1.29	0.008	0.00002	12.1	2.94	0.007	0.041	280	0.0005	0.001	8.23	0.0001	17.4	746	0.019
16-Nov-17	0.0005	0.42	654	0.023	0.12	0.027		4.12	0.00005	5.91	1220	0.0005	0.0005	1.13	0.008	0.00002	8.1	2.91	0.007	0.044	299	0.002	0.001	8.15	0.0001	18.7	738	0.013
20-Dec-17	0.0005	0.38	707	0.02	0.09	0.024		3.75	0.00005	5.77	1260	0.0005	0.0005	1.15	0.007	0.00002	9.74	2.48	0.005	0.042	338	0.002	0.001	8.27	0.0002	19.9	704	0.01
17-Jan-18	0.0005	0.42	705	0.027	0.08	0.03		4.81	0.00005	4.77	1250	0.0005	0.0005	1.16	0.004	0.00002	12	3.58	0.015	0.044	332	0.003	0.0005	8.2	0.0001	19.5	812	0.006
14-Feb-18	0.0005	0.03	716	0.019	0.06	0.026		4.56	0.00005	4.86	1240	0.0005	0.0005	1.09	0.116	0.00002	11.1	3.09	0.021	0.049	343	0.004	0.0005	8.24	0.0003	18.8	720	0.034
14-Mar-18	0.0005	0.32	724	0.013	0.09	0.022		4.43	0.00005	5.56	1230	0.0005	0.0005	1.28	0.003	0.00002	11.8	3.1	0.015	0.032	366	0.002	0.0005	8.18	0.0003	17.6	692	0.0025

KVAD Seepage 94 data summary April, 2017 to March, 2018

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe - Filt	Hg	K	Mg	Mn - Filt	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Zn
Minimum	0.0005	0.03	0.007	0.0005	0.06	0.007		2.68	0.00005	4.77	1190	0.0005	0.0005	1.03	0.003	0.00002	7.94	1.23	0.0005	0.028	280	0.0005	0.0005	8.12	0.0001	16.6	643	0.0025
Maximum	0.0005	0.53	0.032	0.015	0.12	0.032		4.81	0.00005	5.91	1260	0.0005	0.015	1.29	0.116	0.00002	12.1	3.58	0.021	0.052	366	0.004	0.001	8.27	0.0004	23.6	812	0.034
Mean	0.0005	0.335	0.02275	0.002292	0.08	0.02275		4.015	0.00005	5.466667	1231.667	0.0005	0.002292	1.174167	0.018333	0.00002	10.51333	2.709167	0.010125	0.039333	313.1667	0.002458	0.000667	8.198333	0.000208	19.70833	711.5	0.012458
Median	0.0005	0.37	0.0235	0.0005	0.075	0.0235		4.105	0.00005	5.6	1230	0.0005	0.0005	1.17	0.008	0.00002	10.95	2.925	0.0085	0.039	301	0.002	0.0005	8.2	0.0002	19.3	698	0.01
90th Percentile	0.0005	0.42	0.0297	0.0056	0.109	0.0297		4.552	0.00005	5.88	1250	0.0005	0.0056	1.277	0.0284	0.00002	11.99	3.099	0.0159	0.0485	342.5	0.0039	0.001	8.249	0.0003	21.98	785.6	0.0188
95th Percentile	0.0005	0.4695	0.0309	0.01005	0.1145	0.0309		4.6725	0.00005	5.8935	1254.5	0.0005	0.01005	1.2845	0.0687	0.00002	12.045	3.316	0.01825	0.05035	353.35	0.004	0.001	8.259	0.000345	22.72	799.9	0.02575

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 COMPOSITION, TEXTURE, HARDNESS.	DEPTH	STRUCTURES JOINTS (SPACING, ATTITUDE, SMOOTHNESS, APERTURE, COATING, INFILLING) BEDDING, VEINS, SEAMS, FAULTS, CRUSHED ZONES	SAMPLE NUMBER AND SPT. WATER PRESSURE TEST (LUGEONS)
	CORE LOSS.		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		
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 25
	NON CORE DRILLING. DRILLER REPORTS IRONSTONE AND SHALE.		7.30 V-BIT REFUSAL	
938.8		9.00		

LIFT AND % CORE LOSS: 100
REDUCED LEVEL AND METHOD: 945 AUGV 940 RR

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

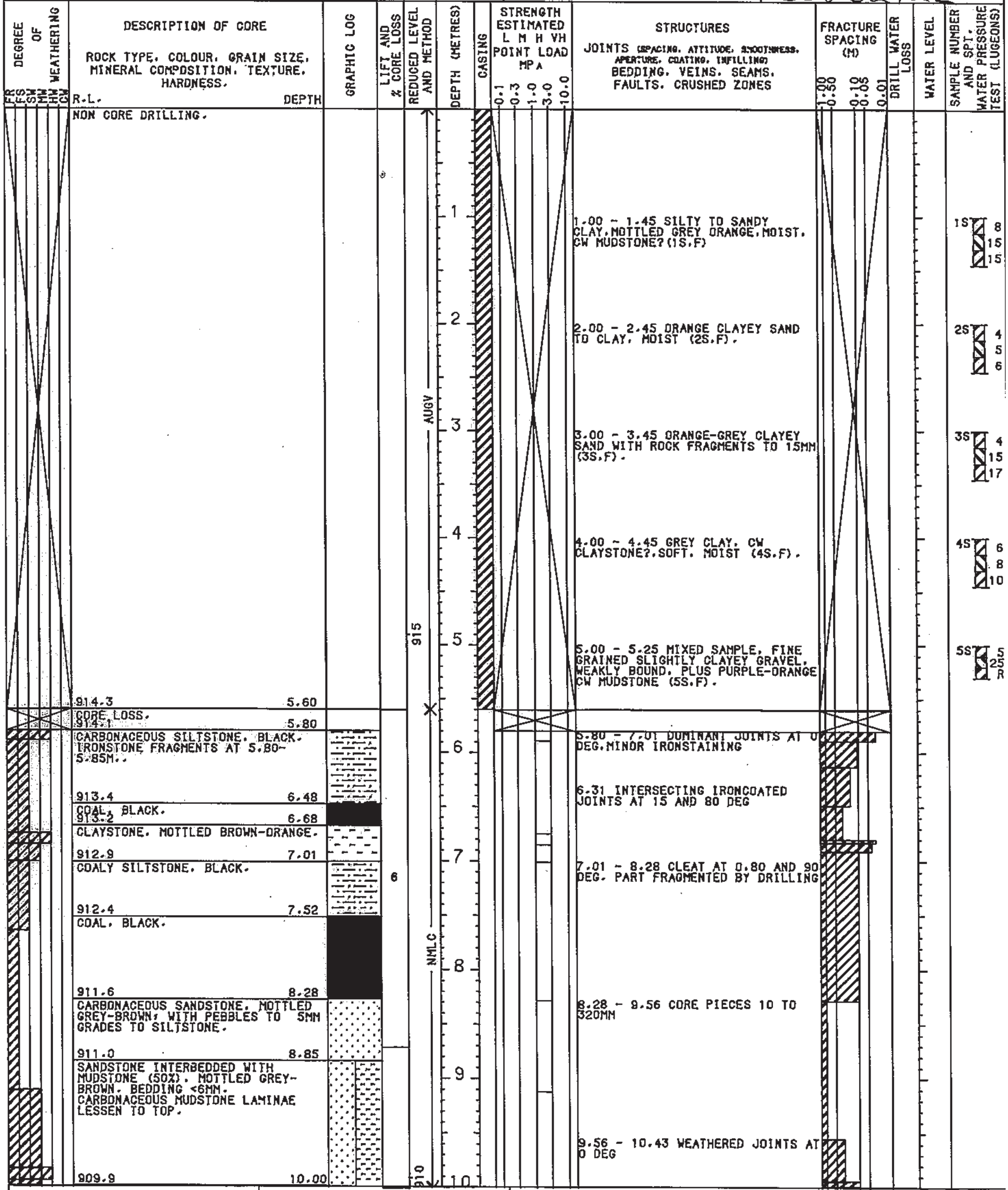
W .GM1/D 2

INCLINATION: 90
AZIMUTH:

ISG CO-ORDINATES: 215588E 1303352N

COLLAR R.L.: 919.9
DATUM: AHD

SHEET 1 OF 2
LOCATION PLAN NO.
DE202722



DESCRIPTION OF CORE
ROCK TYPE, COLOUR, GRAIN SIZE, MINERAL COMPOSITION, TEXTURE, HARDNESS.

R.L.	DESCRIPTION	DEPTH
	NON CORE DRILLING.	
914.3		5.60
	CORE LOSS.	
914.1		5.80
	CARBONACEOUS SILTSTONE, BLACK. IRONSTONE FRAGMENTS AT 5.80-5.85M..	
913.4		6.48
	COAL, BLACK.	
913.2		6.68
	CLAYSTONE, MOTTLED BROWN-ORANGE.	
912.9		7.01
	COALY SILTSTONE, BLACK.	
912.4		7.52
	COAL, BLACK.	
911.6		8.28
	CARBONACEOUS SANDSTONE, MOTTLED GREY-BROWN; WITH PEBBLES TO 5MM GRADES TO SILTSTONE.	
911.0		8.85
	SANDSTONE INTERBEDDED WITH MUDSTONE (50%), MOTTLED GREY-BROWN. BEDDING <6MM. CARBONACEOUS MUDSTONE LAMINAE LESSEN TO TOP.	
909.9		10.00

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

SAMPLE	SPT
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

DEGREE OF WEATHERING: FR FS SW MW HW CW

DESCRIPTION OF CORE: ROCK TYPE, COLOUR, GRAIN SIZE, MINERAL COMPOSITION, TEXTURE, HARDNESS.

R.L.	DEPTH	DESCRIPTION OF CORE
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	CONGLOMERATE.
903.0	16.90	CORE LOSS.
902.9	17.00	COAL, BLACK.
901.9	18.03	

GRAPHIC LOG

LIFT AND % CORE LOSS: 6

REDUCED LEVEL AND METHOD: 905 NMLC

DEPTH (METRES): 11 12 13 14 15 16 17 18

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

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

FRACTURE SPACING (M): 1.00 0.50 0.10 0.05 0.01

DRILL WATER LOSS

WATER LEVEL

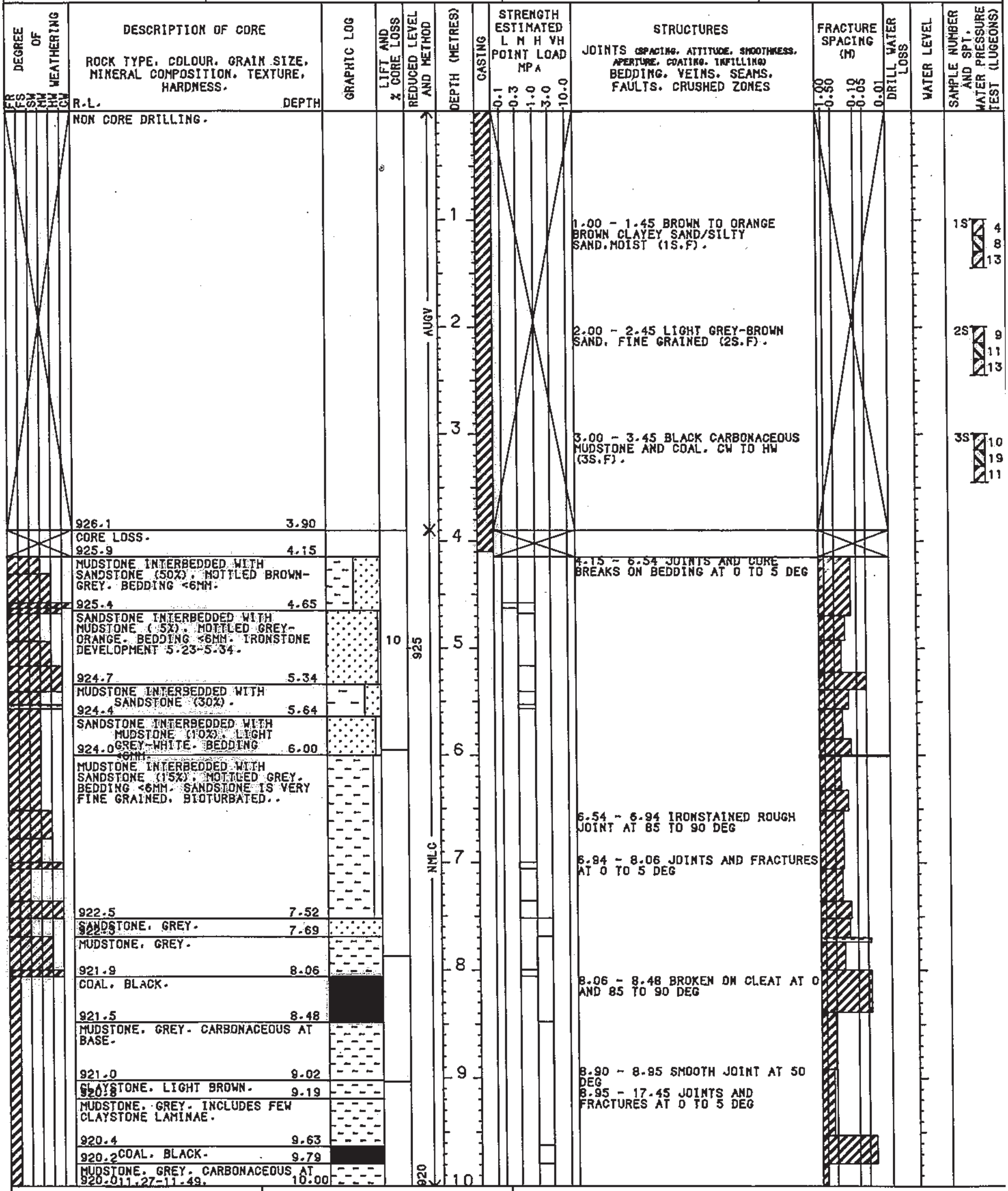
SAMPLE NUMBER AND SPT. WATER PRESSURE TEST (LUGEONS)

END OF HOLE

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.	DESCRIPTION OF CORE	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:

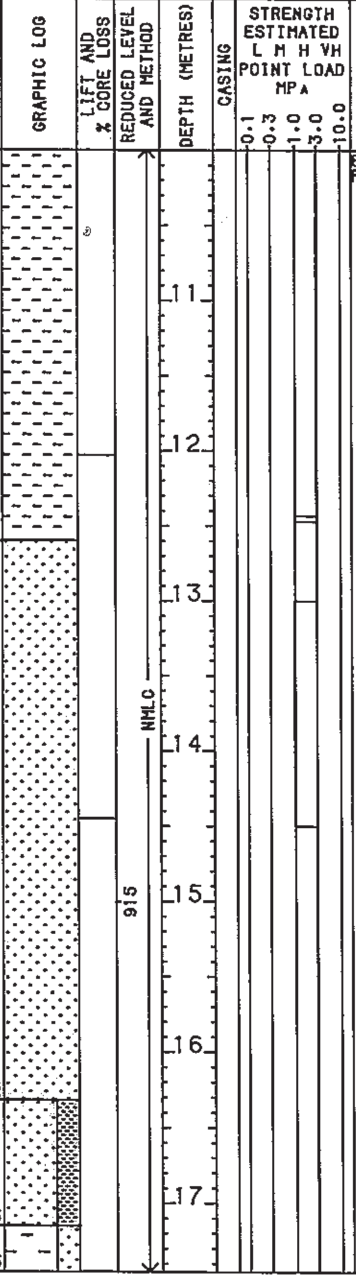
ELECTRICITY COMMISSION OF N.S.W. GEOTECHNICAL LOG	WALLERAWANG P.S GROUND WATER MONITORING	W .GM1/D 3

INCLINATION: 90 AZIMUTH:	ISG CO-ORDINATES: 216191E 1303706N	COLLAR R.L.: 930.0 DATUM: AHD	SHEET 2 OF 2 LOCATION PLAN NO. DE202722

DEGREE OF WEATHERING: FR FS SW MW HW CW

DESCRIPTION OF CORE
ROCK TYPE. COLOUR. GRAIN SIZE. MINERAL COMPOSITION. TEXTURE. HARDNESS.

R.L.	DESCRIPTION OF CORE	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

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)

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

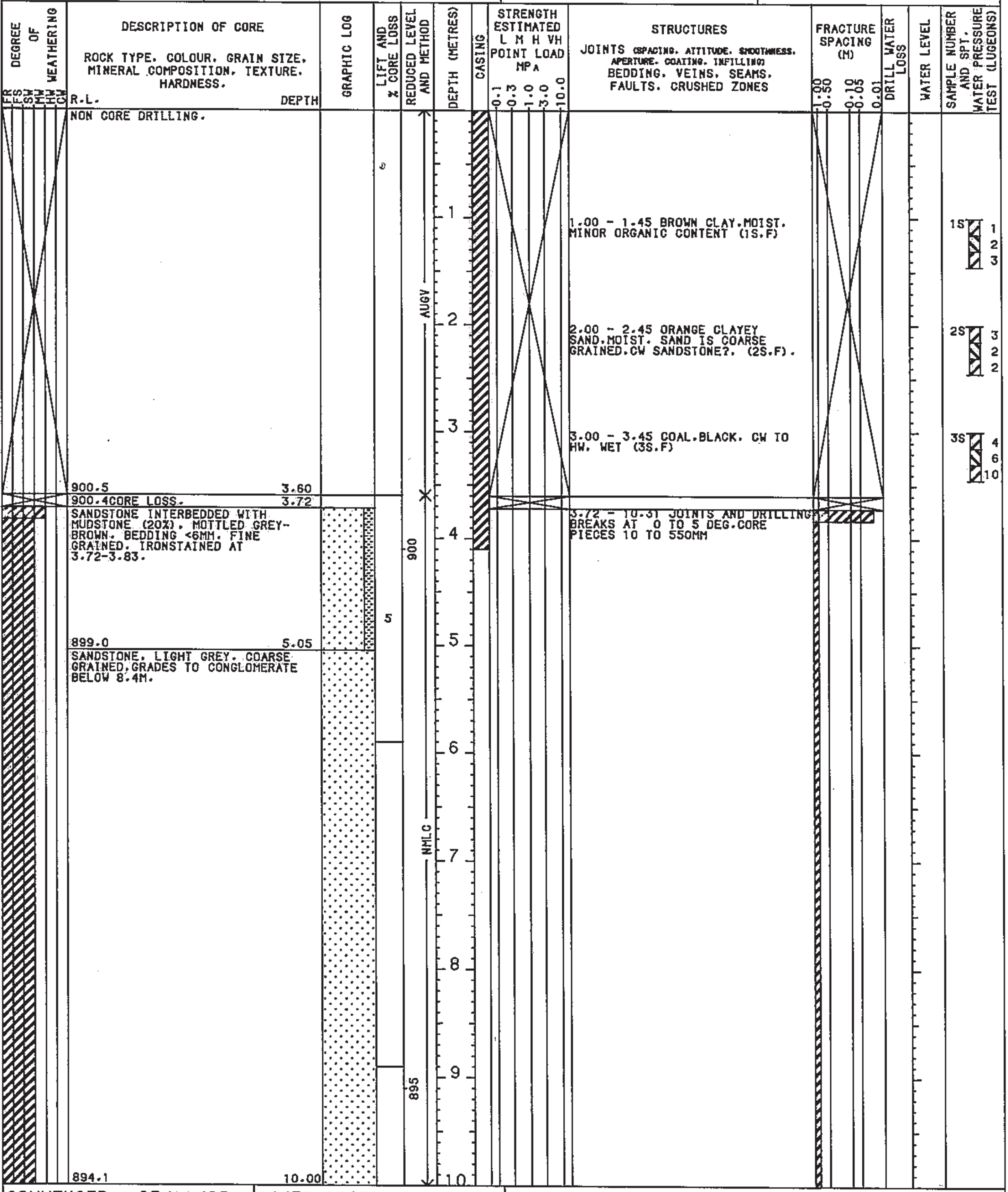
DEGREE OF WEATHERING FR FS SW MW HW CW	DESCRIPTION OF CORE ROCK TYPE, COLOUR, GRAIN SIZE, MINERAL COMPOSITION, TEXTURE, HARDNESS. R.L.	DEPTH	GRAPHIC LOG	LIFT AND % CORE LOSS	REDUCED LEVEL AND METHOD	DEPTH (METRES)	CASING	STRENGTH ESTIMATED L M H VH POINT LOAD MPA 0.1 0.3 1.0 3.0 10.0	STRUCTURES JOINTS (SPACING, ATTITUDE, SMOOTHNESS, APERTURE, COATING, INFILLING) BEDDING, VEINS, SEAMS, FAULTS, CRUSHED ZONES	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)
	NON CORE DRILLING. 905.7	1.00			AUGV	1	▨						
	TOPSOIL. DARK BROWN. WET. ORGANIC RICH (1S.F).. 905.2	1.45	U U U U		905		▨						1S 1 1 0
	NON CORE DRILLING. 904.7	2.00				2	▨						
	CLAY. BROWN. MOIST TO WET. MINOR ORGANIC CONTENT AND SAND FINE TO COARSE (2S.F).. 904.2	2.45	/ / / /				▨						2S 1 2 2
	NON CORE DRILLING. 903.7	3.00				3	▨						
	CLAYEY SAND. LIGHT ORANGE. MOIST TO WET. FINE GRAINED (3S F). 903.2	3.45	/ . . .				▨						3S 1 1 2
	NON CORE DRILLING. 902.7	4.00				4	▨						
	SAND. LIGHT GREY. WET. FINE TO COARSE GRAINED. ROCK FRAGMENTS TO 20MM INCLUDED (4S F).. 902.2	4.45	. . . .										4S 2 3 4
	NON CORE DRILLING. 900.7	6.00			RR	5 6			4.60 V-BIT REFUSAL				
					900	7 8 9 10							

COMMENCED: 05/11/85	CONTRACTOR: MCDERMOTT	DRILL TYPE: PIO 160	
COMPLETED: 05/11/85	DRILLER: J.SHAW	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



DESCRIPTION OF CORE
ROCK TYPE. COLOUR. GRAIN SIZE. MINERAL COMPOSITION. TEXTURE. HARDNESS.

R.L.	DESCRIPTION	DEPTH
	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

STRUCTURES
JOINTS (SPACING. ATTITUDE. SMOOTHNESS. APERTURE. COATING. INFILLING) BEDDING. VEINS. SEAMS. FAULTS. CRUSHED ZONES

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).

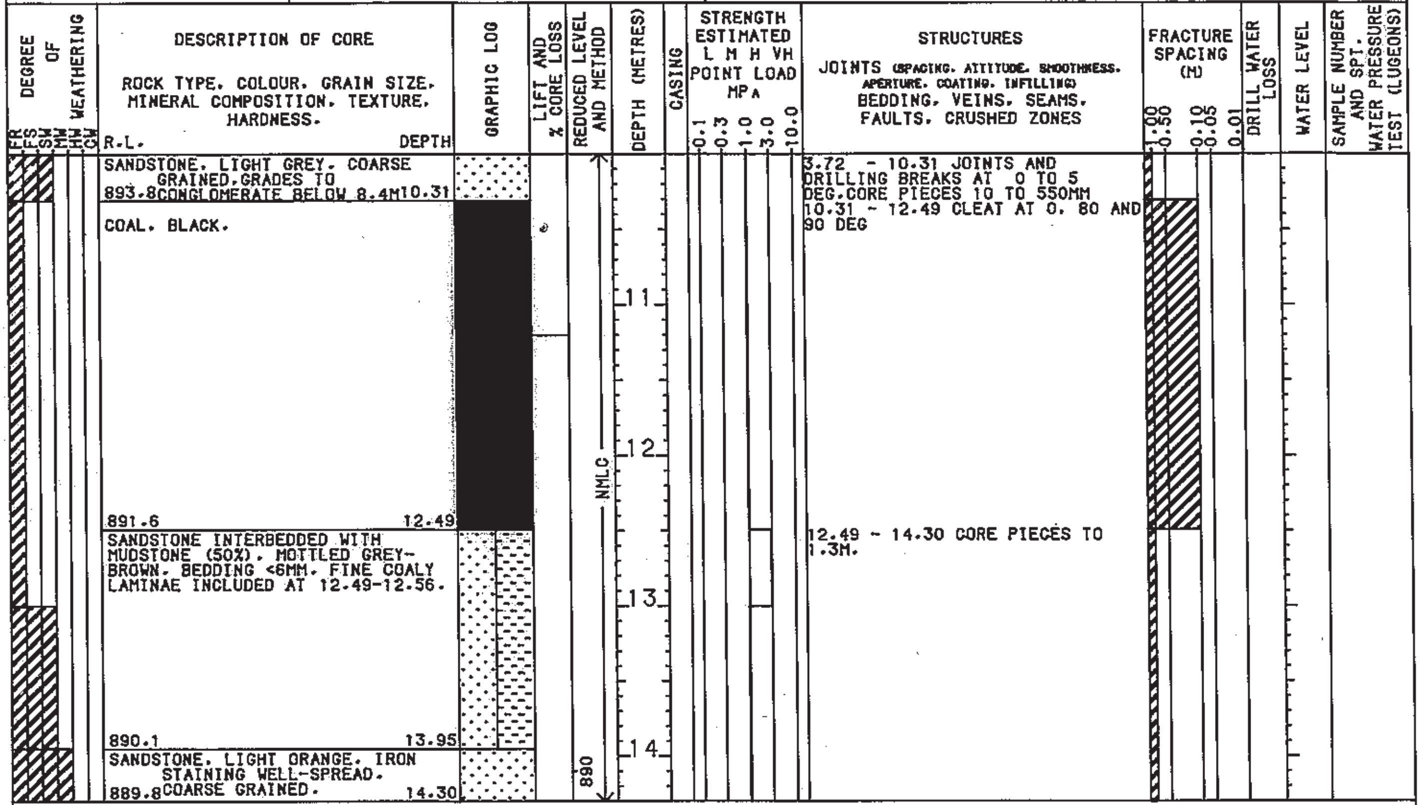
3.00 - 3.45 COAL.BLACK. CW TO HW. WET (3S.F)

3.72 - 10.31 JOINTS AND DRILLING BREAKS AT 0 TO 5 DEG.CORE PIECES 10 TO 550MM

COMMENCED: 05/11/85	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 5

INCLINATION: 90 AZIMUTH:	ISG CO-ORDINATES: 215566E 1304170N	COLLAR R.L.: 904.1 DATUM: AHD	SHEET 2 OF 2 LOCATION PLAN NO. DE202722



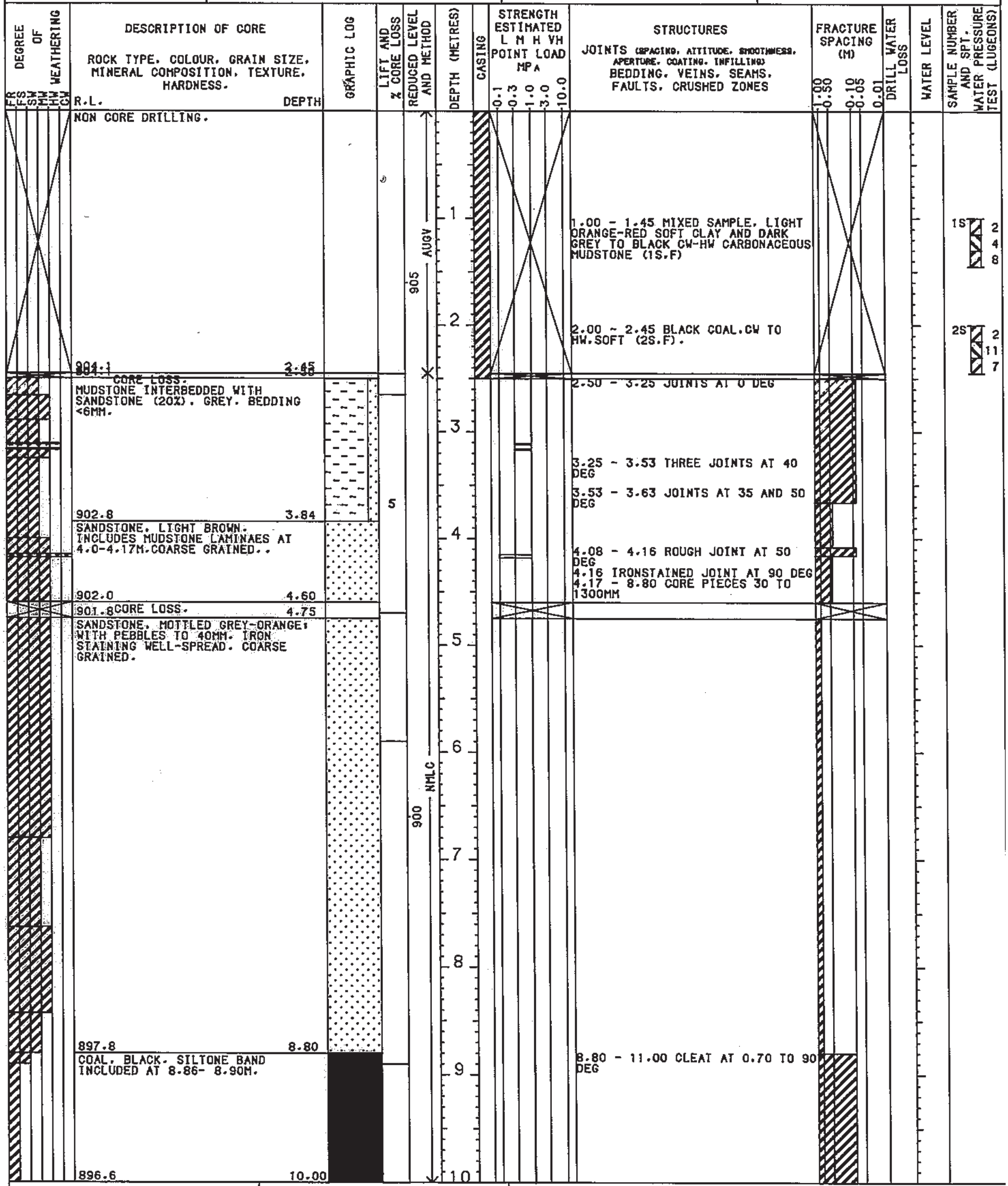
R.L.	DESCRIPTION OF CORE ROCK TYPE. COLOUR. GRAIN SIZE. MINERAL COMPOSITION. TEXTURE. HARDNESS.	DEPTH	STRUCTURES JOINTS (SPACING. ATTITUDE. SMOOTHNESS. APERTURE. COATING. INFILLING) BEDDING. VEINS. SEAMS. FAULTS. CRUSHED ZONES
893.8	SANDSTONE. LIGHT GREY. COARSE GRAINED.GRADES TO CONGLOMERATE BELOW 8.4M	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. DE202722



DESCRIPTION OF CORE
ROCK TYPE. COLOUR. GRAIN SIZE. MINERAL COMPOSITION. TEXTURE. HARDNESS.

R.L.	DESCRIPTION	DEPTH
	NON CORE DRILLING.	
904.1		2.45
	CORE LOSS.	
	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

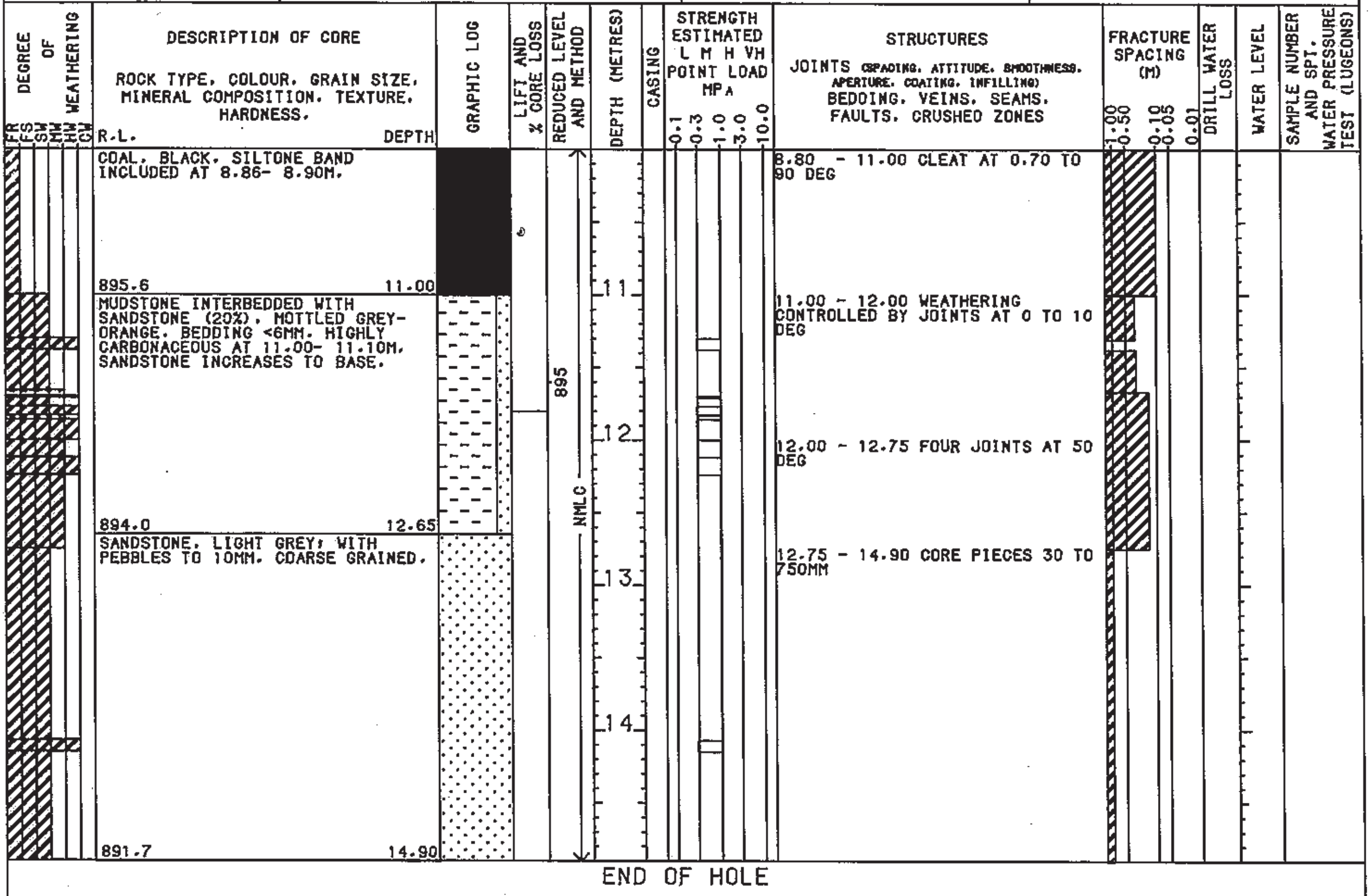
4.08 - 4.16 ROUGH JOINT AT 50 DEG
4.16 IRONSTAINED JOINT AT 90 DEG
4.17 - 8.80 CORE PIECES 30 TO 1300MM

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
COAL, BLACK, SILTONE BAND INCLUDED AT 8.86- 8.90M.	895.6	11.00
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
SANDSTONE, LIGHT GREY; WITH PEBBLES TO 10MM. COARSE GRAINED.	891.7	14.90

STRUCTURES JOINTS (SPACING, ATTITUDE, SMOOTHNESS, APERTURE, COATING, INFILLING) BEDDING, VEINS, SEAMS, FAULTS, CRUSHED ZONES
8.80 - 11.00 CLEAT AT 0.70 TO 90 DEG
11.00 - 12.00 WEATHERING CONTROLLED BY JOINTS AT 0 TO 10 DEG
12.00 - 12.75 FOUR JOINTS AT 50 DEG
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:

Appendix E

D1 – D6 Long Term Groundwater Elevations

Figure E1: D1 - Groundwater Elevation

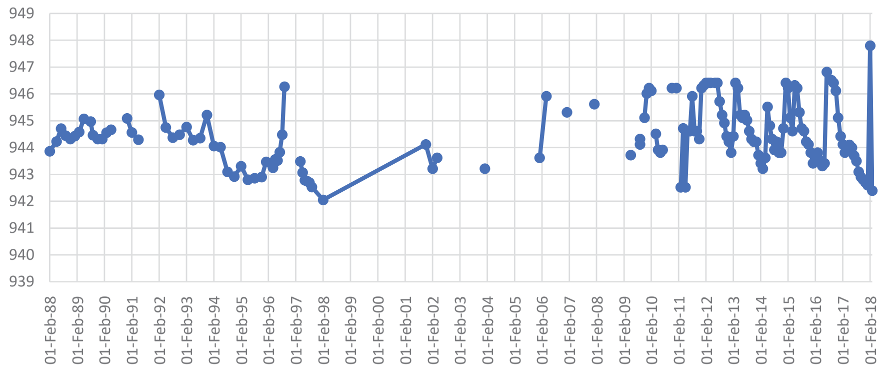


Figure E2: D2 - Groundwater Elevation

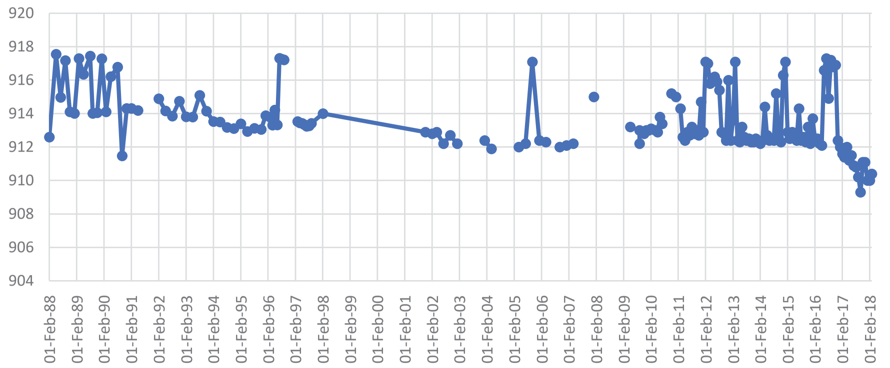


Figure E3: D3 - Groundwater Elevation

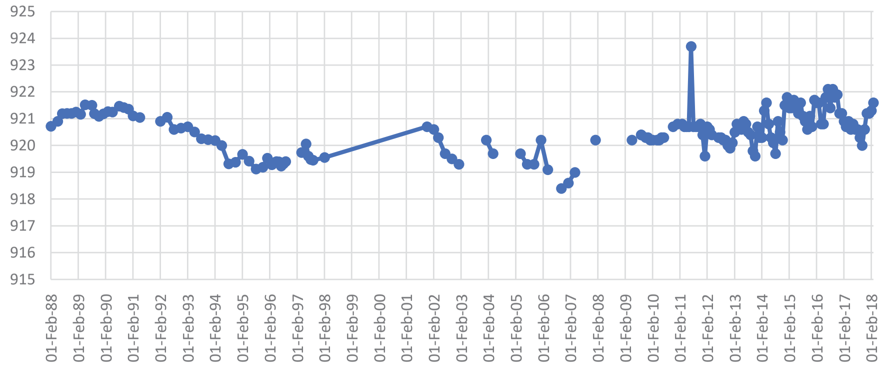


Figure E4: D4 - Groundwater Elevation

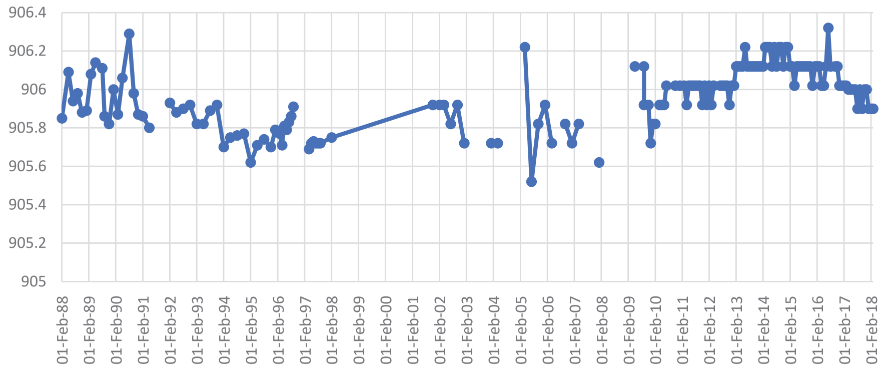


Figure E5: D5 - Groundwater Elevation

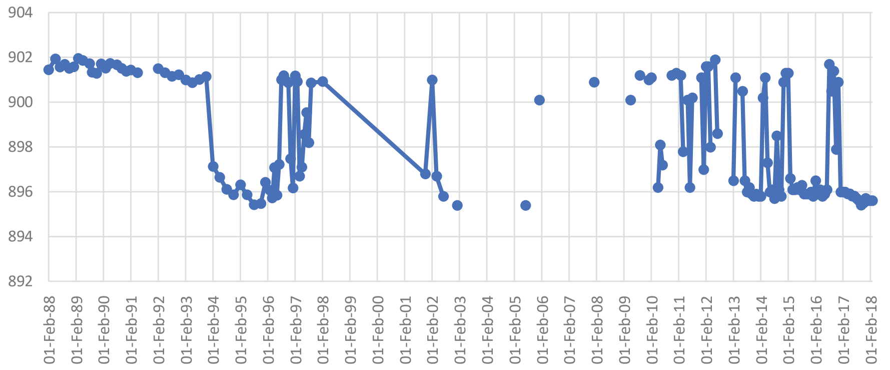
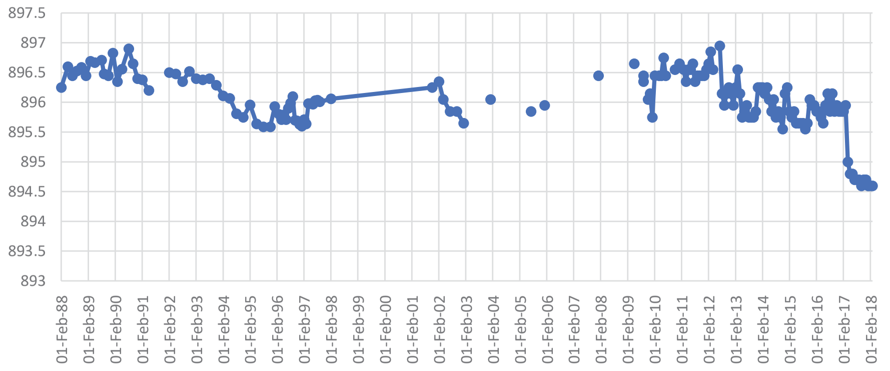


Figure E6: D6 - Groundwater Elevation



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Appendix E
EnergyAustralia NSW Community Sponsorships and Donations – 2017/18

Recipient	**Reason**	**Month / Year**
Portland Art Show	Local Art Exhibition raising funds for Portland and buying work from local artists	April 2017
Sea Bees Fishing Club	Sponsorship for Annual Fishing Tournament at Lake Lyell	May 2017
Red Cross Calling	Match staff donations	May 2017
St. Josephs School Portland	Hire of Amusement Ride for School Fete	June 2017
Careflight	Matching Staff Donations 1/1/16 – 31/12/17	June 2017
The Smith Family	Matching Staff Donations 1/1/16 – 31/12/17	June 2017
Lithgow PCYC	Matching Staff Donations 11/1/16 – 31/12/17	June 2017
Cancer Council	Match monies raised by Staff for Cancer Council Biggest Morning Tea	July 2017
Lithgow City Council	Creation of a Tech lab for adults and young children at Library	September 2017
Lithgow City Tennis Club	Assist with upgrade of the undercover seating area	September 2017
Catholic Care Social Services	Assist with costs of the Recover Wellbeing Group	September 2017
Lithgow Tidy Towns	Assist with the laneway art project in the Lithgow CBD	September 2017
Wallerawang/Lidsdale Progress Assoc.	Pyrotechnic display at New Year’s Eve celebration at Lake Wallace	September 2017
Capertee Progress Association	To install more efficient heating to the Capertee Memorial Community Hall	September 2017
Lithgow Bears Rugby Club	Assist with costs of Kids Disco to raise funds for mental illness/suicide prevention in the local area	September 2017
L J Hooker	Donation towards Charity Auction	September 2017
La Salle Academy	2017 Award Presentation Ceremony	October 2017
Mitchell Conservatorium	Sponsorship of Scholarship for local musician	October 2017
Portland Central School	Annual Presentation Day 2017	November 2017
St Joseph’s Primary School Portland	Annual Presentation Day 2017	November 2017
Mingaan	Assistance to NAIDOC Ceremony 2017	November 2017
Barton Park Arboretum	Costs associated with 10 Year Celebration of the Arboretum	November 2017
Lithgow Public School	Funding Books in Homes Program for students	November 2017
Greater Lithgow Arts Council	Assist with annual award ceremony	November 2017
Lithgow Swimming Club	Assist with Twilight Swimming Carnival	November 2017
Wallerawang Public	Towards annual presentation Day	December 2017

Recipient	Reason	Month / Year
School		
Capertee Public School	Towards annual presentation Day	December 2017
Cooerwull Public School	Towards annual presentation Day	December 2017
Cullen Bullen Public School	Towards annual presentation Day	December 2017
Hampton Public School	Towards annual presentation Day	December 2017
Lithgow Public School	Towards annual presentation Day	December 2017
Meadow Flat Public School	Towards annual presentation Day	December 2017
St Patricks School Lithgow	Towards annual presentation Day	December 2017
Lithgow Community Nursery	Assist with purchase sunsafe shirts & ongoing costs of organisation	December 2017
Barton Park Arboretum	Assist with general upkeep and maintenance	December 2017
Zig Zag Public School Lithgow	Annual Presentation Day	December 2017
Lithgow High School	Towards annual presentation Day	December 2017
Lithgow Oberon Landcare Association	Assist with Landcare activities in the Lithgow/Oberon districts	December 2017
Lithgow City Council	Sponsorship of 2017 Halloween Festival	December 2017
Central Acclimatisation Society	Gone Fishing Day at Lake Wallace	December 2017
Lithgow Lions Club	Christmas Cakes	December 2017
Lithgow Show Society	Towards 2018 Lithgow Show	December 2017
Kelso Fire Brigade	Towards 2018 Fire & Rescue NSW Regional Championships	December 2017
St Patricks/St Vincent's Days for Girls	Hygiene kits for women in East Timor	December 2017
Josephite Foundation	Organisation providing loans to people on low incomes	December 2017
Hartley Advisory Committee	Back to Hartley weekend	December 2017
Legacy NSW (Lithgow)	Matching staff donations	December 2017
Lithgow Environment Group	Hoskins Church Solar Panels	January 2018
IronFest	Sponsorship of Annual Community Event	March 2018

Recipient	**Reason**	**Month / Year**
Portland Art Show	Sponsorship via purchase of art work	March 2018
Lithgow PCYC	Matching donations	March 2018
Careflight	Matching donations	March 2018
Royal North Shore Hospital	Matching donations	March 2018
The Smith Family	Matching Donations	March 2018